THE EFFECTS OF A 10-WEEK STEP AEROBICS TRAINING ON VO_2max, ISOMETRIC STRENGTH AND BODY COMPOSITION OF YOUNG WOMEN

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Abstract. Health status is partly determined by physical fitness level. Physical fitness can be developed through different physical activities under condition that regularity and intensity are maintained on optimal level. One of such physical activities is step aerobics - one of the most popular collective fitness forms offered in fitness clubs. The objective of this study was to evaluate the influence of step aerobics training on VOmax, isometric strength and body composition of young female students.

Female students aged 19–21 of University of Physical Education and Sport in Gdańsk were subjects in this study. VO_2max, isometric strength of elbow flexors and knee extensors, as well as body composition, were measured week before and week after a ten-week step aerobics training. For statistical analysis, basic descriptive statistics and student's t-test were applied for dependent variables.

After ten weeks of training there were no statistically significant changes in body composition, probably due to lack of calorie intake control. Significant changes were observed in isometric strength of elbow flexors but no changes in isometric strength of knee extensors. There was a compensation in isometric strength noted between left and right leg after ten weeks of training, where left leg was weaker than the right leg before training. Significant changes were noted in VO_2max values, which increased from 42.04 ml/kg/min^{-1} to 45.71 ml/kg/min^{-1}.

Step aerobics training can sufficiently increase VO_2max in young females and has a potential in developing strength of upper extremities. When body composition is the main purpose, diet should be taken under consideration.

Key words: step aerobics, isometric strength, body composition, VO_2max

Introduction

Health status and physical fitness are closely related in that health status is very strongly, although not entirely, determined by physical fitness level (Blair et al. 2001; Kyröläinen et al. 2010; Sassen et al. 2009). Physical fitness is developed through physical activity patterns provided that regularity and intensity are programed on optimal level. Irregular physical activity or when the intensity of the physical activity pattern is too low, no physiological adaptations, which might have crucial impact on health status, ever occur. Unfortunately, only 10% of Polish society

is physically active on a regular basis (TNS OBOP 2011). The decline of regular physical activity is also observed in other European countries. Such situation can be influenced by very little leisure time, especially in less wealthy part of Polish society. To stop this negative trend, special emphasis should be put on collective forms of fitness, which are more common and less expensive than one on one personal training sessions . Fitness forms especially have a potential to develop many physical fitness components in one training session.

Step aerobics is one of the most popular collective forms of fitness in health centers and fitness clubs. Step aerobics, invented by Gin Miller in the end of the eighties of twentieth century, combine step-on and step-off movements with marching, dancing, jogging and jumping exercise, put together in choreographed sequences using a step bench at various heights ranging from 10 to 25 cm (Zarębska 2007). The main purpose of step aerobics is to develop cardio-respiratory efficiency even tough strength increase was also observed in few studies (Hallage et al. 2010; Kravitz et al. 1993). In addition, step aerobics is considered a low-impact activity for knee and ankle joints when the bench height is relatively low, which makes it a safe form of fitness (Santos-Rocha et al. 2002).

The aim of this study is to present the influence of step aerobics training on VO_2max, isometric strength of upper and lower extremities and body composition in young female subjects, in order to demonstrate the potential of step aerobics in developing many health related outcomes.

Material and methods

Experimental design

Laboratory sessions were conducted at a laboratory of exercise science at University of Physical Education and Sport in Gdańsk one week before the training program and one week after. Inclusion criteria for subjects recruited for the study included their general health status allowing them to participate in the training program and age between 19 and 21. All subjects consulted their general health status with healthcare professional. Before the laboratory and training session all subjects were informed about the testing and training protocol and gave their informed consent to the procedures of the study. Training sessions were conducted three times a week on non-consecutive days and were led by the same certified instructor.

Subjects

Nineteen healthy female students of the University of Physical Education and Sport in Gdańsk aged 19–21 were recruited for the research study. Body composition, BMI, height and age of the subjects are shown in Table 1.

Table 1. Subjects characteristics before training

	Age	Height (cm)	Body weight (kg)	BMI	FAT (%)	FAT-MASS (kg)	FFM (kg)
X	19.53	169.47	63.14	21.93	24.70	16.15	46.97
SD	0.70	5.82	10.61	3.24	6.14	6.98	4.29

BMI – body mass index FAT% – percent body fat, FAT-MASS, FFM – fat free mass.

Training program

Step aerobics training was conducted according to valid collective fitness forms training methodology. All participants exercised on the bench set at a height of 15 cm. Single training session consisted of a warm-up, main part which was a choreographed sequence, and a cool down with breathing and stretching exercises. The intensity during the sessions was controlled by music tempo and oscillated between 120 BPM to 145 BPM.

Body composition

Body weight, fat mass, fat free mass, body fat percentage and BMI were measured on Tanita Body FAT Monitor/ Scale Analyzer TBF 300. Circumferences of hips, waist, thighs, arms, and calves, were also measured.

VO2max testing

For estimating VO_2max PWC 170 test was used. The test was conducted on the Monark 839 E cyclo ergometer. Heart rate was monitored through Polar heart rate monitor. First five minutes of the test was executed at a power of 100 watt and speed of 80 rpm. After first five minutes the power was increased every 2 minutes with 20 watt. Heart rate and the power were recorded at the end of every 2 minutes. The test was conducted until the heart rate exceeded 170 BPM.

Isometric strength testing

Isometric strength of elbow flexors and knee extensors was estimated with JBA St, Staniak SMT1 station, equipped with WMT1 tensometric sensor. All data was recorded through HMF software v 1.1. All strength measurements were conducted at 90° angle in elbow and knee joint.

Statistical analysis

For statistical analysis Statistica 8.0 software was used. Basic descriptive statistics and student's t-test were applied for dependent variables. The significance level was set to $P < 0.05$.

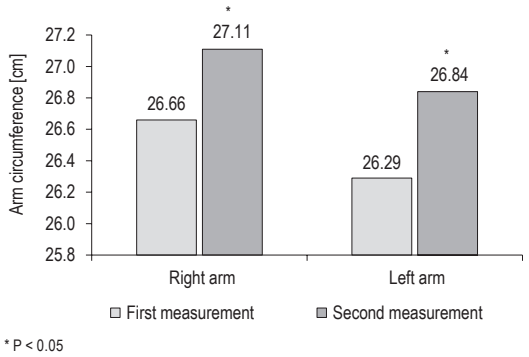
Results

No statistically significant changes occurred in body composition and BMI after ten weeks of step aerobics training (Table 2). Even though minor changes were observed.

Table 2. Body composition components and BMI changes after 10 weeks of training

Body composition	Before training	After ten weeks of training	Difference between mean values
Body mass (kg)	63.14 ±10.61	62.82 ±10.01	(–) 0.32
BMI	21.93 ±3.24	21.87 ±3.12	(–) 0.06
FAT (%)	24.7 ±6.14	24.76 ±6.39	(+) 0.06
FAT-MASS (kg)	16.15 ±6.98	16.11 ±6.74	(–) 0.04
FFM (kg)	46.97 ±4.29	46.72 ±4.02	(–) 0.25

Circumferences of right and left arm increased by 0.45 cm and 0.55 cm respectively (Figure 1). Minor changes were also observed in both thighs and calf muscle circumferences but were not statistically significant.



* P < 0.05

Figure 1. Changes in right and left arm circumferences after training

Comparison of the isometric strength of knee extensors before training period showed statistically significant difference of 7.53 N between left and right side with an advantage for the right side (Figure 2). After twelve weeks of training the isometric strength increased only in the left leg and equaled with isometric strength values of the right side before the training period. The increase in strength of left knee extensors was not statistically significant. A statistically significant increase in isometric strength was recorded in left and right elbow flexors muscles of 5.61% and 11.49% respectively. The differences in strength values of upper and lower extremities before and after training are shown in Table 3.

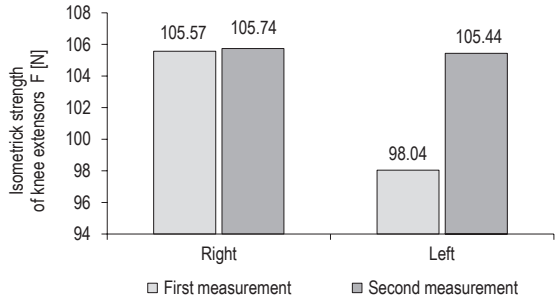


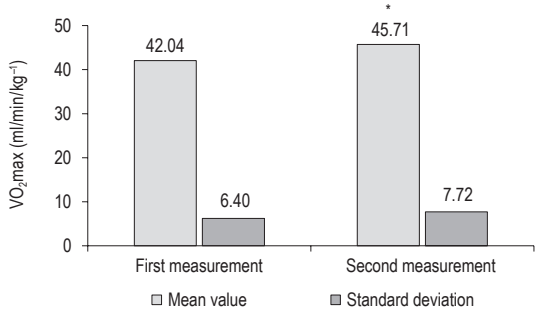
Figure 2. Changes in isometric strength of left and right knee extensors before (first measurement) and after (second measurement) step aerobics training

Table 3. Changes in isometric strength of knee extensors and elbow flexors after ten weeks of step aerobics training

Isometric strength	Lower extremities		Upper extremities	
	Right	Left	Right	Left
Strength before training (N)	154.03 ±34.34	148.36 ±38.03	105.57 ±22.09	98.04 ±22.07
Strength after (N)	171.73 ±37.70	156.69 ±33.16	105.74 ±18.80	105.44 ±17.50
Differences in strength before and after training (N)	17.70*	8.33*	0.17	7.40
Strength differences (%)	11.49*	5.61*	0.16	7.55

* P < 0.5.

VO_2max values increased significantly from 42.04 ml/kg/min^{-1} to 45.71 ml/kg/min^{-1} after ten weeks of step aerobics training (Figure 3).



* P < 0.05

Figure 3. Changes in VO_2max values before and after step aerobics training

Discussion

Step aerobics main purpose is to develop cardiorespiratory fitness. Research studies demonstrate positive effect of aerobic oriented training on fat oxidation and calorie expenditure, which can directly influence changes in body composition (Achten and Jeukendrup 2004; Hansen et al. 2007). Present study demonstrates no statistically significant changes in body composition after ten weeks of step aerobics training. Absence of changes in body composition might be due to the fact that eating patterns or calorie intake of subjects were not controlled during the research. It is well known that calorie intake is one of the major factors affecting body composition (Connolly et al. 1999). Step aerobics training increased daily calorie expenditure. A study of Rixon et al. (2006) showed that one hour step aerobics class caused similar calorie expenditure as one hour running. Such situation could influence more calorie consumption among participants of the study to compensate calorie deficiency. Apart from calorie intake intensity, there can be another factor influencing changes in body composition. Some studies indicate no differences between low and high intensities in stimulating changes in body composition among obese subjects (Ballor et al. 1990; van Aggel-Leijssen et al. 2002). In contrast, studies of Irving et al. (2008) and Mezghanni et al. (2012) showed higher percent body fat reduction after high intensity, opposed to low intensity aerobic training.

It should be considered that subjects were students of sport university and their physical fitness was above average. In the present study, subjects trained at intensity of 70% of their heart rate maximum which effected in the increase of VO_2max.

After ten weeks of step aerobics training, circumferences of both thighs and calves decreased. However, circumferences of right and left arm increased, which can be directly associated with increase in isometric strength of left and right elbow flexors. It can be assumed that the increase in static strength of upper extremities can be associated with intense symmetrical and asymmetrical arm moves in different planes of motion (which are part of the choreographic sequence). The increase in strength of upper extremities after step aerobics training was also noted in other studies (Hallage et al. 2010; Kravitz et al. 1993). Furthermore, no strength increase in lower extremities might be associated with an absence of external resistance. Rhae et al. (2003), in meta-analysis, showed that external resistance sufficient to develop maximal strength in subjects that have never done strength training before should oscillate between 40–60% 1RM. As mentioned before, subjects participating in the study were female students of University of Physical Education and Sport, whose general fitness level was above average. However, a difference in isometric strength between left and right knee extensors was observed during the first measurement before training period. The biggest increase in isometric strength was observed in the left leg, which values before training period were lower than the right leg. After ten weeks of training the difference between legs compensated. The choreographic sequence included symmetrical moves loading both legs equally, which might be the major reason of compensation in strength values of both legs.

Values of VO_2max in this particular study increased from 42.04 ml/kg/min^{-1} to 45.71 ml/kg/min^{-1}. Other studies also confirm the increase of VO_2max after step aerobics training, including two studies confirming that step aerobics training is able to develop cardiovascular efficiency in elderly female subjects (Kravitz et al. 1993; Williford et al. 1998; Kraemer et al. 2001; Jakubec et al. 2008). Jakubec et al. (2008) in his research on effectiveness of dance aerobics and step aerobics on cardiovascular fitness demonstrated the increase in oxygen consumption in female subjects between the age of 40 and 60, and Hallage et al. (2010) in a group of women at the age of 60. Even though this study examined young females, this is an evidence that step aerobics training can be beneficial in females of all ages.

In conclusion, ten weeks of step aerobics training caused positive changes either in VO_2max values and isometric strength values of both elbow flexors in young female students. There were no sufficient changes in body composition and strength of lower extremities. Further investigation should be done to evaluate other fitness components of step aerobics like joint range of motion, joint stability, and balance.

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