THE IMPORTANCE OF PROGRAMMED PHYSICAL EXERCISE IN PREVENTION AND TREATMENT OF ADOLESTENT OBESITY

Original scientific paper

Aleksandra Sibinović[1] and Sanja Mandarić[2]

[1]*Vožd Karadjordje Elementary school, Leskovac, Serbia,*
[2]*Faculty of Sport and Physical Education, University of Belgrade, Belgade, Serbia*

Abstract

  The study included 75 subjects, aged 13 + 0.6 years. The effects of programmed physical exercise were monitored in the terms of morphological characteristics (eight variables) and functional capacity (one variable). The experimental factor was a specially programmed eight-week physical exercise course of step and kick aerobics, three classes a week (24 classes) impemented in "Vožd Karadjordje" Elementary school, Leskovac. The results of this research suggest that the specially programmed step and kick aerobic physical exercise classes had a significant effect on the improvement of the morphological characteristics (the reduction of body skin wrinkles, the reduction of body fat), the reduction of body weight and the increase of maximal oxygen consumption.

Keywords: *children morphological characteristics, children functional abilities, physical health, cardiovascular fitness, Step aerobic, volleyball, athletics, obesity*

INTRODUCTION

  Obesity is a chronic, multifactorial disease which represents the positive energy balance over a long period, due to the increased energy intake and decreased energy consumption or combination of both (Hall, Heymsfield, Kemnitz, Klein, Schooler, Spekman, 2012; Lean, 1998). Each state of the increase of fatty components of body composition above 20% for men and 25% women, indicates the existence of obesity (Bray, 2010), which is in clinical practice, mostly reflected by a body mass index (Tsigos et al., 2008). Numerous studies suggest the epidemic obesity widespreding, and therefore this requires a more comprehensive analysis of the mechanisms involved in the maintenance of energy homeostasis (World Health Organization, 2000; Nešić Balšić, Janjić, Stojiljković, & Borović-Dimić, 2009; (Hall et al., 2012). Thus, on the basis of the research results, at the end of the turn of the millennium, it was noted that approximately 6% of the American population was clinically diagnosed as pathologically obese, while 33% older than 20 years was overweighted (Ko, Chan, Woo, Lau, Yeung, Chow, (1997); Taegtmeyer, & Allahim, 2008). Next research on the population of the United States indicated that the number of obese people in the period of 2000-2007. increased from 30.9% to 33.8% (Yoo, Choi, Park, Cheong, & Bae, 2013). According to the data from 2000. about 7% of the world's population is overweighted, while there are 3 times more of those with excessed weight (Kopelman, 2000). The World Health Organization (WHO) estimates that worldwide there is a half of a billion of overweight adults and more than 700 million obese ones.

  Unfortunately, the trend of overweightness and obesity has also been noted at school children. In the general population, the percentage of obese children is alarmingly high, showing the tendency of further expansion especially at the age of puberty, which causes a number of psychological problems and changes at this age (Kopelman, 2000; Lobstein, Baur, & Uauy, 2004). According to the International Working Group on Obesity, Serbia is among the top countries with the rapid increase of obese children in the last ten years. Secondary phenomenon of obesity in children, is caused by skipping meals, eating sandwiches, cakes and drinks high in fat and sugar (Mokdad, Serdula, Dietz, Bowman, Marks, & Koplan, 2000).

  Regular, programmed physical activity, and diet significantly affect the body weight reduction, the change of metabolism and prevent the risk factors associated with obesity. Children who are physically active, about 45-55 min of daily activities, have a normal body weight, compared to children who spend less time on physical activities (18 minutes a day) and spend more time in sedentary mode, finally become obese (Mitić, 2011). Physical activity, to a large extent, helps in the prevention of obesity, especially among the younger school children (Šiljak, 2008; Dietz, & Robinson, 2005; Ilyes, 1992). The positive effect of physical exercise cannot be only seen on body weight and body composition, but also on the cardiovascular system, locomotor system and mental condition of obese persons (Pereira-Lancha, Campos-Ferraz, Lancha, 2012; Sente, 2012; Petrović-Oggiano, Damjanov, Gurinović, Glibetić, 2010; Ševkušić, 2012; Ivković-Lazar, 2005).

  Accordingly, for the purpose of our research, we applied two group fitness programs – step and kick aerobics. The main objective of these exercise programs is the development of aerobic fitness program, physical health, cardiovascular fitness and repairment of the body composition (Bergoč, Zagorc, & Zaletel, 2007; Ossanloo, Zafari, & Najar, 2012). Step aerobics is a form of aerobics, based on ascending and descending from a stepper following the music beat. The program consists of steps, which can be divided into-changing, non-changing and neutral steps. Thanks to this step structure, it is possible, together with a specific methodology, to make a choreography in aerobic mode that is accessible to each individual during the lesson. The program of step aerobics is characterized by moderate volume of work intensity and moderate consumption of energy (Mandarić, 2003; Sekulic, Rausavljević, & Zenić, 2003; Cvetković, 2007; Sibinović, 2016).

  Kick aerobics has its basis in martial arts. Because of its intensity and specific program, it is particularly suitable for students who are keen on martial arts. The main feature of this exercise program is, first, the choreography of arms and legs strokes, and then the exercises of power and agility Tošić-Stojanović, Kostić, & Đorđević, 2011).

  Researches in the area of group fitness programs show their positive impact in the transformation of the morphological status, especially in terms of the reduction of body composition, developing aerobic endurance, as well as their recommendation as a reliable and modern means of physical education classes (Burgess, Grogan, & Burwitz, 2006; Popov, 1995; Mandarić, 2003; Grassi, Turci, & Sforza, 2006; Viskić-Štalec, N., Štalec, J., Katić, Podvorac, & Katović, 2007; Mandarić &, Sibinović, 2012; Mandarić, Sibinović, & Stojiljković, 2011; Santos-Rocha, Oliveira, & Veloso; 2006).

Sibinović, 2016).

The subject of the research is the influence of the classes of the programmed physical exercise in the prevention and treatment of adolescent obesity. The aim of this study was to assess the role of programmed physical exercise in the prevention and treatment of adolescent obesity.

METHODS

In this research, an experimental method, with the initial and final measurement and an experimental factor, was implemented and realized within the programmed exercise classes in „Vožd Karađođe" Elementary school, Leskovac. The subjects were divided in two experimental and one control group. The experimental group (E1) attended programmed physical exercise classes of step aerobics, while the experimental group (E2) attended programmed physical exercises of kick aerobics. The control group (K) attended regular physical education classes (courses of volleyball and athletics), determined by the Curriculum of Physical Education, Ministry of Education, Science and Technological Development of Republic of Serbia. The classes of programmed exercise of step and kick aerobics did not differ in their structure from the regular physical education classes. For the purpose of this research, the choreography of step and kick aerobics was designed. Exercises that were applied in the introductory-preparation part consisted of exercises which aimed to prepare those muscle groups that will be mostly involved in the main part of the class. This part lasted between 8-10 minutes, with the use of the frontal work with the students. The main part of the class was based on the aerobic choreography on the step bench and application of a combination of punches and kicking, martial arts in kick aerobics. This part of the class lasted between 15-20 minutes, in which the female students were continuously active. In addition to the aerobic choreography in the main part of the class, the exercises aimed to strengthen the muscles of the abdominal wall, the back muscles, muscles of the arms and shoulders, muscle abducts and adductors, as well as gluteal region muscles were also conducted. It should be noted that the exercises for two muscle groups were always conducted during one class. In the final part of the class, the stretching exercises of those muscles groups that were most engaged in the main part of the time were applied.

The sample of examinees

The research has been done on the sample of the seventh grade female students (n = 75), in „Vožd Karadjordje" Elementary school, Leskovac, averaged age of 13, divided in three groups. The first experimental group (E1) consisted of 25 students, the second experimental group (E2) also consisted of 25 students, as well as the control group (K).

The sample of variables

From the morphological characteristics the following variables were applied: body height (TV); body weight (BW); a body mass index (BMI); skinfold above the brachi triceps (AKNT); skinfold over brachi biceps (AKNB); skin folds on the back - (subscapular) (AKNL); skin folds on the side - (supraspinal) (ANSUS); skin fold on the lower leg (medial calf) (AKNP). Body composition variables: percentage of fat in the structure of the body composition (TSTma); percentage of muscle in the structure of body composition (TSMma). Functional capabilities variables: "Shuttle 20m-run", multiple-step progressive load at 20m (Shuttle), a test for the evaluation of the relative maximal oxygen consumption (VO2 max).

Statistic data processing

From the field of descriptive statistics, representative central and dispersive parameters were determined: arithmetic mean - M and standard deviation - SD, while from the comparative statistical procedure, in order to determine the existence of a statistically significant difference between the groups in the initial and the final measurement, the univariant analysis was applied (ANOVA) with repeated measurements. To test the difference between the initial and final measurements within a group was used paired T - test, and for comparison of individual groups in the initial and the final measurement a Tukey post hoc test was applied.

RESULTS

Table 1., shows the results of descriptive and comparative statistics in the field of morphological characteristics, concerning the body composition and the functional capacities of the experimental (E1, E2) and the control group.

According to the results of the descriptive statistics, as shown in Table 1., it can be noted that after the 8-week experimental course, all studied variables of morphological and functional aspects in experimental (E1, E2) groups were improved. After the completion of programmed exercise classes, the female students had reduced body mass, decreased body mass index (BMI), reduced percentage of fat in the body composition (TST). On the contrary, it is noticed in the female students of control group (K) improvement in the following morphological variables: body height (TV); skinfold above the brachi triceps (KNT); skin folds on the biceps brachii (KNB), skin fold on the back (KNL), skin folds on the side (KNS), percentage of fat in body composition (TST), percentage of muscle in the body composition (TSM), as well as the better shuttle-run test results.

The female students of the control group (K) results of the T-test indicate that there is a statistically significant difference in the final measurement of the examined variables of morphological characteristics, the body composition and the functional capacities (Table 1.). Statistically significant differences in the following variables are noted: height, body mass index, triceps skinfold over brachii, skin folds on the back, skin fold on the hip, percentage of muscle in body composition with variables from the functional capabilities of the shuttle-run. Accordingly, it can be said that the female students of the control group, on the final measurement, showed increased values for the following variables: body weight, body mass index and reduced the value of the following variables: skinfold over biceps brachii, skinfold at the back and skinfold on the side, skinfold above the shins, percentage of fat in the body composition.

Analyzing the data of all observations, it can be stated that the results of T – test and the level of significance p <0.01 showed statistically significant differences among mean values of the test samples (E1, E2) between the initial and final measurement, in all the variables. This is proved, on the basis of the results of an analysis of variance (ANOVA) with repeated measurements of morphological characteristics, the body composition and the functional capacities (Table 1.). These changes were observed in the following morphological variables: body height, body weight, body mass index, skinfold above the triceps brachii, skinfold over the biceps brachii, skin folds on the back, skin fold on the hip, percentage of fat in the body composition, percentage of muscles in the body. As for the variable from functional capacity – the shuttle run variable that estimates the maximal oxygen consumption, the results of the T-test show, in Table 1., show that there was, in experimental groups, statistically great differences at a level of significance of 0.001.

Table 2., shows the results of an analysis variance (ANOVA) and

Tukey's test of the morphological characteristics of the body composition and the functional capacities of the control (K) and experimental (E1, E2) groups. According to the Tukey's test results and the significant level (p) shown in the Table 2., it was found out that among the examinees there are no statistically significant difference in the variables of the morphological and functional capabilities at the level of statistical significance of 0.05.

Table 3., shows the results of an analysis variance (ANOVA) and Tukey's test of the morphological characteristics, the body composition and the functional ability to test the difference between the control (K) and experimental (E1, E2) group in the final measurement.

According to the final measurement results there is a statistically significant difference between the experimental groups (E1) and the experimental group (E2) in the following variables: body weight,

skinfold over brachi biceps, percentage of fat in the body composition and the shuttle run at the level of 0.05 and 0.01 statistical significance (Table 3.). When the programmed exercise was realized, we observed statistically significant differences between the experimental (E1) group and control (K) group in the following variables: body mass index, skinfold over brachi biceps, skin fold on the hip, percentage of fat in body composition at the level of statistical significance of 0.05 and to 0.01. These results showed that there was no statistically significant difference in the final measurement between the experimental group (E2) and the control group (K) in the morphological area for the following variables: body weight, body mass index, skin folds on the side surface, a percentage of fat in body composition at the level of statistical significance of 0.05.

Table 1. The results of descriptive statistics, an analysis of variance (ANOVA) and T - test of the morphological characteristics of the body composition and the functional capabilities of the control (K) and experimental (E1, E2) groups on the initial and final measurement.

Variable	Group	N	INITIAL MEASUREMENT		FINAL MEASUREMENT		F	P
			M	SD	M	SD		
TV	K	25	161.78	4.94	162.88***	5.02		
	E1	25	162.54	5.80	163.38***	5.87	195.83	< 0.0001***
	E2	25	161.16	5.05	162.42***	5.08		
TM	K	25	57.5	8.4	58.9	8.5		
	E1	25	59.0	9.5	57.9***	8.2	15.44	0.000161***
	E2	25	54.0	8.7	52.4***	7.8		
BMI	K	25	22.0	3.3	23.0**	3.3		
	E1	25	19.87	2.4	19.20	2.1	4.85	0.003476**
	E2	25	20.6	3.0	19.0**	2.1		
KNT	K	25	15.6	5.1	14.6*	4.0		
	E1	25	15.08	6.6	12.19**	4.8	5.01	0.027512**
	E2	25	15.7	4.3	13.10**	4.6		
KNB	K	25	14.14	3.5	14.06	2.41		
	E1	25	10.73	4.25	8.74**	3.18	17.85	<0.0001***
	E2	25	13.94	3.43	13.63*	2.76		
KNL	K	25	15.82	4.40	14.83*	3.75		
	E1	25	17.42	6.79	16.56**	5.56	37.95	<0.0001***
	E2	25	16.96	4.54	15.37**	4.87		
KNS	K	25	19.26	6.98	17.12***	5.02		
	E1	25	16.30	6.64	14.83***	5.47	39.08	<0.0001***
	E2	25	18.29	9.25	13.49***	5.71		
KNP	K	25	18.26	3.82	18.99	2.70		
	E1	25	18.15	6.06	15.23**	4.40	4.72	0.004076**
	E2	25	18.98	3.81	17.81**	3.70		
TST	K	25	25.78	6.7	25.33	6.76		
	E1	25	24.0	5.95	21.20**	5.20	13.12	0.000469***
	E2	25	24.3	6.03	21.58**	5.82		
TSM	K	25	33.54	2.18	34.01*	33.11		
	E1	25	33.92	2.54	34.15*	2.60	28.8	<0.0001***
	E2	25	33.43	2.05	34.00*	2.10		
ŠATL-RAN	K	25	26.26	2.31	29.03***	4.17		
	E1	25	28.50	4.73	30.13***	4.43	47.52	<0.0001***
	E2	25	24.81	3.31	28.11***	4.47		

Statistically significant difference in the level :* $p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Table 2. The results of an analysis variance (ANOVA and) Tukey's Test of morphological characteristics, body composition and functional capabilities for testing the difference between control (K) and experimental (E1,E2) group

Variable	Group	N	M Initial	M Final	F	P
TV	K	25	161.78	162.88		
	E1	25	162.54	163.38	195.83	< 0.0001***
	E2	25	161.16	162.4		
TM	K	25	57.5	58.9		
	E1	25	59.0	57.9	15.44	0.000161***
	E2	25	54.0	52.4		
BMI	K	25	22.0	23.0		
	E1	25	19.87	19.20	4.85	0.003476**
	E2	25	20.6	19.0		
KNT	K	25	15.6	14.6		
	E1	25	15.08	12.19	5.01	0.027512**
	E2	25	15.7	13.10		
KNB	K	25	14.14	14.06		
	E1	25	10.73	8.74	17.85	<0.0001***
	E2	25	13.94	13.63		
KNL	K	25	15.82	14.83		
	E1	25	17.42	16.56	37.95	<0.0001***
	E2	25	16.96	15.37		
KNS	K	25	19.26	17.12		
	E1	25	16.30	14.83	39.08	<0.0001***
	E2	25	18.29	13.49		
KNP	K	25	18.26	18.99		
	E1	25	18.15	15.23	4.72	0.004076**
	E2	25	18.98	17.81		
TST	K	25	25.78	25.33		
	E1	25	24.0	21.20	13.12	0.000469***
	E2	25	24.3	21.58		
TSM	K	25	33.54	34.01		
	E1	25	33.92	34.15	28.8	<0.0001***
	E2	25	33.43	34.00		
ŠATL-RAN	K	25	26.26	29.03		
	E1	25	28.50	30.13	47.52	<0.0001***
	E2	25	24.81	28.11		

Statistically significant difference in the level: * $p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Table 3. The results of an analysis variance (ANOVA) and Tukey's test of morphological features and functional capabilities to test differences between the control (K) and experimental (E1, E2) groups in the final measuring

Variable	MK	ME1	ME2	F	P	T_{E1-E2}	T_{E1-K}	
TV	162.88	163.38	162.42	1.33	0.269177	0.96	0.5	0.4
TM	58.9	57.9	52.4	4.69	0.004229**	5.5*	1	6.5*
BMI	23	19.20	19.0	4.85	0.003476**	0.2	3.8*	4*
KNT	14.6	12.9	13.63	6.16	0.000711	0.2	1.7	1.5
KNB	14.14	8.74	13.63	4.91	0.003230**	4.89*	5.66*	0.51
KNL	14.83	16.56	15.37	3.83	0.012231	1.19	1.73	0.54
KNS	17.12	14.83	13.49	3.76	0.013342*	1.34	2.29*	3.63*
KNP	18.99	15.23	17.81	4.72	0.004076**	2.58	3.76	1.18
TST	25.33	31.20	21.58	4.2	0.007734**	9.62*	5.87*	3.75*
TSM	34.01	34.15	34.00	2.83	0.042487*	0.15	0.14	0.1
ŠATL-RAN	29.03	30.13	28.11	7.82	0.00101***	2.02*	1.1	0.92

Statistically signifficant difference in the level * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

DISCUSSION

When the eight-week experimental program of step and kick aerobics was finished, some important and positive changes in the field of morphological characteristics, the body composition and functional abilities were observed. Since the basic characteristics of the implemented aerobic program is musical accompaniment, such improved results are justified, which is in accordance to the research in this field (Viskić-Štalec, et al., 2007; Mandarić Sibinović, 2012; Mandarić, et al., 2011; Sibinović, 2016).

The research results concerning the variables related to morphological characteristics of the body composition in the experimental groups indicate that the programmed classes selected from the two group fitness programs had a positive effect. So, the results of the body height variable indicate that the programmed physical exercise contributes to the growth and development of the female students of the test sample, despite the impact associated with the acceleration and the effects of puberty, which is in agreement with the results of research in this field (Mandarić, 2003; Sibinović, 2016). The body weight variable at the final measurement on the basis of Tukey's test revealed a significant difference between the experimental groups as well as the experimental group which attended the programmed kick aerobics and the control group. The subjects of the

experimental group, reduced their body weight, and it can be said that the programmed step and kick aerobic classes had an impact on weight loss. The research results can be compared with similar studies which results indicate a reduction in body weight after conducting programmed step and kick aerobic classes and physical education classes (Mandarić, 2003; Sekulić, et al., 2003; Sente, 2012; Sibinović, 2016).

Programmed step and kick aerobic classes, thanks to their aerobic choreography specific content and exercises to develop strength of certain muscle groups applied in the main part of the class, significantly influenced the decrease in the value of the body mass index, skinfold over biceps brachii and skin fold on the hip. It is interesting to point that, the amount of subcutaneous fat decreased in the examined students, and just at the variable skinfold over biceps brachii which usually decreases at the age between 13 and 15. The results of research correspond to the results of other authors who have dealt with this issue (Grego, Luiz, Goncalves, Padovani, 2006; Doder, D., Savić, & Doder, R. 2007; Tošić-Stojanović, Kostić, &, Đorđević, 2011; Aryana, Li, & Bommer, 2012). The smallest reduction of subcutaneous adipose tissue has been observed in triceps skinfold brachii, skinfold tibia, the fold of the skin on the back, which can be connected to a combination of the loss of subcutaneous adipose tissue and by increasing the muscle mass of these variables. Apart to the natural growth and the genetic potential, the changes that have occurred in the morphological characteristics and body composition, may be due to the physical education classes, which thanks to its content can help prevent the appearance of obesity in the examined aged group. The changes dynamics in other parameters of reduction of body weight and skinfold was in line with the involvement of individual body parts or muscle groups in the training (Abe, Kojima, Kearns, Yohena, & Fukuda, 2003; Tosić-Stojanović, et al., 2011).

Of utmost importance is the reduction of the percentage of the body composition fat, in the tested sample, because the amount of body fat is one of the predictors of the metabolic syndrome and other undesirable medical complications. The obtained results are consistent with the studies indicating the importance of programmed physical aerobic activity, the prevention or treatment of metabolic disorders and obesity (Ferrari, 2008; Aryana, & Bommer, (2012). Identified changes in body weight, subcutaneous folds and body mass index BMI, percentage of fat in body composition may be changes that occurred due to the eight-week experimental program, as programmed step and kick aerobic exercise. The obtained results indicate that the programmed physical exercise is an effective means for the prevention of adolescent obesity, so that they can be highly recommended for physical education classes in primary school. Further course of exercise to maintain body weight of the test sample should be directed in aerobic and anaerobic mode in order to stop further weight reduction and the exercise should be focused on the development of cardiorespiratory endurance and muscle hypertrophy. The available literature in our country and worldwide, describe the close connection between the body weight, physical activity and aerobic fitness during childhood and adolescence in the prevention and treatment of obesity (Obradović, Milošević, & Srdić, 2007; Christ, Iannello, Iannello, & Grimm, (2001).

The functional capabilities research results indicate that the experimental program significantly influenced the increase of maximal oxygen consumption. However it should be known that a significant increase of this physical abilities is observed in girls aged 11-13 and boys aged 12-14. The mean value of maximal oxygen consumption for girls aged 10-14 is 32.2 ± 7.7 ml / kg / min (Karila, de Blic, Waernessyckle, Benoist, & Scheinmann, 2001), while examined cardio-

respiratory form for girls aged 11-14 years is 37.9 ± 7.2 ml / kg / min. The similarity between these results and the programmed step and kick exercise classes research can be seen. Comparing the two group fitness programs, statistically significant difference between the step and kick aerobics, which can be justified by the nature of applied content. It should be noted that the obtained results of the research are within the scope of the result in which it was concluded that the step aerobic has the greatest influence on, as it is stated "cardiovascular fitness" and the maximum oxygen consumption (Brick, 1996; Zagorc, Zaletel, & Ipavec, 2000; Ossanloo et al.,, 2012; Pillarella & Roberts, 1996).

CONCLUSION

Based on the data obtained from this research, that were analyzed by special statistic procedures, after the completion of the eight week experimental programmed exercise, it is evident that the step and kick aerobics as exercising programs affected the improvement of most assessed variables, with statistical significance in the morphologic characteristics, the area of body composition and functional abilities in adolescents. Generally, it can be concluded that programmed exercise of step and kick aerobics affect the transforming of the tested area, most important, there was a reduction of body weight, reducing of skin wrinkles, reducing the percentage of fat in body composition, and the improvement of maximal oxygen consumption. Our recommendation is to put them in elemntary school physical education senior grades curriculum, because they proved to be consistent with contemporary trends and interests of adolescents. At the same time the results of the research show that these exercises have positive affect on the motivation of students during the classes, greater intensification of the teaching process compared to traditional physical education classes and give a special contribution in the prevention and treatment of obesity, which represents a contemporary youth disease.

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Correspondence:
Aleksandra Sibinović
Vožd Karadjordje Elementary school in Leskovac,
St. Vidoje Smilevskog 8, 16000 Leskovac, Serbia,
E-mail: sibinovic.aleksandra 1@gmail.com