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RESEARCH PRESENTATIONS

**Risk Factors for Injury and Severe Injury in Youth Ice Hockey: A Systematic Review of the Literature**

M.D. Decloe, BA, C.A. Emery, BScPT, PhD, B. Hagel, MD, PhD, and C. McKay, MSc.

*Affiliation: Sport Medicine Centre, University of Calgary, Calgary, Alberta, Canada.*

**Objective:** The primary objective of this systematic review and meta-analysis was to identify all risk factors for injury in youth ice hockey. The secondary objective was to determine the risk factors for severe injury in this population. **Data Sources:** Ten electronic databases, "grey literature" and the American Society for Testing and Materials Safety in Ice Hockey series (Vol. 1-4) were systematically searched to identify articles examining risk factors for injury in youth ice hockey.

**Study Selection:** The following criteria were applied to all potential articles and initial search results were screened based on a priori study selection criteria: (1) The article was based on primary research with original data. (2) The study population included youth ice hockey players (under age 18). (3) The outcome measure included only injuries sustained during ice hockey participation. (4) The study included one or more potential risk factors and/or prevention strategies for ice hockey injury. (5) The article was published in English. Review articles and case studies were excluded. Studies examining risk in leagues above the Junior age group of play (aged 17-18 years) were also excluded. In total 22 articles were identified for inclusion in the review.

**Data Extraction:** The data extracted included study design, study population, risk factor of interest measured, injury definition(s), and results. Point estimates (including 95% confidence intervals [CIs]) of odds ratios (ORs) or rate ratios (RRs) were calculated where study data were adequate to do so if these were not reported in the reviewed studies. If the authors provided any data differentiating "minor injury" and "severe injury", risk factors were considered for each.

**Data Synthesis:** Participation in games, compared with practices, was associated with an increased risk of injury in all studies examined. Age, level of play and player position produced inconsistent findings. Body checking was identified as a significant risk factor for all injuries (summary RR, 2.45; 95% CI, 1.7-3.6) and concussion (summary OR, 1.71; 95% CI, 1.2-2.44).

**Conclusions:** Findings regarding most risk factors for injury remain inconclusive; however, body checking was found to be associated with an increased risk of injury.

**The Risk of Injury Associated With Body Checking Among Pediatric Ice Hockey Players**

C.A. Emery, BScPT, PhD,<sup>1</sup> W.H. Meeuwisse, MD, PhD,<sup>2</sup> I. Shrier, MD, PhD,<sup>3</sup> C. Goulet, PhD,<sup>4</sup> B. Hagel, PhD,<sup>5</sup> and B. Benson, MD, MSc.<sup>6</sup>

*Affiliation: <sup>1,2,5,6</sup>University of Calgary, Calgary, Alberta, <sup>3</sup>McGill University, Montreal, Quebec, and <sup>4</sup>Laval University, Quebec City, Quebec, Canada.*

**Background:** Ice hockey has one of the highest participation and injury rates in male youth in Canada. Body checking is generally thought to be the most frequent mechanism of injury.

**Objective:** To determine if the risk of concussion, concussion severity, all injury, injury severity and mechanisms of injury significantly differ for Bantam ice hockey players (aged 13-14 years) exposed to rules that permit body checking starting at the Pee Wee level (Alberta, Canada) versus players exposed to rules that do not permit body checking until Bantam (Quebec).

**Design:** Prospective cohort study.

**Setting:** Bantam teams from the top 30% of competitive levels of play in Alberta, Canada and Quebec, Canada. The study period was Oct 2008-Mar 2009.

**Subjects:** Eighty-nine teams from Alberta and 81 teams from Quebec were randomly approached for recruitment. Twenty teams from Alberta and 18 teams from Quebec declined participation or withdrew from the study. Players from 132 teams participated in the study [69 Alberta teams (n = 1003 players), 63 Quebec teams (n = 924 players)].

**Intervention/Observation Technique:** Pee Wee ice hockey players are exposed to rules that permit body checking in Alberta and to rules that do not permit body checking in Quebec.

**Outcome Measurements:** Previously validated injury surveillance was used, including injury assessment by a study therapist and physician referral. The injury definition includes any ice hockey injury that requires medical attention and/or results in time loss from hockey. Standardized concussion definitions, return to activity guidelines, and follow-up by study physicians are based on international consensus for concussion management (2005).

**Results:** Preliminary univariate analysis based on injuries sustained prior to the end of the regular season of play will be presented. Incidence rate ratios (IRR), adjusted for clustering by team, will be reported to estimate risk of concussion, all injury, and all injury resulting in  $\geq 1$  week time loss based on experience of body checking (body checking age 11/no body checking until age 13). Further multivariate analysis will include playoff injuries and will also examine other risk factors and mechanisms of injury.

**Conclusions:** These findings will have important implications for policy decisions related to body checking in minor hockey.

**Acknowledgements:** This study was funded by the Canadian Institutes of Health Research, Alberta Heritage Foundation for Medical Research and the Max Bell Foundation.

### The Effect of Premature Return to Play on Subsequent Injury Risk in Elite Adolescent Ice Hockey and Associated Psychosocial Predictors

C.D. McKay, MSc,<sup>1</sup> C.A. Emery, BScPT, PhD,<sup>2</sup> T. Campbell, PhD,<sup>3</sup> and W. Meeuwisse, MD, PhD.<sup>4</sup>

*Affiliation:* <sup>1</sup>Exercise and Health Psychology Laboratory, Faculty of Kinesiology, University of Western Ontario, London, Ontario, <sup>2,4</sup>Sport Medicine Centre, Roger Jackson Centre for Health and Wellness Research, Faculty of Kinesiology, University of Calgary, and <sup>3</sup>Community Health Sciences, Faculty of Medicine, University of Calgary, and <sup>4</sup>Department of Psychology, University of Calgary, Calgary, Alberta, Canada.

**Objective:** To determine whether return to play prior to medical clearance affects subsequent injury rates in elite minor hockey. Also, to investigate athletic identity, attitudes toward body checking, anxiety, and rumination as injury risk factors.

**Study Design:** Prospective cohort study.

**Subjects:** Three hundred sixteen players from elite (A, AA, AAA) Bantam (aged 13-14 years), and Midget (aged 15-17 years) teams.

**Intervention/Observation Technique:** Participants completed questionnaires early in the season: (1) Medical Questionnaire; (2) Body-Checking Questionnaire; (3) Athletic Identity Measurement Scale; (4) Competitive State Anxiety Inventory-2R; and (5) Stress Reactive Rumination Questionnaire. Injury reports, and physicians' reports for those seeking medical attention, were collected throughout the season.

**Outcome Measurements:** The injury definition included any injury resulting in medical attention, the inability to complete a hockey session, and/or missing a subsequent hockey session. Medical clearance was determined using physicians' reports.

**Results:** The injury rate was 51.52 injuries/100 players/season (95% CI, 42.66-60.30) in Bantam, and 40.76 injuries/100 players/season (95% CI, 33.59-48.23) in Midget. The rate of subsequent injury was 17.48 injuries/100 players/season (95% CI, 11.64-24.72). Injury risk was greater in Bantam than in Midget (incidence rate ratio [IRR] = 1.51; 95% CI, 1.03-2.22), and in AAA (vs. A/AA) (IRR = 1.75; 95% CI, 1.14-2.68). The IRR of subsequent injury for those returning prior to medical clearance was 1.58 (95% CI, 0.30-5.42). Scoring below the 25th percentile on AIMS was associated with first injury (IRR = 1.53; 95% CI, 1.05-2.22), and scoring above the 75th percentile was associated with subsequent injury (IRR = 2.28; 95% CI, 1.01-6.04). No other variables affected injury risk.

**Conclusions:** Returning to play prior to medical clearance is not a risk factor for subsequent injury in elite minor hockey. Those with low levels of athletic identity are at greater risk for first injury, but those with high levels are at greater risk for subsequent injury.

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### The Incidence of Behaviours Associated With Body Checking Among Paediatric Ice Hockey Players

C. Goulet, PhD,<sup>1</sup> L. Nadeau, PhD,<sup>2</sup> and C.A. Emery, BScPT, PhD.<sup>3</sup>

*Affiliation:* <sup>1,2</sup>Laval University, Québec City, Québec, and <sup>3</sup>University of Calgary, Calgary, Alberta, Canada.

**Background:** In Canadian youth ice hockey, the introduction of body checking at young ages is a subject of important controversy. The results of a recent study suggest that the risk of injury is significantly higher in Pee Wee (aged 11-12 years) leagues where body checking is permitted compared to leagues where it is not permitted (Emery et al, 2008).

**Objective:** To determine if the incidence of physical contacts significantly differs for Pee Wee ice hockey players exposed to rules that permit body checking (Alberta, Canada) versus players exposed to rules that do not permit body checking (Québec, Canada).

**Study Design:** Cohort study.

**Setting:** Pee Wee teams from the top 10% of competitive levels of play in Québec City and Calgary. The study period was January to April 2008.

**Participants:** Twelve teams from Québec City and 12 teams from Calgary were randomly selected.

**Intervention:** Pee Wee ice hockey players are exposed to rules that permit body checking in Alberta and to rules that do not permit body checking in Quebec.

**Observation Technique:** In total, 24 games were analysed, 12 in each city. Games were video-recorded and analysed by two trained observers.

**Outcome Measurements:** The intensity of the physical contacts was observed with a validated observation system. Five levels of intensity were coded. Level 1 represents the lowest intensity of contact, and 5 the highest. Physical contacts of levels 1, 2 and 3 were combined and defined as body contact (allowed in Québec); physical contacts of levels 4 and 5 were defined as body checking.

**Results:** One thousand four hundred eighty-five physical contacts were observed. Preliminary univariate analysis shows that there was no difference in the frequency of physical contacts in games played in both provinces. Body contacts were more frequent in Québec City (61.3/team/game; 95% CI, 56.8-65.7) than in Calgary (49.7/team/game; 95% CI, 45.7-53.7). There was more body checking in Calgary (11.0/team/game; 95% CI, 9.1-12.9) than in Québec City (1.8/team/game; 95% CI, 1.1-2.6).

**Conclusions:** The results of the preliminary analysis suggest that the highest rate of injury observed in Pee Wee leagues where body checking is permitted would not be caused by the frequency of the physical contacts but by their intensity.

**Funding:** This study was supported by the Québec Ministry of Education, Leisure, and Sport.

### Examining Sport Concussion Assessment Tool Ratings for a Pee Wee Hockey Cohort With and Without a History of Concussion

K.J. Schneider, PT, DSc, C.A. Emery, BScPT, PhD, W.H. Meeuwisse, MD, PhD, and J. Kang, MSc, PhD (Candidate).

*Affiliation:* Faculty of Kinesiology, University of Calgary, Calgary, Alberta, Canada.

**Objective:** To describe the Sport Concussion Assessment Tool (SCAT) scores for a Pee Wee hockey cohort with and without a history of concussion.

**Study Design:** This study is a secondary data analysis of a prospective cohort examining the risk of injury associated with body checking among pediatric ice hockey players.

**Setting:** Community ice hockey arenas in Calgary, Edmonton, Quebec City and Montreal.

**Subjects:** One hundred fifty teams (n = 2154) of Pee Wee hockey players aged 11 and 12 years were randomly selected by team and consented to

**TABLE 1.** Normative Values for SCAT in 11- and 12-Year-Old Male Hockey Players

Variable	Concussion Median, (Range)	No Concussion Median, (Range)
Total symptom score	2 (0-108)	1 (0-75)
Number of words recalled-immediate	5 (0-5)	5 (0-5)
Number of words recalled-delay	3 (0-5)	3 (0-5)
Number of digits recalled in reverse order	4 (0, 3-6)	4 (0, 3-6)
Number of errors in months of the year in reverse order	1 (0-12)	0 (0-12)

participate in the first year of the study. Thirty-three females were excluded. Males who completed a sport concussion assessment tool at baseline ( $n = 2049/2121 = 96.6\%$ ) were included.

**Intervention/Observation Technique:** A pre-season baseline demographic and injury history questionnaire (including a SCAT) was completed.

**Outcome Measurements:** Sport Concussion Assessment Tool.

**Results:** A previous concussion was reported by 314 players (15.3%). Summary statistics from the SCAT are listed in Table 1.

After adjusting for cluster by team, subjects with a previous history of concussion at preseason evaluation were 1.55 times more likely to report balance problems and dizziness (Odds Ratio [OR] = 1.55; 95% CI, 1.05-2.30), 1.59 times more likely to report a headache (OR = 1.59; 95% CI, 1.19-2.12) and 1.62 times more likely to report neck pain (OR = 1.62; 95% CI, 1.16-2.24).

**Conclusions:** From an injury prevention standpoint, an understanding of the normative values for pediatric male hockey players is important as the SCAT is the current standard of practice. Subjects with a history of concussion were more likely to report symptoms of neck pain, headache and balance problems and dizziness.

### Risk Factors and Mechanisms of Injury Among Female Youth Ice Hockey Players

M.D. Decloe, BA, C.A. Emery, BScPT, PhD, B. Hagel, PhD, and W.H. Meeuwisse, MD, PhD.

*Affiliation:* Sport Medicine Centre, University of Calgary, Calgary, Alberta, Canada.

**Objective:** The objectives of this study were: 1) To examine the incidence of injury in female youth ice hockey, 2) To examine the type and severity of injury associated with female youth ice hockey participation, and 3) To identify risk factors for injury in female ice hockey players.

**Study Design:** Prospective cohort study.

**Subjects:** Twenty-nine teams in the Girls Hockey Calgary Association (GHCA) including Atom (aged 9-10 years), Pee Wee (aged 11-12 years), Bantam (aged 13-14 years) and Midget (aged 15-16 years) age groups.

**Intervention/Observation Technique:** This study is utilizing a validated prospective Injury Surveillance System consisting of a pre-season questionnaire, weekly exposure sheets, injury report forms, the Buss-Perry Aggression Questionnaire, the Empathy Index for Children and Adolescents and a body contact questionnaire. Injury assessments are completed by study therapists and physician referral. The dependant variable is ice hockey injury and independent variables include risk factors for injury.

**Outcome Measurements:** The primary outcome measure is ice hockey injury, defined as any injury occurring in ice hockey during the 2008/09 season that required medical attention, and/or removal from a session, and/or missing a subsequent session.

**Results:** At the time of this preliminary analysis, 315 players on 28 teams had agreed to participate in this cohort study (4 teams from Atom, 6 teams from Pee Wee, 9 teams from Bantam and 9 teams from Midget). Future analysis will be completed using injury rates and relative risks (with 95% confidence intervals) as the main measures of effect, and a Poisson regression model will be fit to calculate risk factors. All analyses will be adjusted for clustering by team.

**Conclusions:** This is the first cohort study of its kind, using prospective injury surveillance, to examine injury rates, mechanisms of injury and risk factors for injury in girls' youth ice hockey.

**Acknowledgements:** Funding for this project was provided by the Alberta Centre for Child, Family and Community Research and the Social Sciences and Humanities Research Council of Canada.

### Sports Injuries and Risk Factors in Youth Soccer

A. Frisch, MSc, A. Urhausen, MD, PhD, R. Seil, MD, PhD, and D. Theisen, PhD.

*Affiliation:* CRP-Santé, Grand-Duchy of Luxembourg.

**Objective:** Evaluation of injury incidence and of preseason functional performance to detect risk factors in young male soccer players.

**Study Design:** Ten-month prospective follow-up.

**Subjects:** Sixty-seven male soccer players aged between 12.7 and 18.6 years enrolled in the national soccer school.

**Intervention/Observation Technique:** Personal data were gathered by a standardized questionnaire. During one soccer season, training and competition volume as well as soccer-related injuries were recorded daily. An injury was defined as an incident occurring during training or competition that prevented the athlete to participate in at least one full training session or game. Preseason anthropometric measurements were performed.

**Outcome Measurements:** Functional tests evaluated the soccer players' endurance (Léger test), lower limb explosive force (squat jump and counter movement jump tests), quadriceps strength (isokinetic tests), coordination (functional hop tests) and static and dynamic balance (single leg balance tests).

**Results:** Overall, 163 injuries were recorded, leading to an average injury rate of 2.4 injuries per athlete for the observed period. Total injury incidence was evaluated at 10.4 injuries/1000 hours. The injury risk was 3.3 (95% CI, 2.39-4.54) times greater in competition (injury incidence of 23.5 injuries/1000 hours) than in training (7.1 injuries/1000 hours) ( $P < 0.05$ ). Most injuries were located at the lower limb (87.1% of all injuries) with the hip/thigh being the most frequently injured body region (43.6%), followed by the ankle/foot (21.5%) and the knee/lower leg regions (20.2%). Regarding the type of injury, 38.7% were muscle problems (sprains), 26.4% contusions and 19.0% sprains. Twenty percent of the injuries were classified as moderate injuries, preventing the athlete from normal training from 8 to 28 days, 7% were severe ( $> 28$  days absence). Almost one fifth of the injuries were recurrent injuries. External violence was the cause of injury in 37%, while 58% and 5% had no external cause or were progressive in nature, respectively. Neither personal data nor variables from the preseason tests were significantly related to increased injury risk ( $P > 0.05$ ).

**Conclusions:** The context of competition is coupled with a greater injury risk compared to training in youth soccer. The absence of a relationship between player-related variables and injury risk warrants further investigation.

### Bilateral Isokinetic Peak Torque Ratios in Youth Soccer Players

J. Brito, BCh, R. Buranarugs, MSc, E. Oliveira, MSc, J. Maia, PhD, J. Soares, PhD, A. Seabra, PhD, and A. Rebelo, PhD.

*Affiliation:* Sports Faculty, University of Porto, Porto, Portugal.

**Objective:** This study aims to examine the peak torque in the knee extensor and flexor muscle groups, as well as the hamstring to quadriceps (H/Q) ratios on the right and left lower limbs in youth soccer players according to age level and positional role.

**Study Design:** Cross-sectional study.

**Subjects:** Two hundred fifty-one youth Portuguese male soccer players from two different age groups (G1:  $n = 104$ ; G2:  $n = 147$ ), training 2-4 times per week (mean  $\pm$  SD; age, G1 =  $12.5 \pm 0.6$ ; G2 =  $14.3 \pm 0.6$ ). Players were divided according to usual positional role on the field: central-defenders, fullbacks, midfielders, forwards, goalkeepers.

**Intervention/Observation Technique:** Players were divided according to usual positional role on the field: central-defenders, fullbacks, midfielders, forwards, goalkeepers.

**Outcome Measurements:** Subjects were evaluated using an isokinetic dynamometer at angular velocities 1.57 rad.s<sup>-1</sup>. Differences by age levels and positional roles were tested with an independent measures t-test and factorial analysis of variance. Bonferroni adjusted alpha levels for multiple comparisons test was used to check for specific differences by positional role and age.

**Results:** Significant differences ( $P < 0.001$ ) were found between G1 and G2 concerning peak torque of the knee extensor and flexor muscles in both lower limbs. No significant differences were found ( $P > 0.05$ ) in reciprocal balance about the knee for both limbs. Despite central defenders from both groups appearing to present higher peak torque of the knee extensor and flexor muscles in both lower limbs than all the other players, the analysis of variance according to positional role revealed that no significant differences were found in any of the variables between all the positional roles considered ( $P > 0.05$ ).

**Conclusions:** This study indicates that isokinetic muscle strength of the knee extensor and flexor muscles changes according to age level. Positional role on the field does not influence isokinetic strength of the knee muscles. Youth soccer players also appear to present normal values of H/Q ratio. Future studies should

focus on the influence of maturational factors, height, weight and training experience in isokinetic strength.

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### Interventions to Decrease the Risk of Ankle Injuries in Basketball Players

A. Rampurada, MBBS, MRCS Ed, MSc Sports Injury,<sup>1</sup> and A. Macfarlane, MSc, MCSP<sup>2</sup>.

*Affiliation:* <sup>1</sup>Sheffield Centre of Sports Medicine, University of Sheffield, and <sup>2</sup>The Centre for Sport and Exercise Science, Sheffield Hallam University, Sheffield, United Kingdom.

**Introduction:** Basketball is one of the most popular sports in the world (played by 11% of the world population). Lower limb injuries in basketball are common and ankle injury seems most frequent. Ankle sprains constitute the majority of ankle injuries in basketball players both during practice and game, and at all levels of play. Ankle injuries have both immediate and long-term effects on the health and morbidity of the player.

**Objective:** To identify and understand risk factors for ankle injuries in basketball players and to formulate interventions to decrease them.

**Search Strategy:** We systematically searched MEDLINE, PubMed, EMBASE, CINAHL, SPORTDiscus and National Library for Health using the terms ankle injury, prevention, basketball and risk factors.

**Results:** Our search revealed 137 articles including 21 reviews. Very few articles were specific to ankle injury in basketball. Risk factors were divided into intrinsic and extrinsic risk factors and potentially modifiable risk factors were identified. Potentially modifiable risk factors are the area of focus in our review. Balance and proprioception training is the most important potentially modifiable factor. Other factors like skills training, joint strength and stability, overall fitness level, warm up, right footwear and ankle support are also important. The strongest predictor of ankle injury is a history of ankle injury (fivefold). Air cells may decrease rear foot stability and players with air cells in their heels are 4.3 times more likely to injure their ankles. Use of warm up decreases the risk of ankle injury by 2.7 times. Forty-five percent of ankle injuries were sustained during landing, and another 30% occurred during cutting or twisting maneuver. Centers playing inside the key tended to be at greatest risk for injury. Rate of injury during game situation is 2 times higher than practice. Ankle taping and ankle braces reduce ankle sprain injury in basketball. We must not ignore the importance of preparticipation evaluation by physicians, physiotherapists, and coaches.

**Conclusions:** Balance and proprioception training seems to be the most important potentially modifiable factor. Further prevention strategies need to be developed and validated. RCT and economic evaluation should be conducted to measure the impact of these prevention strategies.

### The Effect of Helmets on the Risk of Head and Neck Injury Among Snowboarders and Skiers: A Systematic Review

K. Russell, MSc, J. Christie, BSc (Student), and B. Hagel, PhD.

*Affiliation:* Alberta Children's Hospital, Calgary, Alberta, Canada.

**Objective:** To review the literature on helmet effectiveness in snowboarders and skiers.

**Study Design:** This is a systematic review and meta-analysis. Comprehensive literature searches were conducted in: MEDLINE, Academic Search Complete, SPORTDiscus, EMBASE, ERIC, PubMed, and SafetyLit. Relevant conference proceedings and the reference lists of all included studies were hand searched. The titles and abstracts were independently screened by two reviewers and potentially relevant studies were independently assessed to determine if they: (1) were a controlled trial, cohort, case-control, or case-crossover study; (2) compared snowboarders or skiers with and without helmets; and (3) measured at least one objective outcome, such as head injury, neck injury, or severity of head/neck injury. Methodological quality was assessed using the Downs and Black checklist. Data were extracted and the results were checked for accuracy and completeness by a second reviewer. Extracted data included study design, demographic characteristics, data

source, and results. Summary odds ratios (OR) and 95% confidence intervals (CI) were calculated using random effects modeling.

**Subjects:** Ten studies were included.

**Intervention/Observation Technique:** Helmet use while snowboarding or skiing.

**Outcome Measurements:** Head or neck injury.

**Results:** The pooled odds ratio indicated that skiers and snowboarders wearing a helmet were significantly less likely to have a head injury than those not wearing a helmet (OR, 0.65; 95% CI, 0.54-0.79). The protective effect of helmets was observed in case-control studies using non-injured controls (OR, 0.58; 95% CI, 0.36-0.92) as well as controls with injuries other than to the head or neck (OR, 0.64; 95% CI, 0.52-0.80). Compared with no helmet or a knit hat, wearing a helmet also significantly reduced the odds of severe head injury versus a minor head injury (OR, 0.55; 95% CI, 0.42-0.72). The protective effect of helmets was observed among children < 13 (OR, 0.37; 95% CI, 0.22-0.61). There was no evidence for an association between neck injury and helmets (OR, 0.84; 95% CI, 0.69-1.03).

**Conclusions:** The evidence suggests that helmets reduce the risk of head injury among snowboarders and skiers without increasing the risk of neck injury.

### Mechanism of Injury and Probability of Head Injury Among Children Hospitalized for a Ski/Snowboard or Ice Hockey Injury

A.K. Macpherson, PhD, and C.A. Emery, BScPT, PhD.

*Affiliation:* School of Kinesiology & Health Science, University of Calgary, Calgary, Alberta, Canada.

**Objectives:** The objectives of this study were 1) to compare the likelihood of head injury between skiers and snowboarders who fall compared to those who sustain a collision, and 2) to compare children injured in hockey by being struck by an object (puck, stick, board) to those who collided with another player.

**Study Design:** Cross-sectional study.

**Subjects:** All Canadian children hospitalized from 2001 to 2005 in provinces with ICD-10 coding were included if they were classified based on the ICD-10 injury-specific codes for skiing/snowboarding and for ice hockey.

**Intervention/Observation Technique:** Injuries were classified based on the ICD-10 injury-specific mechanism of injury codes for skiing/snowboarding (fall = W0201, collision = W0204, W2200, W5100) and for hockey (struck by an object = W2102, W2103, W2202, collided with a person = W5102). In addition, demographic data included age and gender.

**Outcome Measurements:** Skiing/snowboarding and ice hockey injuries based on ICD-10 injury-specific codes resulting in hospitalization. In addition, head injuries as classified by the primary diagnosis falling within the ICD coding S00 to S09 range.

**Results:** Over the 4-year period, 5255 children from included provinces were hospitalized. Of these, 3061 were skiing or snowboarding and 2194 were playing hockey when the injury was sustained. Males were more frequently injured than females (78% and 95% were male skiers and hockey players, respectively). In both sports, 12% of injuries were head injuries. Multivariate logistic regression analysis found that those who fell while skiing were significantly less likely to have a head injury (OR, 0.44; 95% CI, 0.33-0.59) than those injured in a collision after controlling for age and sex. In ice hockey, those who struck or were struck by an object (ie, puck, stick, boards) were significantly more likely to have a head injury than those who collided with another player (OR, 1.32; 95% CI, 1.03-1.69).

**Conclusions:** Head injuries among children involved in winter sports are common. Many head injuries are associated with striking or being struck by an object. These results suggest that ongoing strategies to promote helmet use in skiing/snowboarding are likely to reduce the likelihood of head injuries. Strategies to promote a safe ice hockey environment and reduce the risk of head injury should be examined and evaluated in ongoing studies.

### Is Body Mass Index a Risk Factor for Sport Injury in Adolescents?

S.A. Richmond, CEP, MSc, PhD (Candidate), and C.A. Emery, BScPT, PhD.

*Affiliation:* Sport Medicine Centre, University of Calgary, Calgary, Alberta, Canada.

**Objective:** The objective of this study was to investigate the relationship between body mass index (BMI) and sport injury in adolescents.

**Study Design:** This was a secondary data analysis examining a cross-sectional survey from a combined junior high and senior high population in the Calgary area (n = 4343) in 2005–2006.

**Subjects:** Adolescents were between 12-19 years of age from junior and senior high schools in the Calgary area.

**Intervention/Observation Technique:** A multivariate logistic regression analysis, controlling for clustering by school, was used to examine the relationship between BMI and sport injury. Gender, age, and hours of sport participation as potential effect modification and confounding were also examined. BMI percentile as the exposure was stratified as healthy weight (< 85th percentile for gender and age), overweight (85th-95th percentiles) and obese (>95th percentile).

**Outcome Measurements:** Sport injury as the outcome was defined as any self-reported sport injury sustained in the previous one year. Medically treated injury was defined as an injury that was treated by a medical professional (ie, physician, physiotherapist).

**Results:** The incidence proportion for all sport injury in the previous year was 65.69% (95% CI, 64.23-67.15). There was an increased risk of injury in overweight compared to healthy BMI, adjusted for hours of sport participation (odds ratio [OR], 1.3; 95% CI, 1.01-1.73). There was also an increased risk of injury with increasing hours of participation, where the OR associated with the highest participation group was 4.53 (95% CI, 2.91-5.73), compared to the lowest. There was no significant difference in injury risk by gender (OR, 1.01; 95% CI, 0.89-1.15), or by age group (OR, 14-15y), 1.05; 95% CI, 0.85-1.30; (16-17y), 0.95; 95% CI, 0.78-1.18; (18-19y), 0.77; 95% CI, 0.54-1.09 compared to the youngest group (12-13y).

**TABLE 1.** Multivariate Main Effect Logistic Regression Model Predicting Injury

Injury	All Sport		Medically Treated Injury	
	Adjusted OR, (95% CI)	P-value	Adjusted OR, (95% CI)	P-value
<b>BMI Percentile</b>				
< 85th	1.00		1.00	
85th-95th	1.30 (1.01-1.72)	0.04*	0.99 (0.76-1.29)	0.954
>95th	1.20 (0.84-1.73)	0.302	0.96 (0.68-1.35)	0.823
<b>Exposure (hrs/wk)</b>				
< 1	1.00		1.00	
1-2	1.54 (1.12-2.12)	0.008	1.55 (0.81-1.83)	0.031
>2-4	2.12 (1.57-2.86)	<0.001*	1.61 (1.12-2.36)	0.013*
>4-7	2.44 (1.75-3.38)	<0.001*	2.46 (1.70-3.58)	<0.001*
>7-10	4.42 (3.26-5.97)	<0.001*	4.62 (2.46-5.32)	<0.001*
>10	4.53 (2.91-5.73)	0.001*	6.39 (4.95-11.04)	<0.001*
<b>Gender</b>				
Female	1.00		1.00	
Male	1.01 (0.89-1.15)	0.465	0.97 (0.83-1.15)	0.751
<b>Age Category</b>				
12-13	1.00		1.00	
14-15	1.05 (0.85-1.30)	0.985	1.06 (0.82-1.37)	0.636
16-17	0.95 (0.78-1.18)	0.617	1.07 (0.83-1.37)	0.614
18-19	0.77 (0.54-1.09)	0.095	0.91 (0.59-1.42)	0.683

\*Significance based on P < 0.05.

**Conclusions:** There is an increased risk of sustaining a sport injury in overweight adolescents compared to those of healthy weight. There is also a greater risk of injury with increasing hours of sport participation. There is a need for research that will lead to both sport injury prevention and promotion of healthy weights in adolescents.

**The Risk of Catastrophic Injury in Sports and Recreation in Ontario in Participants 20 Years Old or Less**

C.H. Tator, CM, MD, PhD.

*Affiliation: Toronto Western Hospital, University of Toronto and ThinkFirst Canada, Toronto, Ontario, Canada.*

**Objective:** To determine the epidemiology of catastrophic injuries in participants 20 years of age or less in sports and recreation in Ontario during the ten-year period, 1986-1995, and to examine prevention strategies.

**Study Design:** Data on catastrophic injuries collected by questionnaire to 3500 Ontario Medical Association members in specialties treating catastrophic injuries and by trauma data coordinators at all Ontario regional trauma centres during four 12-month study periods in 1986, 1989, 1992 and 1995. Data on deaths was obtained at the office of the Chief Coroner.

**Subjects:** Participants 20 years of age or less in all sports and recreational activities in Ontario during 1986-1995.

**Outcome Measurements:** Risk measured in terms of number of catastrophic injuries per 100 000 population and 100 000 participants.

**Results:** Of the 2154 participants with catastrophic injuries, 44.7% were 20 years of age or less. The <11 years group comprised 13.0%, and the 11-20 years group comprised 31.7% of the total. In the <11 group, 68.1% of the injured were males and the male/female ratio was 2:1, whereas in the 11-20 group 81.9% of the injured were males and the male/female ratio was 4:6. Thus, in the 11-20 years group the increased risk taking behaviour pattern of males in sports and recreation was firmly established, and remained for the subsequent decades. The only activities with higher incidence in females were horseback riding and gymnastics. The major types of injuries in sports and recreation were head, spine, drowning and eye injuries. Of the more than 100 activities in this study, 25 had mean and/or median ages in the 20 years or less age range. The activities with the largest number of injured in this age range were bicycling, baseball, alpine skiing, tobogganing, playgrounds and play, soccer, football and badminton. Lower incidences of catastrophic injuries in childhood and adolescence were recorded in dirt biking, hockey, rugby, snowboarding, in-line skating, missiles, and water sports. Large numbers of children and adolescents sustained catastrophic injuries in snowmobiling and ATV riding.

**Conclusions:** The majority of these catastrophic injuries were preventable. Numerous deficiencies in injury prevention were identified in the areas of education, adult supervision, use of protective equipment, especially helmets and PFDs, and regulations.

**Managing Acute Ankle Sprains in a Pediatrics Emergency Department: Implementing an Interdisciplinary Approach**

I. Gagnon, PhD, L. Grilli, PT, MSc, C. Galli, PT, and D. Friedman, PT.

*Affiliation: Trauma Programs, Montreal Children's Hospital, Montreal, Quebec, Canada.*

**Objective:** To evaluate the implementation of a standardized interdisciplinary intervention for pediatric ankle sprains in the Emergency Department (ED) as well as to explore parental and professional satisfaction with the intervention. A secondary objective was to measure recovery time until readiness for return to play.

**Study Design:** Cross-sectional descriptive study.

**Subjects:** Thirty-nine children diagnosed with an acute ankle sprain in the Montreal Children's Hospital (MCH) ED over a three-month period.

**Intervention/Observation Technique:** Following an exhaustive literature review on the effectiveness in treatment of acute ankle sprains, a high incidence sport injury, the MCH Trauma Program developed a standardized and comprehensive multi-component intervention (management, teaching, exercises, crutch walking, return to sports guidelines) for children with an acute ankle sprain seen in the ED. Two perspectives were used to determine implementation. First, the medical charts of all children having presented with an ankle sprain in the MCH-ED during the study period were reviewed. Information excerpted from the charts regarded the nature of the injury and the ED management. The second phase involved a telephone interview with the parent who accompanied their child to the ED in order to review the episode of

care and their satisfaction with the intervention. Professionals' satisfaction was also explored by means of interviews.

**Results:** Documentation and interviews did not yield consistent implementation levels. Indeed, a higher number of parents reported having received the intervention than their child's medical record documented (51% vs. 41%). Parents who reported having received the intervention reported higher satisfaction with their episode of care, decreased need for an individual physiotherapy consultation and more compliance to the recommended home program than parents who did not receive it. Professionals reported high levels of satisfaction with the intervention and provided suggestions for improvements.

**Conclusions:** Implementation of a standardized and comprehensive intervention to children with acute ankle sprains in a pediatric ED is feasible and leads to increased satisfaction and increased compliance to discharge instructions. These factors may prevent a return visit to the ED and decrease rate of re-injury while practicing sports. However, the incomplete documentation of treatment in children's medical records illustrates the difficulties related to charting in an ED context.

### Effectiveness of a Primary School-Based PA Injury Prevention Program: a Randomized Controlled Trial

D.C.M. Collard, MSc, E.A.L.M. Verhagen, PhD, M.J.M. Chin A Paw, PhD, and W. van Mechelen, MD, PhD.

*Affiliation:* EMGO Institute and Department of Public & Occupational Health, VU University Medical Center, Amsterdam, the Netherlands.

**Objective:** To study the effects of a 1-year school-based injury prevention program on acute physical activity injury incidence and severity in primary school children.

**Study Design:** Cluster randomized controlled trial.

**Subjects:** Subjects included 2210 Dutch primary school children aged 10-12 years.

**Intervention/Observation Technique:** Schools were randomized to receive or not receive the intervention program targeting acute physical activity injuries which consisted of a teacher manual, informative newsletters and posters, a website, and simple exercises to be carried out during physical education classes ( $n = 1117$ ) or receive the regular curriculum ( $n = 1093$ ).

**Outcome Measurements:** Incidence and severity of acute physical activity injuries per 1000 hours of physical activity participation.

**Results:** Data from 1015 children in the intervention and 996 children in the control group were analyzed. After one school year, the overall physical activity injury incidence per 1000 hours of physical activity participation was significantly reduced in the intervention group compared to the control group (hazard ratio [HR], 0.68; 95% CI, 0.49-0.95). The largest intervention effect was observed on injury incidence during organized sports activities (HR, 0.55; 95% CI, 0.31-0.98). In boys, the severity of the overall physical activity injuries was significantly lower in the intervention group compared to the control group (OR, 0.12; 95% CI, 0.02-0.72).

**Conclusions:** Our school-based intervention-program was effective in reducing acute physical activity injury incidence in primary school children. The program also decreased the severity of physical activity injuries in boys.

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### A Pilot Study Examining the Effectiveness of a Combined Obesity and Sport Injury Prevention Program in Junior High Schools

S.A. Richmond, CEP, MSc, PhD (Candidate), C.A. Emery, BScPT, PhD, P.K. Doyle-Baker, DPH, and A. Nettle-Aguirre, PhD.

*Affiliation:* Sport Medicine Centre, University of Calgary, Calgary, Alberta, Canada.

**TABLE 1.** Baseline Characteristics (From Self-Reported Baseline Questionnaire)

Group	Intervention N = 349	Control N = 334
	Mean, (95% CI) or Proportion, (95% CI)	Mean, (95% CI) or Proportion, (95% CI)
Age, yrs	12.92 (12.82 - 13.01)	12.86 (12.77 - 12.95)
Height, cm	162.54 (161.46 - 163.63)	161.1268 (160.00 - 162.25)
Weight, lbs	110.79 (108.02 - 113.56)	108.82 (106.33 - 111.31)
Previous injury, past 6 weeks	10.60% (7.58 - 14.30)	6.02% (3.72 - 9.15)
Previous injury, past 1 year	20.92% (16.77 - 25.57)	16.52% (12.69 - 20.95)
Concussion	13.3% (9.7 - 16.9)	9.0% (5.9 - 12.0)

**Objective:** The objective of this study is to investigate the effectiveness and feasibility of a combined sport injury and obesity prevention program in junior high schools (adolescents aged 11-15 years).

**Study Design:** This is a randomized controlled trial design. Schools were randomized to the prevention program or control group by school.

**Subjects:** The subjects in this study are adolescent boys and girls aged 11-15 years recruited from 2 public schools in the North and South areas of Calgary. All grade 7-9 students enrolled in physical education (PE) classes were recruited for participation in the study.

**Intervention/Observation Technique:** The intervention program is 15 minutes in duration, and involves both high intensity and neuromuscular training which precedes each PE class. The program mimics a warm up and is designed to combine physical activity at greater than 75% maximum heart rate, with prescribed lower extremity and core strength, agility and balance training exercises. The control program utilizes the current standard of practice in PE classes, a 15-minute dynamic warm up.

**Outcome Measurements:** Primary outcome measures are waist circumference (cm) and all sport injury. This is defined as any injury occurring during a sporting activity that requires medical attention and/or cessation of the sporting activity, and/or resulting in at least 1 day loss from sporting activity. Secondary outcomes include: body composition [triceps skin fold (mm), BMI percentile ( $\text{kg}/\text{m}^2$  by age and gender)], aerobic fitness [ $\text{VO}_2$  maximum ( $\text{ml}/\text{kg}^{-1}\cdot\text{min}^{-1}$ )] and musculoskeletal fitness (push ups, curl ups, grip strength, trunk flexibility, vertical jump, unipedal dynamic balance, and vertical drop jump). Timelines for assessment are at baseline and 3 months following initiation of program.

**Results:** There were 349/481 (72.56%) participants in the intervention school and 334/653 (51.15%) participants in the control school who agreed to participate. Preliminary results for baseline characteristics at baseline are presented in Table 1. The primary between group comparisons for injury rates (# of injuries/1000 participation hours) will be estimated using incidence rate ratios based on multivariate Poisson regression analysis. A between group comparison of physical measures including body composition, aerobic and musculoskeletal fitness will be made using multivariate linear regression analysis.

**Conclusions:** The future direction for this research includes determining the effectiveness of such a neuromuscular prevention program in PE classes based on individual level analysis in this pilot study. In addition, the feasibility of a larger cluster RCT will be determined.

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