Title: Adding vibration to high-intensity intervals increase time at high oxygen uptake in well-trained cyclists

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Introduction: The importance of accumulated time ≥90% of maximal oxygen uptake (VO_{2max}) to improve performance in well-trained endurance athletes is well established[e.g.1,4,5,9]. However, continuous work at such high intensities cannot be sustained for a long time. Therefore, there is a quest for developing high-intensity aerobic interval training (HIT) sessions that optimizes time ≥ 90% VO_{2max}. It is possible to add vibration while performing cycling exercise by mounting a cycle to a vibration plate[8] with concomitant increase in muscle activation[6] possibly due to increased activation of the stretch-sensitive muscle spindles ensuring increased Ia afferent signals and thus a larger excitatory inflow to the motoneurone pool[2,7,8]. Increased muscle activation could in theory increase VO_2, and it has been observed that adding vibrations while cycling at the high workloads, similar to that used for HIT sessions, can increase VO_2 compared to cycling without vibration in recreationally to moderate trained persons[3,8]. However, the effect of adding vibration to a HIT session in well-trained cyclists has not previously been investigated. Thus, the primary purpose of the present study was to compared the acute effect of an all-out traditional HIT session without vibration (TRAD) with the same all-out HIT session with added vibration during the work intervals (VIB) on time ≥ 90% VO_{2max}, muscle activation and power output in well-trained cyclists.

Method: Ten cyclists (24±7 yrs, 180±5 cm, 73.2±6.2 kg, VO_{2max}:78.6±7.4 $mL \cdot min^{-1} \cdot kg^{-1}$) visited the test laboratory on three separate occasions; first they performed a graded protocol to exhaustion to determine VO_{2max} and peak heart rate (HR_{peak}) followed by familiarization to cycling with vibration. On the subsequent two visits, time ≥90% of VO_{2max}, average power output during the work intervals, time ≥90% HR_{peak}, surface electromyography (EMG) activity, blood lactate concentration ([La-]) and rate of perceived exertion (RPE) was measured during the 6x5 min all-out HIT session with or without vibration during the work intervals with 2.5 min relief period in between. In order to say something about the recovery demand of these two HIT protocols, peak power output was measured during seated leg press before each session and 5 minutes after the last work interval. The order of interval protocols on the 2nd and 3rd test session was randomized and it was 48 ± 1 hrs between these two sessions.

Results: VIB was superior to TRAD on time ≥90% of VO_{2max}, (10.99±7.00 vs. 6.95±5.28 min, respectively, Fig. 1), time ≥90% of HR_{peak} (24.61±2.38 vs. 19.97±4.12 min, respectively) and averaged EMG activity in m. Vastus Lateralis (Fig. 2) during the work intervals (all $p<0.05$). Mean values across work intervals showed no difference between VIB and CON in mean power, RPE, or blood lactate concentration. There were no differences between VIB and TRAD in peak power in leg press either before (755 ± 141 vs. 753 ± 140 W, respectively) or after (756 ± 146 W vs. 742 ± 164 W, respectively) the HIT session.

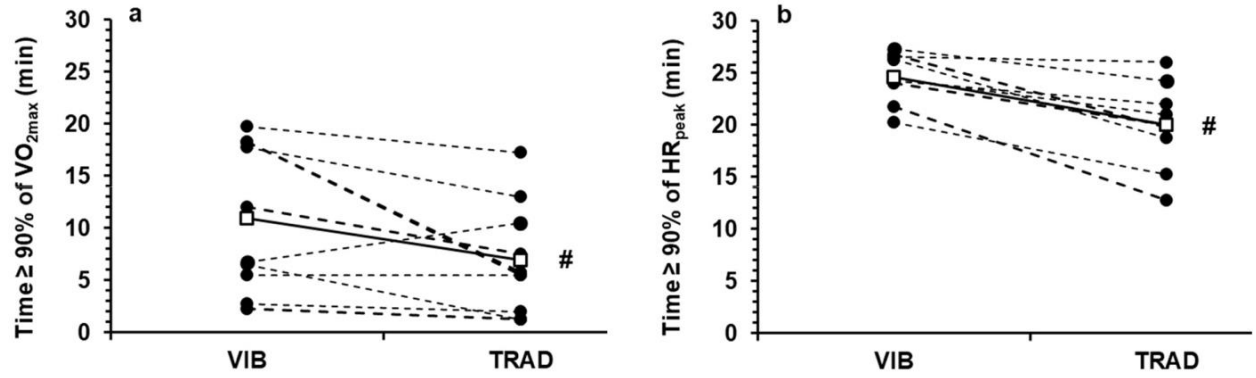

Figure 1 Individual data points (circle) and mean values (square) for time ≥ 90% VO_{2max} (a) and time ≥ 90% HR_{peak} (b) during a 6x5 min all-out HIT session with vibration (VIB) or without vibration (TRAD).# Significant difference between treatments ($p < 0.05$).

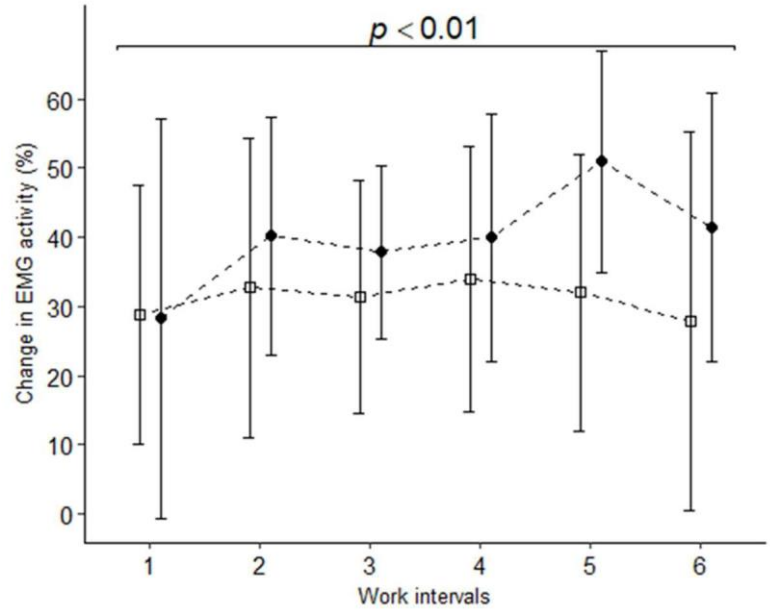

Figure 2 Percentage change in electromygraphic (EMG) activity of the m. Vastus Lateralis during a 6x5 min all-out HIT session with vibration (VIB = black circles) or without vibration (TRAD = white squares). p < 0.01 significant main effect of conditions.

Conclusion: The present study indicated that adding vibration to the work intervals during a HIT session can acutely speed up the physiological responses of the cardiovascular system and increase time ≥90% VO_{2max} and should therefore be considered in order to optimize the exercise stimulus of well-trained cyclists.

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