Muscle deoxygenation during repeated sprint running: effect of active vs. passive recovery

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Introduction

Active recovery has recently been shown to impair intermittent performance[1,2] and repeated sprint ability (RSA) during cycling[5,6]. This is thought to be due to the reduction in oxygen availability that occurs with active recovery, which may limit muscular PCr and ATP resynthesis in the early recovery phase (within 20 to 30 seconds) following exercise[3]. However, in all pre-cited RSA studies, participants exercised exclusively on standard[1,2] or front-access cycle ergometers[5,6], neither of which replicates specific team sport movements. Since exercise mode can influence muscle recruitment patterns, the proportion of anaerobic system participation and RSA[4], an assessment of the muscle deoxygenation levels during repeated sprint running was necessary to fully understand the effects of recovery type under conditions resembling those experienced during team sport activity. The purpose of the present study was to compare the effect of active (AR) versus passive recovery (PR) on muscle oxygenation during short repeated maximal running.

Methods

Ten moderately trained male subjects (26.9 ± 3.7y, VO_2max: 55.1 ± 7.7 $ml.min^{-1}.kg^{-1}$) performed 6 repeated maximal 4-s sprints interspersed with 21-s of either AR (2.0$m.s^{-1}$) or PR (standing) on a non-motorized treadmill (Fig. 1). Recording was breath-by-breath for oxygen uptake (VO_2, Medgraphics CPX Gas Analysis System; St. Paul, MN), beat-to-beat for heart rate (HR), and 6Hz for near-infrared spectroscopy deoxyhemoglobin (HHb, NIRS, Niromonitor NIRO-200, Hamamatsu Photonics, Japan). Capillary blood lactate ($[La]_b$) was also measured after each exercise. Mean running speed ($AvSp_{mean}$) and percentage speed decrement (Sp%Dec) were computed for each recovery condition.

Fig 1. Participant performing a 4-s sprint on the non-motorized treadmill (Force model, Woodway, Waukesha, WI, USA).

Results

Results show that $AvSp_{mean}$ was significantly lower and Sp%Dec significantly higher for AR versus PR (Fig. 2). All cardiorespiratory and NIRS values were higher during AR compared to PR: mean VO_2 (3.64 ± 0.14 vs. 2.91 ± 0.15L, $P<0.001$), HR (159.9 ± 2.6 vs. 154.7 ± 2.6bpm, $P < 0.01$), HHb (94.4 ± 5.3 vs. 83.4 ± 1.5% of HHb during the first sprint, $P<0.05$) and $[La]_b$ (13.5 ± 0.8 vs. 12.7 ± 0.7$mmol.l^{-1}$, $P=0.03$).

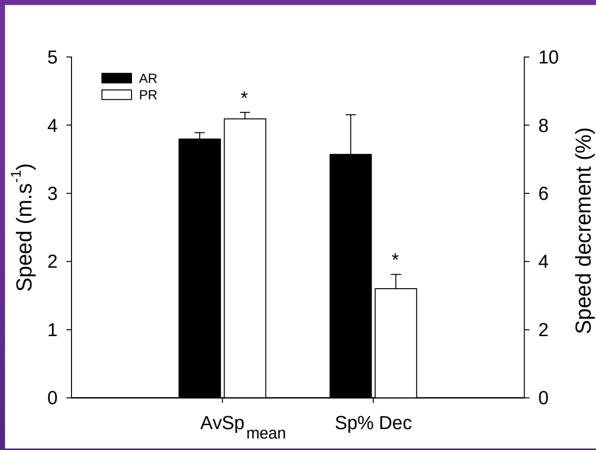

Fig 2. Mean average speed ($AvSp_{mean}$, $m.s^{-1}$) and percentage of speed decrement (Sp%Dec, %) during the six 4-s all-out sprints with 21 s of active (AR) or passive recovery (PR) between sprints. Values are mean ± SE (n = 10). * Significant difference vs. AR ($P < 0.001$).

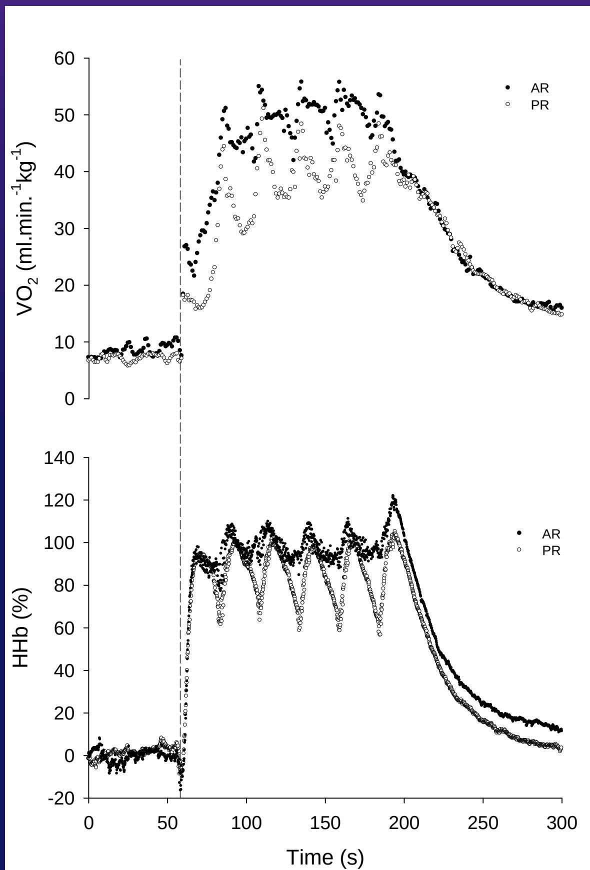

Fig 3. Mean oxygen uptake (VO_2) and deoxyhemoglobin (HHb, expressed as a percentage of HHb level at the end of the first sprint) after each of the 6 sprints interspersed with active (AR) or passive recovery (PR) for the ten subjects. Dashed line represents the start of the RSA tests. For the sake of clarity, error bars have been omitted.

Conclusions

The present study shows, as for cycling exercises, that during sprint running, active compared with passive recovery conditions were associated with a higher oxygen uptake, blood lactate accumulation, and muscle deoxygenation, as well as a reduced repeated sprint ability. This implies that 'lowering' recovery intensity (i.e., walking or standing, if possible, rather than jogging) during team sport events might be an effective strategy for improving repeated sprint running performance.

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