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Original research article

ANALYSIS OF THE EFFECTS OF A PILATES PROGRAM ON THE FLEXIBILITY OF WOMEN*

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Abstract. *The aim of this paper was to examine the influence of Pilates exercises on the flexibility of women. The research was conducted on an adequate sample of women (n=60), aged 35-40, consisting of 38 participants who did Pilates exercises (the experimental group) and 22 participants who did no type of recreational activities (the control group) from the territory of Novi Sad. The experimental program of exercises called Pilates was conducted over a period of 6 months, twice a week. The flexibility of the participants was evaluated by implementing three motor tests: 1) the Flex with a bat for the evaluation of the dynamic flexibility of the shoulder; 2) the Seated hamstring stretch for the evaluation and monitoring of the flexibility of the posterior side of the thigh (m. semitendinosus, m. semimembranosus and m. biceps femoris) and the muscles of the lower leg (m. gastrocnemius and m. soleus); 3 the Standing hamstring stretch, for the stretching of the posterior side of the thigh (m. semitendinosus, m. semimembranosus and m. biceps femoris) in a standing position, modified for the evaluation and monitoring of flexibility of the mentioned muscles, as well as for the gluteal muscles and the erector spinæ muscle group. The use of the multivariate analysis of covariance (MANCOVA) established the existence of statistically significant differences in flexibility between the experimental and control group.*

Key words: *Pilates, women, flexibility, motor tests.*

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INTRODUCTION

Modern living conditions, the daily race for basic income necessary for survival, force a person to forget about the basic natural demands of the human body. Feeling tense, being overweight and having hypertension are the consequences caused by this lifestyle. A modern woman is interested in the benefits of fitness and more and more often takes up group fitness training. Group fitness programs are very popular among the female population and they are especially important for 'lifelong' recreational exercise. They are great fun and very efficient if they are planned and programmed adequately. They are always done under the supervision of an instructor who is in charge of the training and has complex demands when it comes to the knowledge, expertise and class organization. Group fitness programs belong to multi-structural cyclic activities and they have a positive effect on anthropological characteristics and abilities. The most visited group fitness training programs include aerobics and Pilates (Kenedy & Yoke, 2005).

The method called Pilates is a system of physical exercises primarily aimed at increasing the flexibility and strength of the body. Pilates makes an impact on correct body posture and joins the body and mind (Latey, 2001; Krejg, 2005). It was invented in the 1920s by Joseph Pilates, born in 1880 near Duseldorf in Germany. He called his method "Contrology". The name itself indicates the way this method encourages people to use their mind in order to be able to consciously "control" the movements while exercising. The Pilates method also teaches people who exercise how to breathe during exercises, which is very important for the alleviation and prevention of backache (Latey, 2001).

Flexibility is a synonym for the mobility of joints and it is defined as the ability to make active and passive movements of the joints with the biggest possible amplitude (Herodek, 2006). It depends on the mobility of joints and elasticity of muscles. The anatomic structure of every joint is the point up to which mobility can extend, while muscle elasticity is a precondition of successful mobility in the joined function of all muscles. Depending on the fact whether movement is made under the influence of internal (muscle) or external (gravitation, inertia, force of the other person who exercises) forces, there are two types of flexibility (active and passive). The level of flexibility is affected by a range of factors, such as temperature, exhaustion, fitness, sex and, for this research especially interesting, the influence of chronological age. Individual flexibility already deteriorates during childhood and adolescence if the person does not take part in a training process or organized exercise (Obradović, 1999). According to Fleischman (1964) and Perić (1997), taking the functional adjustment of muscle spindles and Golgi tendon organs into account, there are two types of flexibility: *dynamic* (in phases) and *static* (extended). Dynamic flexibility is connected to movements with a big amplitude which are made slowly or by staying in a certain position. The term flexibility is not uniformly used in a terminological sense. Various terms can be found in a number of papers: flexibility, mobility, elasticity, ductility, resilience. The aim of the current research was to determine the effects of the Pilates program in recreationally active women.

THE METHOD

The sample of participants consisted of 60 women, aged 35-40 from the territory of Novi Sad. The sample was divided on two sub-samples: an experimental sub-sample (N=38), who did Pilates exercises twice a week for six months, and a control sub-sample (N=22), which did not take part in any kind of recreational activities.

With the purpose of evaluating flexibility, the following tests i.e., variables were used (Bala, Stojanović, & Stojanović, 2007; Sudarov, 2007).

1. The "*Flex with a bat*" for the evaluation of the dynamic flexibility of the shoulder - (FLBATH in cm),
2. The "*Seated hamstring stretch*" for the evaluation and monitoring of the flexibility of the posterior side of the thigh and the muscles of the lower region of quadriceps - (SEATHS in cm),
3. The "*Standing hamstring stretch*", modified for monitoring the development of the flexibility of the body and hip - (STANHS in cm).

In previous studies (Madić, 1996; Obradović, 1999), the tests showed good metric characteristics of the female population.

The research lasted for six months. During that period the experimental program was implemented twice a week for one hour in the rhythmic hall of the Faculty of Sport and Physical Education in Novi Sad. The initial and final measurements lasted 4 hours (one hour on Mondays and Tuesdays for the period of two weeks). The testing was done during evening training sessions. The best out of three possible results was marked as the result of the test. The testing was organized in accordance with work places and was conducted by the group of trained teachers, assistants and senior-year students of the mentioned Faculty. The participants received timely informed about the testing procedure.

The obtained results were processed using the package SPSS 15.0. The effects of the experimental program at the end of the treatment were determined by the multivariate analysis of the covariance (MANCOVA) and univariate analysis of covariance (ANCOVA).

RESULTS AND DISCUSSION

According to the descriptive statistics for the experimental sub-sample (Table 1), the values of arithmetic means show the existence of the differences for the variables SEATS and STANHS in favor of the final measuring. For the variable FLBATH a lower value of the result was determined at the final measuring, which is actually a positive result.

According to the descriptive variables for the control sub-sample (Table 1), there are differences among the values of arithmetic means for the variables FLBATH and SEATHS in favor of the initial measuring and at variable STANHS in favor of the final measuring.

Table 1. Basic descriptive characteristics of motor tests for the experimental and control sub-sample in the initial and final measuring (No. 1=initial measuring, No. 2= final measuring).

Variable		N	MIN	MAX	AM	S	N	MIN	MAX	AM	S
			Experimental sub-sample					Control sub-sample			
FLBATH	No. 1	38	59	116	84.84	14.314	22	50	108	84.18	11.070
(cm)	No. 2		56	102	82.55	15.146		56	102	83.95	11.282
SEATHS	No. 1		43	81	62.71	8.618		47	79	60.68	10.153
(cm)	No. 2		47	84	66.01	7.984		47	83	60.55	9.913
STANHS	No. 1		18	40	30.68	5.644		22	46	31.14	4.912
(cm)	No. 2		19	40	32.73	4.996		20	39	32.52	4.571

Legend: MIN-minimum values, MAX-maximum values, AM-arithmetic mean, S-standard deviation.

The multivariate analysis of covariance (MANCOVA, Table 2) offered values which prove that there are statistically significant differences in flexibility between the experimental and control sub-sample (F= 5.769, p=0.002). There are statistically significant differences determined by the ANCOVA method for the variable SEATHS between the experimental and control sub-sample (F=14.820; p=0.00).

Table 2. The results of the evaluation of differences between the experimental and control sub-sample.

Variable		Initial (corrected)		Final			
	Sub-sample	AM	S	AM	S	F	P
FLBATH (cm)	experimental	82.36[a]	1.165	82.55	15.146	0.975	0.328
	control	84.27[a]	1.534	83.95	11.282		
SEATHS (cm)	experimental	65.33[a]	0.565	66.01	7.984	14.820	0.000[*]
	control	61.72[a]	0.744	60.55	9.913		
STANHS (cm)	experimental	32.87[a]	0.332	32.73	4.996	1.223	0.274
	control	32.26[a]	0.438	32.52	4.571		

F=5.769, p=0.002

Legend: AM-arithmetic mean, S-standard deviation,
[*]statistically significant difference ($p < 0.01$)

The results of three tests for the evaluation of flexibility, used on a sample of 60 women (38 of the experimental sub-sample, 22 of the control sub-sample, aged 36-40), showed the changes in flexibility as a motor ability of women who were included in recreational physical activities, which is in accordance to the results of Obradović, Cvetković, & Kalajdžić (2009).

According to the previous studies (Hupprich & Sigerseth, 1950; Milne, Sebfeldt, & Reuschlein, 1976; Gajić, 1985), the decrease of the level of flexibility, or a falling trend, was determined for participants with the increase of their age, since they were not included in the training process or daily activities with purpose of developing flexibility (Munns, 1981; Germain & Blair, 1983; Agre, Pierce, Raab, McAdams, & Smith, 1988).

CONCLUSION

The participants who took part in Pilates achieved better results in all motor tests at the final measuring: the Seated hamstring stretch, Standing hamstring stretch and the Flex with a bat. The Pilates method proved to be a successful tool for developing flexibility in physically i.e., recreationally active women.

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ANALIZA UTICAJA PILATES PROGRAMA NA FLEKSIBILNOST KOD ŽENA

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Cilj ovog rada bio je da se istraži uticaj Pilates vežbi na fleksibilnost kod žena. Istraživanje je sprovedeno na odgovarajućem uzorku žena (n=60), sa teritorije Novog Sada, starosti 35-40 godina, podeljenih na eksperimentalni sub-uzorak (n=38) koji je sprovodio vežbe Pilatesa i kontrolni sub-uzorak (n=22) koji nije sprovodio nijedan vid rekreativnih aktivnosti. Eksperimentalni program Pilates vežbi sprovođen je u trajanju od 6 meseci, dva puta nedeljno. Fleksibilnost kod ispitanica je procenjivana primenom tri motorička testa: 1) fleksije sa palicom za procenu dinamičke fleksibilnosti ramena; 2) istezanja m. semitendinosusa, m. semimembranosusa i biceps femorisa (engl. Hamstring) u sedećem položaju za procenu i praćenje fleksibilnosti mišića zadnje lože buta i mišića potkolenice (m. gastrocnemiusa i m. soleusa; 3) istezanja mišića zadnje lože buta (m. semitendinosusa, m. semimembranosusa i m. biceps femorisa) u uspravnom položaju, modifikovano za procenu i praćenje fleksibilnosti navedenih mišića, kao i glutealnih i mišića opružača kičmenog stuba. Primenom metode multivarijantne analize kovarijanse (MANCOVA) utvrđena je statistički značajna razlika u fleksibilnosti između eksperimentalne i kontrolne grupe.

Ključne reči: *pilates, žene, fleksibilnost, motorički testovi.*