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The Effects of Step Aerobics on Anthropometric Characteristics Transformation and Body Composition in Young Females

Efectos de los Pasos Aeróbicos Sobre la Transformación de las Características Antropométricas y la Composición Corporal en Mujeres Jóvenes

Omer Spirtovic[1]; Ilma Capric[1]; Mima Stankovic[2]; Dusan Djordjevic[2]; Mejra Corovic[3]; Borko Katanic[1] & Igor Jelaska[4]

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SUMMARY: The aim of this study was to determine the effects 12 weeks Step aerobics program on anthropometric characteristics and body composition in young females. A total of 94 female participants were randomly divided in two groups. The E group subsample consisted of 44 participants (20±0.4 years), who had three Step aerobics program trainings per week and the C group subsample consisted of 50 participants (20±0.6 years), who did not take part in any organized exercise program and only conducted their regular daily activities. The following measurements were used: Body height, body weight, waist size, abdomen skinfold, back skinfold, upper arm skinfold, upper leg skinfold, body fat percentage and muscle mass percentage. Upon the Step aerobics program implementation, there was a body fat reduction by 4.9 % and waist size by 7.7 %, while the muscle mass was increased by 9.4 %. Above mentioned skinfolds showed a reduction ($p>0.05$) at the final measurement compared to the initial one – abdomen by 25 %, upper leg by 23.7 %, back by 15.7 % and upper arm by 3.5 %. Likewise, there was a body fat percentage reduction by 2.1 % and BMI by 6.4 %. Based on the obtained results, we can conclude that the Step aerobics training is efficient in reducing subcutaneous fat tissue and viscelar fat, as well as in increasing muscle mass.

KEY WORDS: Fitness; Recreation; Body composition; Step aerobic; Young women.

INTRODUCTION

Keeping in mind the dangers a sedentary lifestyle has on human health, it seems that physical exercises, especially aerobics, might have an important role in preventing obesity, as well as in increasing the health status on a higher level and maintaining it as such (Permadi, 2019). In numerous medical branches, alongside sports philosophy, body composition assessment is a crucial component of a physiological profile of an athlete (Karaba-Jakovljevic´, 2016). Muscle mass, fat mass, bone mass and other anatomical components are a part of the body composition, which contributes to the total body mass of a person, and could be affected by a training activity, a diet regime, genetics, age and sex as interconnected factors (Stojiljkovic *et al*., 2005). Physical exercise might be a part of a medical or conditioning training, which results in improved physical and mental performances, as well as in critical physiological functions (Dyrstad *et al*., 2019).

Different aerobic programs can be implemented in order to achieve the needed and desired body composition and anthropometric characteristics change (Osei-Tutu & Campagna, 2005) and their realization is possible using specialized facilities, fitness centers to train. One of the main motives for exercising is having the desired looks, that is, getting the desired figure using an adequate training program. Besides walking and running, which are used as aerobic exercises to lose weight and modify body composition, there are different types of exercises followed by music such as steps, jumps, turns, hops and other body movements (Yalcinkaya *et al*., 2020). Programmed exercise can positively affect body composition parameters, either independently or combined with aerobic activities and appropriate diet (Kriketos *et al*., 2000; Yilmaz, 2013; Alves *et al*., 2017). Recreational fitness Step aerobics program, done by group E participants, took place three times per week with the goal of affecting their body composition.

[1] Department of Biomedical Sciences, Study Program of Sport and Physical Education, State University of Novi Pazar, 36300 Novi Pazar, Serbia.
[2] Faculty of Sport and Physical Education, University of Nis, 18000 Nis, Serbia.
[3] Faculty of Medicine, University of Belgrade, 11000 Belgrade, Serbia.
[4] Faculty of Kinesiology, University of Split, 21000 Split, Croatia.

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Rauf *et al*. (2021), concluded that female student strength training had a positive effect, not only on motor skills, but also on body composition. Other authors (Stalec *et al*., 2007; Holmerová *et al*., 2010; Zaletel *et al*., 2013) have also confirmed the effects of this type of training on morphological characteristics transformation and on overall health status of an individual. Waist circumference is now more often used as a useful and quickly measured health screening tool for abdominal obesity because it reflects important health disparities in cardiorespiratory fitness (Barber *et al*., 2014).

The rationality of the study on the effects of step aerobics on the transformation of anthropometric characteristics and body composition in young women lies in investigating the concrete results and the impact of this type of exercise on the body. Hence, our study aim is to determine the effect of a 12-week Step aerobics program on anthropometric characteristics and body composition in young females. This study was designed to provide clear guidelines and recommendations for practicing Step aerobics in order to achieve the desired results.

MATERIAL AND METHOD

Participants sample. A total of 94 female participants were randomly divided in two groups. The experimental group subsample (E) was firstly consisted of 50 participants, but due to the illness and lack of training and motivation, a total of 6 participants dropped out of the experiment. Hence, a total of 44 participants (20±0.4 years) were included for the E group subsample. During the 12 week period, participants realized three Step aerobics program trainings (including music) per week, they were on their usual diet and did not suffer from any chronical diseases, nor had any disturbances of the locomotor system which could have limited their motion range during the trainings. The control group subsample (C) consisted of 50 participants (20±0.6 years) continued their everyday activities during this experiment, did not take part in any organized exercise program, and only conducted their regular daily activities. The ethical committee of State University of Novi Pazar gave consent to this research experiment (Ethics Committee Approval: 340/23).

Procedures. The aerobics exercise effects on anthropometric characteristics and body composition were studied based on the way the training had on voluminousness and body mass, thickness of skinfolds, body fat percentage and muscle mass percentage. Hence, the following measurements were used: body height (BH), body weight (BW), waist size (WS), skinfold abdomen (SA), skinfold back (SB), skinfold upper arm (SUA), skinfold upper leg (SUL), body fat percentage (BF%) and muscle mass percentage (MM%). Anthropomertic measuring was conducted using standardized instruments defined by the International Biological Program (IBP) (Katzmarzyk *et al*., 2011). BW in (kg), BF% and MM% were calculated using bioelectrical impedance device TANITA UM-72 (Body Composition Monitor, Tanita Cor, Tokio, Japan) (Vasold *et al*., 2019), which had already been used elsewhere (Mustedanagic *et al*., 2016; Bratic *et al*., 2022). Skinfolds were measured using Harpenden skinfold caliper (Naz *et al*., 2017). The Martin anthropometer was used for BH, while WS was determined by a centimeter measuring tape. For BMI, the standardized procedure was implemented based on the formula BMI = body weight [kg] / body height [m^2]. After the initial measuring, a 12-week training program was implemented, followed by the final measuring in order to determine the achieved training results. During the testing, the air temperature in the room was between 23 °C and 26 °C, and both the initial and final measuring started at 10am and was completed by 1pm in order to exclude daily measurement variations.

Training protocol. Step aerobics program was conducted in 12 weeks, 3x per week, for 60 min each session. During that time, 36 training sessions were realized in total, which were realized at the State University of Novi Pazar gymnasium. Each training consisted of introductory-preparatory period, with the intensity of heart frequency from 122 to 135 beats per minute, main period with the pulse range from 121 to 160 beats per minute and the final cooling down period. The optimal intensity was calculated based on the maximal frequency of the heart beats (220 – participants' age). For monitoring heart frequency during the physical activities, Polar V800 was used and it proved to be a valid and reliable measure instrument (Caminal *et al*., 2018). The participants participated voluntarily and all pedagogical and physiological principles were respected during the program. The training program was designed in such a way where, during the first month easier exercises with lighter loads were applied. That was followed by gradually increased loads for more complex exercises in order to achieve the training effect.

As presented in Table I, in the introductory-preparatory part, which made 10 % of the total training duration, different cyclic machines were used and dynamic stretching was implemented in order to prepare and warm up the body. To realize the first part of the main training section, which made 55 % of the total training duration, the stepper was used and all the activities were followed by the fast rhythm music. The second part of the main section took up 25 % of the total training duration and it consisted of various arm and shoulder strengthening exercises, core exercises, as well as back and leg strengthening exercises. The final 10 % of the training was for relaxing exercises, which had the aim to calm the organism down, and for the

Table I. The strength and aerobic training basic characteristic.

Training structure	Duration (60 min)	Activity
Introductory-preparatory part	10 %	1. Cyclic machines; 2. Dynamic stretching exercises.
Main part	55 %	1. Basic step; 2. Over the top; 3. "V" step; 4. "A" step; 5. "L" step; 6. Mambo; 7. Knee up; 8. Lunge.
	25 %	1. 10x3 arm strengthening exercises (push ups); 2. 10x3 elastic band back strengthening exercises; 3. 15x3 core strengthening exercises (trunk elevations); 4. 10x3 leg strengthening exercises (squats, lunges); 5. 60s plank; 6. 60s side plank; 7. 60s “superman”.
Final part	10 %	1. Stretching; 2. Muscle-relaxing exercises.

stretching exercises emphasizing the spine stretching, muscle relaxing and returning the vital body functions to their primary level.

Statistical analysis. The data was analyzed using SPSS v25. Firstly, the following parameters of descriptive statistics were observed: Arithmetic mean, standard deviation, asymmetry coefficient, flatness coefficient and range, with separate display of the control and the experimental group at both the initial and the final measurements. The normality test was used, as too many groups would have caused incomprehensibility and test results inconsistency. For determining differences significance in the average scores of both groups, t-test was used for the independent samples, alongside Levene’s test of equality of variances, to determine the possible variance. With the t-test results, average scores and their 95% confidence interval were given. The t-test for dependent samples was used to determine the differences in average scores at the initial and final measuring. With the t-test results, average scores and their 95% confidence interval were given.

RESULTS

The sample does not include any participant with the BH (Min=156 cm; Max=177 cm) and BW (Min=40.6; Max=73) extreme values and due to the small relevant deviation between the initial and the final measuring of the minimal and maximal scores in each group, those values were left out. Table II shows descriptive statistics values for both groups from both measures.

The descriptive statistics, together with the above mentioned, confirm the sample representativeness. Namely, there are no significant differences among variables between the average values of the initial measuring of the experimental and the control group, making every later significant difference affected by the treatment the participants took part in. This conclusion will be further confirmed. There are no extreme values in the variability measures values – standard deviation and range, which is another confirmation that there are no extreme values.

The skewness and kurtosis values, excluding few cases, show approximately normal variables distribution and are confirmed via normality test. This conclusion, along with the previously mentioned, confirms applicability and reliablity of the results obtained (Table III).

The average BW ($t=-1.620$; $p=0.126>0.05$) and BMI values ($t=-1.673$; $p=0.115>0.05$) showed non significant changes. Even though the BW had non significant improvements, we can conclude that the physical state of the participants, represented by the given values, did not improve. The average values of the other variables showed significant increases ($-2.442\geq t\geq -4.334$; $p\leq 0.027<0.05$). The average MM % value was significantly reduced at the final measuring ($t=4.568$; $p=0.000<0.05$).

In addition, we will confirm significant efficiency of the program by confirming the improvements of the physical characteristics of the E group participants at the final measuring compared to the initial one (Table IV).

Table II. Descriptive statistics values for both groups from the initial and the final measuring.

Variable	Group	Mean		St.Dev.		Skew.		Kurt.		Range	
		Ini	Fin	Ini	Fin	Ini	Fin	Ini	Fin	Ini	Fin
BH (cm)	**C**	168.875		5.841		-0.345		-0.464		20	
	E	168.125		6.490		-0.400		-0.700		21	
BW (kg)	**C**	57.675	59.131	8.569	8.482	0.092	-0.136	-1.214	-0.853	25.4	28.2
	E	56.956	53.488	6.889	6.982	-0.438	-0.420	-0.774	-1.133	22.6	22.0
BF%	**C**	21.625	22.619	4.208	4.431	-1.849	-1.379	2.818	2.745	14	18.8
	E	21.775	19.006	4.344	4.032	-1.544	-1.355	2.040	1.285	15.4	13.6
MM%	**C**	43,375	42.688	5,045	4.976	0,913	0.929	-0,080	-0.097	17	17
	E	43,150	45.194	5,087	5.174	0,898	0.986	0,013	0.318	17	17.5
WS	**C**	71.750	72.250	4.837	4.958	-0.270	-0.242	-0.645	-1.001	16	15
	E	71.813	68.525	5.049	4.693	-0.450	-0.821	-0.156	0.016	18	16.5
SUA	**C**	11.313	11.719	6.444	6.371	0.028	0.091	-1.781	-1.697	16.5	17.5
	E	11.906	9.394	6.406	5.437	0.084	0.173	-1.734	-1.761	17	14
SA	**C**	15.812	16.200	6.167	6.141	1.166	1.204	0.576	0.573	20	19.4
	E	15.581	12.506	6.117	5.483	1.226	1.124	0.651	0.311	20	17.5
SB	**C**	11.219	11.781	4.246	4.159	0.482	0.492	1.436	0.863	17	16
	E	11.450	9.000	4.615	3.715	0.702	0.837	1.677	1.468	18.5	14.5
SUL	**C**	20.188	20.812	6.221	6.207	-0.226	-0.252	-0.117	-0.303	22	21.6
	E	19.400	16.687	6.135	5.385	-0.224	-0.092	-0.135	0.031	21.7	19
BMI	**C**	20.462	20.945	2.863	2.586	0.244	0.441	-0.354	0.193	9.83	9.13
	E	20.119	18.876	1.917	1.840	0.285	-0.023	1.044	0.366	7.61	7.17

Legend: E-experimental group, C-control group, St.Dev.-standard deviation, Skew-skewness, Kurt-kurtosis, BH-body height, BW-body weight, WS-waist size, SA-skinfold abdomen, SB-skinfold back, SUA-skinfold upper arm, SUL-skinfold upper leg, BF%-body fat percentage, MM%-muscle mass percentage, BMI-body mass index, Ini-Initial measurement, Fin-Final measurement.

Table III. Average control group scores at initial and final measuring comparison.

Variable (Ini – Fin)	t_15	p	Differences mean	95% CI for Differences mean	
				Lower	Upper
BW (kg)	-1.620	0.126	-1.456	-3.373	0.460
BF%	-2.926	0.010*	-0.994	-1.718	-0.270
MM%	4.568	0.000**	0.688	0.367	1.008
WS	-2.449	0.027*	-0.500	-0.935	-0.065
SUA	-2.784	0.014*	-0.406	-0.717	-0.095
SA	-4.013	0.001**	-0.388	-0.593	-0.182
SB	-4.137	0.001**	-0.562	-0.852	-0.273
SUL	-4.334	0.001**	-0.625	-0.932	-0.318
BMI	-1.673	0.115*	-0.483	-1.099	0.132

Legend: BW-body weight, BF%-body fat percentage, MM%-muscle mass percentage, WS-waist size, SUA-skinfold upper arm, SA-skinfold abdomen, SB-skinfold back, SUL-skinfold upper leg, BMI-body mass index, Ini-Initial measurement, Fin-Final measurement, t_15-effect size, p-statistical significance (*p<0,05; **p<0,01)

Table IV. Average experimental group values at initial and final measuring comparison.

Variable (Ini – Fin)	t_15	p	Differences mean	95% CI for Differences mean	
				Lower	Upper
BW (kg)	8.508	0.000**	3.469	2.600	4.338
BF%	8.072	0.000**	2.769	2.038	3.500
MM%	-14.104	0.000**	-2.043	-2.353	-1.735
WS	12.127	0.000**	3.288	2.707	3.865
SUA	6.589	0.000**	2.512	1.700	3.325
SA	14.556	0.000**	3.075	2.625	3.525
SB	7.980	0.000**	2.450	1.796	3.104
SUL	8.154	0.000**	2.712	2.003	3.421
BMI	8.255	0.000**	1.244	0.923	1.565

Legend: BW-body weight, BF%-body fat percentage, MM%-muscle mass percentage, WS-waist size, SUA-skinfold upper arm, SA-skinfold abdomen, SB-skinfold back, SUL-skinfold upper leg, BMI-body mass index, Ini-Initial measurement, Fin-Final measurement, t_15-effect size, p-statistical significance (**p<0,01)

The program resulted in a significant average values reduction of all the variables (t≥6.589; *p*=0,000<0.05), apart from the MM % which showed a significant increase (t=-14.401; *p*=0,000<0.05). T-values were notably higher than in the C group, and p-values were asymptotically equal to zero, emphasizing that the achieved changes influenced by the program were greatly intensive. Therefore, the program proved to be highly efficient, especially compared to the standard training regime, showing the following changes: BW (–2.1 %), BF % (-4.9 %), MM % (9.4 %), WS (7.7 %), SUA (-3.5 %), SA (-25.8 %), SB (-15.7 %), SUL (-23.7) and BMI (-6.4 %).

DISCUSSION

Our study aim was to determine the effects 12-week Step aerobics program on anthropometric characteristics and body composition in young females. This study shows that the applied training program had a positive effect on all the variables. After the Step aerobics program had been finalized, E group showed body mass reduction by -2,1 % and a significant muscle mass increase by 9,4 % at the final measuring compared to the initial.

These results are consistent with the Pantelic *et al*. (2013), who have also presented the clear image of the three months effect the aerobic dancing on body composition in young females. The final measuring of the above mentioned research indicates the BW reduction by 3,7 % and MM % increase by 2,4 % compared to the initial measuring. According to Stiegler & Cunliffe (2006), there is a relationship between aerobic activity and overall BW decrease. BW declines during an aerobic endurance training program, although lean mass values remain constant or increased, whereas waist circumference fell by 7.7 % (Zouhal *et al*., 2020; Bratic *et al*., 2022). When comparing both the initial and final measurements, there is a significant decrease (p0.05) in the SA (-25.8 %), SB (-15.7 %) and SUL (-23.7 %). BF % and BMI was reduced by 4.9 % and 6.4 %, respectively. This type of training is consisted of complex encompassed workouts for the entire body and especially targeted the muscles of the abdominal wall and back, thus it most likely caused a change in waist circumference, owing to the reduction of adipose tissue. The findings of the study by Ryzková *et al*. (2017), show that a six week endurance and strength training program increased the physical fitness, particularly in the trunk muscles. Many authors have demonstrated that the favorable influence of planned exercise on body composition yielded comparable results (Stojiljkovic *et al*., 2010; Ljubojevic *et al*., 2014; Bjelica, 2020). Hrgetic *et al*. (2016) have also demonstrated significant changes in body composition occurred in women after a three month training period.

As a result, it is possible to advocate using adequate strength exercises as part of an aerobics program to enhance muscle mass (Pantelic *et al*., 2013; Spirtovic *et al*., 2023). The facts cited should highlight the significance of this workout program's influence on the body composition of women who utilize fitness programs with music, which can undoubtedly have a favorable effect on their aesthetic appearance and, more importantly, on their health level. Given that the Step aerobics program produced significant results, it can be recommended to people who want to improve their aesthetic appearance, regulate their weight and body composition through fitness activities, which is one of the prerequisites for living a healthier life.

To get meaningful insight into the overall effectiveness of aerobics endurance training, future research should record any changes in daily non-exercise activity and calorie consumption. Some of the study's flaws include: 1) dropout rate of the E group participants; 2) a lack of techniques for monitoring non-exercise activities; and 3) a failure to employ energy intake recall devices. However, it should be highlighted that inventories based on energy intake recall might be deceptive and provide erroneous data.

CONCLUSION

After analyzing the results of studies on the effects of Step aerobics on the transformation of anthropometric characteristics and body composition in young women, we can draw several conclusions. First, Step aerobics can lead to a decrease in body mass and an increase in muscle mass in young women. This can result in improved body composition and increased overall fitness levels. Step aerobics can also have a positive effect on cardiovascular health and increase endurance. However, it is important to note that individual factors such as exercise regularity, diet and genetics can affect results. Further research is needed to better understand the long-term effects of Step aerobics on body transformation in young women.

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RESUMEN: El objetivo de este estudio fue determinar los efectos de un programa aeróbico Step de 12 semanas sobre las características antropométricas y la composición corporal en mujeres jóvenes. Un total de 94 mujeres participantes fueron divididas aleatoriamente en dos grupos. La submuestra del grupo E estuvo compuesta por 44 participantes (20 ± 0,4 años), que realizaron tres entrenamientos del programa aeróbico Step por semana y la submuestra del grupo C estuvo compuesta por 50 participantes (20 ±

0,6 años), que no participaron en ningún programa de ejercicio organizado y sólo realizaron sus actividades diarias habituales. Se utilizaron las siguientes mediciones: altura corporal, peso corporal, tamaño de cintura, pliegue cutáneo del abdomen, pliegue cutáneo de la espalda, pliegue cutáneo de la parte superior del brazo, pliegue cutáneo de la parte superior de la pierna, porcentaje de grasa corporal y porcentaje de masa muscular. Al implementar el programa aeróbico Step, hubo una reducción de la grasa corporal de un 4,9 % y del tamaño de la cintura de un 7,7 %, mientras que la masa muscular aumentó un 9,4 %. Los pliegues cutáneos mencionados anteriormente mostraron una reducción ($p>0,05$) en la medición final en comparación con la inicial: abdomen en un 25 %, parte superior de la pierna en un 23,7 %, espalda en un 15,7 % y parte superior del brazo en un 3,5 %. Asimismo, hubo una reducción del porcentaje de grasa corporal del 2,1 % y del IMC del 6,4 %. Con base en los resultados obtenidos, podemos concluir que el entrenamiento aeróbico Step es eficaz para reducir el tejido adiposo subcutáneo y la grasa visceral, así como para aumentar la masa muscular.

PALABRAS CLAVE: Aptitud física; Recreación; Composición corporal; Paso aeróbico; Mujer joven.

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Corresponding author:
Mima Stankovic, MSc
University of Nis
Faculty of Sport and Physical Education
Nis
SERBIA

E-mail: mima.stankovic974@gmail.com