Abstract

The Effects of Anaerobic Training (Sprint or Strength) on Endurance Performance in Untrained Men

Introduction: High-performance sports currently require specialized fitness and motor preparation so as to maximize athletic performance in the short preparation period and then maintain its level for as long as possible. Also in recreation and amateur sports, attractive forms of activities/training are being sought so as to encourage people with sedentary lifestyles to take up physical activity. In most sports and in everyday life, aerobic capacity, i.e. the ability to perform prolonged efforts of an endurance nature, is crucial. Traditional methods aimed at improving aerobic capacity are those that involve performing prolonged efforts of a continuous or interval nature at low to moderate intensity. From a sporting perspective, on the other hand, training methods are sought that would be most effective in improving aerobic capacity. Shorter, but more intense, speed and strength training, compared to continuous and monotonous endurance training, can be a great alternative for further training, while increasing motivation levels and improving physical capacity, which can translate into better sports performance in endurance sports and/or the health of recreational exercisers. Among the proposed methods of high-intensity (and therefore anaerobic or anaerobic-based) training, the most common are high intensity interval training (HIIT), sprint interval training (SIT) and strength training (resistance) (ST). These training methods are also increasingly being used to improve the body's endurance capacity. The data so far indicate that training with a dominant anaerobic metabolism can be an interesting yet effective alternative to traditional endurance training methods of performing prolonged efforts of low to moderate intensity.

Objective: The purpose of this study was to determine the effects of different forms of training with dominant anaerobic metabolism on the body's exercise capacity (aerobic and anaerobic capacity), and in particular on the endurance capacity of young men, as assessed by maximum oxygen uptake and second ventilatory threshold. The study used two different methods of anaerobic training, producing different physiological and biochemical changes and effects. The first, strength training (ST), targeted improvements in muscle strength. The second, sprint interval training (SIT), was aimed at improving muscle speed and power. It was hypothesized that both forms of anaerobic training would be as effective in improving endurance capacity as traditional aerobic interval training (AIT). The purpose of the study was refined with the following research questions.

1. Does anaerobic training (sprinting or strength training) improve aerobic capacity to a similar degree as aerobic interval training?

2. Does speed and strength training have a similar effect as interval aerobic training on endurance capacity assessed using ventilation thresholds?

3. Can speed and strength training be effective in reducing body fatness among the subjects?

4. Will anaerobic capacity (lower limb power) increase in a similar way to aerobic training after anaerobic training?

Methods: The study involved 60 young men who were recruited into four groups performing different physical training: salt training (ST), sprint training (SIT), aerobic training (AIT) and a group without intervention (CON). In each group, somatic measurements and an aerobic and anaerobic capacity test were performed twice (before and after the exercise intervention). In addition, each subject's declared physical activity was estimated and habitual diet was analyzed, and inclusion and exclusion criteria were made. Each exercise intervention lasted six weeks, with three workouts per week. Participants were instructed to maintain their usual diet and physical activity during the intervention. Prior to the intervention, participants were introduced to the exercise testing procedures and familiarized with the cycloergometer technique. On the first day of the study, participants took somatic measurements and performed an anaerobic capacity test two hours apart and aerobic capacity. These measurements were repeated one week after the training. Participants had to refrain from eating for two hours before the exercise tests and were asked not to participate in any intense exercise 24 hours before the exercise tests, and to hydrate during this time. They were not allowed to consume alcohol or caffeinated beverages for several days immediately before the performance tests. All tests were conducted at the same time of day starting at 8 a.m., and the subjects were after a lightly digested meal. The studies were performed under laboratory conditions, at the Academy of Physical Education in Cracow, Poland, at the Laboratory of Physiological Basis of Adaptation. Exercise tests and workouts took place under similar conditions, with an ambient temperature of about 21°C and humidity of about 40%. The sample size was determined before the study began. G*Power software version 3.1.9.7 (Germany) was used to calculate the sample size, with the ANOVA option selected with repeated measures. The required sample size was 15 participants per group (total sample size = 60).

Results: Both anaerobic training (SIT and ST) and aerobic interval training were effective in improving maximal oxygen uptake. It was shown that there was a significant increase in absolute VO2max in all training groups, and the effect size was comparable in the ST (p<0.001; ES=0.50), SIT (p=0.008; ES=0.39) and AIT (p=0.005; ES=0.55) groups. In addition, all three training methods resulted in significant increases in the maximum power obtained in the graded test. Anaerobic training had no effect on submaximal levels i.e. at the level of the first and second ventilatory thresholds. Only training of an aerobic nature, induced changes in these parameters: increased power and VO2 at the level of VT I and VO2 at the level of VT II. All workouts (ST, SIT and AIT) improved anaerobic peak power, while only SIT and ST improved anaerobic average power in the Wingate test. None of the workouts significantly reduced body fatness. Only significant changes occurred in LBM levels in the ST group, which showed an increase in LBM.

Conclusions: Training with a dominant anaerobic metabolism, both sprinting and strength training, proved to be an effective method of training aerobic capacity. After SIT and ST, as well as AIT, the maximal oxygen intake of the male subjects increased significantly, and the observed effect size was comparable in the study groups. Endurance capacity, assessed by ventilatory thresholds, did not change significantly under the influence of anaerobic training, whether sprinting or strength training. Only interval aerobic training had a positive effect on power levels and oxygen uptake at ventilatory thresholds. None of the workouts (SIT, ST, AIT) resulted in a significant reduction in body fatness of the male subjects. Only after strength training was a significant increase in the men's lean body mass observed. Anaerobic training (SIT and ST) significantly increased anaerobic peak and average power, which may indicate an improvement in phosphagen and glycolytic performance. Interval aerobic training, performed on a bicycle ergometer, significantly increased only the peak power of the male subjects. Training with dominant anaerobic metabolism can be a complement to interval aerobic training or an effective alternative to interval aerobic training in shaping aerobic and anaerobic capacity, especially in sports with mixed energy (anaerobic-anaerobic) backgrounds.