Two Weeks Effect of High- and Moderate-Intensity Training on Aerobic- and Anaerobic Endurance

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Abstract

High intensity interval training (HIIT), performed at 120-140% lactate threshold, was thought to be an efficient and safe way that offers similar benefits to moderate intensity and sprint interval training. **Purpose**: To compare the effects of high intensity interval (HIIT) and adjustable speed continuous (ASCT) training (matched for training time) on PCr resynthesis, aerobic- and anaerobic endurance. **Methods**: Pre- and post training, graded running test (GRT: 5-min stages started at 2.0 m/s and increased by 0.5m/s, 1-min break between stages) and 20-m shuttle run test (SRT: 3 sets × 3 repeats, 30-s and 1-min break between repeats and sets, respectively) were assessed in 16 male basketball players (20.3 + 1.3 yrs, 182.5 + 5.8 cm, 76.6 + 13.8 kg). The 2-mmol/l aerobic- (2-AT) and 4-mmol/l anaerobic threshold (4-AnT) were obtained from GRT. Blood lactate concentrations (La) were taken from SRT after each set, and the third and fifth min after test. Subjects were arranged by 4-AnT then S type matched pair into HIIT ($N = 8$, 7 repeats, 2-min interval at 120-140% 4-AnT, 1-min rest between intervals) and ASCT ($N = 8$, continuous, change speed every 5-min at 4-AnT and 2-AT) group and performed 7 times 20-min running training (2 wks, separated by 1 day). Thresholds and La were compared using two- and three- way ANOVA with repeat measures. **Results**: Both groups had significant improvement in 2-AT (18.2-19.0%, $p < 0.05$), but only HIIT had significant increase in 4-AnT (3.1 + 0.5 vs. 3.4 + 0.5 m/s, $p < 0.05$). ASCT had significant decrease in the La during and after SRT ($p < 0.05$), but in HIIT only the first set was lower significantly ($p < 0.05$). The La during and after SRT in ASCT were significantly lower than HIIT after training ($F = 4.8$, $p < 0.05$). **Conclusion**: When training time is matched in two weeks, HIIT improves both aerobic- and anaerobic endurance, but not to PCr resynthesis; ASCT increases the aerobic endurance and PCr resynthesis, but keep anaerobic endurance constant.

Key words: high intensity interval training, adjustable speed continuous training, PCr resynthesis, aerobic endurance, anaerobic endurance

High Intensity Interval- and Adjustable Speed Continuous- Training on

Aerobic and Anaerobic Endurance in two weeks

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In one symposium of 2007 ACSM annual meeting suggested that high intensity interval training (HIIT) could increase high-intensity performance, fat-metabolism rate and aerobic endurance (3,6). Two weeks of high-intensity aerobic interval training (HIIT) performed at an exercise intensity (80–95% $\dot{V}O_2$ peak) could offer benefits similar to moderate intensity training (MIT, 60–75% $\dot{V}O_2$peak) (8) and sprint interval training (SIT, 150–300% $\dot{V}O_2$peak power) regimens (2,9). HIIT was suggested in this study to be an efficient (less time than MIT) and safe (lower intensity than SIT) training choice.

Endurance training was found to affect repeated sprint ability by improving metabolic recovery (PCr resynthesis) between sprints (7), and implemented in most team sports including basketball training that is identified to be intermittent high intensity exercise as predominant (4). Adjustable speed continuous training was found to increase La clearance and metabolism change ability (10) and often be used daily as endurance training. This study compared the effects of high intensity interval (HIIT) and adjustable speed continuous (ASCT) training (matched for training time) on PCr resynthesis, aerobic- and anaerobic endurance within two weeks. Previous HIIT researches were mostly done through ergometers (3,9), this study was done though treadmill to investigate the effects from HIIT in running.

METHODS

Subjects were 16 male basketball players (20.3 ± 1.3 yrs, 182.5 ± 5.8 cm, 76.6 ± 13.8 kg) who have been trained about basketball skills for 5.1±2.5 yrs. Graded running test (GRT: 5-min stages started at 2.0 m/s and increased by 0.5m/s, 1-min break between stages) and 10-m shuttle running test (SRT: 3 sets× 3 repetitions, 30-s and 1-min break between repetitions and sets, respectively) were assessed in pre- and post training. The 2-mmol/l aerobic- (2-AT) and 4-mmol/l anaerobic threshold (4-AnT) were obtained from GRT. Blood lactate concentrations (La) were taken from SRT after each set (Set1, Set2, Set3), and the third and fifth min after test (E3, E5). The studies (5,7) showed that better PCr resynthesis of athletes had lower blood lactate accumulation during repeated sprint, thus repeated shuttle run was utilized in this study to assess PCr resynthesis of subjects. Subjects were arranged by 4-AnT then matched into HIIT (N = 8, 7 repeats, 2-min interval at 120-140% 4-AnT, 1-min rest between intervals) and ASCT (N = 8, continuous, change speed every 5-min at 4-AnT and 2-AT) groups and performed 7 times 20-min running training over two weeks with every training to be separated by one day. Before training, there is no difference at 2-At (2.2 ± 0.2 vs.2.1 ± 0.1 m/s), 4-AnT (3.1 ± 0.2 vs. 3.3 ± 0.1) and La of SRT between groups. Training intensity was set as a percentage of the LT which causes similar metabolic and cardiac stresses to individuals who have different fitness levels rather than $\dot{V}O_{2\,max}$ (1). This study implemented HIIT on treadmill and was designed refer to the experience from HIIT on ergometers (3,9). All values are reported as mean ± SE, thresholds and blood lactate concentration were compared using two-way ANOVA with repeat measures.

Results

Both groups had significant improvement in 2-AT (HIIT: 2,2±0.2-2.6±0.2 m/s, 18.2%; ASCT: 2.1±0.1-2.5±0.1, 19.0%, $p < 0.05$), but only HIIT group had significant increase in 4-AnT (3.1±0.2-3.4±0.2 m/s, 9.7%, $p < 0.05$) after training. The ASCT group kept their 4-AnT constant (3.3±0.1-3.3±0.1 m/s, $p > 0.05$).

ASCT had significant decrease in the La during and after SRT ($p < 0.05$), but in HIIT only the Set1 was lower significantly ($p < 0.05$). The La at Set2, E3 and E5 of ASCT were significantly lower than HIIT after training (F = 5.2-8.4, $p < 0.05$).

Discussion

This study has shown those two weeks HIIT by running required less training volume and time to increase 2-AT and 4-AnT than cycling (3) which might recruit less muscle than running. Compare to ASCT, the HIIT may offer higher intensity (after training La: 3.4±0.2 vs. 9.4±0.8 mmol/l) to stimulate glycolysis and increase phosphofructokinase (PFK) activity. However, the intensity of HIIT may be too high to only increase PCr resynthesis slightly. Although the HIIT by running could increase aerobic- and anaerobic endurance, it could not increase PCr resynthesis. The result is different from previous study (3). This study also found that 20 minutes adjustable speed continuous training (ASCT) could efficiently increase 2-AT. This result indicates that ASCT by running could stimulate rapid change between aerobic and anaerobic metabolism and enhance clearance of blood lactate which result in 2-AT increase within two weeks. ASCT also kept the anaerobic endurance constant; this could be explained because the training intensity was close to anaerobic threshold. Under constant intensity (no significant difference between pre- and post test heart rate), the lactate concentration during and after SRT were both lower than pre-training for ASCT group, which indicates the increase of PCr resynthesis. Further research could be done to confirm if ASCT is better than moderate continuous training to enhance aerobic endurance and PCr resynthesis. When training time is matched in two weeks, HIIT improves both aerobic- and anaerobic endurance, but not to PCr resynthesis; ASCT increases the aerobic endurance and PCr resynthesis, but keep anaerobic endurance constant.

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