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Effects Of Pilates Program On Voluminous And Subcutaneous Fat

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Abstract. *Pilates largely avoids high impact, high power output, and heavy muscular and skeletal loading. The population from which the sample was taken was defined as the female population, aged 24 ± 3.4 years. The total sample of subjects was 40 and divided into 2 subsamples, 20 women who practiced Pilates and 20 control groups without activity. Variables were tested:Body weight;Upper arm circumference; Abdominal circumference; Waist circumference; Upper thigh circumference; Skin fold of upper arm; Leather fold of the back; Leather fold suprailiac; Skin fold of abdomen; Skin fold of thigh. Based on the realized research and results, it can be concluded that the Pilates program has a positive effect on the reduction of subcutaneous adipose tissue and volume, no statistically significant changes were observed in the control group.*

Keywords - skin fold, fat, activity, program, final, body weight**.**

INTRODUCTION

The Pilates method is one of the most common recreational activities available today. Its creator, Joseph Pilates, created this method with the goal of restoring the natural balance of muscles. Exercises shorten the shortened muscles again, and strengthen the steam muscles, which have weakened, (Cavina et al., 2020). The very essence of Pilates is related to the development of the mind and body, which work together and through that work a healthier life is achieved (Aladro-Gonzalvo, et al., 2011). Pilates largely avoids high impact, high power output, and heavy muscular and skeletal loading. Aibar-Almazán et al. Many women are very active both physically and mentally, regardless of age. It's hard to say if exercise really prolongs life, but in any case, it slows down the aging process and prevents the body from being weakened prematurely. However, everyone must find the right balance for themselves, because the human body is an adaptive organism that adapts to the increase in work and workload. Numerous studies suggest physical activities such as running for 12 minutes, 2-3 times a week (Şavkin, R., & Aslan, 2017, Bjelica et al., 2018). Other authors suggest running in the heart rate zone of 120 per minute and training three times a week, while some believe that the exercise program should consist of interval or continuous training with an intensity of 50% for beginners, up to 80% maximum heart rate for more advanced exercisers, three times a week for 30 to 40 minutes. This way of exercising leads to maximum oxygen consumption, stroke volume, maximum cardiac output, in a word, to improve the functional abilities of the organism (Evangelou, et al., 2021). Recreational activities also have a positive effect on the mental structure, all with the aim of increasing or maintaining self-confidence, alleviating and eliminating fear or discomfort, and reducing nervous irritability (Fourie et al., 2013). Traditionally, the term recreation has meant a break from work that would allow a person to return to work (Lee et al., 2016). Many studies have proven that exercise is good, it is only important that the intensity, scope and frequency of exercise are adequate for the subject who exercises. Some research suggests that the Pilates program may influence the quantitative improvement of the volume, subcutaneous fat, and flexibility of subjects (Schroeder, Crussemeyer & Newton, 2002; Segal, Hein & Basford, 2004; Kloubec, 2005; Malnar, Šterbik, Fužinac-Smojeve, Jerković & Bobinac, 2007; Sekendiz, Altun, Korkusuz & Akın, 2007; Obradović, Cvetković and Kalajdžić, 2008; Emery, De Serres, McMillan & Côté, 2010).

In the mentioned research works, programs of different duration of 4-16 weeks were realized. In six-week programs, the frequency of exercise ranged from two to three times a week for 50 to 60 minutes (Burgess, Grogan & Burwitz 2005; Obradović, Cvetković and Kalajdžić, 2008; Rogers & Gibson 2009; Cvetković, 2009; Emery, De Serres, McMillan & Côté 2010; Eyigor, Karapolat, Yesil, Uslu & Durmaz, 2010). Experimental programs have proven their positive effect on voluminousness, subcutaneous adipose tissue and, in the end, general satisfaction with their appearance, which increasingly leads to the motivation of respondents to engage in recreational activities.

METHOD

Sample of respondents

The population from which the sample was taken was defined as the female population, aged 24 ± 3.4 years. The total sample of respondents was 40. The first subsample of 20 respondents represents a group of women who were included in a recreational Pilates

program for a certain period (ten weeks, ie three trainings per week lasting 60 minutes). The second subsample of 20 respondents represents a control group that had no other form of organized recreational activity other than daily activities.

Sample of measuring instruments

The measures that defined the basic parameters for determining the volume and weight of the body were a set of 10 measures: Body weight (AMAST); Upper arm circumference (AONAD); Abdominal circumference (AOTRB); Waist circumference (AOSTR); Upper thigh circumference (AONAT); Upper arm skin fold (AKNNA); Skin fold of the back (AKNLE); Suprailiac skin fold (ASIKN); Abdominal skin fold (AKNTRB); Leather upper leg crease (AKNNAT).

Experimental program

The program lasted 10 weeks, frequency 3 hours per week for 45 minutes. A total of 30 Pilates classes were completed. During each class, 30 to 35 separate exercises are realized. Introductory part (warm-up) lasting 5 minutes - a short jog is followed by additional exercises to prepare the body for the next stresses (6-8 exercises). The main part of 30 minutes contained exercises that represent a model of recreational Pilates program - 20-25 moderate pace exercises in one series with 8-10 repetitions (abdominal muscles; back muscles; arm and shoulder girdle muscles; abductor and adductor muscles and muscles of the gluteal region). The final part of ten minutes was dedicated to stretching and relaxation exercises with the aim of calming the body - 6-8 endurance exercises with a minimum duration of 15-20 seconds, 10 minutes.

Statistical data processing

Based on the set goals and tasks of the research, the following mathematical-statistical analyzes were used to verify the research hypotheses, which were performed using the statistical package for data processing STATISTICA 6.0. The following parameter of descriptive statistics was calculated for each applied measuring instrument: Arithmetic mean (Mean), in univariate and multivariate analysis of variance used for differences.

RESULTS WITH DISCUSSION

Table 1. Basic statistical parameters of voluminosity and subcutaneous adipose tissue of the experimental and control group subjects at the initial and final measurements.

		EXP group		CON group	
Variable	**N**	**Initial (Mean)**	**Final (Mean)**	**Initial (Mean)**	**Final (Mean)**
AMAST	40	56.09	55.36	61.83	61.61
AONAD	40	25.60	25.52	26.42	26.34
AOTRB	40	69.94	68.77	71.06	70.98
AOSTR	40	78.42	77.17	78.38	78.99
AONAT	40	55.44	55.35	56.30	56.65
ACNE	40	25.92	25.02	25.72	25.94
AKNLE	40	19.84	17.26	18.16	18.75
ASIKN	40	40.80	30.83	45.28	46.06
AKNTRB	40	33.28	23.52	32.92	33.58
AKNNAT	40	36.24	34.52	39.68	40.26

Legend: EXP- experimental group, CON- control group, p– significance level, AMAST- body weight, AONAD- upper arm circumference, AOSTR- waist circumference, AOTRB- abdominal circumference, AONAT- upper leg circumference, AKNNA- upper arm fold, AKNLE- skin back fold, AKNTRB- skin fold of the abdomen, ASIKN- suprailiac skin fold, AKNNAT- skin fold of the upper leg.

Insight into the results of the applied variables of volume and subcutaneous adipose tissue of the subjects of the experimental group on the initial measurement in Table 1, it can be concluded that the average body weight of the subjects included in the experiment is

56.09 kg. Average body weight is lower than the recommended values for a given age (56.09 kg versus the recommended 59.80 kg) (http://www.halls.md/chart/women-weight-w.htm). Measured average values of body weight are lower than the body weight of respondents included in the research of other authors (56.09 kg versus 61.06 kg; Rakić, Božić-Krstić, Savić, Pavlica, Bala & Madić, 1998; 56.09 kg versus 61.75 kg; Tomljenović, B., Tomljenović, F. and Radošević, 2007; 56.09 kg versus 61.05 kg; Cvetković, Obradović and Kalajdžić, 2008; 56.09 kg versus 60.28 kg; Vlašić, Oreb and Furjan-Mandić, 2007; 56.09 kg versus 59.70 kg; Caput-Jogunica & Ćurković, 2007) before engaging in regular recreational activities. The obtained data have value only if they are compared with some standards accepted so far, which correspond to one population, gender, age or height. The parameters of volume and subcutaneous adipose tissue of the control group at the initial measurement are shown in Table 1. The measurement results showed that the body weight of the control group was 61.83 kg and was higher than the experimental group (61.83 kg vs. 56.09 kg). The values of body weight are higher in relation to the values recorded in the respondents included in the exercise programs in the research Cvetković, Obradović and Kalajdžić (2008) (61.83 kg versus 59.72 kg).

Parameters of voluminosity and subcutaneous adipose tissue of the examinees of the experimental group at the final measurement. The average value of body weight is 55.36 kg and it is lower than the recommended values for a given age - 55.36 kg compared to the recommended 59.80 kg (Hassager, 1986). The measured average values of body weight are slightly lower than the body weight of the respondents included in the research of the authors Tomljenović, B., Tomljenović, F. & Radošević (2007) (55.36 kg versus 63.91 kg); Cvetković, Obradović and Kalajdžić (2008) (55.36 kg versus 59.43 kg) before the implementation of the program of recreational activities. Compared to the initial measurement, the value of body weight decreased by 0.7 kg (56.09 kg versus 55.36 kg). Such data are expected and it can be considered that the decrease in body weight was influenced by the realized experimental program of Pilates with a ball. Insight into the results of the measured measuring instruments of volume and subcutaneous adipose tissue of the control group at the final measurement, it can be concluded that there was a slight decrease in the applied measuring instruments AONAD - upper arm circumference and AMAST - body weight. These differences were most likely caused by factors other than physical exercise because the control group did not engage in organized physical exercise (reduced food intake, etc.). In all other applied measuring instruments for the assessment of volume and subcutaneous adipose tissue, there was a numerical increase in value.

Table 2. Multivariate analysis of volume and subcutaneous adipose tissue variance between experimental and control groups at initial and final measurements

EXP / CON group Initial measure					**EXP / CON group Final measure**				
Wilks	**F**	**df1**	**df2**	**p**	**Wilks**	**F**	**df1**	**df2**	**p**
0.640	2,196	10	39	**0.039***	0.659	2,016	10	39	0.058

Legend: Wilk's- Wilks lambda test, F- Ra's F approximation, df- degrees of freedom, p- significance level, statistical significance differences * r <0.05

By inspecting the results in Table 2, which shows a multivariate analysis of the variance between the subjects of the experimental (EKS) and control (KON) group on the initial measurement in the applied measuring instruments to assess the volume and subcutaneous adipose tissue, it can be concluded that there is a statistically significant intergroup difference. .039). These results indicate that the groups on the initial measurement with different measuring instruments of volume and subcutaneous adipose tissue differ, ie that there are significant differences in the measured values. The results of the multivariate analysis of variance between the subjects of the experimental and control groups in the final measurement shown in Table 2 do not show the existence of a statistically significant intergroup difference at the significance level of .05 (p = .058). Therefore, it can be argued that the subjects of the experimental and control groups at the final measurement have similar values of volume and subcutaneous adipose tissue. These results indicate that after the implementation of the program there were changes in the volume and subcutaneous adipose tissue between the groups, because there were statistically significant differences in the initial measurement.

Table 3. Univariate analysis of volume and subcutaneous adipose tissue variance between experimental and control groups at initial and final measurements

		EXP / CON group Initial measure		**EXP / CON group Final measure**	
Variable	**N**	**F**	**p**	**F**	**p**
AMAST	40	7,378	0.009	8,562	0.005
AONAD	40	1,298	0.260	1,275	0.264
AOTRB	40	0.545	0.464	1,480	0.230

AOSTR	40	0.000	0.984	0.588	0.447
AONAT	40	0.506	0.480	1,191	0.281
ACNE	40	0.005	0.946	0.096	0.759
AKNLE	40	0.756	0.389	0.518	0.475
ASIKN	40	0.654	0.423	7,577	0.008
AKNTRB	40	0.006	0.937	5,267	0.026
AKNNAT	40	0.590	0.446	1,671	0.202

Legend: EXP- experimental group, CON- control group, p– significance level, AMAST-body weight, AONAD- upper arm circumference, AOSTR- waist circumference, AOTRB- abdominal circumference, AONAT- upper leg circumference, AKNNA- upper arm fold, AKNLE- skin back fold, AKNTRB- skin fold of the abdomen, ASIKN- suprailiac skin fold, AKNNAT- skin fold of the upper leg

At the univariate level, it is only appliedstatistically significant difference was found in the measuring instrument AMAST-body mass (p = .009). In the following applied measuring instruments for the assessment of volume and subcutaneous adipose tissue, it is noticeable that the subjects of the experimental group had lower values in most applied measuring instruments except for the measuring instrument: AOSTR - waist circumference, AKNNA - skin fold of the abdomen, where lower values were observed in the control group. The results obtained in this way support the fact that the examinees of the experimental and control groups of different values of voluminosity and subcutaneous adipose tissue were at the initial measurement. Table 3 shows the results of the univariate analysis of variance between the subjects of the experimental and control groups in the space of the applied measuring instruments of volume and subcutaneous adipose tissue. By inspecting the results at the univariate level, it is possible to see that there is an intergroup statistically significant difference in the measuring instruments AMAST - body weight and ASIKN - suprailiac skin fold, at the significance level of .01 (r = .005, r = .008) and AKNTRB - skin fold. abdomen, at a significance level of .05 (r = .026). For other applied measuring instruments for the assessment of voluminosity and subcutaneous adipose tissue, no statistical significance was found. In all applied measuring instruments for the assessment of volume and subcutaneous adipose tissue, it was noticed that the subjects of the experimental group had lower values than the subjects of the control group (AMAST - body weight, AONAD- upper arm circumference, AOTRB- abdominal circumference, AOSTR- waist circumference, AONAT- upper leg circumference, AKNNA- upper arm fold, AKNLE- back skin fold, ASIKN- suprailiac skin fold, AKNTRB- abdominal fold, AKNNAT- skin fold).

CONCLUSION

The research was conducted with the aim of determining the effects of programmed recreational physical activity on voluminous, subcutaneous adipose tissue in women who recreationally practice Pilates. The research was focused in two directions, namely: the implementation of recreational physical activity programs for women for ten weeks; to assess the changes achieved under the influence of experimental treatment and to build and verify an appropriate methodology that would be used in future research and applied in practice. Based on the realized research and results, it can be concluded that the Pilates program has a positive effect on the reduction of subcutaneous fat and volume. It would be interesting to follow in some future research the effects of the same experimental program on motor skills.

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