EFFECTS OF COMBINED STRENGTH AND ENDURANCE TRAINING ON MAXIMAL AND SUBMAXIMAL BICYCLE-ERGOMETER TEST PERFORMANCE AND LOWER EXTREMITY MUSCLE POWER IN MIDDLE-AGED WOMEN

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Introduction: Previous studies have shown that combined strength and endurance (SE) training may be beneficial for endurance athletes. It seems to improve the economy of endurance performance more than endurance training by enhancing the efficiency of the neuromuscular system [1]. The purpose of this study was to investigate the effects of SE training in middle-aged women on the economy of endurance performance and on maximal oxygen uptake (VO2max), estimated in submaximal exercise test (SUB) and measured in maximal exercise test (MAX). In addition, the effects of SE on muscle power and strength of the lower extremities were examined.

Methods: Subjects (n=85, 40-65 year old women) were randomly divided into three training groups and a control group (C, n=17). Two of the groups did either endurance (E, n=20) or strength training (S, n=24) twice a week, and one group (SE, n=24) did both types of training 2 plus 2 times a week. The 21-week training period was progressive and supervised. The measurements took place before, in the middle, and at the end of the training period. Individually selected intensity levels of SUB (30, 40, 80% of maximal aerobic cycling power) were calculated from the MAX. The strength measurements included the recordings of maximal isometric force of bilateral leg extension (ISO) and power with the load of 50% of maximum. The results were analyzed with ANOVA with repeated measures, the level of significance was set at p<0.05.

Results: Training did not have a significant group effect on the economy (VO2/P) (SE -7,6 %, E -5,9 %, S -5,6 % and C -4,0 %). VO2max improved in SE and E by 17.0 % and 17.6 % (p<0.001) and in S and C by 5.3 % and 2.3 % (ns). SE and E improved more than S and C (p<0.001). The VO2max values of SUB and MAX correlated in the initial measurement (r=0.82, p<0.001), but the values were overestimated in SUB on average by 3.7 ml/min/kg (p<0.001) compared to MAX. After the training period the correlation between VO2max of SUB and MAX in the training groups was 0.77 (p<0.001), and 0.56 (p<0.001) between the changes in SUB and MAX. The ISO values improved in SE and S by 21.8 % and 19.0 %, (p<0.001), in E by 7.7 % (p<0.05) and in C by 8.3 % (ns). Power increased in SE and in S by 12.5 % and 8.8 % (p<0.05), but not in E (-5.5 %) or C (-6.4 %). SE and S improved power considerably more (p<0.001) than E and C.

Conclusions: Endurance training improved VO2max and strength training enhanced strength and power with only two training sessions per week. The strength training in the SE group did not interfere with the development of endurance performance. Different types of training did not lead to changes in economy when the same relative (%) loads were compared. The SUB test can be used for predicting aerobic capacity of middle aged women, but it overestimates the VO2max and does not detect the training-induced changes as accurately as the direct measurement.


Keywords: Testing, Training, Ergometry