The effect of altering the rest period during interval training on adaptations to muscle metabolism, ion regulation and exercise performance

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Exercise training has been shown to reduce the ionic and metabolic disturbance within skeletal muscle during exercise. This may be beneficial to athletes involved in various sporting pursuits, as a greater ionic/metabolic disturbance during a given exercise task is linked with early muscle fatigue. Interval training is a popular training method used by athletes to improve both power and endurance performance. While the adaptations to various interval-training programs have been documented, little research has compared the affects of manipulating the rest period between intervals, on muscle and performance adaptations. The purpose of the present study was to determine the effects of altering the rest period between intense, exercise intervals (during 5 weeks interval training), on adaptations to repeated sprint performance, aerobic fitness and muscle metabolism and ion regulation.

Methods. Twelve, recreationally trained females (mean ± SD: age 20 ± 3 y, mass 62.3 ± 10 kg), participated in this study. Tests consisted of a graded exercise test (GXT) to determine VO_{2peak} and the lactate threshold (LT), followed 48 and 96 h later, by two, high-intensity exercise tests. On these days, subjects performed a constant intensity cycle test (CIT: 45 s at 200% VO_{2peak}). On test day one, 60 s after the CIT, subjects performed a repeated-sprint test (5 × 6 s sprints, 24 s rest between sprints). On day two, subjects had muscle biopsies before and after the CIT and did not perform the repeated-sprint test. Capillary blood was sampled at the end of each stage of the GXT and before and after the CIT and repeated-sprint test to determine blood lactate and hydrogen ion (H^+) concentration. Muscle biopsies (vastus lateralis) were taken to determine muscle ATP, PCr, lactate and H^+ accumulation and muscle buffer capacity. Subjects were randomly assigned to one of two training groups. Group one performed high-intensity interval training, with 1 min rest periods between intervals (HIT-1), while group two performed high-intensity interval training with 3 min rest periods between intervals (HIT-3). Each subject had a matched partner (matched on the LT) in the opposing group, with whom they were required to complete an equal amount of work during each training interval and session (10 × 2 min at 150% LT, 3 $d.wk^{-1}$ × 5 weeks).

Results. There were significant increases in VO_{2peak} (11% HIT-1 *vs* 9% HIT-3; $p<0.05$) and the LT (8% HIT-1 *vs* 15% HIT-3; $p<0.05$) for both groups, with no differences between groups. There were also significant improvements in mean peak power ($W.kg^{-1}$; 9% HIT-1 *vs* 10% HIT-3; $p<0.05$) and total work ($J.kg^{-1}$, 13% HIT-1 *vs* 11% HIT-3; $p<0.05$) completed during the repeated sprint-test for both groups with no differences between groups. There were no significant changes in muscle buffer capacity or immediate post-CIT blood lactate or H^+ following the training period ($p>0.05$). There were significant reductions in the changes to muscle ATP (~30%), PCr (~30%), lactate (~80%) and H^+ (~60%) following training for both groups ($p>0.05$), however, no differences between groups.

Discussion/Conclusions. Similar to others using endurance activity (1-2 h), we have shown that interval training (3 days per week × 5 weeks) can significantly reduce the metabolic disturbance during short-term, high-intensity exercise (45 s). Our results also show that, when intense interval training (~100% of VO_{2peak} intensity), is interspersed with either short (1 min) or longer (3 min) rest periods between each interval, there is little difference in the metabolic and ionic adaptations within the muscle or changes to VO_{2peak}, the LT or repeated-sprint performance. It is likely that the reduced metabolic disturbance during the 45 s of high-intensity exercise, contributed to the improved repeated-sprint performance, as the concentration of PCr and H^+ within muscle has previously been shown to affect repeated-sprint performance. It appears that the workload during each interval may be more important to training adaptations following very high-intensity exercise, than the length of the rest period between efforts. This may have important implications for those wanting to improve exercise performance or health, as a greater training stress during intense intervals (shorter rest periods), did not result in a greater training adaptation.