Tuesday November 4th 2025

ISPRM 25

MOROCCO
MARRAKESH

19TH WORLD CONGRESS

3-7 NOVEMBER 2025

Email: Benoit.Vandenbroeck@uliege.be

OC ID 906

Effects of high-intensity eccentric cycling on aerobic and functional capacities in sedentary people.

Benoît Vandenbroeck – PhD Student ULiège

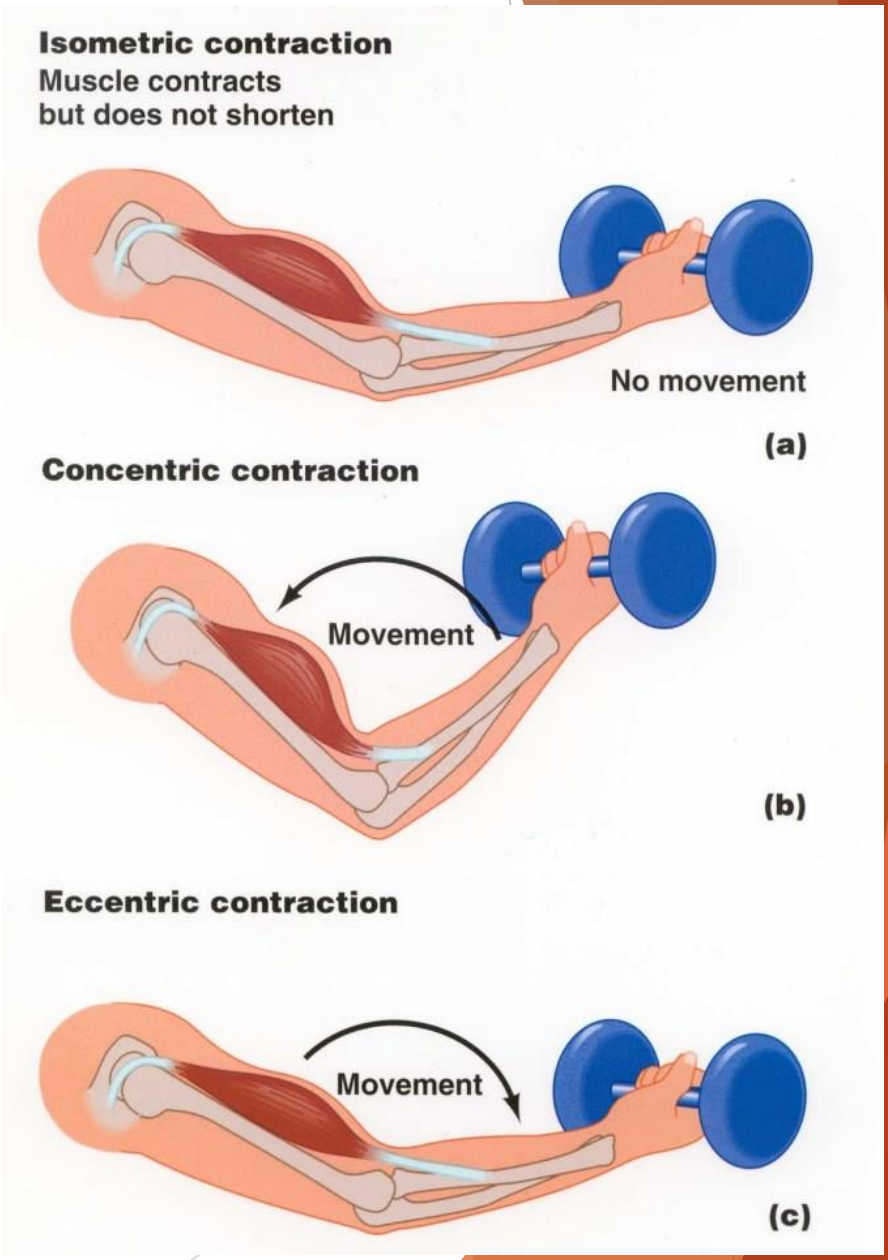
OC ID 906

Supervisor – Dr HODY Stéphanie
Co-Supervisor – Prof KAUX Jean-François

I hereby declare that I have no conflict to disclose with respect to this presentation

Eccentric Contraction

- « Lengthening of the muscle while contracting »
- Eccentric vs Concentric contraction
  - *Higher **forces***
  - *Lower **metabolic** cost*
  - *Unique **neural** strategies*
- Benefits in rehabilitation for frail people : Heart Failure, COPD, Elderly



LIÈGE université Médecine

Objectives

- Evaluate the **feasibility** of a 12-week high intensity interval **eccentric** cycling training

- Compare the **benefits** of eccentric HIIT, concentric HIIT and continuous moderate eccentric training
  - *Muscular function*
  - *Functional capacities*

- **Optimize** physical **reconditionning** and chronic pathologies **rehabilitation**

(sedentarity, neuropathologies, geriatric pathologies,…)

Methods

Sample size estimation
8 – 15 / group

43 healthy adults
(61,5 ± 4,5yrs)

- Eccentric interval (n=15) → 120 – 135% MAP
- Eccentric continuous (n=15) → 80 – 90% MAP
- Concentric interval (n=13) → 80 – 90% MAP

Work-matched training protocol
(100% eMAP = 150% cMAP)

Stratified randomization

Pre-test – W1

Familiarization (T1) W2/W5 – Training (T2) W6/W9 – Training (T3) W10/W13

Rating of perceived exertion (RPE,Borg), Heart rate (HR), Muscle soreness (DOMS), Cognitive fatigue (Fat)

Post-test – W14

Maximal oxygen consumption (VO2 max), Maximal aerobic power (MAP), Maximal isometric force (MIF), Prehension, Balance error scoring system (BESS), Ten times sit to stand test (TTSST), Timed up and go (TUAG), 6–minute walking test (6MWT)

LIÈGE université Médecine

Population

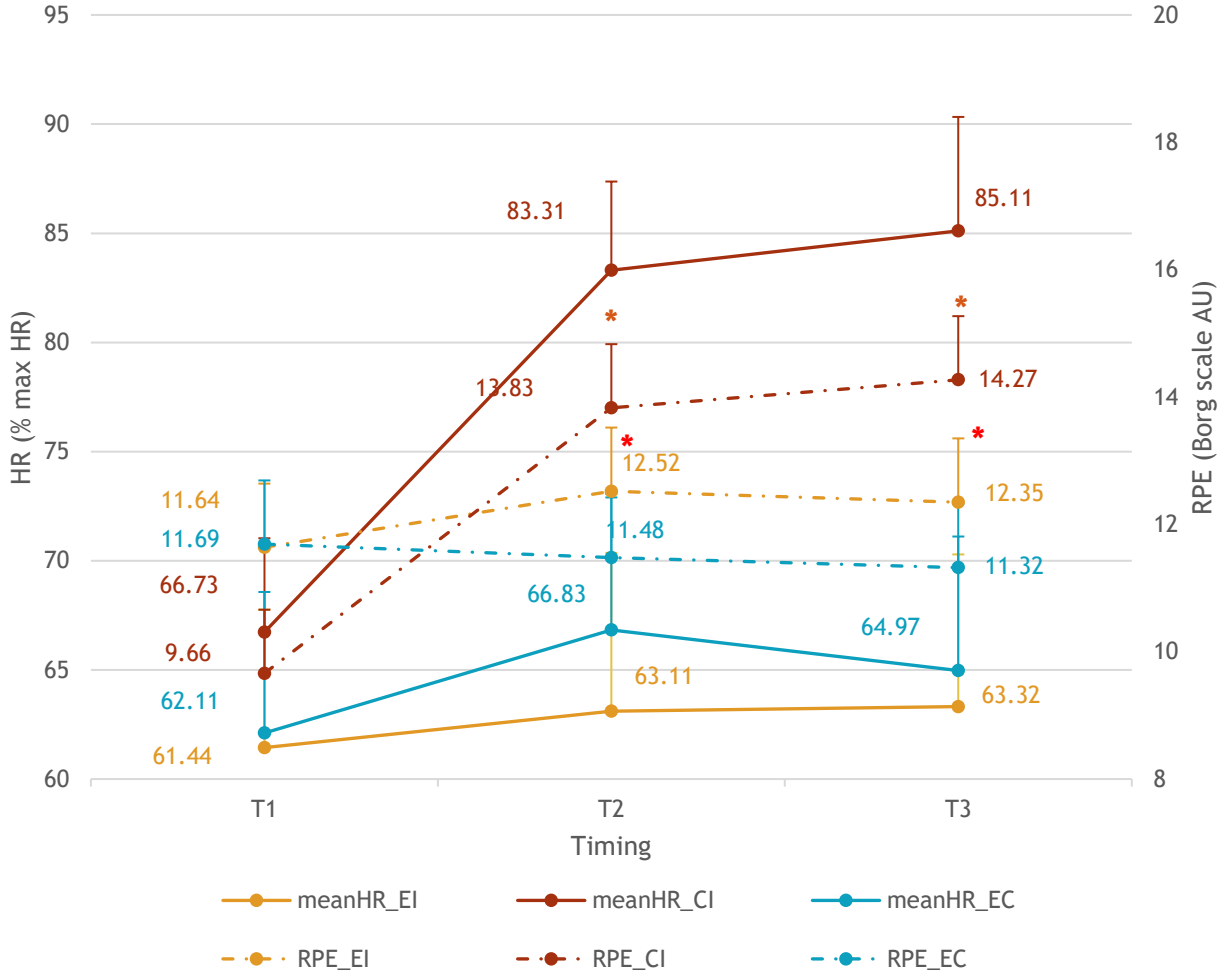
N=43	CI (13) (6w, 7m)	EI (15) (7w, 8m)	EC (15) (7w, 8m)
Age (yo)	60 (57 ; 65)	63 (59.5 ; 65)	60 (56 ; 66.5)
Height (cm)	173 (163 ; 181)	171 (165 ; 179)	167 (161 ; 182)
Weight (kg)	79.7 (66 ; 85.3)	76 (61.7 ; 95.8)	74,4 (65.2 ; 92.6)
VO_2 max (mL/min/kg)	23.4 (21.4 ; 28.3)	24.6 (21.9 ; 28.4)	21.4 (18.1 ; 23.9)
MAP (W)	182 (135 ; 202)	182 (131 ; 211)	165 (130 ; 193)
MG (%)	33.4 (21.4 ; 35.1)	30.9 (25.6 ; 32.7)	30 (28.2 ; 30.2)

N = number of subjects; CI = concentric interval; EI = eccentric interval; EC = Eccentric continuous

LIÈGE université Médecine

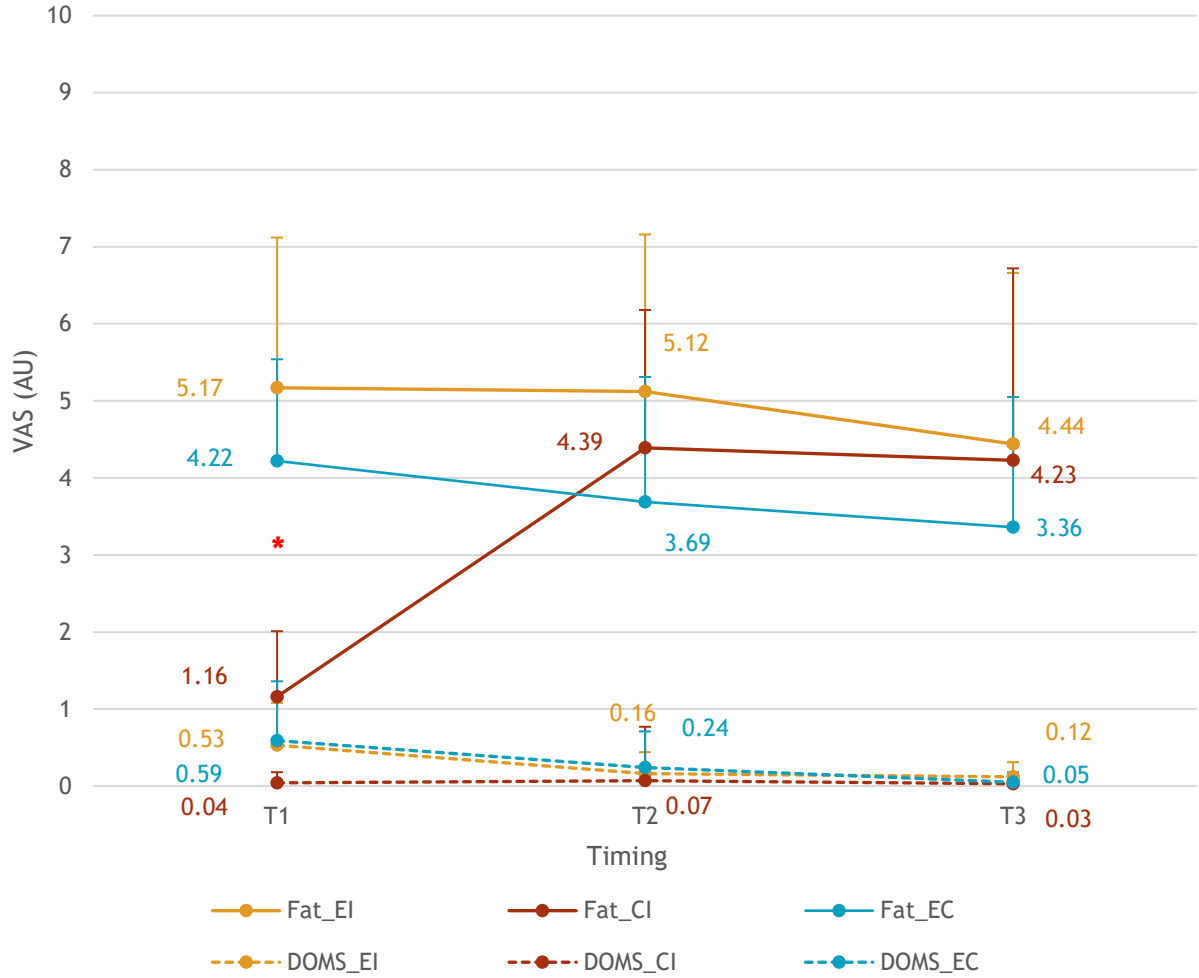
Results

Heart rate and RPE



* Mean HR : Ecc < Conc during each phase (p<0.0001)
* RPE : Ecc < Conc during T2 & T3(p<0.001)

DOMS and cognitive fatigue over time



* Fat : Ecc > Conc during T1(p<0.05)

LIÈGE université Médecine

Results

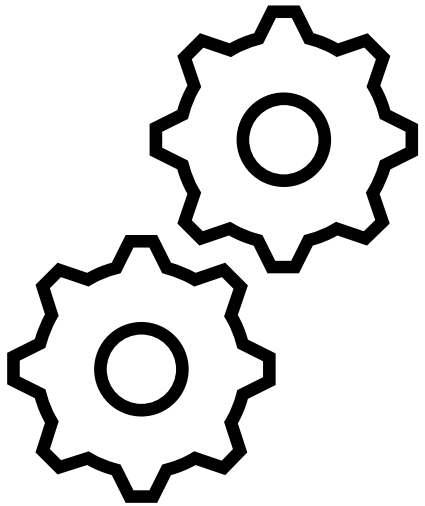
Functional parameters

Test	CI	EI	EC	Test	CI	EI	EC
MIF	**23.9%** (17.4 ; 39.2)	**13.5%** (7.5 ; 26.5)	**17.4%** (12.8 ; 18.7)	*Handgrip*	-3.4% (-7.3 ; 2.3)	-2.8% (-4.5 ; 5.3)	-0.2% (-5.1 ; 5.9)
BESS	**34.5%** (14.3 ; 45.5)	**22.5%** (12.8 ; 29)	17.4% (-4 ; 29)	*TUAG*	**9.3%** (4.5 ; 13.8)	-1% (-9.4 ; 6.2)	**2.9%** (-0.7 ; 10.9)
TTSST	**10.5%** (5.5 ; 14)	**14%** (11 ; 16.5)	**16.8%** (1.1 ; 24)	*VO_2 max*	**14%** (11.7 ; 15.4)	1% (-3.9 ; 7.8)	-1% (-4.9 ; 6.4)
6 MWT	**4.2%** (1.5 ; 6.8)	**5.8%** (3.5 ; 7.2)	**5.5%** (3.4 ; 7.4)	*MAP*	**17.8%** (12.7 ; 20.7)	3.8% (-1.6 ; 5.1)	1.1% (-1 ; 6.5)

Green Bold characters indicate a statistically significant difference ($p<0.001$);
Red characters indicate non-sigificant difference MANOVA (time*group)

LIÈGE université Médecine

Conclusion



High intensity eccentric cycling

- ✓ ***Feasible***
  - *No Soreness*
  - *Better tolerated than CI (significantly)*
  - *As well tolerated as EC*
- ✓ ***As efficient as CI and EC***
  - *Muscular benefits*
  - *Functional benefits*
- ✓ ***Low metabolic cost***
  - *Lower HR than CI (significantly)*
  - *Same demand than EC*
- X ***No aerobic improvement***
  - *CI more efficient*
  - *More efficient than EC*

Safe, efficient and promising method to be used in rehabilitation

THANK YOU

Email: Benoit.Vandenbroeck@uliege.be

19TH WORLD CONGRESS ISPRM MARRAKESH 3-7 NOVEMBER 2025