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Conference Abstract

Effect of different rest intensities on time spent near maximal oxygen uptake during a decreasing high-intensity training session – a pilot study

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1. Introduction

Besides exercise economy, fractional utilization of maximal oxygen uptake ($\dot{V}O_{2max}$) and durability, $\dot{V}O_{2max}$ is one of the four major parameters reflecting endurance exercise performance (Spragg, Leo, & Swart, 2023). In order to improve $\dot{V}O_{2max}$ high-intensity interval training (HIIT) is commonly applied (Buchheit & Laursen, 2013). When more time is spent near $\dot{V}O_{2max}$ during HIIT (e.g., 90% of $\dot{V}O_{2max}$) research has demonstrated larger improvements in $\dot{V}O_{2max}$. (Midgley & McNaughton, 2006). Various HIIT protocols have been assessed recently (for review: de Oliveira-Nunes, Castro, Sardeli, Cavaglieri, & Chacon-Mikahil, 2021), like a HIIT-protocol with decreasing duration of work as well as rest periods (Vaccari, Giovanelli, & Lazzer, 2020). Results of this research have demonstrated a longer time spent above 90% of $\dot{V}O_{2max}$ compared to longer intervals (i.e., 4 min) and shorter intervals (i.e., 30 s). Most studies assessing the effects of HIIT on $\dot{V}O_{2max}$ have modified intensity and duration of the work intervals, however, much less is known about modifying rest intensity. Therefore, the aim of this pilot study was to assess whether different rest intensities notably affect time spent near $\dot{V}O_{2max}$ during an exhaustive HIIT-protocol.

2. Materials and Methods

Six trained cyclists and triathletes (3 male, 3 female; age: 32.1 ± 6.1 yrs; body mass: 67.0 ± 11.0 kg; stature: 1.77 ± 0.06 m; $\dot{V}O_{2max}$: 51 ± 7 mL·min^{-1}·kg^{-1}; incremental peak power output [iPPO]: 312 ± 76 W; $iPPO_{rel}$: 4.6 ± 0.7 W·kg^{-1}) volunteered for this study.

After a preliminary incremental exercise test (25 W·s^{-1}) until volitional exhaustion participants performed two different decreasing HIIT sessions. All tests were conducted on an electromagnetically braked ergometer using the participants' own bikes (Cyclus2, RBM electronics GmbH, Leipzig, Germany). During all tests respiratory gases were measured continuously breath-by-breath (MetaMax 3B, Cortex, Germany). To determine ventilatory thresholds (i.e., VT1 and VT2) breath-by-breath raw data were analyzed as 15-s bins. $\dot{V}O_{2max}$ was taken as the highest 30-s rolling average during the test and was confirmed by the following criteria: plateau in $\dot{V}O_2$ despite an increase in work rate, a RER > 1.10, and/or a $\dot{V}E/\dot{V}O_2$ >35.

A 15-min warm-up at 80% of VT1 was followed by a HIIT with a 3:2 work:rest ratio with decreasing durations from 3 min to 30 s (exemplary protocol in Figure 1). Work intensity was set at 50% of the difference between VT2 and iPPO. Rest intensity was set either at VT1 (HIGH) or 80% of VT1 (LOW). HIIT session was terminated either when participants were exhausted or when twelve 30-s:20-s-intervals were completed. After each interval, blood samples to assess blood lactate (BLa) concentration were obtained from the earlobe to assess for maximal [BLa]. Differences in workload between protocols were evaluated by calculating total mechanical work of all completed work and rest periods.

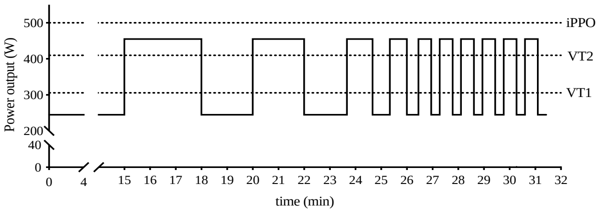

Figure 1. Exemplary LOW HIIT-session (i.e., 80% of VT1). For better visibility only six 30-s:20-s intervals are displayed. iPPO = incremental peak power output; VT = ventilatory threshold.

After completion of the interval sessions breath-by-breath data was exported and outliers that were above or below three SD of the subsequent five breaths were excluded from further analysis. Recorded data was analyzed as the mean of three consecutive breaths and interpolated to 1-s intervals. Data was subsequently analyzed for time spent above the individual cutoff values of 90% and 95% of $\dot{V}O_{2max}$, respectively. Differences between the protocols were assessed using a paired samples *t*-test with an alpha level of $P < 0.050$. Effect sizes were assessed using Cohen's *d*.

3. Results

Work intensity was 275 ± 72 W, rest intensity was 131 ± 41 W and 163 ± 51 W for HIGH and LOW, respectively. Mechanical work accomplished during the HIIT-sessions was 247 ± 85 kJ and 234 ± 78 kJ for HIGH and LOW, respectively ($P = 0.468$; $d = 0.32$). No significant differences were revealed for time spent > 90% (598 ± 173 s vs 582 ± 271 s for HIGH and LOW, respectively; $P = 0.865$; $d = 0.07$) and > 95% of $\dot{V}O_{2max}$ (243 ± 179 s vs 250 ± 228 s for HIGH and LOW, respectively; $P = 0.866$; $d < 0.01$). Furthermore, peak [BLa] was not significantly different between the protocols (12.8 ± 2.2 mmol·L^{-1} vs 12.6 ± 2.7 mmol·L^{-1} for HIGH and LOW, respectively; $P = 0.764$; $d = 0.13$).

4. Discussion and Practical Applications

Results of the current work suggest that different rest intensities in the moderate exercise intensity domain do not significantly affect accumulated time near $\dot{V}O_{2max}$. Furthermore, rest intensities did not significantly influence mechanical work accomplished during HITT. Therefore, when prescribing HIIT coaches and practitioners should focus more on interval duration rather than on rest intensity in order to increase $\dot{V}O_{2max}$. Based on the results of the current pilot study, either a LOW or HIGH approach can be chosen when prescribing HIIT session with no physiologically meaningful differences in time spent near $\dot{V}O_{2max}$.

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