

THE EFFECT OF CYCLIC AEROBIC ACTIVITY ON SOME BODY COMPOSITION PARAMETERS IN WOMEN 19-30 YEARS OLD

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(Original scientific paper)

**Nertila Kusari¹, Daniela Shukova Stojmanovska², Abdula Elezi³,
Seryozha Gontarev², Georgi Georgiev²**

¹ PhD student on University of Ss. Cyril and Methodius, Faculty of physical education, sport and health, Skopje, North Macedonia,

² University of Ss. Cyril and Methodius, Faculty of physical education, sport and health, Skopje, North Macedonia,

³ University of Prishtina "Hasan Prishtina", Faculty of physical education and sport, Prishtina, Kosovo

Abstract

The research was conducted on a sample of 100 women 19 to 30 years old, all students on University "Fehmi Agani" in Gjakovica. The sample was divided into two groups, each of 50 women: first group, the experimental group (EG), underwent three months of cycling ergometer program and the second, control group (CG), were women that didn't participate in aerobic activity. The body composition was assessed by TANITA BC-601. The experimental program was applied three times weekly, and lasted 3 months. The training started with duration of 40 minutes and with time increased to 60 minutes, while the intensity started from 50% of maximum heart rate and increased with time to 70%. The results were processed with the SPSS statistical package and the following statistical protocols were applied: minimum, maximum, mean, standard deviation and coefficient of variability, univariant and multivariant analysis of variance, univariate and multivariate analysis of covariance and T-tests for dependent samples. The results showed that in just three months, statistically significant differences were found in the following variables: reduced body weight by 8.74%, percentage of adipose tissue by 13.09%, body mass index by 8.82%, percentage of visceral fat by 24.75% and metabolic age by 2.99%.

Key words: woman, experimental group, control group, body composition, cyclic aerobic activity.

Introduction

Movement is undoubtedly one of the most important prerequisites for good health, better life and improved quality of life. Life without movement cannot be imagined, because the various form of movement belong to the most basic biotic needs wherewith human life is maintained and continued.

People who live a healthy lifestyle and are regularly involved in some type of exercise, are less likely to develop chronic diseases, including diabetes, cardiovascular diseases, tumors, or mental illness. Even recreational physical activity is useful for body weight control, it provides better joint mobility, reduces the risk of osteoporosis and increases bone strength, improves balance and coordination, improves breathing and sleep, and improves physical well-being. In fact, people who take part in recreational activities have a lower body mass index (BMI) than those that do not, and are less likely to become ill. In that regard (Beedie et al, 2000), sports and recreation can be an important tool for positive changes in society. Cyclic and acyclic movements and various kinesiological activities have a significant and comprehensive effect on the anthropological status of people and the quality of their life. Actually, physical activity has a positive effect on morphological, psychological, and sociological characteristics, as well as cognitive, motor and functional abilities (Birch et al, 2005).

When it comes to cyclic aerobic activity, it should be pointed out that this physical activity as a muscle activity, comprehensively engages all systems of the body and activates physiological processes as the body's natural response to kinesiological irritation. No medication or psychic stimulus can replace the effect of muscle work, because they can activate only partial parts and only some systems, but not all as in physical activity (Rowland , 1990).

If we observe today's human, we see him from the perspective of the modern seated man (homo sedans), who is characterized by lack of movement (hypokinesia), excessive food intake and stress, and one can say

that cyclic aerobic activities and sports are imposed as a real need (Warburton et al, 2006). Undoubtedly, pediatric hypokinesia impairs the biological growth and development, it leads to the “rejuvenation” of serious diseases (hypertension, heart failure, etc.) and inactivity in old age can be fatal (Gallahue et al, 2003). Regardless of age and body weight, physical activity controlled in a systematic way contributes to maintaining optimal health both in adolescent (Ortega et al, 2007), and in adults as well (Maggio, et al, 2008). It is very important to develop the habit of exercising in early years of life, so that it can later become a way of living, and thus affect the quality of life.

It is known that age is one of the factors that cause worsening of health, but some research show that already at age of 6-14 years (Gontarev et al, 2018), 11 -18 years (Myrtaj et al, 2018) or 21-28 years (Zeqiri et al, 2020), body weight, body fat, metabolic age, percentage of visceral fat and BMI increase with years, followed by decrease of the percent of muscle tissue, calories spent and water percentage, which all contributes in health deteriorating. Physical activity, regardless of age and gender, has a very important role in preventing excessive body weight (Trapp et al, 2008).

Materials and methods

Subjects of the study

The research was conducted on a sample of 100 women from 19 to 30 years of age (with age partialization) who were not previously involved in physical activity. The sample was divided into two groups. The first group was the experimental group (EG), which included 50 women undergoing three months of experimental cyclic aerobic program. The second group was control group (CG), which consisted of 50 women who did not participate in the experimental treatment, however were subjected only to the measurements applied for the purposes of this paper. The only condition that was applied in the sample determination was that the women involved in the research voluntarily agreed to be a part of this research.

Parameters for body composition assessment

Prior the measuring, for every subject - age, gender and height (previously assessed in standing position) were entered in the Body composition monitor, with recommended preconditions followed (ACSM, 2005; Heyward, 2006). The other variables of body composition were assessed by TANITA BC-601, the method of bioelectrical impedance, which became a reference method in research studies in the body composition analysis and have high correlation with the percentage of body fat obtained in clinical methods (Jürimäe et al, 2003; Jürimäe et al, 2007), The parameters for assessing the body composition in this paper are as follows: age (AGE), body height (HEIG), body weight (WEIG), percentage of adipose tissue (BOFA), muscle mass (MMAS), bone mass (BOMA), body mass index (BMI), daily calorie intake (DCI), metabolic age (MEAG), total body water (TBWA) and percentage of visceral fat (VIFA).

Experimental program

For implementation of special aerobic program in the experimental group - cyclic ergometer - RING RX 220 was used (estimated the heart rate frequency) during 3 months (Christiansen et al, 2010), while the trainings were organized three times a week (Beqa et al, 2018; Hunter et al, 2012). For each respondent, first maximal hearth rate frequency was first assessed and then each training was adjusted according to the personal fitness level (Ewing et al, 2011). The training consisted of:

- An introductory part of the training which included warm-up and stretching exercises. It lasted from 5 to 10 minutes. The purpose of the introductory part of the training is to increase muscle circulation and to raise the physiological functions to a higher level;
- The main part of the training contained activity with different duration (that depended on the fitness level), and started with 40 minutes, during the first month, to 60 minutes in the third month, and with different intensity (that depended on the fitness level, and was assessed individually), 50% from maximal hearth rate frequency in the first month to 70% from maximal hearth rate frequency in the third month (Macura, 2008; Venables et al, 2005; Van Aggel-Leijssen et al, 2002);
- The last part of the training lasted from 5 to 10 minutes and it was intended to calm down and cool the body.

Methods of data processing

For all variables that were applied for measurement of the body composition, for each sub-sample separately, the following statistical parameters for central tendency and variability measures were

calculated: basic descriptive parameters - mean (X), standard deviation (SD), coefficient of variability (KV%), minimal result (MIN) and maximal result (MAX). Multivariate analysis of variance (MANOVA) and univariate analysis of variance (ANOVA) were used in order to determine the differences in the initial measurement between the experimental and the control group in the body composition variables. Multivariate analysis of covariance (MANKOVA) and univariate analysis of covariance (ANKOVA) were used in order to determine the differences in the final measurement between the experimental group and the control group in the body composition variables. The differences in the body composition between the initial and the final measurement in the experimental group and in the control group, separately, were determined by T-tests for dependent samples.

Results

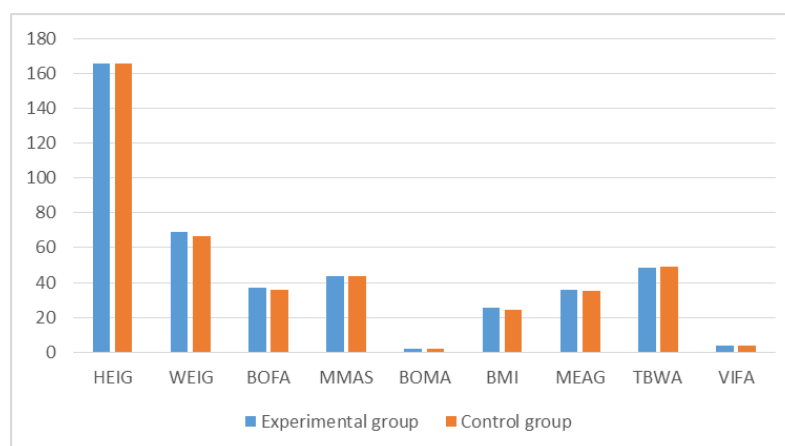
In order to determine whether the groups are homogeneous, a multivariate analysis of variance with age partialization, was applied in the initial measurement. The analysis of the variance in the initial measurement of the body composition assessment measures of the experimental and the control group are presented in Table 1. In the initial measurement, of the body composition assessment measures, there were no significant statistical differences between the respondents from the experimental group and the control group at the multivariate and univariate level, which was expected.

Table 1. Significance of differences in the body composition assessment measures between the experimental and the control group in the initial measurement

	Value	F	Hypothesis df	Error df	Sig.	η^2
Pillai's trace	,07	,71	10	88	,713	,07
Wilks' lambda	,93	,71	10	88	,713	,07
Hotelling's trace	,08	,71	10	88	,713	,07
Roy's largest root	,08	,71	10	88	,713	,07

	Experimental group		Control group		F	Sig.	η^2
	Mean	SD	Mean	SD			
HEIG	165,31	6,00	165,66	5,98	0,01	0,924	0,00
WEIG	69,15	10,46	66,76	8,18	1,47	0,228	0,02
BOFA	36,81	3,31	35,79	5,18	1,78	0,185	0,02
MMAS	43,58	3,31	43,41	2,54	0,08	0,781	0,00
BOMA	2,30	0,23	2,27	0,19	0,66	0,418	0,01
BMI	25,29	3,36	24,34	2,83	1,65	0,202	0,02
DCI	2171,34	157,65	2199,60	155,12	0,16	0,689	0,00
MEAG	35,74	4,08	35,04	7,43	0,06	0,801	0,00
TBWA	48,30	3,68	49,07	2,98	1,38	0,243	0,01
VIFA	3,96	1,59	3,54	1,09	1,60	0,209	0,02

Figure 1. Differences in the body composition assessment measures between the experimental and the control group in the initial measurement



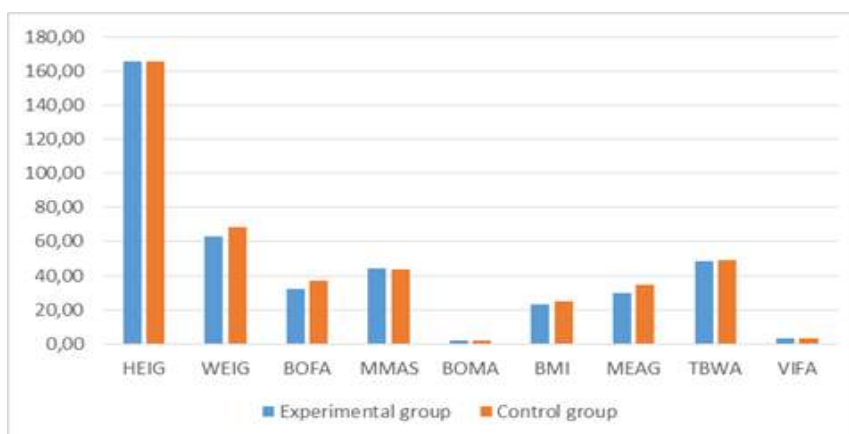
Such state suggested that both groups of respondents were relatively homogenized, whereby conditions were created to begin the experimental program from equal starting positions for the respondents from both groups. In order to neutralize the differences in terms of age, and the results measured in the initial measurement, i.e. to prevent them leading to a “systematic error”, the groups are additionally homogenized with an appropriate statistical procedure, (multivariate and univariate analysis of covariance) for determination of the differences in the final measurement between the experimental group and the control group.

Table 2. Significance of differences in body composition assessment measures between the experimental and the control group in the final measurement

	Value	F	Hypothesis df	Error df	Sig.	η^2
Pillai's trace	,79	32,78	9	79	,000	,79
Wilks' lambda	,21	32,78	9	79	,000	,79
Hotelling's trace	3,73	32,78	9	79	,000	,79
Roy's largest root	3,73	32,78	9	79	,000	,79

	Experimental group		Control group		F	Sig.	η^2
	Mean	SD	Mean	SD			
HEIG	165,31	6,00	165,66	5,98			
WEIG	63,10	9,97	68,25	7,66	188,40	0,000	0,68
BOFA	31,99	3,89	37,01	4,51	129,88	0,000	0,60
MMAS	44,03	4,09	43,71	2,58	0,18	0,671	0,00
BOMA	2,28	0,21	2,27	0,18	0,04	0,839	0,00
BMI	23,06	3,28	24,88	2,60	194,82	0,000	0,69
DCI	2236,32	119,45	2210,44	128,74	14,92	0,000	0,15
MEAG	29,84	4,07	34,84	6,69	156,12	0,000	0,64
TBWA	48,29	4,47	49,21	3,22	0,68	0,411	0,01
VIFA	2,98	1,19	3,52	1,28	36,61	0,000	0,30

Figure 2. Differences in body composition assessment measures between the experimental and the control group in the final measurement



Multivariate and univariate analysis of covariance were applied in order to determine whether statistically significant differences existed in the body composition assessment measures in the final measurement of the experimental group and the control group. These results are presented in Table 2. By applying multivariate analysis of covariance (MANKOVA) i.e. by testing the significance of the differences of the arithmetic means in the body composition assessment measures in the final measurement of both groups of respondents, a statistically significant difference was found, because Wilks' Lambda is .21 and for degrees of freedom $df = 9/79$, which gives a statistical significance at level $Q=.00$. The magnitude of the partial effect of the determinants (partial η^2) shows a large effect of influence .79. In order to determine which body composition assessment measures have statistically significant differences, univariate analysis of covariance (ANKOVA) was calculated individually for each body composition assessment measure

partially. The overview of Table 2 shows that there were statistically significant differences in 6 out of 10 variables. Intergroup differences were found in the variables: WEIG (F=188,40; p=0,000), BOFA (F= 129,88; p=0,000), BMI (F= 194,82; p=0,000), DCI (F= 14,92; p=0,000), MEAG (F= 156,12; p=0,000) and VIFA (F= 36,61; p=0,000). The partial effect of the determinants, partial η^2 , is ranked between .15 and .68 and it shows a large effect of influence. The largest effect in determining the differences is shown by the variables: BMI -body mass index (partial η^2 =.69), WEIG - weight (partial η^2 =.68) and MEAG - metabolic age (partial η^2 =.64).

In order to define the differences in the body composition assessment measures between the initial and the final measurement in the experimental group, T-tests for dependent samples were used. The test results are presented in Table 3.

Table 3. Significance of differences in arithmetic means from the initial and the final measurements in the respondents from the experimental group

Variables	Initial		Final		%	R	T-test	Sig
	Mean	SD	Mean	SD				
HEIG	165,31	6,00	165,31	6,00	0,00			
WEIG	69,15	10,46	63,10	9,97	-8,74	0,964	15,28	0,000
BOFA	36,81	3,31	31,99	3,89	-13,09	0,785	14,05	0,000
MMAS	43,58	3,31	44,03	4,09	1,03	0,609	-0,95	0,346
BOMA	2,30	0,23	2,28	0,21	-0,70	0,963	1,83	0,073
BMI	25,29	3,36	23,06	3,28	-8,82	0,957	16,08	0,000
DCI	2171,34	157,65	2236,32	119,45	2,99	0,833	-5,22	0,000
MEAG	35,74	4,08	29,84	4,07	-16,51	0,796	16,02	0,000
TBWA	48,30	3,68	48,29	4,47	-0,02	0,717	0,02	0,986
VIFA	3,96	1,59	2,98	1,19	-24,75	0,886	9,01	0,000

Table 3 shows that there were statistically significant differences between the initial and the final measurement in the experimental group, which were found in the variables: body weight (WEIG), percentage of adipose tissue (BOFA), body mass index (BMI), daily calorie intake (DCI), metabolic age (MEAG) and percentage of visceral fat (VIFA). Statistically significant differences between the average performances of the respondents in this group during the experimental program (initial-final measurement) were not observed in the variables: muscle mass (MMAS), bone mass (BOMA) and total body water (TBWA). On the basis of the calculated percentage increase of the values of the arithmetic means between the initial and the final measurement, it can be concluded that 3 months after the commencement of the exercise program the respondents from the experimental group reduced: the body weight by 8.74% (-6.05 kg), the percentage of adipose tissue by 13.09%, the body mass index (BMI) by 8.82%, the percentage of visceral fat by 24.75% and metabolic age by 16.51% (- 5.9 years), while the daily calorie intake increased by 2.99% (70kcal extra).

Chart 3. Differences in arithmetic means from the initial and the final measurements in the respondents from the experimental group

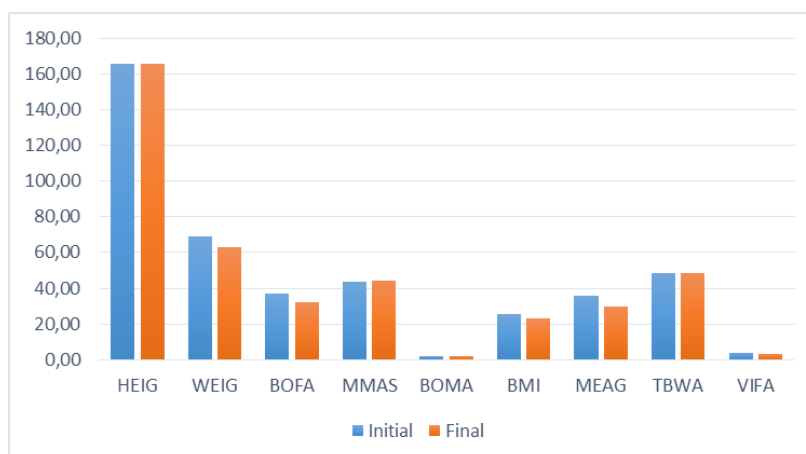
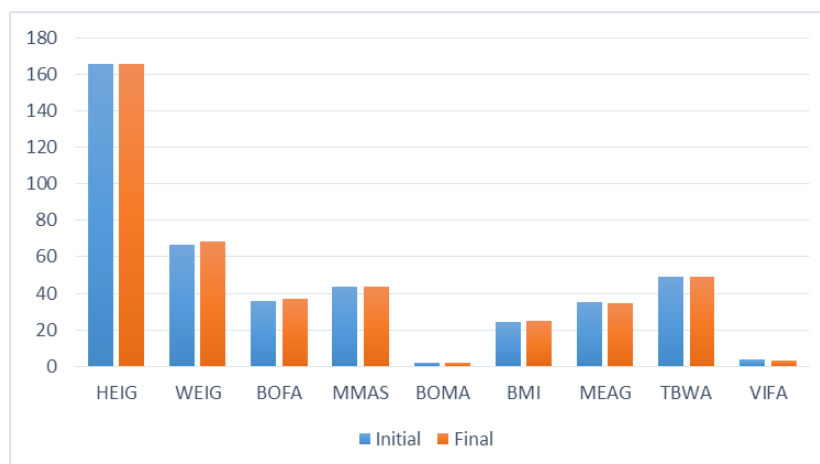


Table 4. Significance of differences in arithmetic means from the initial and the final measurement in the respondents from the control group

Variables	Initial		Final		%	R	T-test	Sig
	Mean	SD	Mean	SD				
HEIG	165,66	5,98	165,66	5,98	0,00			
WEIG	66,76	8,18	68,25	7,66	2,23	0,953	-4,23	0,000
BOFA	35,79	5,18	37,01	4,51	3,40	0,817	-2,87	0,006
MMAS	43,41	2,54	43,71	2,58	0,67	0,818	-1,34	0,188
BOMA	2,27	0,19	2,27	0,18	-0,26	0,982	1,14	0,261
BMI	24,34	2,83	24,88	2,60	2,24	0,945	-4,17	0,000
DCI	2199,60	155,12	2210,44	128,74	0,49	0,904	-1,14	0,260
MEAG	35,04	7,43	34,84	6,69	-0,57	0,962	0,68	0,498
TBWA	49,07	2,98	49,21	3,22	0,29	0,947	-0,97	0,336
VIFA	3,54	1,09	3,52	1,28	-0,56	0,583	0,13	0,898

Table 4 shows that statistically significant differences were found between the initial and the final measurement in the control group, in the following variables: body weight (WEIG), percentage of adipose tissue (BOFA) and body mass index (BMI). Statistically significant differences between the mean values of the respondents from the control group were not observed in the variables: muscle mass, bone mass, daily calorie intake, body vitality, total body water and percentage of visceral fat. Based on the calculated percentage increase in the values of the arithmetic means between the initial and the final measurement, it can be concluded that after 3 months the respondents from the control group increased their body weight by 2.23% (+1.5kg), percentage of adipose tissue by 3.40% and the body mass index by 2.24%.

Chart 4. Differences in arithmetic means from the initial and the final measurement in the respondents from the control group



Discussion

In the research the effect of a 3-month cyclic aerobic program on body composition in 50 women from 19 to 30 years of age was evaluated. Based on the obtained results, it is evident that the experimental cyclic aerobic program has contributed to reduced values of body weight, percentage of adipose tissue, body mass index, percentage of visceral fat and metabolic age, in comparison to the control group. In the final measurement, compared with the initial measurement, the respondents from the experimental group averagely reduced the values of these variables: body weight for 6.05 kg (9%), percentage of adipose tissue for 13%, body mass index for 8.8%, percentage of visceral fat for 25% and metabolic age for 5.90 years (16%), while there is increase in burned calories for 64.98 kcal (3%), which is not so high, in comparison to calories spent in the exercise. After three months, the body weight of the control group was increased for 1.49 kg (2%), the percentage of adipose tissue was increased for 3.4% and the body mass index for 0.54 (2,24%). Statistically significant differences were not found in the other indicators of body composition. It can be seen that the recreational content of the cyclic aerobic program can significantly contribute to the

reduction of adipose tissue, body weight, body mass index and other indicators of body composition and improve of health, which was also confirmed by other authors (Donnelly et al, 2000; Trapp et al, 2008).

There are differences not only in the opinions about the duration of the program to achieve reduction of the weight, but also in the daily and weekly time spent in exercising and also in the intensity of exercising. Some authors (Weinsier et al, 2002), think that more exercise is needed to reduce and maintain weight and they recommend 60-90 min/day of brisk walking. But most authors (Institute of Medicine, 2002), recommend 60 min/day of moderate intensity physical activity, some recommend exercise approximately 45-50 minutes/day or 300-360 minutes/week, while some recommend at least 30 minutes/daily, 5 times a week, or total of 150 minutes/weekly (ACSM, 2005) in order to lose and maintain the weight.

Different authors recommend different duration of the exercise program for weight loss and decrease in body fat. So some recommend 3 months (Christiansen et al, 2010), some 4 months (Trapp et al, 2008) or even 5 months (Tremblay et al, 1994), although some differences in body composition may appear even after 1 month (Venables et al, 2005).

On the other hand the type and intensity of physical activity applied during weight loss program is also important (Tremblay et al, 1994), suggesting that respondents involved in vigorous endurance physical activities had lower fat levels of upper body than those who applied less intensive activities. The suggested intensity vary from 40% VO₂max (Horton et al, 1998), to 55% VO₂ max (Despres et al, 1991), with preference to low intensity training which can provide increasing of the fat oxidation by 40% (Van Aggel-Leijssen et al, 2002), although the maximal fat oxidation in female starts at 52% VO₂max and 62% maximal heart rate - HRmax (Venables et al, 2005). The intensity that provides the most optimal stimulus for weight loss is the intensity from 50% to 70% from maximal hearth rate frequency (Van Aggel-Leijssen et al, 2002). Some of the more recent studies suggest that more intense forms of physical activity are more beneficial when monitoring weight loss and health status in comparison with moderate-intensity activities (Strbad et al, 2011), but those intensities are hard to apply on sedentary persons and the chance that they will quit exercising is very high. Therefore, in recent years, researchers have focused on determining the volume and intensity of exercise and daily activities, as well as their impact on the components of fitness and body composition (Gordon et al, 2000).

The type of training applied in the research is also playing a role in the success of losing weight. Some authors (Skrypnik et al, 2015) found in their research that there weren't any statistically significant differences between groups of obese woman applying different type of training (endurance and endurance-strength training), while others (Marzolini et al, 2012; Willis et al, 2012) have opposite findings and claim that mixed endurance-strength exercise were found to be more effective than endurance exercise in reducing body weight. Interval training can be more effective in weight loss by 28% than moderate intensity activities (Viana et al., 2019) but according to some authors similar body fat decrease may appear in both with more time demanding of the second one (Hunter et al, 2012) and very similar energy expenditure in both types of training (Trapp et al, 2008). Cycle ergometer was applied in some research (Trapp et al, 2008) and was efficient not only for weight loss, but also for maintaining weight (Lunn et al, 2009), although its efficiency depends on the individual adiposity and the distribution of the fat (Lafortuna et al, 2008).

Conclusion

The following conclusions can be drawn, based on the obtained results:

- In the initial measurement, in the body composition assessment measures, the respondents from the experimental group and the control group were not statistically different at the multivariate and univariate level.
- In the final measurement, in the body composition assessment measures, the respondents from the experimental group and the control group statistically differ at the multivariate and univariate level.
- Intergroup differences were found in the following variables: body weight, percentage of adipose tissue, body mass index, daily calorie intake, metabolic age and visceral percentage of adipose tissue in favor of the experimental group. After a period of 3 months following the commencement of the exercise program, the respondents from the experimental group reduced: body weight by 8.74% (-6.05 kg), percentage of adipose tissue by 13.09%, body mass index by 8.82%, percentage of visceral fat by 24.75% and metabolic age by 16.5% (-5.9 years) and increased the value of daily calories intake by 16.51% (+64.98kcal) which is not so high, in comparison to calories spent in the exercise.
- Statistically significant differences between the initial and the final measurement in the control group were found in the following variables: body weight, adipose tissue percentage and body mass index.

On the basis of the calculated percentage increase in the values of the arithmetic means between the initial and the final measurement, it can be concluded that after 3 months, the respondents from the control group increased: body weight by 2.23% (+1.49 kg), percentage of adipose tissue by 3.40% and body mass index - BMI by 2.24%.

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