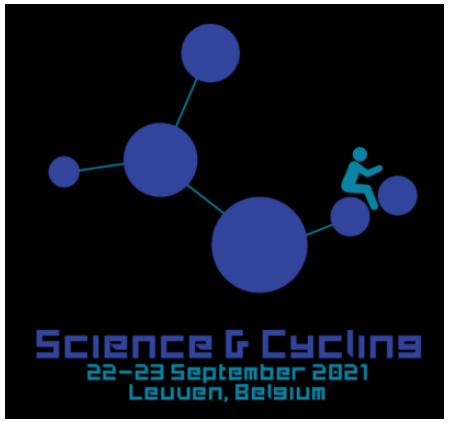


Adding vibrations during high intensity cycling increases acute physiological responses

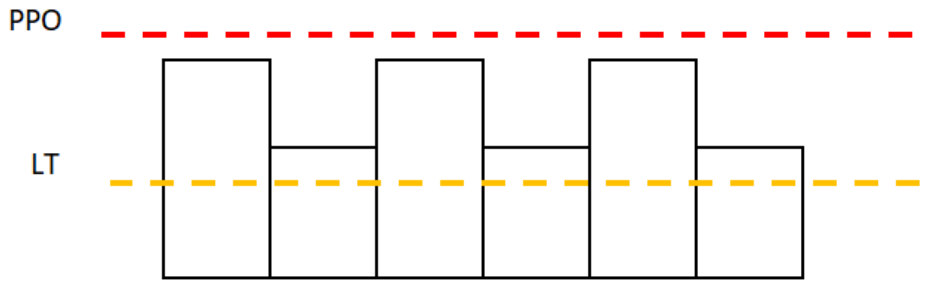
Sébastien DUC[1], Tomas URIANSTAD[2], Bent RØNNESTAD[2]

[1] Laboratory of Performance, Health, Metrology and Society, University of Reims Champagne Ardennes, Reims, France
[2] Section for Health and Exercise Physiology, Inland Norway University of Applied Sciences, Lillehammer, Norway.
sebastien.duc@univ-reims.fr

- $\dot{V}O_{2max}$ can be increased after high intensity interval training (HIIT) program (Buchheit & Laursen, 2013)

- Improvement of $\dot{V}O_{2max}$ depends on total time >90%$\dot{V}O_{2max}$ per training session (Migdley & Mc Naughton, 2006)

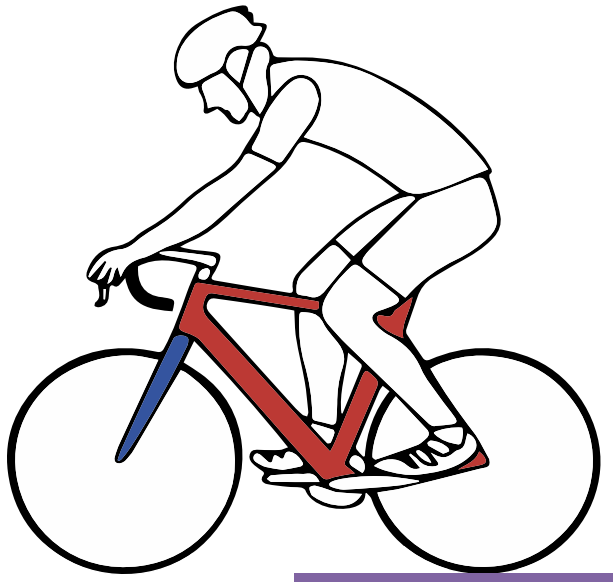
- Time > 90% $\dot{V}O_{2max}$ can be increased by 43% during a HIIT included varied-intensity work intervals (Bossi et al., 2020)



- Training stress can be increased by adding vibrations (VIB) while cycling

- Addiing VIB (40 Hz) during a single HIIT session (6 × 5 min all-out) increase time >90%$\dot{V}O_{2max}$ by 58%

(Rønnestad et al., 2018)



VIBRATIONS

↳ <u>Mechanisms:</u> recruitment of fast twitch fibres (tonic reflex vibration) AND/OR upper limb muscles for damping

Limit : all-out HIIT could be too difficult for less-trained cyclists

adding intermittent vibrations during a varied-intensity HIIT may be an effective strategy to increase time >90%VO_{2max} with minimising discomfort to the cyclists

To evaluate the **acute effects of adding vibrations** (VIB; 40 Hz) to the **submaximal intensity during a varied-intensity HIIT session** on the responses of the **cardiovascular and muscular systems**

Hypothesis : VIB ➡ ↗ muscular recruitment ➡ ↗ $\dot{V}O_2$ ➡ ↗ time >90%$\dot{V}O_{2max}$

- ✓ 12 well-trained male cyclists
- ✓ 3 test sessions separated by 2 days

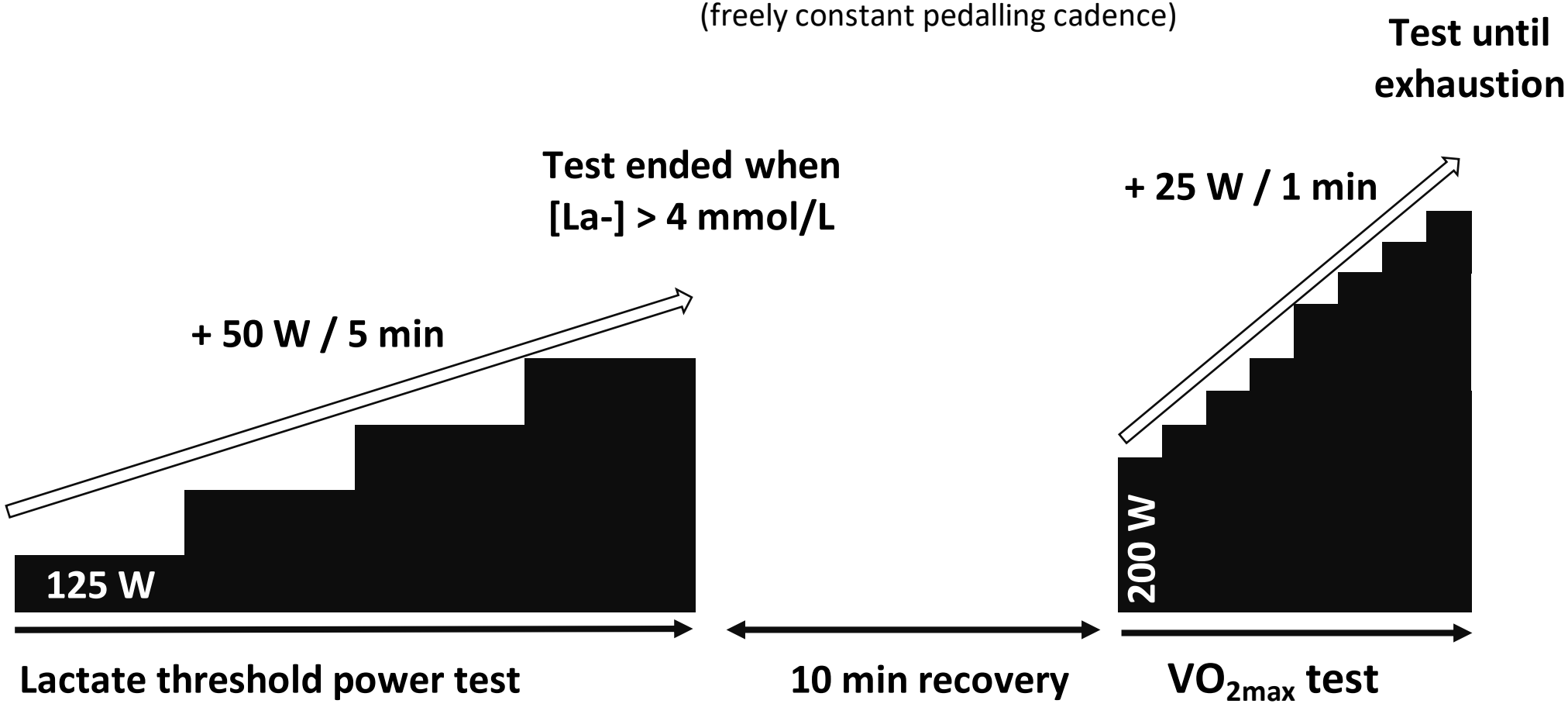
Age (years)	27 ± 9
Body height (cm)	182 ± 4
Body mass (kg)	72.7 ± 5.3
$\dot{V}O_{2max}$ (ml·kg^{-1}·min^{-1})	72.5 ± 8.0
$\dot{V}O_{2max}$ (L·min^{-1})	5.27 ± 0.64
$\dot{W}_{max}$ (W·kg^{-1})	6.1 ± 0.6
$\dot{W}_{max}$ (W)	430 ± 32
MAP (W·kg^{-1})	5.2 ± 0.7
MAP (W)	375 ± 58
HR_{max} (beats·min^{-1})	188 ± 9
$[La^-]_{peak}$ (mmol·L^{-1})	13.8 ± 2.2
$\dot{V}E_{peak}$ (L·min^{-1})	200.2 ± 22.7
RER_{peak}	1.15 ± 0.03
RPE_{peak}	19.3 ± 0.5
$LT_{4\ mmol\cdot L^{-1}}$ (W·kg^{-1})	4.1 ± 0.5
$LT_{4\ mmol\cdot L^{-1}}$ (W)	299 ± 28

UNIVERSITÉ DE REIMS CHAMPAGNE-ARDENNE

Inland Norway University of Applied Sciences

FIRST TEST SESSION

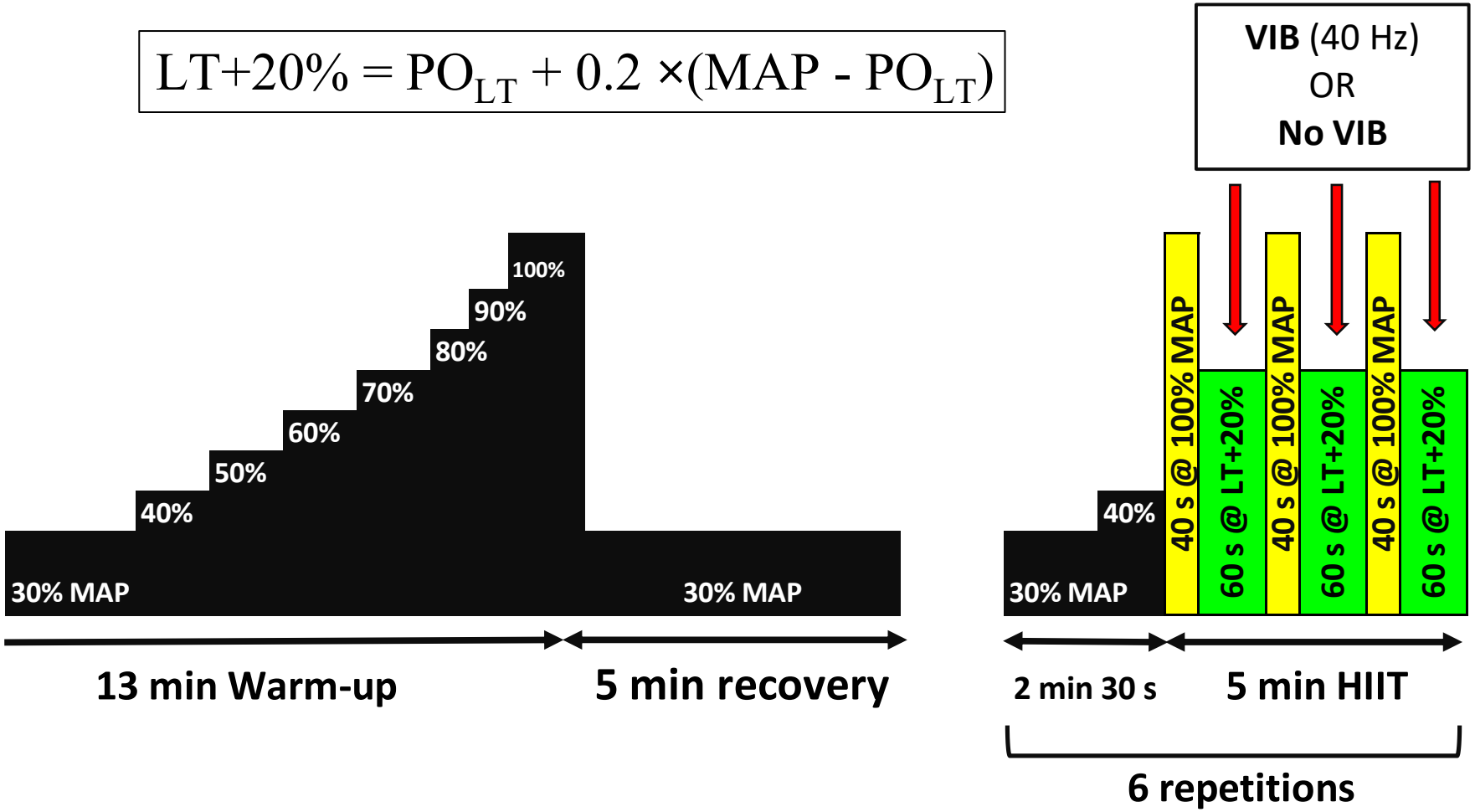
(freely constant pedalling cadence)

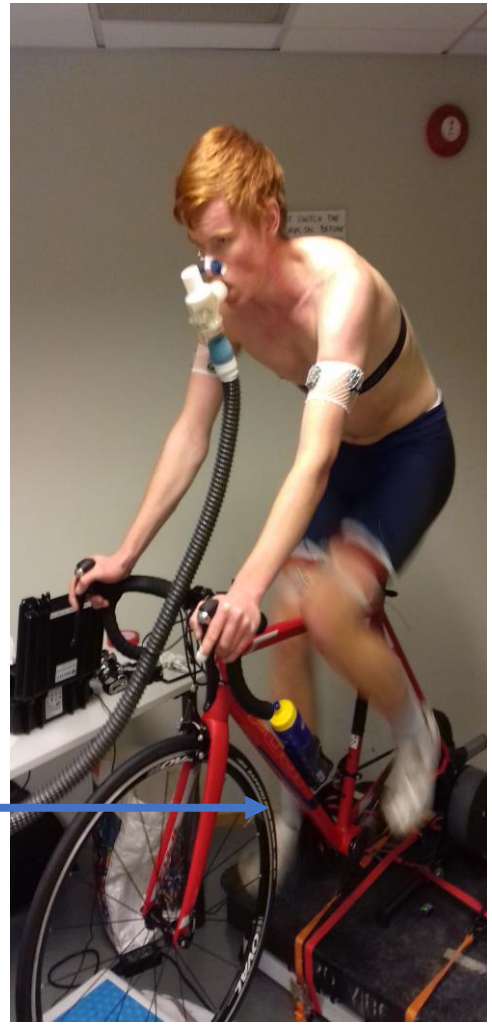


SECOND ET THIRD TEST SESSIONS

(freely constant pedalling cadence)

$$LT{+}20\% = PO_{LT} + 0.2 \times (MAP - PO_{LT})$$





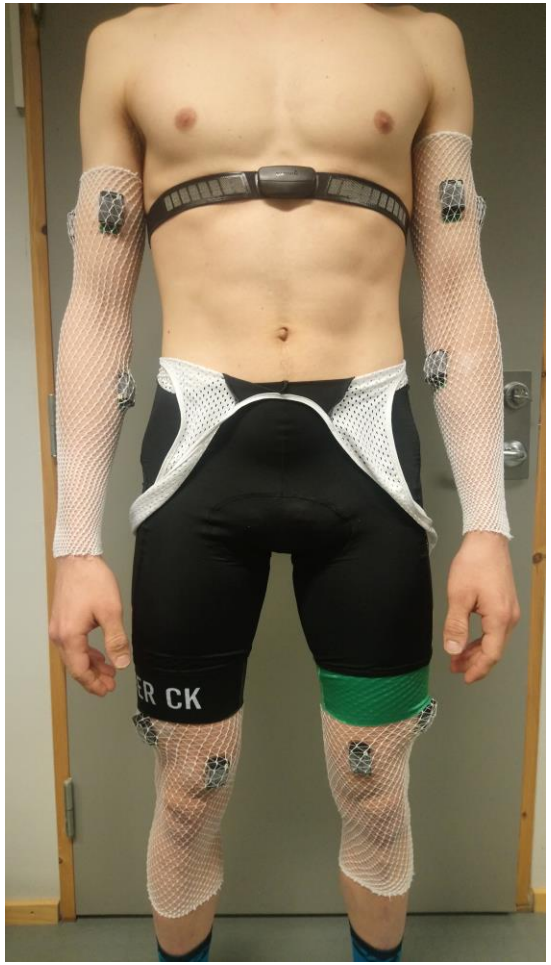
SRM crankset

Direct drive trainer
(Wahoo KIRCK)

Vibration plate
(PneuVib Pro)

Data collection

- PO, CAD, HR (every 1 s)
- VO_2 and VCO_2 (averaged every 10 s)
- Blood lactate and RPE (6-20 scale Borg)
- EMG activity of lower limbs (vastus lateralis, vastus medialis, rectus femoris, biceps femoris) and upper limbs (biceps and triceps brachii) with Trigno Sensors (Delsys)



Data analysis

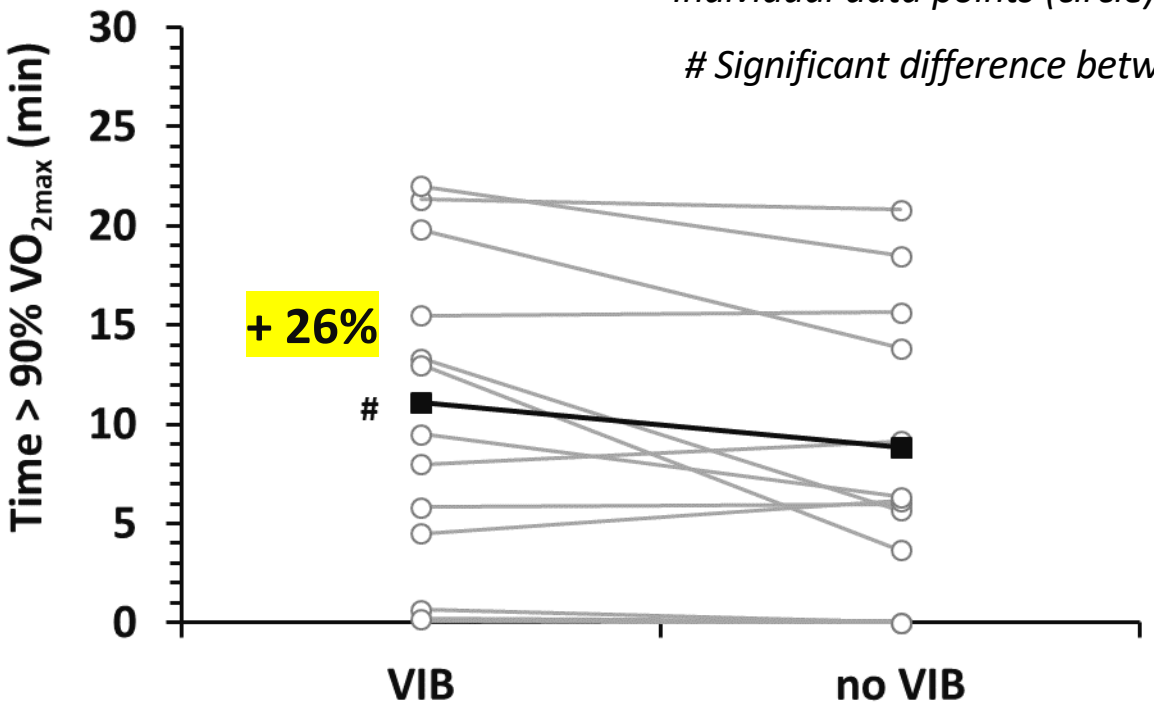
- Total time over HIIT session >90%$\dot{V}O_{2max}$
- Global muscular activity of lower limbs (mean of VL, VM, RF and BF) and upper limbs (mean of BB and TB)

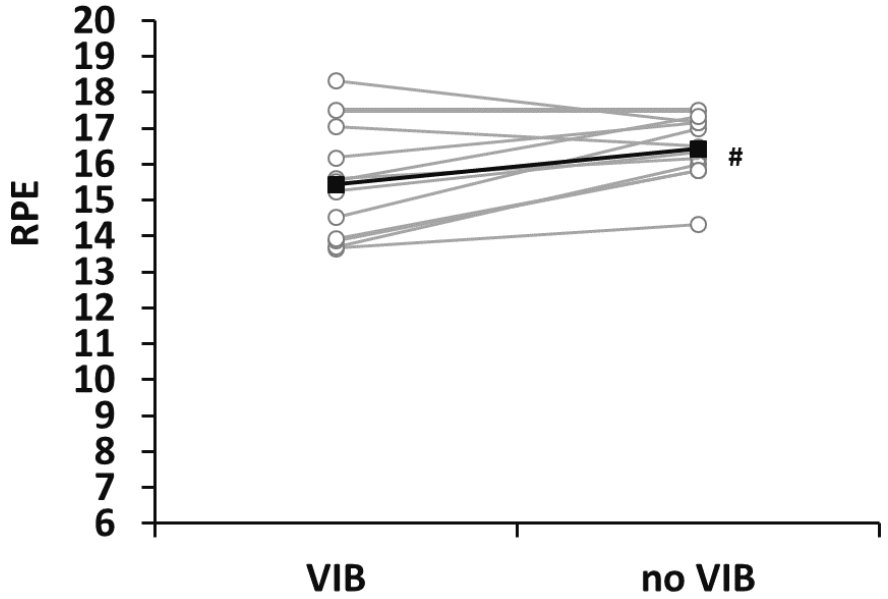
Statistics

- Student`s two-tailed paired t-tests ($p < 0.05$)

Individual data points (circle) and mean values (square)

 # Significant difference between treatments (p < 0.05)



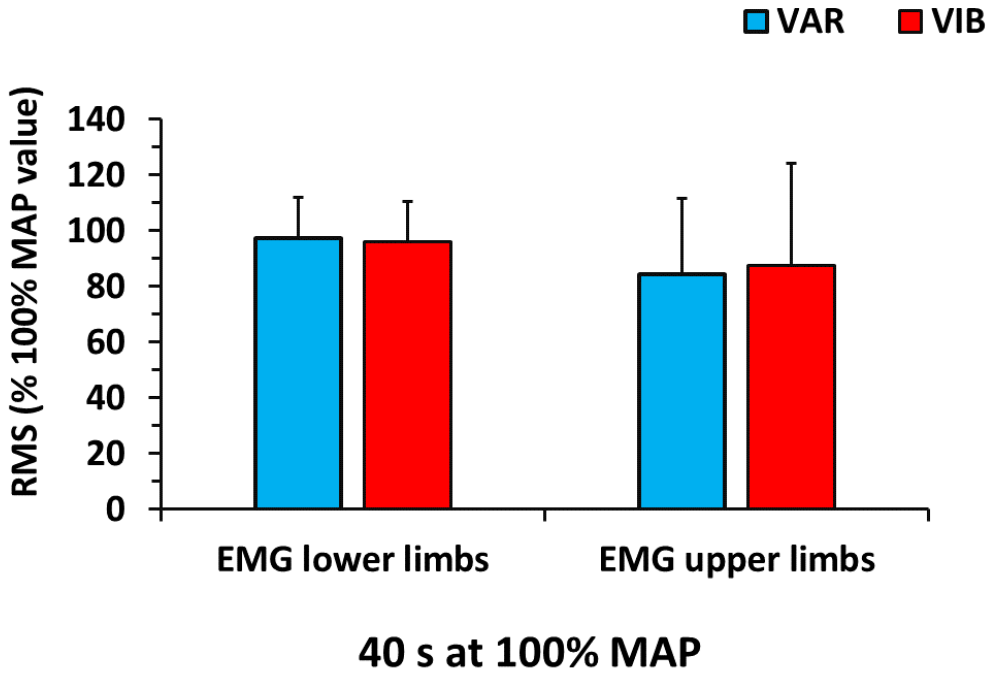


- VIB ↗ Total time ≥ 90% → *In accordance with Rønnestad et al. (2018)*
- Mean RPE was lower in VIB → ↘ *pain sensation associated with exercise ?*

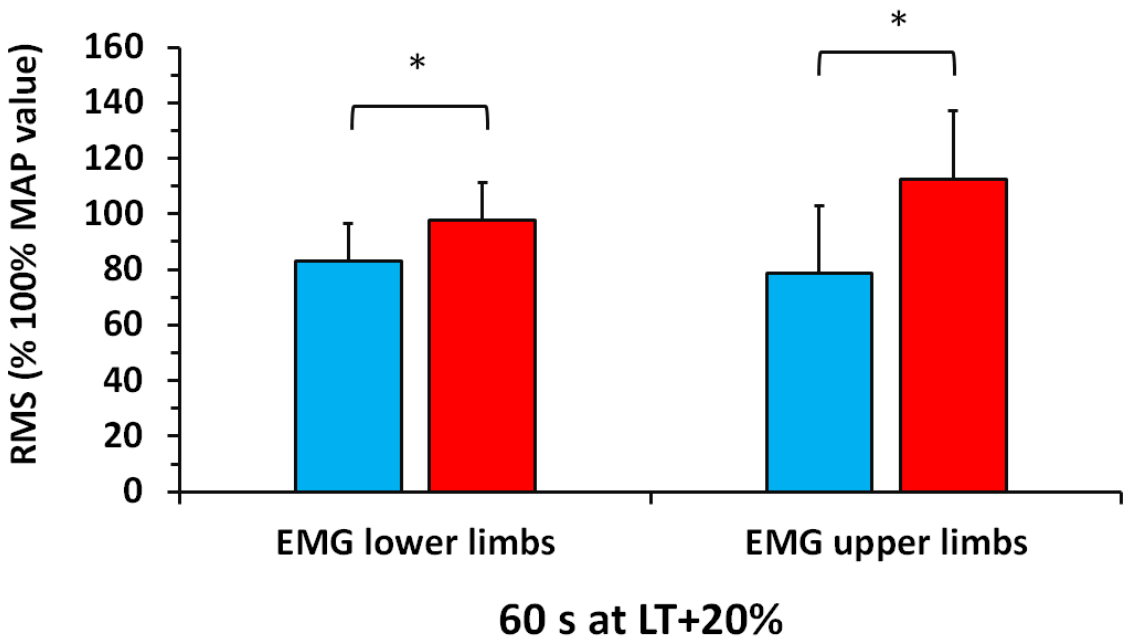
- No significant difference in HR and Lactate between VIB and VAR

	VIB	No VIB
$\dot{V}O_{2mean}$ (L.min)	4.53 ± 0.50#	4.45 ± 0.49
$\dot{V}O_{2mean}$ (%$\dot{V}O_{2max}$)	86.2 ± 3.5#	84.6 ± 3.8
Total VO_2 (L)	135.9 ± 15.1#	133.3 ± 14.5
time >90%$\dot{V}O_{2max}$ (min)	11.1 ± 7.6#	8.8 ± 6.9
HR_{mean} (beats.min^{-1})	169 ± 9	167 ± 8
time >90%HR_{max} (min)	17.7 ± 4.2	14.1 ± 6.6
$\dot{V}E_{mean}$ (L·min^{-1})	141.2 ± 21.6	137.0 ± 20.5
RER	0.96 ± 0.02	0.97 ± 0.02
$[La^-]_{mean}$ (mmol·L^{-1})	8.8 ± 3.1	8.5 ± 2.8
RPE_{mean}	15.4 ± 1.6#	16.4 ± 0.9
Leg RPE_{mean}	6.7 ± 1.9	6.6 ± 1.7

Science & Cycling, Louvain 2021



40 s at 100% MAP



60 s at LT+20%

- No significant differences were found at 100% MAP
- VIB ↗ EMG activity of lower and upper limbs at LT +20%

Adding vibration to the submaximal intensity of a varied-intensity HIIT session acutely increases time ≥ 90% VO_{2max} and muscular activity of upper and lower limbs

Next

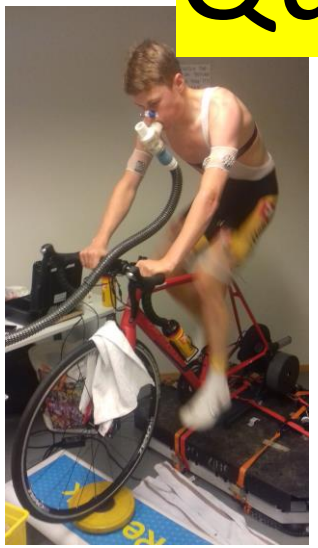
- Find the better intensity-time-vibration frequency combination during a single varied HIIT session to maximize time ≥ 90% VO_{2max}
- Study of long-term effects (positive and negative) → 8 weeks HIIT training with VIB

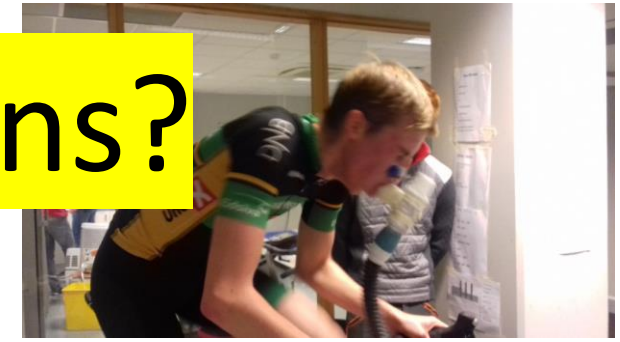
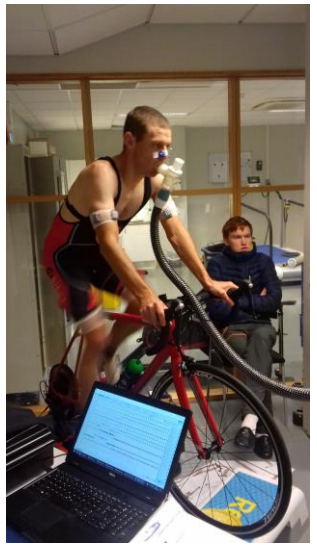
Thank you to all the cyclists and students of the University of Lillehammer for their involvement in this study









Questions?

Science & Cycling, Louvain 2021