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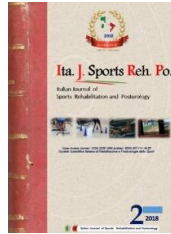


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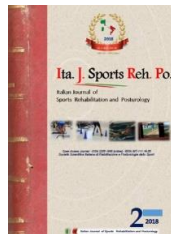
The Effects of Pilates programs on motor skills and morphological characteristics of women

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Abstract

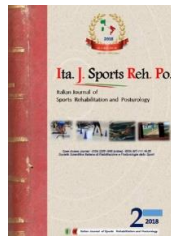
Background. Pilates program has taken the leading place among group recreational programs in the last year, and its development trend has been constantly increasing. **Purpose.** The aim of this research is to determine the impact of pilates programs on motor skills and morphological characteristics of women. **Methods.** The sample consisted of 50 women, aged 38 to 45 years old. Pilates program lasted 3 months or 24 training sessions of pilates. Variables that have been used to assess morphological characteristics are: height (AVIS), weight (ATEZ), chest circumference (AOGP), waist circumference (AOST), hip circumference (AOKU). For the assessment of motor abilities, five tests have been used: hull lifting on the bench for 30 s (MDZT), push ups (MSKL), deep squat for 30 s (MCUC), deep sit and reach (MPRK), shoulder circumduction test (MISP). **Results.** The greatest changes on morphological values and motor skills have been measured in the field of strength. There have not been measured significant differences in the flexibility tests. **Conclusion.** The question arises why there were no significant differences in the field of flexibility tests. The basic assumption is that inadequate tests were selected, and that the selected tests did not cover all the regions of the body. (Bjelica Bojan, Joksimović Marko, Seisenbekov Yerlan, D'Onofrio Rosario, Perović Tijana. - *The Effects of Pilates programs on motor skills and morphological characteristics of women* - Ita J Sports Reh Po 2018; 5 ; 2 ; 1063 - 1073 ISSN 2385-1988 [online] IBSN 007-111-19-55 ,CGIJ OAJI :0,101)

Key words: Fitness, Motor Ability, Pilates, Strength, Flexibility

Introduction

Insufficient physical activity is one of the nation's greatest health problems, and it has been proven to be a factor contributing to the development of chronic diseases and disorders² Health should be viewed in a wider sense, and not just as the absence of disease¹⁵. Health, which by definition WHO²¹, is not just a mere absence of disease or the presence of work and life skills, but above all a state of complete physical, psychological and social well-being, is a fundamental determinant of the survival and progress of every human being and society as a whole.

Pilates was created by Joseph Pilates, who combined exercises, movement, philosophy, gymnastics, martial arts, yoga and dance using this type of activity as an approach to a healthy lifestyle. This exercise program is based on 6 key principles: concentration, centering, control, precision, treatment and proper breathing¹³. The very essence of Pilates refers to the development of mind and body, working together and through that work a healthier life is achieved³. Pilates gives an incredible selection of exercises that are suitable, regardless of the level of physical state, from completely unprepared person



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through obese to the athletes⁷. Some studies suggest that the pilates program can influence the quantitative improvement of voluminosity, subcutaneous fat tissue and flexibility of respondents^{19,18,11,14,20,16,8}.

Muscles will develop depending on exercise, the body will be freed from additional fat¹⁰. Pilates is proposed as an effective and safe method for people with fibromyalgia-chronic muscular disease syndrome¹. Pilates is one of the activities that has become very popular, so a large number of experts do researches in this field⁴. Women easily decide to start with recreational and fitness programs in centers or gyms to reduce their body weight and improve their level of strength and thus become healthier⁹.

Method

The study was conducted on a sample of 50 women, aged 38 to 45 years. The research was conducted in Belgrade, at the 'Feel Pilates' Center. The program lasted 3 months (24 training sessions). The timing structure, load and volume of each training session was precisely determined. Pilates training session consisted of three parts: warm up (10 min.), main part (40 min.), final part (8-10 min.). The duration of the main part of the training session was 40 minutes, with about 25 exercises, 8-10 repetitions of each exercise. The character of the exercises was focused on: the abdominal muscles; back muscles; muscles of arms and shoulders; abductor and adductor muscles and muscles of the gluteal region.

Variables that have been used to assess morphological characteristics are: height (AVIS), weight (ATEZ), chest circumference (AOGP), waist circumference (AOST), hip circumference (AOKU). For the assessment of motor abilities, five tests have been used: hull lifting on the bench for 30s (MDZT), push ups (MSKL), deep squat for 30 s (MCUC), deep sit and reach (MPRK), shoulder circumduction test (MISP). The basic statistical parameters have been applied for this research: arithmetic mean, standard deviation (sd), minimum (min) and maximum (max) range of results. ANOVA - Univariate variance analysis. The significant statistical difference between the first and the second measurements.

Results and Discussion

The first four tables show the basic descriptive parameters from the first and second measurement. In Table no. 1 five variables, weight, height, chest circumference, waist circumference, hip circumference have been showed.

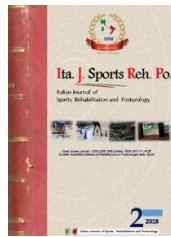


Table 1. Descriptive statistics, Initial measurments (1 measurement), morphology.

	N	Minimum	Maximum	Mean	Std. Deviation
AVIS	50	159,0	186,0	171,100	5,7401
ATEZ	50	49,5	85,0	63,060	7,2031
AOGR	50	62,0	105,0	88,830	7,8640
AOST	50	62,5	91,0	76,510	7,1009
AOKU	50	87,0	117,0	98,560	6,6988

In Table no. 2 the basic descriptive indicators from the second, final measurement, have been showed.

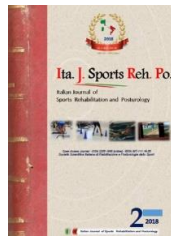
Table 2. Descriptive statistics, FINAL (2nd MEASUREMENT), morphology.

	N	Minimum	Maximum	Mean	Std. Deviation
AVIS	50	159,0	186,0	171,121	5,9555
ATEZ	50	47,0	72,0	59,240	5,5606
AOGR	50	62,0	105,0	88,830	7,8640
AOST	50	62,5	91,0	76,510	7,1009
AOKU	50	87,0	117,0	98,560	6,6988

From the parameters shown, it can be concluded that the values of arithmetic mean of ATEZ variable is different and it is assumed that in the subsequent statistical procedure, the difference between two measurements will occur.

Table 3. Descriptive statistics, INITIAL (1st measurment), motor skills.

	N	Minimum	Maximum	Mean	Std. Deviation
MDZT	50	,0	24,0	15,460	3,8925
MSKL	50	,0	30,0	11,300	8,1397
MCUC	50	,0	32,0	19,160	5,0360
MPRK	50	,0	115,0	13,810	16,7377
MISP	50	35,0	120,0	82,570	17,7177



In Table no. 3 an overview of the basic descriptive parameters related to the used motor tests when examining women who practice pilates programs has been given. Three tests for repetitive strength have been used: hull lifting, push ups and squats. To test the flexibility, two tests have been chosen: deep sit and reach and shoulder circumduction test. The selection of tests was performed on the basis of previously used tests of a certain group of authors.

Based on the values of the arithmetic means, it can be noticed that there are differences in the values of the variables between the initial and final measurements in the experimental group, i.e. we notice an increase in the arithmetic mean of the final measurement versus the initial one. The significant differences in the values of the arithmetic means in all motor variables between the initial and final measurements are not noticed in the control group.

Table 4. Descriptive statistics, Final (2nd measurement), motor skills.

	N	Minimum	Maximum	Mean	Std. Deviation
MDZT	50	,0	24,0	15,460	3,8925
MSKL	50	,0	30,0	11,300	8,1397
MCUC	50	,0	32,0	19,160	5,0360
MPRK	50	,0	115,0	13,810	16,7377
MISP	50	35,0	120,0	82,570	17,7177

The researches by Babayigit⁵, have showed that there have been statistically significant differences in the final versus initial testing in the experimental group in all examined variables. On the other hand, in the control group there has not been any significant difference between the final and initial testing. It is concluded that Pilates exercises are effective in improving the dynamic balance, reaction time, flexibility and muscle strength. Their findings indicate that Pilates exercises can be a useful tool for people who want to improve their health. In addition, pilates exercises can be used for rehabilitation preventive purposes.

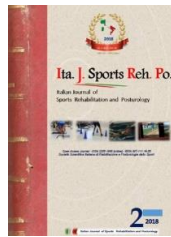
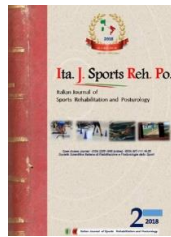


Table 5. ANOVA, morphology.

		Sum of Squares	df	Mean Square	F	Sig.
AVIS	Between Groups	,490	1	,490	,014	,905
	Within Groups	3352,420	98	34,208		
	Total	3352,910	99			
ATEZ	Between Groups	166,410	1	166,410	4,294	,041*
	Within Groups	3798,000	98	38,755		
	Total	3964,410	99			
AOGR	Between Groups	612,563	1	612,563	11,092	,001*
	Within Groups	5412,085	98	55,225		
	Total	6024,648	99			
AOST	Between Groups	299,290	1	299,290	8,874	,004*
	Within Groups	3305,170	98	33,726		
	Total	3604,460	99			
AOKU	Between Groups	216,090	1	216,090	7,530	,007*
	Within Groups	2812,400	98	28,698		
	Total	3028,490	99			

Observing the column Sig. which shows statistically significant differences, it can be concluded that the pilates program that lasted for 3 months influenced changes in body weight of respondents (ATEZ ,041), and to all the parameters that had been taken and that are related to the circumferences. Chest circumference (AOGR ,001); Waist circumference (AOST ,004); Hip circumference (AOKU ,007). These results have proven that Pilates programs have a significant contribution to the regulation of body weight and circumference changes, i.e. in all measurement parameters because exercises with their complexity include all regions of the body as a whole.

Pantelić & Mladenović¹⁷, have studied changes in anthropometric characteristics and body composition in 37 female students from the University of Kragujevac, aged 22 to 26, after four months of aerobic exercising with music. The following anthropometric variables have been measured: body mass (ABMS), body height (AHEI), chest circumference (ACHC), waist circumference (AWAI), mid-upper arm circumference (AMUA), thigh circumference (ATIC), lower leg circumference (ALLC), and also five skinfold thickness measures: mid-upper arm skinfold tickness (AMUST), back skinfold tickness (ABST), waist skinfold tickness (AWST), thigh skinfold tickness (ATST), lower leg skinfold tickness (ALST). T



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The aerobic exercises program has resulted in statistically significant changes in the following variables: body mass (ABMS), waist circumference (AWAC), thigh circumference (ATIC), back skinfold thickness (ABST), waist skinfold thickness (AWST), thigh skinfold thickness (ATST), since their values have been reduced, and also there has been statistically significant difference in body composition between initial and final measures. Donnelly⁶, studied the effects of the 16-month controlled exercising on body weight and body constitution of young obese men and women. The study examined the long-term effects of a mid-intensity exercise program on body weight and body constitution of adult men and women. The sample for this research consisted of 131 persons, of which 74 completed the program in whole. The sample of 131 persons was divided into two groups, an experimental and control group. The experimental group had organized aerobic exercising, while the control group did not have any organized exercising. During realization of aerobic exercising, energy consumption was measured, and all the participants were subjected to a diet. The results of the study showed that there was not increase in body weight of women, and caused a loss of weight in men. Men of the experimental group had a statistically significant reduction in body weight of 5.2 ± 4.7 kg and a decrease in the body mass index of 4.9 ± 4.4 compared to the control group in which no significant changes were recorded. In women who practiced, there was no statistically significant difference in body weight, body mass index and body fat, and there was also no statistical significance in the control group. There were no significant changes in body fat either in men or in women, nevertheless the groups reduced the percentage of body fat. The authors concluded that mid-range exercising gave results in terms of reducing obesity in the young adult population. Obradović, Cvetković, & Kalajdžić¹⁶ conducted a research on a sample of 78 female students of the first and second year of the Faculty of Physical Education in Novi Sad. The experimental program which lasted for six weeks with a frequency of three training sessions a week. The experiment was carried out in order to determine the effects of pilates on the morphological characteristics of female students of the Faculty of Physical Culture. The following variables were used to assess the body's voluminosity: chest circumference (ACHC), relaxed mid-upper arm circumference (ARMUC), contracted mid-upper arm circumference (AMMUC), thigh circumference (ATIC), lower leg circumference (ALLC). For subcutaneous fat tissue assessment these tests were used: back skinfold thickness (ABST), triceps skinfold thickness (ATST) waist skinfold thickness (AWST), mid-upper leg skinfold thickness (AMLST), lower leg skinfold thickness (ALLST). Body composition indicators were obtained by measuring body composition monitor Tanita BC-540, which are: body weight (ABWE), body fat percentage (ABFAT), body water percentage (ABWAT) and muscle mass in kg (AMMAS). The entire study lasted for 8 weeks and the experiment lasted for 6 weeks. The authors concluded that Pilates exercising for three training sessions a week for a period of six weeks caused positive changes in female students of the Faculty of Physical Culture in terms of their body composition, although anthropometric sizes do not confirm this.

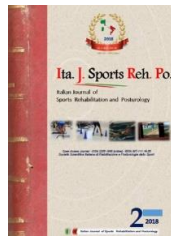
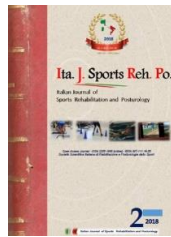


Table 6. ANOVA, motor skills.

		Sum of Squares	df	Mean Square	F	Sig.
MDZT	Between Groups	106,090	1	106,090	9,496	,003*
	Within Groups	1094,900	98	11,172		
	Total	1200,990	99			
MSKL	Between Groups	552,250	1	552,250	12,166	,001*
	Within Groups	4448,500	98	45,393		
	Total	5000,750	99			
MCUC	Between Groups	146,410	1	146,410	5,820	,018*
	Within Groups	2465,300	98	25,156		
	Total	2611,710	99			
MPRK	Between Groups	441,000	1	441,000	1,755	,188
	Within Groups	24630,690	98	251,334		
	Total	25071,690	99			
MISP	Between Groups	144,000	1	144,000	,536	,466
	Within Groups	26308,810	98	268,457		
	Total	26452,810	99			

Regarding the parameters taken for strenght assesment, we also notice positive effect of the program on the strength of the female respondents and the significant differences in the tests: hull lift (MDZT ,003); push ups (MSKL ,001); squats (MCUC ,018). In the remaining two tests for flexibility testing, there were no statistically significant differences at the conclusion level $p < 0.05$. Test Values: sit and reach (MPRK ,188); shoulder circumduction test (MISP) ,466). are not statistically significant, but if we look at the arithmetic mean of the results from the descriptive statistics, we can conclude that there are small differences in relation to the initial measurement, but they do not have statistical significance. The question arises why there were no significant differences in the field of flexibility tests. The basic assumption is that inadequate tests were selected, and that the selected tests did not cover all the regions of the body.

The study of Kloubeca¹², showed that the experimental group that used the pilates method did more push-ups and hull lifts than the control group of middle-aged women. This study suggests that individuals can improve their muscular endurance and flexibility using a relatively low intensity of pilates exercises that do not require equipment or a high level of skill. Research that was conducted by Sekendiza.²⁰



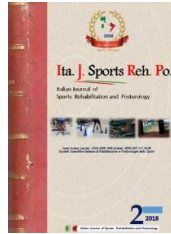
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I was concluded that modern pilates exercises positively affects the strength of the abdominal muscles and the lower part of the back and the flexibility of the lower back in adults, as well as abdominal endurance. Based on the research of Obradović, Cvetković, & Kalajdžić¹⁶ which was conducted on the female students of the first and second year of the Faculty of Physical culture, it was concluded that there were statistically significant differences between initial and final measures. The female subjects of the experimental group showed better results in all motor tests covered by this study. It can be concluded that the applied treatment has caused the transformation process of the motor skills of the examinees. The results of the applied motor tests in the control group also differed significantly in the initial and final measurements, but the levels of significance of these differences are lower than in the case of the experimental group. A new study of Kloubeca¹¹, showed statistically significant improvements at $p \leq 0.05$ on abdominal endurance, knee flexibility and muscular endurance of the upper part of the body, except in the variables of holding and balance. This study showed that the 12-week Pilates exercise program, twice a week for an hour and half, in middle-aged men and women, was sufficient for a statistically significant increase of abdominal endurance, flexibility of the knees and muscular endurance of the upper body. This study suggests that individuals can improve their muscular endurance and flexibility using a relatively low intensity Pilates exercises that do not require equipment or a high level of skill and is easy to master and use as a personal fitness habit.

Conclusion

Although very old, the Pilates program has taken the leading place among group recreational programs in the past year, and its development tendency is steadily increasing. Each exercise in Pilates activates a large number of muscles, so the noticeable results are not long waited. The results of a univariant variance analysis confirm the resulting changes in certain characteristics between the initial and final states in the experimental group of female subjects. Analyzing the structure of the univariant analysis, we can conclude that the biggest changes occurred in the measured morphological values and motor abilities from the strength field. There were no significant differences in flexibility tests. The question arises why there were no significant differences in the field of flexibility tests. The basic assumption is that inadequate tests were selected, and that the selected tests did not cover all the regions of the body.



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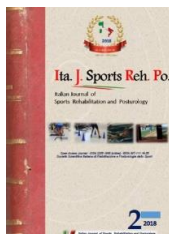
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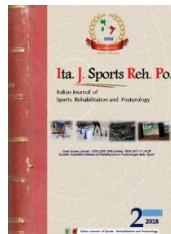


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