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EFFECTS OF GROUP EXERCISE PROGRAM ON MORPHOLOGICAL STATUS OF FEMALE UNIVERSITY STUDENTS

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ABSTRACT

The objective of the research was to determine the effects of the "Body Workout" aerobic exercises on morphological characteristics of female university students after a period of 2 months with training sessions in the duration of three hours per week. The sample of research participants was made up of female university students from the Faculty of Sports and Physical Education in Novi Sad (AGE = 22.13±0.98 years) that were actively included in the workout program. The total sample participating in the research comprised of 52 participants, 25 of which comprised the experimental group (AGE=22.11±0.89; TV=166.11±5.01) while the remaining 27 of them comprised the control group (AGE=22.45±0.78 years, TV=169.51±5.04). The experimental group followed the "Body Workout" aerobic exercises model and the control group followed the regular curriculum for the university course of Fitness (Rekreacija in Serbian) at the Faculty of Sports and Physical Education in Novi Sad. At the initial measuring, there were no statistically significant differences among the participants (P=0.41). Physical changes that occurred in the participants' bodies during the research period of two months were followed by means of monitoring of twelve morphological characteristics. According to the research results, significant effects were determined in transformation of morphological characteristics among the members of the

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experimental group on the level of the entire system (P=0.00) and the individual differences could be perceived in the final measuring in variables Circumference of the lower leg (p=0.05), Skinfold of biceps brachii (p=0.00), Skinfold of triceps brachii (p=0.00), Skinfold of the forearm (p=0.00), Sub-scapula skinfold (p=0.02) and Abdominal skinfold (p=0.00) among the members of the experimental group. That is an indication that the experimental Body Workout program had a significant impact on the above-mentioned characteristics. At the same time, it was determined that the experimental program of aerobic exercises produced the greatest effects on the reduction in subcutaneous fatty tissue.

Key words: Morphological characteristics; Effects; Aerobic exercise; Female students

INTRODUCTION

Physical abilities of people pertain to the production of energy needed for metabolic processes. A higher level of physical abilities is important for normal functioning of all age groups of population, and in particular of the students who are at risk due to the long periods of sitting required owing to their regular daily academic schedule. Adequate physical fitness helps in reducing the incidence of cardiovascular diseases, reduction of fatty tissue, reduction in body weight.

Towards the end of 20th century, actress Jane Fonda managed to ensure huge media attention and placed and positioned (Bergoč and Zagorc, 2000) a program called *Work Out*. The program mainly consisted of exercises of static character, with the focus on static muscle contractions of lower extremities with simultaneous conducting of exercises for the upper body by using the available equipment (additional weights) or without them. The activity of leg muscles included exercises such as squats and lunges. Such a program is also available under some other names, such as: body toning, body shaping, body sculpt, body styling.

Exercise programs focused on body mass regulation are based on the principle of an increased workload within one activity type, although they may also comprise of a combination of (often) two or three different activities. Such programs are aimed at increasing calories' consumption and at speeding up the metabolic processes in muscle cells. It can be expected that any significant effect of the workout program on the reduction of subcutaneous fat will be achieved only under conditions of an extended duration of workout (of more than 30 minutes) and where a large number of muscle groups is included in a moderate intensity workout. During the muscle activity, all the body organs' systems are engaged, metabolism is faster and oxygen consumption is increased, individual biochemical and physiological processes intensify. With systematic repetition of adequate exercise programs, long-term and stable adaptation is provided. Adaptation is characterized with morpho-functional structural changes on the level of cell structures, tissues, organs and individual organs' systems. Parallel to that, regulation mechanisms are improved, both in functioning of individual organs and of the systems of organs and system of human organism as a whole.

Based on the research works completed so far (Arslan, 2011; Gezer & Çakmakçi, 2011; Mandarić, Sibinović, Mikalački and Stojiljković, 2011; Mandić, Sibinović and Stojiljković, 2011; Korshøj, Ravn, Holtermann, Hansen & Krustrup, 2016; Abad, Nascimento, Souza, Figueroa, Ramona, Sartori, et al., 2017; Batacan, Duncan, Dalbo, Tucker & Fenning, 2017; Brito-Monzani, Sanches, Bernardes, Ponciano, Moraes-Silva, Irigoyen, et al, 2017; Lidegaard, Søgaard, Krustrup, Holtermann & Korshøj, 2017; Mora-Rodriguez, Ramirez-Jimenez, Fernandez-Elias, Guio de Prada, Morales-Palomo, Pallares, et al., 2017) it can be concluded that aerobic exercises are a series of activities of cyclic character affecting the respiratory and cardiovascular system of the persons performing the exercises, by improving their functioning, with the aim of preventing the diseases of all the organic systems and preventing hypokinesis and other cardiorespiratory diseases.

The results of research work carried out by fore-

ign authors who studied the effects of aerobic workout on body composition and morphological characteristics (Pillarella & Roberts, 1996; La Forge, 2000; Gezer & Çakmakçi, 2011; Serkan, Hazar & Hazar, 2012), as well as of the researchers from this region (Zagorc, Zaletel and Ižanc, 1998; Obradović, 1999; Mandarić, 2003; Obradović, 2004) are pointing out to the positive effects of aerobic workout on morphological characteristics of women.

In addition to the multitude of physical exercise available at the Faculty, as well as in addition to the huge variety of physical activities available to the female students today outside of the Faculty, there was a question of whether an innovative program can produce any positive effects on individual morphological characteristics, bearing in mind the identical principle of workout in aerobic exercises with music and the didactical and methodical approaches implemented in physical education and their practical applications in regular classes of Physical Education. This is where the objective of this research has emerged: to determine the effects of the "Body Workout" aerobic program on morphological characteristics of female students over a period of 2 months with the weekly training sessions in the total duration of 3 hours. Morphological characteristics were in the focus of research work. Research work was undertaken commencing from the hypothesis (H$_1$) that the experimental training program of aerobic training ("Body Workout") would lead to some positive changes in the morphological status of the female participants in the experimental group in this research, compared to the control group of research participants.

METHOD

The research was of the longitudinal character, and participants were randomly divided into two groups. The sample of participants in the research was made up of female university students of the Faculty of Sports and Physical Education in Novi Sad (AGE=22.13±0.98 years). The total number of female participants in the research sample was 52; 25 of them in experimental group (AGE=22.11±0.89; TV=166.11±5.01) and 27 of them in the control group (AGE= 22.45±0.78 years; TV=169.51±5.04).

Female participants in both the groups were healthy females (they possessed medical reports issued by the sports medical doctors). During the treatment, the participants in the experimental group did not attend any other forms of physical training except for the Body Workout aerobic exercises. The female participants in the control group were female students who attended and exercised in classes with practical instruction that comprised regular curriculum for the Fitness course in the Faculty of Sports and Physical Education in Novi Sad.

The following morphological characteristics were applied for the assessment of morphological characteristics of the female students:

1) For the assessment of skeleton longitudinal measure:
   a) Body height - kg
2) For the assessment of body volume and mass, the following were measured:
   a) Body mass - cm,
   b) Circumference of the upper arm - cm,
   c) Circumference of the lower arm - cm,
   d) Circumference of the upper leg – cm, and
   e) Circumference of the lower leg – cm;
3) For the assessment of the subcutaneous fatty tissue, the following were measured:
   a) Skinfold biceps brachii- mm,
   b) Skinfold triceps brachii -mm,
   c) Skinfold of the lower arm - mm,
   d) Skinfold of the upper leg - mm,
   e) Skinfold of the lower leg - mm,
   f) Subscapula skinfold –mm, and
   g) Abdominal skinfold - mm.

Anthropometer was used for measuring the body height, decimal digital weight scale was used for measuring body mass and a calliper of the John Bull type was used for measuring subcutaneous fatty tissue on the above listed reference points. Complete measuring was conducted by the authors of this study, both during the initial and during the final measuring.

Testing was conducted at two points in time (initial and final). Assessment of morphological characteristics was conducted in the premises of the Faculty of Sports and Physical Education in

Novi Sad. On the occasion of testing, all the rules and preconditions for conducting the protocol were complied with.

Description of the Experimental Treatment

Prior to the treatment, the participants were divided into two groups: experimental and control group. The experimental group (E) attended the classes of programmed aerobic Body Workout exercises and the control group (C) attended regular lectures, without any participation in a specific physical activity.

The experimental program included the Body Workout aerobic exercises that included body shaping and strengthening exercises without equipment and with small weights (dumbbells). It was applied on the experimental group of participants only.

The time structure of exercising consisted of three parts:

The introductory part (warming-up) – lasting for 10 minutes – increasing the level of functional abilities by doing exercises of the skipping type in place and moving within the radius of 1 m;

The main part – lasting 40 minutes – was focused on body shaping and strengthening exercises by doing the Body Workout aerobic exercises. Exercises done without equipment and those with small weights (dumbbells) were applied, for different muscle groups with the load of 60-70% with 1RM (repetition maximum) with 30 seconds and up to 1-minute pauses in between the exercises' series. Exercises included a higher number of repetitions (10-15) for upper limbs and 15-20 repetitions for lower limbs, in 3 to 5 series.

The final part – lasting 10 minutes – was dedicated to stretching and relaxation exercises aimed at calming the organism down. Exercises of static stretching were carried out, with the minimum duration of 20 seconds. The selection of exercises depended on the muscle group that the exercises focused on during the training.

The experimental program lasted two months and it was realized as a part of the regular classes at the Faculty of Sports and Physical Education. During the said period, the experimental program was carried out 3 times a week.

The content of workout of the control group (C) was determined based on the Curriculum for the university course of Fitness at the Faculty of Physical Culture in Novi Sad. The number of classes of comprising of practical instruction was the same as the number of classes for the experimental group. Two models of curriculum contents were done alternatively as the introductory part of the classes (one model – one class): walking and running with tasks (a combination of 4 to 6 tasks per one class) and tag games (a combination of 2 to 3 tag games per class). As a preparatory part of the class, different combinations of body sculpting exercises (comprising of 6 to 10 exercises in one combination of exercises per class) were done. As a part of the basic part of the class, curriculum units were done in accordance with the regular curriculum for the university course of Fitness, which all belonged to the group of Team Building games. The closing part of the class comprised of stretching.

In statistical data processing, parameters of descriptive statistics, arithmetic mean (AM) and standard deviation (SD) were used. From the field of comparative statistics, with a view to determining the significance of differences between the two groups of participants (the experimental and the control group), in the initial measuring, with the aim of determining the differences multivariate (MANOVA) and univariate (ANOVA) variance analysis were used, and with a view to determining the effects of the training, the multivariate analysis of covariance (MANCOVA) and univariate analysis of covariance (ANOVA) were used with the concluding level $p \leq 0.05$.

RESULTS

It was determined based on the value of F (F=1.06) that there were no statistically significant differences (P=0.41) in the overall system of variables at the initial measuring between the experimental and the control group (Table 1). Based on individual analysis of each variable analysed, it was concluded that there were no statistically significant differences between the two groups. Based on these results, we could conclude that there were no differences in statistical

respect between the experimental and control group at the initial measuring according to the v- ariables observed.

Table 1 – Analysis of differences between the groups at the initial measuring

Group	Control group		Experimental group			
Variable	AM	SD	AM	SD	f	p
Body mass (kg)	61.51	9.21	58.72	7.71	1.31	0.24
Circumference of upper arm (cm)	25.72	2.61	25.13	2.21	0.95	0.34
Circumference of lower arm (cm)	21.91	1.71	21.78	1.33	0.27	0.62
Circumference of upper leg (cm)	51.15	5.32	50.08	4.33	0.68	0.43
Circumference of lower leg (cm)	37.27	2.67	36.29	1.85	2.99	0.09
Skinfold biceps brachii (mm)	7.88	3.05	7.08	2.35	0.95	0.34
Skinfold triceps brachii (mm)	10.39	3.97	9.56	2.14	0.75	0.38
Lower arm skinfold (mm)	6.25	1.88	5.78	1.31	0.94	0.34
Upper leg skinfold (mm)	12.75	4.79	11.32	2.97	1.74	0.19
Lower leg skinfold (mm)	6.46	2.62	5.64	2.09	1.23	0.26
Subscapula skinfold (mm)	13.03	6.43	13.64	4.75	0.13	0.73
Abdominal skinfold (mm)	12.91	6.44	12.12	4.039	0.31	0.57

Legend: AM – arithmetic mean, SD – standard deviation, f – the value of f-test of univariate analysis of variance, p – level of significance of univariate analysis

Once that the results of the initial measuring were neutralized and the results of the final measuring were compared between the two subsamples observed (Table 2), it became obvious that there was a statistically significant difference (P=0.00) on the level of the entire system of morphological variables (F=6.86). When observed individually, it could be concluded that such differences occured in the variables of Circumference of lower leg (p=0.05), Skinfold biceps brachii (p=0.00), Skinfold triceps brachii (p=0.00), Lower arm skinfold (p=0.00), Subscapula skinfold (p=0.02) and Abdominal skinfold (p=0.00) in favour of the female participants in the experimental group. Bearing in mind the values of their corrected arithmetic means, better results were clearly noticeable among the participants in the experimental group.

Table 2 – Results of MANCOVA analysis of the morphological variables for participants in individual groups

Factor	Variable	f	p	Group	AM*
	Body mass (kg)	2.11	0.15	K	60.71
				E	59.05
	Circumference of the upper arm (cm)	2.80	0.10	K	25.84
				E	25.47
	Circumference of the lower arm (cm)	0.51	0.44	K	21.98
				E	21.88
	Circumference of the upper leg (cm)	0.19	0.69	K	51.19
				E	50.33
Group	Circumference of the lower leg (cm)	3.99	0.05*	K	37.36
				E	35.83
	Skinfold biceps brachii (mm)	12.77	0.00†	K	7.80
				E	6.41
	Skinfold triceps brachii (mm)	27.10	0.00†	K	10.32
				E	7.01
	Skinfold lower arm (mm)	15.84	0.00†	K	6.26
				E	5.00
	Skinfold upper leg (mm)	1.57	0.22	K	12.70
				E	10.98

Skinfold lower leg (mm)	0.69	0.22	K	6.45
			E	5.45
Subscapula skinfold (mm)	5.52	0.02*	K	13.41
			E	12.58
Abdominal skinfold (mm)	10.19	0.00†	K	12.93
			E	10.85

Legend: f – univariate f test; p – level of statistical significance of the f test; AM* - corrected arithmetic mean; *p<0.05.†p<0.01.

DISCUSSION

The results of this research also served to determine some statistically significant differences between the control and experimental group in favour of the female participants in the experimental group, with the focus on the improved condition of subcutaneous fat, i.e. on the reduction of subcutaneous fat. The research results obtained confirmed the initial hypothesis of this research. In the previous research works on the similar samples of participants, Cvetković (2009) and Ko & Choi (2013) obtained similar results when they determined the positive effects of aerobic workouts on their morphological status with a focus on the reduction in subcutaneous fat and body weight. Similar results were obtained from the research conducted on a population of female adolescents by Lima, Bonardi, Campos, Bertani, Scher, Moriguti, et al (2017), where a combination of aerobic training and training with weights produced reductions in body mass, nutrition levels as well as the total amount of body fat. Mandarić, Sibinović, Mikalački and Stojiliković (2011) also determined positive effects on the morphological characteristics, but on a somewhat younger sample of female participants. This group of researchers obtained similar results as well, which were analogous to the results of the current research, and they concluded that subcutaneous fat was reduced in the reference points and that it could be presumed that the positive effects of aerobic workout were visible the most in respect of the reduction of subcutaneous fat. Based on all of the above said, we arrived at the final conclusion that the two months' aerobic workout program had led to the reduction in the parameter of subcutaneous fat among the female university students and that this program could be applied in the reduction of subcutaneous fatty tissue, as well as in maintenance of overall health condition, which was additionally confirmed by the research results obtained by Kostić, Đurašković, Miletić and Mikalački (2006), and also by Mandić, Sibinović and Stojiljković (2011).

Differences among the female participants in the research occurred both in the total system of variables at the final measuring and in individual variables, and specifically: in variables used for the assessment of body volume and mass, variable of Circumference of lower leg and variables used to assess the condition of subcutaneous fat. Upon an analysis of the results obtained, it was noticeable that the female participants in the experimental group differed from those in the control group according to the variables such as: the Circumference of the lower leg, Skinfold biceps and Skinfold triceps brachii, Skinfold on the lower arm, Subscapula skinfold and Abdominal skinfold, which could be attributed to the aerobic workout program followed by them, which comprised of exercises that were directly targeting the above mentioned parts of the body.

Observed from the aspect of metabolic processes, i.e. physiology, physical activity intensifies the effect of insulin on peripheral tissues (skeletal muscles); increases glucose clearance in the liver and reduces its production. Thus, the response of GLUT-4 and of enzymes regulating deposition and oxidation of glucose in skeletal muscles is increased. It is due to that that an increased conversion of fibres of the type IIb in type IIa occurs, as well as that the capillary density of muscles is increased, which is coupled with the changes in fasting insulin. The effects of physical activity of aerobic character lead to a reduction in accumulation of abdominal fat and intramuscular triglycerides. The increase in mus-

cular mass increases the space for depositing of glycose, which contributes to the reduction in insulin resistance. It is due to that that the liver of physically active persons becomes more sensitive to insulin and is thus able to better control the glucose production. Control of metabolism of free fatty acids is increased, peripheral glucose clearance is increased and the production of glucose in liver is reduced.

On the other hand, it is necessary to note and highlight the difference between the one-off and long-term effects of physical activity. The effects in the research were short-term and lasted for two months, but with one hour of training. Up to 2 hours after exercising, glucose takeover is increased partly owing to the insulin-independent mechanism, which probably pertains to the increase in GLUT-4 induced by contractions. Only one exercising can increase insulin sensitivity for a minimum of 16 hours after the workout. Physical activity produces effects on insulin sensitivity through numerous adaptations of transport and metabolism of glucose, but also of the metabolism of fats and it also produces impact on hepatic glucose output.

By neutralising the differences at the initial measuring, the participants in the experimental group achieved much better results in the variable Circumference of the lower leg (35.83 cm to 37.36 cm) compared with the participants in the control group. At the final measuring, there was a reduction in the subcutaneous fatty tissue values on the upper arm (biceps brachi 6.41 mm to 7.80 mm; triceps brachia - 7.01 mm to 10.32 mm), on the lower arm (5.00 mm to 6.26 mm), on the back (subscapula skinfold - 12.58 mm to 13.41 mm) and on the abdominal skinfold (10.85 mm to 12.93 mm) among the participants in the experimental group. Following the completion of experimental treatment and conducted final measuring, we learnt that there were statistically significant differences in favour of the experimental group among the variables tested.

Differences occurred among participants in the experimental group if observed against the participants in the control group, in variables such as: the Circumference of the lower leg (since during this kinetic activity, lower limbs were constantly contracted, either in static or in concentric - eccentric contractions); Skinfold biceps brachii, Skinfold triceps brachii, Skinfold lower arm and Subscapula skinfold (this can be explained by the use of small hand weights when doing movements during the experimental treatment, with the aim of providing loads for upper limbs and thus, these limbs were more active than usual); and finally, in the variable of Abdominal skinfold (abdomen comprised, perhaps, the most active muscle group, immediately following the lower limbs) where a significant differences among the groups can be perceived in favour of the experimental group. All the above perceived elements can be ascribed to the effect of the aerobic workout program that includes the elements of exercises in the structure of its movements which are directly activating the above listed body parts and thus impacting the reduction in the values of the above listed parameters.

The results of research showed that significant effects in transformation of morphological characteristics among the participants in the experimental group were determined. Results obtained are indicative of the practical applicability in the courses of physical exercises with female students wishing to reduce their body mass. This points out to the fact that the experimental Body Workout aerobic programs produced significant impact on the above-mentioned characteristics of the condition of subcutaneous fat. The results obtained in this research, however, cannot be taken to be true in general for all the students and shall be thus accepted with reservation, since the sample of female participants was small. The limitations of the study were also reflected in the fact that the diet of the female participants was not controlled, and it would thus be necessary, in the research work taken in the future, to additionally pay attention to this element as well, since a reduction in dietary intake or a mere change in the intake of foodstuff can produce impact on results obtained. In short, owing to a weight reduction diet and physical activity, muscle cells and other targeted tissues are reacting better to insulin and are thus better using

glucose which, with intensive physical activity, result in a reduction in subcutaneous fat deposits.

It is not only this one, but an endless number of other sports programs lead to the development of skills, teamwork, discipline, improved socialisation among young people. Sports and physical activity serve to meaningfully occupy the social life of the young, produce their positive approach to life and guard them against succumbing to the negative social phenomena. The result of all that is a harmonious, functional and aesthetic development, greater strength, economic functioning of muscles and of the entire organism, better coordination in muscular activity, increased vital capacity, slower rhythm of breathing, lower blood pressure, faster restitution following substantial physical exertions and stress. The importance of physical activity of the aerobic exercise type and workout with weights lies with their effect on insulin sensitivity, even independently from the effect they have on the reduction of body mass and on the reduction of subcutaneous fat. Significant mental and health benefits should be added to all of the above, such as strong will, perseverance, harmonic relations, generosity and socialisation, which are developed through the aerobic programs as a group type of physical training.

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