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Original empirical article

THE EFFECTS OF A PHYSICAL ACTIVITY PROGRAM ON THE VOLUME AND SUBCUTANEOUS FATTY TISSUE AMONG PEOPLE WHO SUFFERED MYOCARDIAL INFARCTIONS

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Abstract. *Our research included 60 male subjects aged 50 to 60, 30 of which made up the experimental group, and the remaining 30 made up the control group. We studied the effects of a physical activity program on the changes in volume and the subcutaneous fatty tissue of individuals who had suffered myocardial infarctions (MI). The experimental physical activity program was realized over a period of 21 days, and the activities were divided into three parts: 1) gymnastics exercises, 2) walking along health trails and 3) riding on a bicycle ergometer. The overall duration of each daily exercise session was 45 minutes at the beginning and 60 minutes at the end of the program. Ten variables were included in the research, which covered the area of voluminosity and subcutaneous fatty tissue. We calculated the basic descriptive parameters, and in order to determine the differences between the groups at the initial and final measuring and the differences between the initial and final measuring of each group, we used the t-test. We used a multivaraite and univariate analysis of covariance (MANCOVA/ANCOVA) to determine the actual effects of the physical activity. The level of statistical significance was 0.05. All of the statistical analyses were calculated with the help of the Statistica 6.0 statistics package. The results from the final measuring have indicated that the realized physical acitivity program had a positive effect on the changes in the volume and subcutaneous fatty tissue of the subjects in the experimental group, or in other words, that it led to changes in body mass (p= .000), average thorax volume (p= .003), abdomen volume (p= .000), thigh volume (p= .021), abdominal skin folds (p= .032) and thigh skin folds (p= .003). Our research confirmed the positive effects of the program of physical activity on changes in volume and subcutaneous fatty tissue in the sense that it led to their decrease among people who had suffered myocardial infarctions.*

Key words: *physical activity, myocardial infarction, voluminosity, subcutaneous fatty tissue*

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INTRODUCTION

In today's day and age man lives and works in conditions which have significantly changed his natural need to move, while his life has been significantly influenced by the development of technology. Anxiety, hypertension and obesity are just some of the negative consequences which the modern way of life has brought, and which lead to problems in the functioning of certain organs or systems of organs, in the sense that they lead to a decrease in their functional capacity (Livengood, Caspersen, Koplan, & Blair, 1993). Research has shown that inadequate physical activity is the main health problem of any nation and that it leads to an increase in the risk of cardiovascular disease, as well as other chronic illnesses such as diabetes, obesity, hypertension and the like (Blair & Brodney, 1999; Warburton, Gledhill, & Quinney, 2001; Taylor, et al., 2004). Cardiovascular diseases are at the very top of the scale of modern day diseases and the leading cause of death in most developed countries. On the basis of the data found in various studies conducted in industrially developed countries, heart disease and coronary disease are the cause of anywhere from one third to one half of all fatalities; among them, the myocardial infarction is the leading cause of death (Ostojić et al., 2002). Based on the data from of the World Health Organization (taken from Ostojić et al., 2002) just in 1999 a total of 17 million people worldwide died of cardiovascular disease.

The external factors which affect man can to a great extent be responsible for the changes in the way our systems of organs function in a positive sense, and can also influence changes in certain anthropological characteristics. When it comes to reducing the risk of cardiovascular disease, controlled physical activity, as an external factor, plays a very important part (Hu, Stampfer, Solomon, Liu, Colditz, Speizer, Willet, & Manson, 2001). The need to rehabilitate individuals who have suffered myocardial infarctions is increasing not only due to the rate with which the disease is spreading, but also because of the very course the illness can take, as it significantly diminishes one's work capacity and even leads to disability over time (Balady et al., 2000).

Physical exercise programs are one of the most important rehabilitation methods for people who have suffered from myocardial infarctions, and are in fact the basis of myocardial rehabilitation today (Kavanagh, 2000). The need for physical activity is especially prominent in cases of individuals who have been diagnosed with myocardial infarctions (Wannamethee, Shaper, Walker, & 2000; Jolliffe, Rees, Taylor et al., 2001).

Before allowing someone to embark on a program of physical activity, it is important to carefully consider an entire set of factors related to this individual. Certain authors cite that physical activity should be initiated relatively soon after the myocardial infarction **(**Pedersen & Saltin, 2006). It would be necessary to take the following characteristics into consideration: age, gender, prior physical activity, motivation for participating in the physical activity program, the state of the locomotor apparatus, and especially the remaining functions of the cardiovascular system (Nedeljković, Kanjuh, & Vukotić, 2002) as well as the intensity and extent of the load so that the exercise could have a positive effect. The main effect of physical exercise on people with a myocardial infarction has to do with an improvement in arterial function, while the main aim behind their rehabilitation, considering the fact that these people are usually also suffering from other disorders and illnesses, is to prevent or decrease immobility. In order to recognize the positive effects of exercise, it is necessary to compile an exercise program based on the characteristics of each individual in turn, so that the process would lead to an improvement in cardiovascular abilities and changes to anthropometric characteristics and body composition.

A certain number of authors have studied the changes in voluminosity and subcutaneous fatty tissue caused by different physical exercise programs, among people with myocardial infarctions.

Savage, Brochu, Poehlman, & Ades (2003) proved in their research that with the help of certain exercise programs, it was possible to reduce body mass and waist volume. Kostić, Đurašković, Miletić, & Mikalački (2006) have shown that physical exercise can help reduce back skin folds and abdominal skin folds among women.

Similar results have been found in the work by O'Donovan, Owen, Bird, Kearney, Nevill, Jones, & Woolf-May (2005) who have studied the changes in cardio-respiratory fitness, risk factors and the anthropometric characteristics of people with heart disease. Their program lasted for a period of 24 weeks and included exercises of varying intensity but with the same amount of energy consumption. The sample of subjects consisted of 64 men, 42 of which completed the experiment (14 subjects from the group with moderate intensity exercises – 60% of VO2 max; 13 subjects from the group with high intensity exercises - 80% of V02 max and 15 from the control group, who did not exercise at all). The results have shown a decrease in waist volume among the subjects of the groups that did exercise (the group with moderate intensity exercises 95±14 cm as compared to 96±15 cm; the group with high intensity exercises to 92±9 cm as compared to 94±9 cm). An increase was found among the subjects of the control group. The authors have concluded that greater exercise effects were achieved by the subjects who used high intensity exercises in relation to those who used moderate intensity exercises.

Mertens, Kavanagh, Campbell, & Shephard (1998) studied whether low intensity exercise for people in the post-myocardial infarction period was enough to reduce their body mass and subcutaneous fatty tissue. Following the completion of the experiment, the authors concluded that the planning of the rehabilitation program for people who had suffered myocardial infarctions should include, it addition to exercise, natural forms of movement (primarily walking), that the intensity of the exercise should be low and that the physical activity should be realized over a longer period of time (to a great extent).

Volek, Gomez, Love, Weyers, Hesslink Jr., Wise, & Kraemer (2002) have shown that physical exercise should lead to a decrease in body weight and changes in body build, or in other words, that it should have a positive effect on people in a post-myocardial infraction period, primarily men rather than women.

The aim of our research was to study and determine the effects of a physical exercise program on the changes in volume and subcutaneous fatty tissue among men who had suffered a myocardial infraction. The results should provide the answer to the question of whether the realized program of physical exercise could lead to changes in the voluminosity and subcutaneous fatty tissue of these people.

METHOD

Participants

The population from which the sample was extracted was defined as the population of men aged 50 to 60, who have suffered from a myocardial infraction three or four months prior to the onset of the study. The sample of subjects who were included in the experimental program number 30 subjects who made up the experimental group (E, n=30) and who took part in the experimental program of physical exercise, and 30

subjects who made up the control group (C, n=30), and who were not involved in any organized form of physical activity (Table 1).

Table 1. Basic characteristic experimental (E) and control (C) group

	E		C	
	Mean	SD	Mean	SD
AGE	56.71	2.86	56.47	50.00
BODHI	171.92	7.25	171.55	161.50
BODWE	80.61	10.70	84.41	63.60

Legend: *Mean - means, SD - standard deviation, AGE - years, BODHI -body hight, BODWE - body weight*

Instruments

For the purpose of this research, all the measurements were carried out in accordance with the method of the International Biological Program (IBP) (Weiner & Lourie, 1981).

- **To evaluate body voluminosity:** average thorax volume, abdominal volume, upper arm volume, upper leg volume and lower leg volume.
- **To evaluate subcutaneous fatty tissue:** abdominal skin folds, back skin folds, upper arm skin folds, upper leg skin folds, and lower leg skin folds.

The experimental program of physical activity

The aim of the experimental physical activity program was to induce changes to the variables for the evaluation of volume and subcutaneous fatty tissue. The physical exercise program lasted 21 days, and the daily physical exercise sessions were divided into three parts: 1) gymnastic exercises, 2) walking on health trails and 3) riding the bicycle ergometer. The overall duration of the daily exercise sessions was 45 minutes at the beginning and 60 minutes at the end of the experiment. The duration of the gymnastics segment was 20 minutes at the beginning of the program (the first and second week), and the duration increased to 25 minutes at the end of the program (the third week). The overall number of exercises ranged from 23 at the beginning to 30 at the end of the exercise program, while the number of reps for each exercise was 5 to 10. The tempo was moderate.

The borderline values on the basis of which we dosed the load during the realization of the program were 55% to 70% of the maximum heart rate frequency noted during the subjects' load response test, and according to the guidelines set by various authors (Franklin, 1998; Quell, Porcari, Franklin, Foster, Andreuzzi & Anthony, 2002; Duncan et al., 2004; Newton, Mutrie, & McCarthur, 1991; Lazović, Devečerski, Lazović, & Živković, 2006). The upper and lower limits of the heart rate frequency were calculated with the help of the formula provided by Vučković & Mikalački (1999) and Mikalački (2005). The characteristics of the program are shown in Table 2.

Table 2. The experimental program of physical activity

		Gymnastic exercises	Walking	Bicycle-ergometer
Week I	Overall duration of individual PA	20 minutes	15 minutes	10 minutes
	Intensity of the PA	55-70% MHF	55 - 70% MHF	55 - 70% MHF
	Tempo (steps/min)	-	70 - 80	-
	Speed (km/h)	-	2,5 - 3,0	-
	Number of rest intervals	-	2	1
	Speed of pedal turning (number/min)	-	-	50
Week II	Overall duration of individual PA	20 minutes	15 minutes	10 minutes
	Intensity of the PA	55 - 70% MHF	55 - 70% MHF	55 - 70% MHF
	Tempo (steps/min)	-	70 - 80	-
	Speed (km/h)	-	2,5 - 3,0	-
	Number of rest intervals	-	2	1
	Speed of pedal turning (number/min)	-	-	50 - 60
Week III	Overall duration of individual PA	25 minutes	20 minutes	15 minutes
	Intensity of the PA	55-70% MHF	55 - 70% MHF	55 - 70% MHF
	Tempo (steps/min)	-	80 - 100	-
	Speed (km/h)	-	3,5 - 4,0	-
	Number of rest intervals	-	3	2
	Speed of pedal turning (number/min)	-	-	60

Legend: PA - physical activity; MHF - maximum heart rate frequency noted during the subjects' load response test on the bicycle ergometer

Procedure

The data were processed with the help of a statistics package Statistica 6.0. We calculated the basic descriptive parameters for all the results: the means and standard deviation. In order to determine the differences between the initial and final measuring of the subjects of the experimental and control group, and between the groups at the initial and final measuring, we used the t-test. The multivariate analysis of covariance (MANCOVA) and the univariate analysis of covariance (ANCOVA) were used to determine any effects that the physical exercise program might have had on the results of the final measuring. The necessary precondition for the further use of these analyses was to neutralize (make equal) the differences between the groups at the initial measuring. Following the completion of the result neutralization, we determined the real effects of the experimental program of physical activity on the relevant group of subjects. The intergroup differences at the univariate level were determined with the help of the adjusted means (Adj. Means), while at the same time we were able to test the differences with the help of the *F*-test. The statistical significance level was 0.05.

RESULTS

The results of our research are shown in the following tables (Table 3, 4 and 5). Table 3 shows the basic statistical parameters of volume and subcutaneous fatty tissue of the subjects in the experimental (E) and control group (C) at the initial and final measuring and the differences between the groups found at the two measurings.

Table 3. The basic statistic parameters and t-test for voluminosity and subcutaneous fatt tissue for the experimental (E) and control (C) group (E) at the initial and final measuring

	Initial				Final			
	E	C			E	C		
	Mean (SD)	Mean (SD)	t	p	Mean (SD)	Mean (SD)	t	p
THVOL	102.87±7.32	105.36±8.48			100.46±6.87	105.03±8.82		
ABVOL	98.13±7.73	101.17±9.96	1.32	NS	95.25±7.42	01.07±10.17	-2.53	**0.014****
UAVOL	30.83±2.81	31.31±3.40	0.59	NS	29.43±2.81	30.74±2.99	-1.75	NS
ULVOL	53.44±5.15	53.20±4.47	0.38	NS	50.24±4.82	52.97±4.58	-2.44	**0.018****
LLVOL	36.34±2.96	37.53±2.90	1.27	NS	36.73±2.46	37.30±3.21	-1.08	NS
ABDSF	30.16±9.41	27.47±6.20	1.08	NS	23.30±7.78	26.31±8.31	-1.45	NS
BACSF	20.84±8.30	22.64±9.04	0.80	NS	19.24±8.24	21.81±8.07	-1.22	NS
UARSF	15.48±6.08	14.11±5.64	0.90	NS	12.90±4.42	12.54±3.98	0.33	NS
ULESF	14.83±7.25	13.51±5.40	0.72	NS	10.87±4.64	11.04±4.81	-0.13	NS
LLESF	9.50±4.26	7.81±2.61	1.89	NS	9.18±3.69	7.76±2.96	1.58	NS

Legend: Mean - means, SD - standard deviation, THVOL - average thorax volume, ABVOL - abdominal volume, UAVOL - upper arm volume, ULVOL - thigh volume, LLVOL - lower leg volume, ABDSF - abdominal skin fold, BACSF - back skin fold, UARSF - upper arm skin fold, ULESF - thigh skin fold, LLESF - lower leg skin fold, NS - not significance, p – the level of significance, **p< .05

Upon analyzing the results shown in Table 3, we can conclude that no statistically significant difference (NS) can be found for any of the variables used to evaluate voluminosity and subcutaneous fatty tissue between the experimental (E) and control (C) group at the initial measuring. At the initial measuring, in the area of voluminosity and subcutaneous fatty tissue, the subjects from the experimental group showed numerically lower values for most of the variables, except for the abdominal skin fold, upper arm skin fold, thigh skin fold and lower leg skin fold variables. Lower values for these variables were also noted for the subjects in the control group. On the basis of everything that we have stated, we can conclude that the subjects in the experimental and control group had approximately the same volume values and subcutaneous fatty tissue values at the initial measuring.

The results from the final measuring between the subjects from the experimental and control group (Table 3) indicate that there is a intergroup statistically significant difference for the THVOL – average thorax volume, abdomen volume, and thigh volume variables at the .05 level of significance (p = .020, p = .014, p = .018). No statistically significant difference (NS) was noted for the rest of the variables. This indicates that following the completion of the experimental program, certain changes took place in these variables, and these changes were probably caused by the realized program of physical activity.

In order to determine the differences between the initial and final measuring of the subjects of the experimental and control group, the t-test for small dependent samples was used.

The results for the t-test between the initial and final measuring of the subjects of the experimental group (E) have shown that there are statistically significant differences found for the thing volume variable, (ULVOL) and thigh skin fold variable (ULESF) at the 0.05 level of significance (ULVOL p= .016) (ULESF p= .015), and abdominal skin fold variable, at the .01 level of significance (p= .003) (Figures 1, 2, and 3).

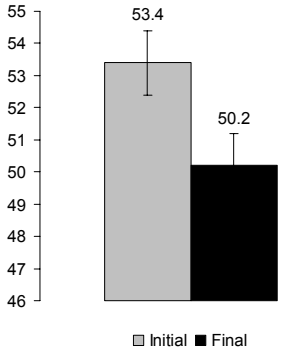

Fig. 1. Changes for the ULVOL* variable, E group

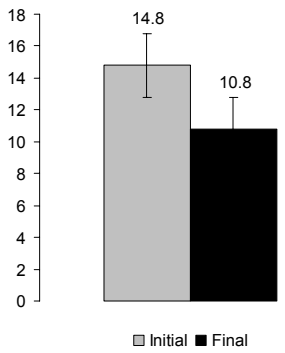

Fig. 2. Changes to the ULESF** variable, E group

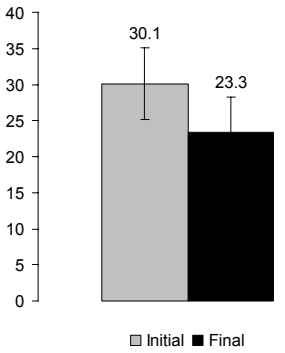

Fig. 3. Changes to the ABDSF* variable, E group

E - experimental group; p – the level of significance; * $p < 0.05$; ** $p < 0.01$

Among the subjects of the experimental group, a numerical decrease (but not a statistically significant one) was noted at the final in relation to the initial measuring in the case of the following measures THVOL 100,46 to 102,87; ABVOL 95,25 to 98,13; UAVOL 29,43 to 30,83; ULVOL 50,24 to 53,44; LLVOL 36,34 to 36,73; ABDSF 23,30 to 30,16; BACSF 19,24 to 20,84; UARSF 12,90 to 15,48, ULESF 10,87 to 14,83 and LLESF 9,18 to 9,50.

No statistically significant difference between the initial and final measuring of the subjects of the control group was found for any of the variables used to evaluate volume and subcutaneous fatty tissue.

Table 4 shows the results for the multivariate analysis of covariance of the subjects of the experimental and control group at the final measuring. We have determined a statistically significant difference at the .01 level of significance (p-level= .001). The noted difference is probably the result of the applied physical exercise program, and so we can conclude that it did lead to a transformation in voluminosity and subcutaneous fatty tissue among the subjects of the experimental group.

Table 4. The multivariate analysis of covariance for the experimental and control group at the finial measuring

Wilks	Rao's R	df1	df2	p-level
0.48	4.23	10	39	**0.001****

Legend: Wilk's - Wilks' Lambda test, Rao's R – Rao's F approximation, df – degree of freedom, p-level – level of significance,, statistically significant difference **p < 0.01

Table 5 shows the univariate differences between the subjects of the experimental and control group at the final measuring, with a neutralization and partialization of the results from the initial measuring. We determined a statistically significant difference for the average thorax volume (p= .000), abdominal volume (p= .000) and thigh volume (p= .001) variables, at the .01 level of significance. In the case of the abdominal skin fold (p= .014) and thigh skin fold (p= .039) variables, the determined statistical significance could be found at the .05 level. The results have proven that the experimental physical activity program most likely led to these changes.

Table 5. The univariate analysis of covariance between the E and C group at the final measuring

	Group	Adj Means	F	p
THVOL	E	102.56	21.9	**0.000****
	C	104.25		
ABVOL	E	96.85	22.6	**0.000****
	C	99.46		
UAVOL	E	29.64	3.9	0.059
	C	30.53		
ULVOL	E	50.22	13.4	**0.001****
	C	53.23		
LLVOL	E	36.99	0.9	0.378
	C	37.25		
ABDSF	E	22.85	6.5	**0.014***
	C	26.75		
BACSF	E	19.97	1.1	0.306
	C	21.09		
UARSF	E	12.52	1.4	0.544
	C	12.91		
ULESF	E	10.31	3.4	**0.039***
	C	11.59		
LLESF	E	8.21	0.7	0.369
	C	8.77		

Legend: THVOL - average thorax volume, ABVOL - abdominal volume, UAVOL - upper arm volume, ULVOL - thigh volume, LLVOL - lower leg volume, ABDSF - abdominal skin fold, BACSF - back skin fold, UARSF - upper arm skin fold, ULESF - thigh skin fold, LLESF - lower leg skin fold, p – the level of significance, *p < 0.05, **p < 0.01

DISCUSSION

After reviewing the results for the basic descriptive parameters at the initial measuring of the subjects in the experimental group, we can conclude that the values for all the variables used to determine volume are smaller, while the values for the measured skin folds are greater in relation to the subjects in other studies (Jović, Marković, & Perunović, 1983). If we only take into consideration abdominal volume, as one of the possible risk factors measured for the subjects of the experimental and control group, we can see that it exceed the values recommended for the average individual (Ostojić et al., 2002). In the research of certain authors, the evaluation of the waist-hip ratio, as one of the measures of voluminosity of the body, indicates its connection to the onset of cardiovascular disease (Reeder, Angel, Ledoux, Rabkin, Young, & Swee, 1992), so that the values measured among the subjects included in the research were expected, since we can assume that the increase in subcutaneous fatty tissue, as one of the factors for obesity onset, can lead to myocardial infarction.

The basic statistical parameters of the subjects in the control group at the final measuring in relation to the initial one have indicated a decrease in the values for circular dimensionality for all of the variables, except for lower leg volume. Greater numerical values for the lower leg volume at the final in relation to the initial measuring can most likely be attributed to an error in measurement, or to higher muscle tonus and muscle mass at the final in relation to the initial one, since a decrease in subcutaneous fatty tissue occurred. The values of the measured skin folds are higher in relation to the values recommended for average individuals (Ostojić et al., 2002). In the case of skin folds we can notice that at the final measuring, the measured numerical values are lower in relation to the initial measuring. The greatest changes or the greatest decrease have been noted for abdominal skin fold and thigh skin fold, while smaller changes were noted for the other variables. We can assume that the numerical decrease is the result of the realized physical activity program, or in other words, that the energy used for the physical exercises came from body fat. Pedersen & Saltin (2006) cite that physical activity causes a reduction in body fat and subcutaneous fatty tissue in the abdomen, and the same authors cite that there is evidence that physical activity is an important component for the prevention of a general increase in weight.

We determined the intergroup differences at the initial and final measuring with the help of the t-test.

The results have shown that at the initial measuring, no significant differences in volume and subcutaneous fatty tissue were found between the two groups, while the research of other authors (Woolf-May & Bird, 2005) has shown that in order to determine the effects of certain programs, it is important that the subjects who are included in the experimental programs have approximately the same characteristics at the initial measuring.

The differences between the groups at the final measuring indicate that there is a statically significant difference between the subjects of the experimental and control group in terms of thorax volume, abdomen volume and thigh volume. The noted differences are most probably the result of the realized physical activity program. A decrease in the numerical values at the final in relation to the initial measuring for the subjects of the E group can be ascribed to the influence of the realized experimental program. Similar results have been found in the research of other authors. O'Donovan, et al. (2005) have determined in their research that a decrease in waist volume has been noted for the

groups who exercised when compared to those who did not, and that a decrease in body mass was also noted.

The t-test results for the initial and final measuring of the subjects of the experimental group indicate that there are statistically significant differences in the variables for thigh volume, thigh skin folds and abdomen skin folds.

Since the greatest genetic conditioning has been determined for longitudinal and transversal dimensionality (H^2=.98), and the lowest for voluminosity and subcutaneous fatty tissue (H^2=.50), it is clear that the greatest changes under the influence of physical activity are possible for these dimensions (Malacko & Popović, 2000). The results for the realized program of physical activity have support this claim. In similar studies, other authors have also come to similar conclusions. Okura, Nakata, & Tanaka (2003) point out that physical activity is the best means for regulating body mass and that it can be used to influence changes in the volume and subcutaneous fatty tissue of individuals.

The data we have cited indicate that it is possible to influence volume and subcutaneous fatty tissue by means of physical activity, or in other words, that the realized program of physical activity most likely led to a decrease in certain variables among the subjects of the experimental group.

The results of the multivariate analysis of covariance (MANCOVA) indicate statistically significant intergroup differences at the final measuring among the subjects of the experimental and control group at the multivariate level, at the .01 level of significance (p-level= .000). These results are most likely the consequence of the realized experimental physical activity program.

Univariate statistically significant differences were determined for the average thorax volume (p= .000), abdomen volume (p= .000), thigh volume (p= .021), abdomen skin fold (p= .014) and thigh skin fold (p= .039). On the basis of the values of adjusted arithmetic means (Adj. Means), we can note that these values, for all the variables, are numerical smaller among subjects of the experimental group in relation to the values noted for the subjects of the control group. These results are within the limits of similar results found in the research of other authors. O' Donovan et al. (2005) proved that physical activity contributes to the decrease in some anthropometric variables. Brochu, Poehlman, & Ades, (2000) have determined that a program of physical activity had an influence on the reduction of body mass. Savage, et al. (2003) proved in their research that the realization of certain exercise programs can reduce body mass and waist volume, while similar results were found by other authors (Okura, et al., 2003; Mertens, et al., 1998; Osei-Tutu & Campagna, 2005).

Chronic exercise effects without any calorie restriction or weight loss are a useful strategy for the decrease of body fat in obese individuals (Lee, Kuk, Davidson, Hudson, Kilpatrick, Graham, & Ross, 2005), while exercise can affect the decrease in visceral, subcutaneous and overall abdominal fat (Slentz, Aiken, Houmard, Bales, Johnson, Tanner, Duscha, & Kraus, 2005).

Ross et al. (2004) cite that exercise without calorie restriction is connected to a significant and extended reduction in total fat, abdominal fat and visceral fat.

Varess, Sido, & Jako (1990) indicate that programmed physical activity can lead to quantitative and qualitative changes in certain variables of anthropometric characteristics, and that these changes are usually in the form of a decrease.

Pedersen & Saltin (2006) indicate the fact that the possible physical activity mechanisms are reflected in an increase in energy which causes lypolisis, and thus reduces body fat by using fat to create energy which is not compensated through calorie intake.

We can conclude that the realized experimental program of physical activity most probably led to the positive changes in the sense of a decrease in subcutaneous fatty tissue among the subjects of the experimental group.

CONCLUSION

Our research was carried out with the aim to determine the effects of a physical activity program on the volume and subcutaneous fatty tissue among individuals who had suffered myocardial infarctions. It confirmed that it is possible to influence changes in volume and subcutaneous fatty tissue, in the form of a decrease, following the realization of a program of physical activity. The physical activity program consisted of gymnastic exercises, walking, and riding a bicycle erogmeter, at intensity level of 55% to 70% maximum heart rate frequency as measured in the load tests, which is a recommendation for this segment of population by a great number of authors and institutions. Statistically significant changes were noted for the following variables: average thorax volume, abdomen volume, thigh volume, abdominal skin fold and thigh skin fold.

On the basis of various studies which indicate the necessity for people recovering from a myocardial infarction to participate in physical activity, we can conclude that the realized program very precisely determined the real effects of the physical exercise program on the volume and subcutaneous fatty tissue of individuals suffering from a myocardial infarction. The realized program of physical activity can offer certain guidelines for future proper organization and realization of programs for people who have suffered myocardial infarctions and who are involved in rehabilitation programs which include physical exercise.

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EFEKTI PROGRAMA FIZIČKIH AKTIVNOSTI NA VOLUMEN I POTKOŽNO MASNO TKIVO OSOBA SA INFARKTOM MIOKARDA

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Istraživanjem je obuhvaćeno 60 muškaraca hronološke starosti 50 do 60 godina, od kojih je 30 činilo eksperimentalnu, a 30 kontrolnu grupu. Istraživani su efekti programa fizičkih aktivnosti na promene volumena i potkožnog masnog tkiva osoba sa infarktom miokarda. Eksperimentalni program fizičkih aktivnosti realizovan je ukupno 21 dan, a aktivnosti su podeljene na tri dela i to: 1) gimnastičke vežbe, 2) hodanje na stazama zdravlja i 3) vožnja na bicikl ergometru. Ukupno vreme svakodnevnog vežbanja iznosilo je od 45 minuta na početku do 60 minuta na kraju programa. Istraživanjem je obuhvaćeno 10 mera koje su pokrivale prostor voluminoznosti i potkožnog masnog tkiva. Izračunati su osnovni parametri deskriptivne statistike, a za utvrđivanje razlika između grupa na inicijalnom i na finalnom merenju i razlika između inicijalnog i finalnog merenja kod svake grupe, primenjen je t-test. Multivarijantna i univariajntna analiza kovarijanse (MANKOVA/ANKOVA) upotrebljena je za utvrđivanje realnih ostvarenih efekata fizičkih aktivnosti. Nivo statističke značajnosti bio je 0.05. Sve statističke analize izračunate su pomoću statističkog paketa Statistica 6.0. Rezultati na finalnom merenju pokazali su da je realizovani program fizičkih aktivnosti imao pozitivne efekte na promene volumena i potkožnog masnog tkiva ispitanika eksperimetalne grupe, odnosno da je doveo do promena kod telesne mase (r= .000), srednjeg obima grudnog koša (r= .003), obima trbuha (r= .000), obima butine (r= .021), kožnog nabora na trbuhu (r= .032) i kožnog nabora butine (r= .003). Istraživanje je potvrdilo pozitivne efekte programa fizičkih aktivnosti na promene volumena i potkožnog masnog tkiva u smislu njihovog smanjenja kod osoba sa infarktom miokarda.

Ključne reči: *fizička aktivnost, infarkt miokarda, voluminoznost, potkožno masno tkivo*