EFFECTS OF ENDURANCE TRAINING ON FUNCTIONAL STATUS OF THE RESPIRATORY MUSCLES IN HEALTHY MEN

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Abstract
Introduction. The aim of the study was to assess the influence of an 8-week endurance training program on the functional status of the respiratory muscles and breathing efficiency. Material and methods. Thirteen healthy, untrained, male students of Physical Education volunteered to participate in the study. Before and after the subjects completed the training program, they were subjected to anthropometric and spirometric measurements, and performed an incremental stress test. The spirometric measurements included maximal inspiratory pressure (PImax), active time, passive time, and diaphragm relaxation time. Measuring PImax is a simple method of evaluating the strength of the inspiratory muscles. The 8-week training program was performed on a rowing ergometer 3 times per week, using aerobic workloads. Results. The study did not confirm a significant improvement in the measured spirometric parameters following the training program. However, we observed a trend of increase in PImax values by 12 ± 21% of borderline after the training program and a significant correlation (p < 0.05) between the changes in PImax and those in VO2 max. Following the training there was also a significant reduction in the amount of body fat by 1.4 kg and an improvement of work capacity. The response of the respiratory system to exercise was also enhanced, as breathing efficiency improved (tidal volume increased in maximal exercise, while lung ventilation, the ventilatory equivalent for oxygen, and breathing frequency decreased in submaximal exercise). Conclusions. The findings of the study suggest that traditional endurance training which is implemented over a 8 weeks is not a sufficiently strong stimulus to cause a significant increase in the strength of the inspiratory muscles.

Key words: endurance training, respiratory muscle strength, aerobic capacity, breathing efficiency

Introduction

Traditional endurance training has been found to improve several key parameters of aerobic capacity, such as VO2 max, the anaerobic/ventilatory threshold, and exercise economy, enhancing the capacity for performing work for a long time without a decrease in its efficiency [1]. These changes are believed to stem from the adaptation of the cardiovascular system to increased effort, but adaptations of the respiratory system in athletes and healthy persons are seldom mentioned. As stated by Cogo [2], it is often assumed that the respiratory system does not restrict the work capacity of athletes. It is also commonly believed that the functional capacity of a healthy respiratory system, including that of the lungs, chest, and neural control systems, exceeds the demands which are imposed upon this system during strenuous effort [3].

Research shows, however, that the respiratory system (in particular restrictions in respiratory flow and diaphragm fatigue) can limit work capacity both in athletes [4] and healthy persons [5, 6]. Bearing this in mind, experts have designed specific methods of training the respiratory muscles using simulators intended to help the respiratory system adapt to exercise by increasing the strength and endurance of these muscles. Several studies have confirmed that respiratory muscle training causes an increase in the strength of these muscle groups and enhances work capacity in athletes [7-11]. It has also been proven that resistance training of the respiratory muscles can serve as an additional physiological stimulus for the athlete’s body in the training process. It is worth emphasizing that nearly all of the authors who have investigated this issue have found respiratory muscle training to have a positive effect on work capacity [12].

On the other hand, the impact of traditional endurance training on changes in the strength of the respiratory muscles still requires investigation, as the findings of studies regarding this issue are contradictory. A significant increase in the strength of the respiratory muscles following endurance training, assessed based on maximal inspiratory mouth pressure (PImax), was found in swimmers [13] and healthy persons [14], but no such increase was observed in athletes practicing various endurance disciplines compared to persons who are not physically active [15-18]. However, our previous study [19] showed that highly trained athletes had higher PImax values af-