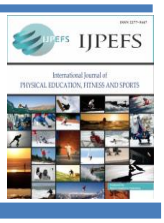
International Journal of
PHYSICAL EDUCATION, FITNESS AND SPORTS



Influence of two-month training program on anthropometry and VO2 max in recreational athletes

Received 17th June 2017
Accepted 28th June 2017

www.ijpefs.com

DOI:10.26524/2017.06.02.4

Miloš Stojković [a] *, Aleksandar Čvorović [a], Velimir Jeknić [a], Filip Kukić [b]

[a] Abu Dhabi Police College, Department of Sport, Abu Dhabi, UAE
[b] Abu Dhabi Police, Police Sports Education Center, Abu Dhabi, UAE
*Corresponding Author: Ph: +971-553296710: Email: stojkovic5789@gmail.com

Abstract: The aim was to evaluate the effect of a two-month training program on some anthropometric characteristics and maximum oxygen consumption (VO2 max) in male and female recreational athletes. Study included 62 participants, 30 males and 32 females. All participants were doing recreational sport, aged from 35 to 50 years old. In order to obtain accurate results, the following instruments were used: measuring tape, InnerScan body composition monitor Tanita BC-532, and "Technogym" treadmill where they were performing submaximal aerobic test. Training process lasted for two months and consisted of two testing sessions. The training program has included three sessions per week for about 90 minutes. T-test for paired samples was used in the statistical program "SPSS", and results suggested that there was a positive effect of a two-month training process on certain anthropometric characteristics and the maximal oxygen uptake in both male and female subjects.

Key Words: body-composition / fitness / sub-maximal test / fat / recreation

Introduction

Modern lifestyle often involves lack of exercise and irregular diet, which leaves a huge impact on human health and therefore increases the risk factors of mortality and less is given to the importance of preserving the health and optimal physical form [1-8]. Reduced amount of physical activity and recreational fitness are both connected with a high risk of all cause and disease specific mortality [17]. Insufficient attention is given to the volume and type of physical activity, which is the fundamental tool for increasing the calorie consumption and the reduction of obesity, which has a pandemic character. Some people continue to believe that only high intensity activities will improve health while others believe that the light activities of their everyday life are sufficient to promote health and improve their physical fitness [18]. Dumith and colleagues [3] has shown that the prevalence of physical inactivity was higher among wealthier and urban countries, and mostly among women and elderly population. However, there is one out of five physically inactive adults around the world [3]. On the other side, indications exist that vigorous-intensity activities might have much more benefit for decreasing cardiovascular disease and premature mortality than moderate-intensity physical activity [13, 21]. Furthermore, side, eating habits, the quantity and quality of food that we consume every day, are the main factors of the health preservation. The positive effect of exercise in everyday life mostly appears through aerobic capacity [4].

Maximal oxygen uptake (VO2max) is a parameter of aerobic capacity in humans. VO2max represents the maximum level of oxygen that can be consumed at a given time [6]. Body composition, mostly is explained as the proportion of lean body mass and fat mass, and it represents a significant somatic characteristic that develops in a relation to various factors such as age, gender, genetics and level of physical activity [14]. It has been widely known that body composition is the result of various factors such as diet, stress, the amount of physical activity and other daily habit related factors. Thus, the body composition could be considered as a reliable indicator of the current health status. Also, body composition has a huge influence on the expression of certain physical abilities, and therefore represents an important indirect indicator of the level of physical fitness [20].

Given that the level of physical fitness is usually defined by successfulness of the task performance or by the health status it could be concluded that physical fitness depends on the development of various physical abilities and good body composition. Consequently, it can be altered because of the adaptation process of those abilities and body composition to a different stressor. Improvement of cardio respiratory fitness and body composition as an effect of training process has already been proven in obese and recreational active runners [10, 12, 19]. Two studies showed that 12-week training program improved cardio respiratory fitness [10, 12] and lipid profiles [19]. Furthermore, 3-week program has also been shown to significantly reduced body weight and improved VO2max in obese patients [19].

However, there is a scarce of data regarding how different gender of recreational level athletes respond to 8 weeks training program in terms of body composition and improvement in cardio respiratory system. Therefore, the aim of this study is to evaluate the effect of a two-month training program on some anthropometric characteristics and VO2max at recreational athletes, for both male and female subjects.

Methodology

Subjects

Sixty-two 35-50 years old recreational athletes from Wellness Land fitness center based in Belgrade, Serbia participated in this study. The sample included both genders of which was 30 were male and 32 female participants. All participants were regularly engaged in recreational sport activities minimum 2 times per week.

Materials and measured parameters

Anthropometric measurement

Anthropometric measurements are of great importance since the large amount of data can be collected with a non-invasive methodology and inexpensive equipment such as bioelectrical impedance analysis [5, 15]. A low-level electrical current is passing through the client's body, facing a different resistance depending on body composition. In relation to the measured resistance, the device is calculating body composition [7, 9].

Body composition measurement procedures were conducted using InnerScan body composition monitor Tanita BC-532 (Tanita, Corporation Tokyo Japan) in accordance with its standard procedures, and centimeter measuring tape for circumference measurements. To analyse the effect of the training procedure, following variables were used:

1. Body weight (WEIGHT), expressed in kilograms (kg),
2. Muscle mass (MUSCLE), expressed in kilograms (kg),
3. Body fat (FAT), expressed in percentage (%),
4. Waist circumference (WAIST), expressed in centimetres (cm),
5. The upper arm circumference (ARM), expressed in centimetres (cm),
6. The upper leg circumference (LEG), expressed in centimetres (cm).

VO2max measurements

Maximal oxygen consumption test was performed on "Techno Gym Excite 900 visioweb" treadmill, which allows implementation of submaximal aerobic test that takes about 15 minutes to be done.

Before the beginning of the test, respondents entered their data into the system in order to calculate the maximum heart rate. The test consisted of three phases with different intensity, which varied between 65% and 75% of the maximum heart rate (220 - years).

- The first phase is warming up, it takes 2 minutes to be done;
- The second phase lasts 3 minutes after raising the heart rate to a certain level;
- The third phase lasts 4 minutes at a constant intensity of 75% of the maximum heart rate.

All measurement procedures were conducted by the same tester before the training process and again after the process.

Training process

The training process lasted for 2 months, and consisted of two testing. Both testing sessions were done and data collected in the year of 2014. The training program was including three sessions a week for about 90 minutes. Trainings and testing were held in fitness center "Wellness Land" from Belgrade in Serbia, where practitioners already had training programs on their Technogym system "TGS" key. The content of the training was aiming on a reducing body weight and loads were given based on previously undertaken Technogym submaximal test of strength. When selecting exercises, mainly they were using exercise on the equipment (circular training) and to strengthen the major muscle groups, with an emphasis on a cardio training with the exercises for stretching at the end. Example of training for a body mass reduction is presented in Table 1.

Table – 1
Example of training for a body mass reduction

I PART	II PART	III PART
1. Walking on a treadmill, 10 min	1. Lower back extension	1. Walking on a treadmill, 40 min
2. Warm up exercises, 5 min	2. Lat machine	2. Stretching
	3. Pectoral press	
	4. Shoulder press	
	5. Leg press	
	6. Leg extension	
	7. Abdominal crunch	
	8. Rotary torso	

During the second part of the training, a form of a circular training was performed. Practitioners were doing the exercises on the machines in three rounds with a break between exercises of 30 seconds and 2 minute break between rounds. They were all using relative loads. During the training and testing, the trainer was trying to motivate exercisers, and the whole training process as well as every training individually was followed on "Technogym My Cloud" system, where the trainer could see each completed training after the subjects finish with check in and check out using the "TGS" key.

Statistical analysis

All results were stored in Microsoft Excel for further analysis. The descriptive statistic for mean, standard deviation (SD), minimum (Min) and maximum (Max) was conducted in Microsoft Excel. To analyze the effect of the training process, paired samples T-test was used with the statistical significance level set to $p<0.05$. Statistical analysis was performed with a help of statistical package SPSS (IBM Statistics 20).

Results

All results for men are shown in Table 2 and for women in Table 3. The main finding of this study is that the applied training had significant effect on WEIGHT, FAT, WAIST AND VO2max in both, male and female subjects. Note in Table 3 that the training had more effect on female subjects because MUSCLE mass has changed significantly (p=0.026 in female vs 0.084 in male) and LEG circumference decreased significantly (p=0.003 in female vs 0.100 in male). Practically, female subjects were more sensitive to applied training program than male subjects.

Table – 2
Results of T-test for paired samples and descriptive statistics for male

Variables	*Initial testing*			*Final Testing*			Difference	Sig.
	Mean±SD	Min.	Max.	Mean±SD	Min.	Max.		
WEIGHT (kg)	93.15±9.48	76.8	125.0	91.39±8.69	77.1	119.0	**-1.76**	**,000**
MUSCLE (kg)	68.40±5.09	58.9	79.5	69.03±5.40	58.5	78.0	0.63	,084
FAT (%)	25.10±7.11	12.0	38.0	22.77±5.74	12.0	34.0	**-2.33**	**,000**
WAIST (cm)	96.88±9.70	82.0	122.0	95.08±9.94	81.0	123.0	**-1.8**	**,000**
ARM (cm)	34.75±3.14	28.5	43.0	34.55±2.73	29.0	40.0	-0.2	,419
LEG (cm)	62.00±4.65	53.0	71.0	61.13±4.19	51.0	71.0	0.87	,100
VO2max (ml/kg/min)	41.08±7.73	26.0	54.0	44.37±8.24	28.0	62.0	**3.92**	**,002**

After finalizing results for male subjects, the results in Table 2 shows that there is statistically significant difference between initial and final testing in four variables, WEIGHT, FAT, WAIST, and VO2 max.

Table – 3
Results of T-test for paired samples and descriptive statistics for female

Variables	*Initial testing*			*Final Testing*			Difference	Sig.
	Mean±SD	Min.	Max.	Mean±SD	Min.	Max.		
WEIGHT (kg)	69.02±13.88	54.9	107.0	67.69±13.58	53.0	104.5	**-1.33**	**,000**
MUSCLE (kg)	44.28±4.29	38.1	56.1	45.07±4.55	38.4	59.5	**0.79**	**,026**
FAT (%)	30.37±7.09	19.1	44.6	29.15±6.96	18.3	42.5	**-1.22**	**,000**
WAIST (cm)	84.67±12.34	67.0	112.0	82.32±11.19	64.0	106.0	**-2.35**	**,000**
ARM (cm)	28.84±3.98	24.0	44.0	28.56±3.73	23.0	43.0	-0.28	,174
LEG (cm)	59.60±7.36	50.5	78.0	58.29±6.42	49.5	75.0	**-1.31**	**,003**
VO2max (ml/kg/min)	44.09±11.04	23.0	71.0	47.22±9.96	29.0	70.0	**3.13**	**,000**

After finalizing results for female subjects, the results in Table 3 shows that there is statistically significant difference between initial and final testing in six variables. All three body composition components ($p<0.05$), two out of three circumference components ($p<0.05$) as well as aerobic fitness component ($p<0.0$).

Discussion

The main findings of this study are that 8-week body reduction training program had significant effect on reduction of weight, fat mass, and waist circumference and improvement in VO2max in both genders.

According to our results both genders showed statistically significant improvements, with greater effects of training process noticed in female group. Male subjects have statistically significant differences between initial and final testing in 4 variables: weight, waist, fat and VO2max, while in female subjects differences occurred between initial and final testing in 6 variables: weight, muscle mass, fat mass, waist circumference, leg circumference, and VO2max. Similar to our findings, Arazi et al. (1) also found that the 8-week morning aerobic training on 20 overweight female subjects aged of 40.2±6.2 years, had significant effect on lipid profile, body composition, WHR and VO2max. Koubaa et al. (12) conducted 12-week of intermittent vs continuous training in 29 obese patients. They found that both programs had significant effect on weight, fat mass, waist circumference and VO2max. Compering to our results, their participants reduced weight for -4.9 kg in continuous training which was similar to ours, but our samples reduced body weight -1.76kg men and -1.33 women. Note that training protocol of Koubaa et al. [12] was consisted only of continuous exercise 60-70% of VO2max, while training protocol of this study included strength training and continuous walking. If we compare results of fat-related weight loss then our results are very similar to Koubaa et al. [12]. It should also be noted that both groups in our study increased muscle mass, 0.63 kg and 0.79 kg, respectively. Even though both group increased muscle mass, only female group significantly improved muscle mass. One more 12-week study investigated effects of two different types of training organisation on body composition and VO2max [10]. Hotternott et al. [10] compared 4 times weekly short after-work training method and 2 long weekend sessions training method. Authors reported improvements in body composition and aerobic fitness in both training methods but after-work group showed stronger impact of training on followed variables. Cardio part of the training in our study was similar to Hotternott et al's [10] which could be the reason why our fat-related weight loss is in line with theirs.

In comparison with two previously mentioned studies [11, 10] it could be concluded that 8-12-week training programs that include continuous exercise on 60-70% of VO2max positively affect the body composition and aerobic fitness. On the other side, if strength training is not included, the muscle mass loss could occur as well. Our study showed that muscle mass can be maintained and improved if strength training is included. In line with our study

Ilic et al. [11] showed that 16-week training on walking speeds close to the preferred transition speed has a huge influence on body fat reduction in overweight and obese patients. Their subjects reduced their body weight for 20 kg obese group (106.79kg to 86.73 kg) and 10 kg overweight group (86.44 kg to 76.11 kg). More importantly groups lost 11.04% and 8.4% of body fat, respectively [11]. Their protocol consisted of cardio part and strength part which resulted in muscle mass maintenance. Both groups lost some fat-free mass but statistically insignificant. It should be highlighted that their subjects lost similar amount of body water as they lost muscle mass and significant amount of visceral fat which reduced weight of internal organs [11]. In that regards, it could be concluded that strength training is very important part of regular training programing.

Furthermore, Caudwell et al. [2], reported that when the exercise program was controlled and supervised, men and women had similar rate of energy expenditure because both genders wasted similar amount of energy, and effects on body composition were the same in both genders in response to their 12-month training. Our study also showed that fat-related weight loss is age-independent because male and female participants had the same rate of fat and weight loss after 8-week training program. Dumith et al. [3] has shown higher prevalence of physical inactivity among women population, while in our research women had slightly better results in relative VO2max than men. One of the possible explanations could be that women give more attention to cardio training, while men are more likely attached to weights and increasing of muscle mass.

Conclusions

Our research has shown that planned and supervised 12-week training program leads to improvements in body composition and cardiovascular fitness and therefore to better health. Considering the relationship between health and planned physical activity directly indicates the possibility of the improvement of modern lifestyle. There are plenty of studies that indicate that a physical exercise can greatly affect human health, as obesity level continue to increase in both developed and developing countries. Individuals need to take some responsibility for themselves and to review their priorities and to develop a lifestyle that will include a healthier diet and daily engagement in physical activity.

Study Limitations

Limitation of this study is a relatively small variable sample and insufficient control of the daily diet of the respondents by the trainer. The practitioners were coming on a training in a different part of the day, some were practicing in the morning and another in the evening after a hard day on their job. The motivation of the subjects was different in spite of the trainer's attempts to motivate all the practitioners.

References

[1] H. Arazi, E. Farzaneh, S. Gholamian, Effects of morning aerobic training on lipid profile, body composition, WHR and VO2 max in sedentary overweight females, *Acta Kinesiologica*, 6 (2012) 19-23.

[2] P. Caudwell, C. Gibbons, M. Hopkins, N. King, G. Finlayson, J. Blundell, No sex difference in body fat in response to supervised and measured exercise, *Medicine & Science in Sports & Exercise*. 45 (2013) 351-358.

[3] S.C. Dumith, C.P. Hallal, S.R. Reis, W.H. Kohl, Worldwide prevalence of physical inactivity and its association with human development index in 76 countries, *Preventive Medicine*, 53 (2011) 24-28.

[4] S.C. Dumith, D. Van Dusen, & W.H. Kohl, Physical fitness measures among children and adolescents: Are they all necessary, The *Journal of Sports Medicine and Physical Fitness,* 52 (2012) 181–9.

[5] V. Gaurav, M. Singh, S. Singh, Anthropometric characteristics, somatotyping and body composition of volleyball and basketball players, *J. Phys. Edu. Sport. Man,* 1 (2010) 28-32.

[6] N. Grujić, *Fiziologija sporta. Petrovaradin: Futura,* (2004).

[7] R. Gudivaka, D. A. Schoeller, R.F. Kushner, M. J.G. Bolt, Single- and multifrequency models for bioelectrical impedance analysis of body water compartments, *Journal of Applied Physiology,* 87 (1999) 1087-1096.

[8] W.L. Haskell, I-M. Lee, R.P. Pate, K.E. Powell, S.N. Blair, B.A. Franklin, C.A. Macera, G.W. Heath, P.D. Thompson, A. Bauman, Physical activity and public Health, *Medicine & Science in Sports & Exercise*, 39 (2007) 1423-1434.

[9] H.V. Heyward, L.A. Gibson, Advanced fitness assessment and exercise prescription, seventh edition. Human Kinetics, (2014).

[10] K. Hottenrott, S. Ludyga, S. Schulze, Effects of High Intensity Training and Continuous Endurance Training on Aerobic Capacity and Body Composition in Recreationally Active Runners, *Journal of Sports Science and Medicine,* 11 (2012) 483 – 488.

[11] D. Ilić, V. Ilić, V. Mrdaković, N. Filipović, Walking at speeds close to the preferred

transition speed as an approach to obesity treatment, *Srpski arhiv za celokupno lekarstvo,* 140 (2012) 58-64.

[12] A. Koubaa, H. Trabelsi, L. Masmoudi, E. Mohamed, Z. Sahnoun, M.K. Zeghal, A. Hakim, Effect of Intermittent and Continuous Training on Body Composition Cardiorespiratory Fitness and Lipid Profile in Obese Adolescents, *IOSR Journal of Pharmacy*, 3 (2013) 31-37.

[13] I.M. Lee, C.C. Hsieh, R.S. Paffenbarger Jr, Exercise intensity and longevity in men. The Harvard Alumni Health Study, *J. Am. Med. Assoc.* 273 (1995) 1179–1184.

[14] L. Mala, T. Maly, F. Zahalka, V. Bunc, Fitness Assessment. Body Composition. Charles University in Praque, Karolinum Press, (2014).

[15] L. Massuça, I. Fragoso, Study of portuguese handball players of different playing status. A morphological and biosocial, *Biology of Sport*, 28 (2011) 37-44.

[16] A. McTiernan, B. Sorensen, ML. Irwin, A. Morgan, Y. Yasui, R.E. Rudolph, C. Surawicz, J.W. Lampe, P.D. Lampe, K. Ayub, Exercise effect on weight and body fat in men and women, *Obesity*. 15 (2007) 1496-512.

[17] B.N. Roohi, Z. Niknam, BMI, Fat Percentage and VO_{2max} in College Female Staff, *J Sports Med Phy Fitness.* 48 (2008) 211-216.

[18] W.H. Saris, S.N. Blair, M.A. Van Baak, S.B. Eaton, P.S.W. Davies, L. Di Pietro, M. Fogelholm, A. Rissanen, D. Schoeller, B. Swinburn, A. Tremblay, K.R. Westerterp, H. Wyatt, How much physical activity is enough to prevent unhealthy weight gain? Outcome of the IASO 1st Stock Conference and consensus statement. *Obes. Res*. 4 (2014) 101–114.

[19] A. Sartorio, S. Ottolini, F. Agosti, F. Massarini, C.L. Lafortuna, Three-week integrated body weight reduction programme markedly improves performance and work capacity in severely obese patients, *Bulimia and Obesity*, 8 (2003) 107-113.

[20] S. Stojiljković, D. Mitić, S. Mandarić, D. Nešić, *Fitnes. Beograd: Fakultet sporta i fizičkog vaspitanja*, (2005).

[21] D.P. Swain, B.A. Franklin, Comparison of cardioprotective benefits of vigorous versus moderate intensity aerobic exercise, *Am. J. Cardiol*, 97 (2006) 141–147.