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THE EFFECTS OF A RECREATIONAL AEROBIC EXERCISE MODEL ON THE FUNCTIONAL ABILITIES OF WOMEN

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Abstract. *This research included 59 women aged 22 to 25, 29 of which made up the experimental group, and 30 the control group. The effects of a recreational aerobic exercise model on the indicators of functional abilities were studied. The experimental model of the recreational aerobic exercise model was realized three times a week, over a period of three months, and the duration of each individual exercise was 60 minutes. The duration of the aerobic part was 35 minutes. The functional abilities were evaluated by means of the following parameters: (1) resting heart rate (the number of heart beats per minute); (2) systolic blood pressure (mmHg); (3) diastolic blood pressure (mmHg); (4) absolute oxygen uptake (l/min); (5) relative oxygen uptake (ml/kg/min). The basic descriptive statistic parameters were calculated for all of the results, and the difference between the initial and final measuring was determined by a canonical-discriminant analysis. The multivariate analysis of covariance (MANCOVA) and the univariate analysis of covariance (ANCOVA) were used to determine the achieved effects of the exercise. A statistically significant difference was found to exist between the initial and final measuring in regards to the applied variables for the evaluation of functional abilities of the subjects belonging to the experimental group, while there were no statistically significant differences found in the case of the subjects belonging to the control group. The results from the final measuring also indicated that the realized recreational aerobic exercise model had a positive effect on the functional abilities of the female subjects belonging to the experimental group (p= .00). This research supports the existing conclusions about the positive effects of recreational aerobic exercise, on the condition that it is realized with the appropriate intensity, length and duration.*

Key words: *aerobic exercise, functional abilities, recreation, women*

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1. INTRODUCTION

Due to the high degree of automatization, modern man is experiencing a high degree of inactivity which is becoming an increasingly significant factor in the appearance of a great number of illnesses. In these current living conditions where technological development has directed man's activities from physical to intellectual labor, modern man is increasingly susceptible to a sedentary lifestyle. This brings about a decrease in physical activity, and thus leads to the endangerment of the health and normal functioning of organs and systems of organs (Hollmnan, 1992; Hollman & Hettinger, 2000; Weineck, 2000). The threat to the health of sedentary individuals is conditioned by a decrease in the functioning of the locomotor, cardio-vascular, and respiratory system, as well as other organs and systems of organs. Physical inactivity and a sedentary lifestyle have a very negative effect on almost all of the systems of the human body, and especially on cardiovascular functions (Fentem, 1992). The decrease in the functional abilities of the human body in the modern world, the development of hypertension and obesity are just some of the problems which can be solved by regular physical activity (Mišigoj-Duraković et al., 1999).

Fitness centers offer a variety of aerobic exercises to music as part of their exercise programs, in the form of various organized physical activities. What is characteristic about this kind of exercise is that all of the participants in the aerobic exercise program exercise to the same rhythm and to the same tempo, and thus activate muscles of various parts of the body.

Taking part in recreational activities, or to be more precise in systematic physical exercise, enhances the harmonious functioning of all organs and systems of organs, and influences the preservation of functional abilities of the cardio-vascular, respiratory, endocrine, locomotor and nervous systems. In addition, physical activities which are performed during exercise have a positive effect on the decrease of arterial blood pressure and hypertension (Hagberg, Montain, Martin et al., 1989; Đurašković, 2002).

On the basis of the research carried out by various authors, the positive influence of aerobic physical activities on functional abilities, body composition, and the muscle strength of man in the sense of a qualitative improvement, has been proven beyond a doubt (Đurašković, Vučković and Lukić, 1992; Paton, Graves, Pollock et al., 1996; Ashutosh, Methrotra & Fragale-Jackson, 1997; Mišigoj-Duraković et al., 1999; Schmidt, Biwer & Kalscheuer, 2001; Kramer et al., 2001; Chambliss, 2005; Kostić, Đurašković, Miletić and Mikalački, 2006).

Thompson, Goodroe, Johnson, and Lambert (1991) have studied the changes to VO2max, heart rate frequency, systolic arterial blood pressure, diastolic arterial blood pressure and the accumulation of lactates in the blood under the influence of two different aerobic dance programs. One group only realized the aerobic dance program, while the other, in addition to the aerobic dance program, also took up upper body strength exercises using weights of around 0,5 kg. The subjects who did aerobic dance with weights achieved better results, but there were no differences in the values for heart rate frequency, arterial blood pressure and lactate between the two groups.

Kostić and Zagorc (2005) compared the effects of two Hi/Lo aerobic models on the cardiovascular fitness of women. The subjects for this research were 29 women aged 25 to 30, who were divided into two experimental groups. The aerobic dance program for the first group was realized over a period of eight weeks, three times a week for a period of 50 minutes. The second experimental group also exercised for eight weeks, but this time five times a week, for a period of 35 minutes. The intensity of the exercise was the same for both groups and ranged from 60% to 75% of the maximum heart rate frequency. The evaluation of cardio-vascular fitness was carried out by means of the following variables: resting heart rate, heart rate under strain, systolic and diastolic arterial blood pressure and absolute and relative oxygen uptake. The results of the research indicated that overall statistically significant differences between the two groups existed in the initial and final measuring and that the variables: resting heart rate and relative oxygen uptake were the greatest contributors to the difference. It was concluded that the effects of both aerobic dance models on cardio-vascular fitness were positive, if the exercise is realized continuously over a longer period of time (three times a week, for 50 minutes), or if the exercise takes place five times a week for 35 minutes.

When the intensity of the load is optimum, the structural or functional adaptation of the organs of the person who is exercising, which are under strain, can lead to an improved tolerance to load. Many of the reactions to load, as well as the body's adaptation to them, are both caused by activities which are appropriate for the abilities of the subject, who experiences an improvement in his general health and the functional capacity of his body (Kohrt et al., 1991).

On the basis of the recommendations of various authors, the exercise program should consist of interval or continual exercise with an intensity of 50% for beginners up to as much as 80% of maximal oxygen uptake or heart rate frequency for the more advanced. The exercise should occur with a frequency of at least three times a week for a period of 30 to 40 minutes. This kind of exercise brings about maximal oxygen uptake, heart volume, maximal minute heart volume, or in a word, the general improvement of the body (Astrand, 1999).

The American College of Sports Medicine (ACSM), recommends that all those who would like to maintain and improve their cardio-respiratory abilities should exercise three to five times a week with the use of rhythmic, aerobic activities which activate large muscle groups in the human body (walking, running, bike riding, using a stationary bike, aerobic dance, etc.). The intensity of the exercise should be from 55/65% to 90% of the maximal heart rate frequency, and the duration of the exercise should be from 20 to 60 minutes. If the intensity of the exercise is smaller than the recommended maximum heart rate frequency values, the duration of the exercise should be increased.

In addition to aerobic exercise, one should also include exercises for the development of stamina, mobility and strength, at least twice a week, which would maintain a body mass without fat, improve muscle strength and stamina and preserve their functions. All this is made possible through an extended participation in regular physical activity and a lifestyle of higher quality (Blair, LaMonte, & Nichaman, 2004).

The aim of the research was to study and determine the effects of the recreational aerobic exercise program to music on the functional abilities of the women who took part in the program. The results should answer the question whether the aerobic exercise program could contribute to the improvement of the functional abilities of women.

2. Methods

Sample of subjects

The population from which the sample for the research was obtained was defined as a population of women aged 22 to 25. The sample of subjects which took part in the experiment consisted of 59 subjects, 29 of which made up the experimental group (E), and 30 the control group (K). The sample of subjects consisted of female students from various departments of the University of Niš (all except the Faculty of Sport and Physical Education of Niš). The subjects of the experimental group who took part in the regular recreational aerobic exercise program gave their informed consent and attended the workouts regularly. During the realization of the experiment they did not participate in any organized physical activities. The subjects of the control group, apart from their everyday activities, did not take part in any organized physical exercise.

Sample of variables

For the purposes of this research, the following parameters were used in order to evaluate the functional abilities: (1) resting heart rate (PULSR) (number of heart beats per minute); (2) systolic arterial blood pressure (SISTP) (mmHg); (3) diastolic arterial blood pressure (DIAP) (mmHg); (4) absolute (maximum) oxygen uptake presented in l/min (AVOU); (5) relative oxygen uptake presented in ml/kg/min (RVOU). The maximal value of oxygen uptake is determined by an indirect method on the bicycle ergometer (Živanić, Životić-Vanović, Mijić and Dragojević, 1999). The relative oxygen uptake was calculated by multiplying the value of oxygen uptake (VO2max) by 1000, and then dividing it by the body weight of the subject. The value of the relative oxygen uptake was expressed in ml/kg/min (Jovanović and Radovanović, 2003).

The experimental model of aerobic exercise

The experimental treatment primarily had as its aim to improve the functional abilities of the subjects of the experimental group (E). During the realization of the aerobic exercise model, all of the physiological and pedagogical principles of exercise were followed. The structure of the workout had all of the characteristics of the Hi/Lo aerobic exercise to music. Every part of the workout was realized to a different tempo, or in other words, the tempo changed according to the phase of the workout.

The characteristics of the model are presented in Table 1.

Table 1. The characteristics of the aerobic exercise model

The overall number of exercises during the experimental program	35
The number of exercises per week	3
The intensity of the exercise	60% - 80% HRmax
The number of weeks	12
The duration of every individual class	60 min
The duration of the aerobic part of the class	35 min
The structure of the individual exercise class	- the introductory part (warm-up) - the main part - the closing (relaxation)

The introductory part (the warm-up) lasted for 10 minutes. The tempo of the music during this part of the workout was from 120 up to 135 beats per minute (Brick, 1996). The exercises used in this part of the workout had as their aim to prepare the joints and large muscle groups for the aerobic part of the workout. Apart from running and stepping in place and movement, simple choreographies were realized, consisting of basic movement structures (steps) for a duration of 20 blocks (1 block = four eights, or in other words, 32 movements).

The main part lasted for 40 minutes. It consisted of two special parts which included: a) an aerobic part and b) exercises for body strength.

The aerobic part lasted for 35 minutes (Zagorc, Zalatel and Ižanc, 1998). The tempo of the music was from 135 up to 155 beats per minute. In this part of the workout, choreographies which consisted of various movements of the hands and feet were used. The popular international names which are usually used for this kind of exercise were used here as the names for the steps. The choreographies consisted of the following steps: march (walk), step touch, dubble step touch, side to side, leg curl, dubble leg curl, knee up, dubble knee up, grapevine, mambo, cha-cha-cha, V step, squat. During the workout, the choreographies also contained various combinations of steps with hand motions and body motions so as to increase the intensity of the exercise. In addition, there were combinations with jumps and more intensive hands and body motions. During the very realization of the workout, the subjects who could not follow the choreography and adapt to the group exercise would continue to march and/or run in place (to the tempo of the music) up until the moment when they were once again able to adjust their movements to the movements of the group. The aim was to prevent the subjects from ending their activity. During the aerobic part of the workout, the pulse of the subjects should have ranged from 121 up to 161 beats per minute. The optimal intensity of the load was calculated on the basis of the maximal frequency of the pulse, following the formula devised by Jovanović (1999), Fc/max = 226 – years of age, and that difference was multiplied by 60% and 80%. Each subject individually monitored her own heart rate frequency by counting her heart beats at 10 second intervals, and then by multiplying that number by 6. If the heart rate frequency reached values higher than 161, the subjects would not stop exercising, but would cease their hand motions or would continue marching or running in place (which has an effect on the intensity of the exercise). What should be mentioned is that the heart rate frequency was not supposed to exceed the calculated values during any phase of the workout.

Body strength exercises. The duration of this part of the workout was 5 minutes. During its realization, series of exercises used to strengthen the muscles of the intestinal wall, the muscles of the back, the muscles of the arms and the shoulder belt, the abductor muscles, and the adductor muscles, and the muscles of the gluteal region were realized. The exercises were performed without a passive break. Each exercise was repeated 10 to 15 times, and depending on the content of the aerobic part, 10 to 12 exercises were performed.

The closing part of the workout (relaxation) lasted for 10 minutes. This part of the workout consisted of relaxation exercises and stretching exercises performed with the aim of calming the body. In this part of the workout, static stretching exercises were realized. The final positions in each exercise were held for 20 to 30 seconds. During the realization of the stretching exercises, the subjects paid special attention to their breathing, and the very execution of the exercises was accompanied by quiet music of a slow tempo.

The data processing method

All of the analyses were performed by means of a statistical package for data processing, Statistica 6.0. All of the basic parameters of descriptive statistics were calculated for all of the results: means, minimal value, maximal value, range, standard deviation. In order to determine the differences between the initial and final measuring of the subjects of the experimental (E) and control group (K), a canonical-discriminant analysis was performed. The variables which gave the greatest contribution to the differences between these two measurings were determined. The multivariate analysis of covariance (MANCOVA) and the univariate analysis of covariance (ANCOVA) were used to determine of the existing effects of the exercise which came as a consequence of the influence of the experimental program at the final measuring. The condition for the application of these analyses was to neutralize (unify) the differences between the groups at the initial measuring.

3. RESULTS

The basic descriptive statistical parameters are shown in Table 2 and Table 3.

Table 2. The basic statistic parameters of the functional abilities of the experimental group (E) at the initial and final measuring

Variables		Mean	Min	Max	Range	StdDev
SISTP	Initial	122.59	110.0	134.0	24.0	8.020
	Final	119.62	106.0	132.0	26.0	7.585
DIAP	Initial	79.90	65.0	94.0	29.0	7.384
	Final	75.52	60.0	86.0	26.0	6.993
PULSR	Initial	73.34	64.0	84.0	20.0	4.842
	Final	69.90	58.0	80.0	22.0	5.122
AVOU	Initial	2.32	1.8	3.1	1.3	0.321
	Final	2.47	2.0	3.2	1.2	0.324
RVOU	Initial	38.18	33.3	43.4	10.1	2.689
	Final	41.47	37.5	45.8	8.3	2.139

Legend:
SISTP – systolic arterial blood pressure, DIAP – diastolic arterial blood pressure, PULSR – resting heart rate frequency, AVOU – absolute value of maximal oxygen uptake, RVOU – relative value of maximal oxygen uptake, Mean – means, Min – minimal value, Max – maximal value, Range – range, StdDev – standard deviation.

The results shown in Table 2 indicate the basic descriptive parameters at the initial and final measuring of the subjects from the experimental group (E). During the interval of the variational width (range), there are fewer than six standard deviations, so it can be concluded that a reduced sensitivity of the applied variables exists. The differences between the initial and final measuring in the numeric sense can be noticed for all of the variables. What can be concluded is that at the final measuring, in comparison to the initial one, the following parameters were reduced: resting heart rate frequency (73,34 beats per minute at the initial measuring, compared to 69,90 beats per minute at the final one) and arterial blood pressure, both systolic and diastolic (122,59 mmHg compared to 119,62 mmHg, and 79,90 mmHg compared to 75,52 mmHg). In the case of the absolute and relative oxygen uptake variables, a numeric increase between the initial and final measuring of 0,15 l/min in the absolute values and 3,29 ml/kg/min for the values for relative oxygen uptake were noted. These results were probably the consequence of the applied model of aerobic exercise, or to be more precise, physical activity on functional abilities.

The determined values of the basic descriptive parameters of the applied variables of the functional abilities of the subjects of the control group (K) at the initial and final measuring are shown in Table 3.

Table 3. The basic descriptive statistic parameters of the functional abilities of the control group at the initial and final measuring

Variables		Mean	Min	Max	Range	StdDev
SISTP	Initial	118.50	95.0	135.0	40.0	9.024
	Final	120.33	105.0	135.0	30.0	7.503
DIAP	Initial	76.07	65.0	90.0	25.0	6.838
	Final	76.47	68.0	90.0	22.0	5.686
PULSR	Initial	72.70	60.0	82.0	22.0	5.478
	Final	71.90	60.0	80.0	20.0	4.715
AVOU	Initial	2.35	1.7	2.8	1.1	0.292
	Final	2.30	1.8	2.8	1.0	0.266
RVOU	Initial	38.90	33.8	43.2	9.4	2.503
	Final	38.26	33.9	43.3	9.4	2.840

Legend:
SISTP – systolic arterial blood pressure, DIAP – diastolic arterial blood pressure, PULSR – resting heart rate frequency, AVOU – absolute value of maximal oxygen uptake, RVOU – relative value of maximal oxygen uptake, Mean – means, Min – minimal value, Max – maximal value, Range – range, StdDev – standard deviation.

By studying the results of the functional abilities of the control group (K) at the initial and final measuring (Table 3), it can be concluded that the values of the central and dispersion parameters indicate that during the interval from the minimal to the maximal results, fewer than six standard deviations can be found, and it can, therefore, be concluded that a decrease in the sensitivity of the applied variables has taken place.

The subjects of the control group (K) showed numerically smaller values of systolic and diastolic arterial blood pressure and resting heart rate frequency at the initial measuring in comparison to the subjects of the experimental group (E) (118,50 mmHg compared to 122,59 mmHg – systolic arterial blood pressure, and 76,07 mmHg compared to 77,90 mmHg in the values of diastolic arterial blood pressure and 72,7 o/min compared to 73,3 o/min for the values of resting heart rate frequency). The values of absolute (maximal) oxygen uptake and the values of relative oxygen uptake at the initial measuring of the subjects of the control group (K) are numerically greater than those of the experimental group (E). The results of the applied variables of the subjects of the K group at the final measuring indicate that an increase in arterial blood pressure (systolic and diastolic), but a decrease in resting heart rate frequency has taken place. The values of the absolute and relative oxygen uptake are lower at the final measuring in comparison to the initial one in the case of the subjects of the K group, which can be interpreted as one of the consequences on not moving. As the subjects of the control group did not take part in any organized form of physical exercise, it is clear that their functional abilities also decreased at the final measuring in comparison to the initial one.

In order to determine the quantitative difference between the initial and final measuring for each group, a canonical discriminant analysis was used.

The differences between the initial and final measuring in regards to the indicators of functional abilities of the E and K groups are shown in Table 4. The canonical-discriminant analysis between the initial and final measuring in the case of the subjects of the E group indicated that a significant discriminant function exists, which is significant and high and is explained by a 70% (Canonical R = .70). The discriminative strength of the variables which is presented by means of the test (Wilks') is high (.550) and indicates the differences between the initial and final measuring. This confirms the existence of a quantitative difference between the initial and final measuring in the case of the subjects of the E group. The experimental exercise model influenced the changes to functional abilities, which can be concluded from the existence of a significant discriminant function, which is at the .01 level of significance (p-level = .000).

In the case of the subjects of the K group, the results of the canonical-discriminant analysis have indicated that the differences between the initial and final measuring are low and of no significance and that within the entire system of applied variables, no statistically significant difference exists (p-level = .735). Taking into consideration the fact that no statistically significant differences were found in the applied variables between the initial and final measuring in the case of the subjects of the K group, it is not necessary to further present the canonical-discriminant functions.

Table 4. The significance of the isolated discriminant function

	Eigen	Canonicl R	Wilks'	Chi-Sqr.	df	p-level
E	0.982	0.70	0. 550	36.589	5	0.000
K	0.051	0.29	0. 351	2.772	5	0.735

Legend:
Eigen – the square of the determinance coefficient (represents the common variance factors which enable the differentiation of the groups on the basis of the function (discriminatory variable)), Canonical R – the coefficient of the canononical correlation (represents the maximal correlation between the linear function of the predictor variables and the linear function of the variables which signify group membership), Wilks' – Test of Wilks' lambda, Chi-Sqr – Bartlett's H ^{2} test, df – the degree of freedom, p-level – the level of significance.

Table 5. The factor structure of the isolated discriminant function of the subjects of the E group

Variables	Root 1
SISTP	-0.31
DIAP	-0.20
PULSR	-0.24
AVOU	0.36
RVOU	0.69

Table 5 shows the factor structure of the isolated discriminant function of the variables for the evaluation of the functional abilities of the experimental group (E). The greatest contribution to the discriminant function in the case of the subjects of the experimental group is made by the variables of the relative oxygen uptake (RVOU = .69) and absolute (maximal) oxygen uptake (AVOU = .36), a then by the variable of systolic blood pressure (SISTP = -.31), resting heart rate frequency (PULSR = -.24) and diastolic arterial blood pressure (DIAP = -.20).

Table 6 shows the centroids of the groups, which are considered to be the means at the initial and final measuring of the subjects of the E group. In the case of the subjects of the experimental group, the results indicate that their discrimination (separation) is high and significant and ranges from -0.97 to 0.97.

Table 6. The centroids of the subjects of the E group

	Root 1
G_1:1	-0.97
G_2:2	0.97

Table 7. The precision of the result classification for the subjects of the E group

	Percent	G_1:1	G_2:2
G_1:1	79.31	23	6
G_2:2	93.10	2	27
Total	86.21	25	33

The success rate for the separation of the initial and final measuring in the case of the applied variables for the evaluation of the functional abilities of the subjects of the E group has been shown in the form of percentiles of the groups (Table 7), and indicates that the explanation for the performed discrimination (separation) has been carried out with a precision of 86, 21%, or to be more precise, 86% of the subjects have experienced a change in their results between the initial and final measuring.

In order to determine the realized effects of the exercise, which have occurred under the influence of the experimental recreational aerobic exercise model, a multivariate analysis of covariance (MANCOVA) has been carried out. The condition for the use of the multivariate analysis of covariance was to neutralize (unify) the differences between the groups at the initial measuring. The differences that exist between the groups at the univariate level with a neutralization of the differences at the initial measuring have been determined with the help of a univariate analysis of covariance (ANCOVA). By studying the results of the multivariate analysis of covariance at the final measuring (Table 8), it can be concluded that a statistically significant difference between the groups does exist at the level of significance of .01 ($p = .000$). The noted difference occurs under the influence of the applied aerobic exercise model, and so it is possible to conclude that the realized program does have a statistically significant effect on the quantitative changes to functional abilities in the case of the subjects of the experimental group.

Table 8. The multivariate analysis of covariance between the experimental and control group at the final measuring

Wilks	Rao's R	df 1	df 2	p
0.305	21.86	5	48	0.000

Legend:
Wilks' – test of Wilks' lambda, Rao's R – Rao's F approximation, df – degree of freedom, p – level of significance.

The results of the univariate analysis of covariance of the applied variables of the functional abilities between the subjects of the experimental (E) and the control group

(K) at the final measuring, with a neutralization and the partialization of the results from the initial measuring, are shown in Table 9. By studying the results, it can be concluded that a statistically significant difference exists in the case of all the applied variables at the .01 level of significance (SISTP p = .000; DIAP p = .002; PULSR p = .000; AVOU p = .000; RVOU p = .000).

Table 9. The univariate analysis of covariance between the experimental and control group at the final measuring

Variables		Initial	Final	F	p
SISTP	Experimental Control	122.59 118.50	119.62 120.33	28.64	.000
DIAP	Experimental Control	79.90 76.07	75.52 76.47	10.98	.002
PULSR	Experimental Control	73.34 72.70	69.90 71.90	33.51	.000
AVOU	Experimental Control	2.32 2.35	2.47 2.30	17.35	.000
RVOU	Experimental Control	38.18 38.90	41.47 38.26	52.44	.000

4. Discussion

On the basis of the performed analysis, it can be concluded that statistically significant differences do exist in the functional abilities between the initial and final measuring in the case of the subjects of the experimental group. The greatest differences between the initial and final measuring have been noted for absolute oxygen uptake, relative oxygen uptake, resting heart rate frequency and systolic arterial blood pressure (all of them p<.01), while somewhat smaller differences have been noted in the case of diastolic arterial blood pressure (p< .05).

Eickhoff, Thorland and Ansorage (1983) studied the effects of aerobic dance on the physiological and psychological changes in the case of 29 women. The experimental workout lasted for 50 minutes. The subjects of the experimental group exercised for 10 weeks, with three weekly workouts. The effects of the exercise were positive and statistically significant for the physiological changes, primarily in the case of women who in the beginning were classified as belonging to the group requiring a lower level of cardio-vascular fitness.

Schmidt, Biwer & Kalscheuer (2001) studied the extent to which three different models influenced an improvement to VO2max and weight loss, over a period of 12 weeks. The research encompassed four groups: three experimental groups which exercises following different programs and a fourth which was not included in the system of organized exercise. The subjects exercised three to five times a week with a load of 75% of their maximum heart rate frequency. After the realized exercise programs, the results indicated that the VO2max had increased significantly, while body mass, the body mass index, the thickness of the skin folds, and volumes had decreased in the case of those subjects who had exercised. The measured values for the control group (the group which did not exercise), had not decreased.

Ashutosh, Methrota & Fragale-Jackson (1997) studied the effects of aerobic exercise with and without difficult exercises, on permanent weight loss and cardio-respiratory fitness in the case of obese women. The study lasted for 12 months, and 31 women participated, aged 42, 8 years on average. The results of the research have shown that all of the subjects from all of the groups experienced weight loss, but that only the groups which had realized aerobic exercise actually experienced an improvement in aerobic ability.

Dowdy, Cureton, DuVal & Ouzts (1985, according to Kostić, 1999) studied the effects of aerobic dance on physical work capacity, cardio-respiratory function and body build on a sample of 28 women aged 25 to 44. The authors concluded that aerobic dance performed for a duration of 35 to 45 minutes, three times a week, for a period of 10 weeks, significantly improved the work capacity (VO2max) and cardio-vascular functions in the case of subjects who used it (from 5% to 7%).

Wilmore & Costill (1999), during the course of their research, came to the conclusion that the appropriate training increases maximal aerobic strength (maximal oxygen uptake, VO2max) from 10% to 20%, as well as the time needed to perform at a sub maximal level, especially in the case of healthier people who live a "sedentary" lifestyle, including men and women of all ages.

Kostić and Zagorc (2005) compared the effects of two Hi/Lo aerobic exercise models on the cardio-vascular fitness of women. The aerobic program for the first group was realized over a period of 8 weeks, three times a week, with the workout lasting 50 minutes. The second group also exercised for a period of 8 weeks, but 5 times a week, and the workout lasted only for 35 minutes. The intensity of the exercise was the same for both groups, and ranged from 60% to 75% of the maximal heart rate frequency. The results of the research have indicated that overall, statistically significant differences between the groups for the initial and final measuring did exist and that the resting pulse and relative oxygen uptake were the variables that contributed to it the most.

Clearly, Moffatt & Knutzen (1984) studied the effects of two and three days of aerobic dance program exercise performed weekly with a maximal oxygen uptake (VO2max) on a sample of 18 students. The subjects that exercised three times a week increased their VO2max by 10%, while the subjects who exercised twice a week did not increase their VO2max values significantly. The results of this research indicate that aerobic dance classes should be used at least three times a week so that the VO2max would increase in the subjects who use it.

Grant, Corbett, Davies, Aichison, Mutrie, Byrne, Henderson and Dargie (2002) compared the obtained effects of two different aerobic exercise models on the functional abilities of women (the exercise models consisted of aerobic dance and walking). The results of the research have indicated that the aerobic dance program had a better effect on VO2max and maximal heart rate frequency than the walking program.

In the abovementioned research, significant positive changes at the final measuring, in comparison to the initial one, occurred under the influence of the various aerobic exercise models. In our research, certain positive, statistically significant changes to VO2max took place, both in the absolute and the relative values in the case of the subjects of the experimental group. Even though the values of VO2max are within the normal range of values for the studied sample (Heyward, 2006), a significant increase in the numerical values at the final measuring, in comparison to the initial one, occurred. The results of the measuring of the realized model of recreational aerobic exercise indicated a positive effect of the exercise on the functional abilities of the subjects who used it in the sense of a qualitative increase. The increase of 8, 6% for the values of relative oxygen uptake (from 38, 18 to 40, 47 ml/kg/min) and 6, 5% for the values of relative oxygen uptake (from 2, 32 to 2, 47 l/min) clearly indicate an improvement in the functioning of the cardio-vascular system and an increase in the overall oxygen uptake at the cell level in the case of the subjects of the experimental group. The results of the research are another confirmation of the positive influence of aerobic exercise on the increase of cardio-vascular abilities, if certain rules are applied during the course of the realization of the aerobic exercise.

Whelton, Chin, Xin and He (2002) studied how physical activity is connected to the decrease in arterial blood pressure. The analysis of random control tests was carried out in order to determine the effects of aerobic exercise on arterial blood pressure. The authors have concluded that aerobic exercise is connected to a significant decrease in systolic and diastolic arterial blood pressure (on average, 3, 84 mmHg for systolic blood pressure and 2, 58 mmHg for diastolic blood pressure). The decrease in blood pressure is connected to aerobic exercise, in the case of participants with hypertension and normotension and participants with excessive and normal weight.

Živković (2005) studied the effects of the regular forms of recreational activities of women aged 19 to 25. The exercise program consisted of 45 lessons, which lasted for 60 minutes. The changes that occurred in the functional ability parameters were expressed at the $p< .01$ and $p< .05$ level of significance. Statistically significant changes were noted for diastolic arterial blood pressure ($p = .032$), while systolic blood pressure experienced no statistically significant changes. Numeric changes occurred for all of the studied variables.

Kokkinos et al. (1995) studied the effects of regular exercise on blood pressure in the case of African-Americans with mild hypertension. The exercise program lasted for 16 weeks, and the intensity of the exercise ranged from 60% to 80% of the maximal heart rate frequency. After the completion of the program, the authors concluded that the diastolic arterial blood pressure had decreased in a statistically significant manner ($p = .002$) for 5 mmHg, while there was no statistical significance to systolic blood pressure, a decrease in the numeric values did occur.

Kingwell and Jennings (1993) studied the effects of non-pharmacological therapy (physical activity) on arterial blood pressure. The experimental program lasted for four weeks. The research was based on three groups which exercised with various intensity (the first group – one hour of walking at 50% of the previously determined maximal work capacity, five times a week (low intensity workout); the second group – 15 minutes of biking at 80% to 90% of the maximal work capacity (high intensity) five times a week; and the third group – three 30-minute biking sessions per week at 65% to 70% of the maximal work capacity (moderate intensity). The authors concluded that the moderate intensity biking lead to a greatest decrease in blood pressure, by 5/3 mmHg (systolic/diastolic), and that smaller changes were noted in the case of the subjects who realized a low intensity walking exercise (3/2 mmHg; systolic/diastolic). The high intensity biking did not lead to any significant changes to the blood pressure. The influence of the exercises on blood pressure varied according to the intensity and duration of individual workouts.

The applied recreational aerobic exercise program has a positive effect on arterial blood pressure, which can be noted in the decrease of both systolic and diastolic blood pressure. The systolic and diastolic blood pressures of the subjects of the E group have lower values at the final measuring in comparison to the initial one, which in this case means better values (119,62 mmHg compared to 122,59 mmHg; 75,52 mmHg compared to 79,90 mmHg). The results of the research have indicated a relatively small, but statistically significant (p = .000; p = .002) change to arterial blood pressure (by 2,5% in the case of systolic and 5% in the case of diastolic blood pressure) in the case of the experimental group in comparison to the control one. The results that were obtained in this manner are similar to the results in the aforementioned research. The changes that occurred in arterial blood pressure are probably the result of the realized aerobic exercise model, which influenced an increase to the elasticity of the blood vessels.

Đurašković, Vučković and Lukić (1992) studied the changes of anthropometric characteristics and physiological-functional abilities of 105 women aged 20 to 49, which continually took part in recreational exercise. The program was realized twice a week with an exercise intensity of 60% to 80% of the maximal heart rate frequency. The authors monitored the changes to 11 variables. After the end of the program, the authors came to the conclusion that the resting heart rate frequency was significantly smaller and that the level of the achieved load was greater in the case of women who took part in recreational activities in relation to the women who did not.

Tomljanović, Sekulić and Čular (1999) studied the differences to some anthropological characteristics, functional and motor abilities between the people who took part in fitness programs and those who did not. The subjects were divided into two groups: the first experimental group (n = 92) which numbered 43 students, and a second, control group, whose members did not exercise in fitness centers (n = 122). Statistically significant differences were obtained for the following variables: body weight, resting heart rate frequency, pulse frequency under strain, and were in favor of those male and female students who exercised in fitness canters.

Kraemer et al. (2001) studied the physiological changes which occur after workouts with a load and bench-step aerobics. The direct evaluation of body composition, aerobic fitness, muscle strength and stamina was carried out one week before the beginning of the research and after a 12-week exercise program. The results showed that the VO2max had improved significantly. In addition, the heart rate frequency decreased significantly in relation to the results from before the exercise program (8 to 9 beats per minute). The authors concluded that the bench-step aerobic model was an efficient means of increasing the physical fitness of women.

Stein, Ehsani, Domitrovich, Kleigher and Rottman (1999) studied the influence of training on the variability of heart rate frequency in the case of normal elderly people. The group that underwent training consisted of 16 subjects (7 men, and 9 women), as did the control group. The variability of heart rate frequency was determined before and after a 12-week exercise period, during which the exercise program consisted of three months of stretching exercises and nine months of aerobic exercise for five hours a week, with an average of 70% of maximal oxygen uptake. The results indicated that the resting heart rate frequency had significantly decreased in the case of the E group (from 67±6 to 63±5 beats per minute). There were no changes to heart rate frequency in the case of the control group. The authors concluded that the training increased the overall variability of heart rate frequency in normal elderly people.

Mandarić (2001) studied the effects of programmed exercise to music on 95 students. The experimental program lasted for eight weeks, and the participants exercised three times a week for a period of 45 minutes. Three groups participated in the experiment: E1, which had classes of aerobic exercise according to the step-aerobic model, E2, which had dance aerobic classes (high-low) and K, the control group, whose members attended physical education classes. Resting heart rate frequency, heart rate frequency under strain and VO2max were the variables used to evaluate functional abilities. The research showed a statistically significant difference in the results of functional abilities from the initial and final measuring in the case of the experimental groups.

Tulppo et al. (2003) studied the effects of moderate and very intense aerobic training on the speed at which the heart beats. The subjects were divided into groups with moderate training (n = 20), very intense training (n = 20) and a control group (n = 15). After an eight-week training period, which included exercises four times a week with an intensity of 70% to 80% of the maximal heart rate frequency for a duration of 30 minutes per exercise for the group with moderate training, and 60 minutes per exercise for the group with intense training, the authors concluded that the average heart rate frequency decreased from 70±7 to 64±8 beats per minute and from 67±5 to 60±6 beats per minute ($p< .001$ in both cases) in the case of the group with moderate training and the group with intense training respectively. In the case of subjects with a job that requires a sedentary lifestyle, aerobic exercise led to a change in the autonomous regulation of heart rate frequency in the direction of a vagal dominance.

In the above mentioned research, the changes to heart rate frequency took place under the influence of the realized recreational exercise programs. Changes in the sense of a decrease in resting heart rate frequency in the case of the subjects of the experimental group were also noted in our research, from 73,34 to 69,90 beats per minute, and they are statistically significant ($p = .000$). The effects of the applied aerobic exercise model on resting heart rate frequency can best be seen on the example of its decrease by around 5%. It can be concluded that the influence of the realized recreational aerobic exercise model led to a more economical heart functioning after its realization.

In order to get a clearer picture of the influence of the aerobic exercise program, it is necessary to study the results of the multivariate and univariate analysis of covariance. For all of the applied variables, at the final measuring significant differences were found to exist between the experimental and control group at the level of significance of .01. The noted statistically significant differences occurred under the influence of the applied recreational aerobic exercise model, performed to music, on the basis of which it can be concluded that the applied exercise model did have a positive effect on the transformation of the functional abilities of the subjects of the experimental group.

5. Conclusion

The research has confirmed that statistically significant changes to the area of functional abilities of the studied sample did take place, following the realization of the cited model of recreational aerobic exercise program performed to music. The exercise model is realized in the zone of a heart rate frequency of 60% to 80% of the maximal frequency of the heart rhythm, which is recommended for the realization of aerobic activities. Statistically significant changes were noted for all of the applied variables: resting pulse, systolic and diastolic arterial blood pressure, absolute oxygen uptake and relative oxygen uptake. The realized recreational aerobic exercise model, performed to music can be recommended for use in everyday activities in fitness clubs. In addition, it can serve as a basis for the development of new aerobic programs aimed at the future.

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EFEKTI MODELA REKREATIVNOG AEROBNOG VEŽBANJA NA FUNKCIONALNE SPOSOBNOSTI ŽENA

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Istraživanjem je obuhvaćeno 59 žena hronološke starosti 22 do 25 godina, od kojih je 29 ispitanica činilo eksperimentalnu grupu, a 30 ispitanica kontrolnu. Istraživani su efekti modela rekreativnog aerobnog vežbanja na pokazatelje funkcionalnih sposobnosti. Eksperimentalni model rekreativnog aerobnog vežbanja realizovan je tri puta nedeljno, u trajanju od tri meseca, a dužina trajanja pojedinačnog vežbanja iznosila je 60 minuta. Trajanje aerobnog dela iznosilo je 35 minuta. Funkcionalne sposobnosti su procenjivanje sledećim parametrima: (1) puls u miru (broj otkucaja u minuti); (2) sistolni arterijski krvni pritisak (mmHg); (3) dijastolni arterijski krvni pritisak (mmHg); (4) apsoluta potrošnja kiseonika (l/min); (5) relativna potrošnja kisoenika (ml/kg/min). Za sve rezultate izračunati su osnovni parametri deskriptivne statistike, a za utvrđivanje razlika između inicijalnog i finalnog merenja primenjena je kanonička diskriminaciona analiza. Multivarijantna analiza kovarijanse (MANKOVA) i univarijantna naliza kovarijanse (ANKOVA) upotrebljena je za utvrđivanje ostvarenih efekata vežbanja. Između inicijlanog i finalnog merenja utvrđena je statistički značajna razlika kod primenjenih varijabli za procenu funkcionalnih sposobnosti kod ispitanica eksperimentalne grupe, dok kod ispitanica kontrolne grupe nije postojala statistički značajna razlika. Rezultati na finalnom merenju su takođe, pokazali da je realizovani model rekreativnog aerobnog vežbanja imao pozitivne efekte na funkcionalne sposobnosti ispitanica eksperimentalne grupe (p= .000). Ovo istraživanje je potvrdilo postojeće zaključke o pozitivnim efektima rekreativnog aerobnog vežbanja ukoliko se ono realizuje odgovarajućim intenzitetom, vremenom i trajanjem.

Ključne reči: *aerobno vežbanje, funkcionalne sposobnosti, rekreacija*