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The Impact of the Pilates Program on the Mobility of Middle-Aged Women

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Abstract: *The aim of the study was to determine the impact of a 16-week Pilates program on the mobility of middle-aged women. The research involved 16 Pilates female exercisers who have been practicing this recreational exercise for at least a year, three times a week. Shoulder Circumduction Test, V Sit and Reach Test, Groin Flexibility Test, Back Scratch Test and Calf Muscle Flexibility Test were used to assess flexibility. In addition to descriptive parameters, repeated-measures ANOVA and Fisher LSD were used in the analysis. 16-week Pilates program has had a positive effect on changes in mobility in female exercisers both in the upper part of the body, in the area of the shoulder girdle ($p < .05$), and in the lower part of the body, in the area of the pelvic girdle and hip joint ($p < .05$). There were no statistically significant changes in plantar flexion. It can be concluded that the Pilates program effectively affects the improvement of flexibility in the shoulder region and the pelvic girdle and hip joint, while in plantar flexors of the feet a statistically significant improvement in the level of mobility under the influence of Pilates exercise was not observed.*

Keywords: *female exercisers, pilates, training, flexibility.*

Introduction

Pilates means exercises which are tantamount to stretching, breathing and control of the position and movement of the body what is indicated by its original name "Contrology" (Wells, Colt & Bialocerkowski, 2012), ie. exercise consisting of physical and mental exercise of the body (Anderson & Spector, 2005). Pilates exercises are based on the six traditional principles: centering, concentration, control, precision, flow and breathing (Latey, 2002). Since Joseph Pilates designed this method in response to the weakness of his body due to various diseases he had, at first due to its nature, this exercise was used exclusively by dancers as a recovery from frequent injuries (Anderson & Spector, 2005). Later, Pilates became a widely used method of recreational exercise, and also in rehabilitation (Latey, 2001; Wells et al., 2012; Byrnes, Wu & Whillier, 2018) as well as the regulation of overweight and the fight against obesity when it can be used as an alternative method of exercise due to the positive effect on cardiorespiratory abilities and body composition (Rayes et al., 2019). Pilates exercise reduces the risk of heart disease (Schroeder, Crussemeyer & Newton, 2002), has a positive effect on the increase in aerobic endurance, and the dynamic balance (Vieira et al., 2017), increases the level of durability and the rate of metabolism of exercisers (Kılıç Uğurlu & Dikdağ, 2018).

Based on one of the principles (centering) which indicates that during the exercise the muscles of the center of the body (powerhouse – space between the ribs and the bottom of the pelvis) are tightened, Pilates is often used as an effective tool in cases when the exercisers have problems with pains in the lower back (La Touche, Escalante & Linares, 2008; Miranda, Souza, Schneider, Chagas & Loss, 2017). If the lower back control of body position and movement is taken into account, Pilates has a significant impact on static and dynamic balance, primarily in women (Oliveira, Almeida & Gorges, 2015).

When it comes to mobility, this ability is one of the very important elements in achieving skeletal-muscular function in order to reach the peak of movement performance (Phrompaet, Paungmail, Pirunsan & Sitilertpisan, 2011). There is a static and dynamic kind of mobility. Static mobility, which is subjective because it is determined by the subject's stretching tolerance, refers to the extent of joint movement in relaxed muscles (Knudson, Magnusson & McHugh, 2000; Nuzzo, 2020). When it comes to dynamic mobility, it represents a more objective type of this ability

and refers to the tension of the muscle tendon (stiffness of the muscle-tendon) within the normal range of motion in the joint (Gleim & McHugh, 1997; Nuzzo, 2019).

And in terms of improving mobility, the Pilates method with its characteristic way of exercising has a significant impact (Segal, Hein & Basford, 2004), which can be seen in the research with different age groups. Pilates exercise gives results in terms of improving the flexibility of children and adolescents (González-Gálvez, Poyatos, Marcos-Pardo, Souza Vale & Feito, 2015; Cibinello, Jesus Neves, Leão Carvalho, Valenciano & Fujisawa, 2020; Hartono, Kesoema, Isma & Anantyo, 2020), students (Kibar et al, 2016; Ružić, 2020), middle-aged people (Kloubec, 2010; Gürhan & Kenan, 2020), the elderly (Oliveira et al., 2015; Oliveira, Oliveira & Pires-Oliveira, 2016; Oliveira, Pires-Oliveira, Aducarub, Oliveira & Oliveira, 2017; Oliveira, Oliveira & Pires-Oliveira, 2017). Based on previous research, the aim of the research is to determine the impact of a 16-week Pilates program on the mobility of middle-aged women.

Material and Methods

Sample of respondents

The study involved 16 Pilates female exercisers (age = 46.14 ± 8.23; height = 167.94 ± 7.24; weight = 61.44 ± 6.64; BMI = 21.8 ± 2.09), who have been engaged in this recreational exercise for at least a year. Before the research was carried out, the written consent of all female exercisers was obtained, as well as the official permission of the aerobics studio in which the research was performed.

Research protocol and organization

The study was conducted over a period of four months (16 weeks). The female exercisers have been subjected to the Pilates training three times a week in the afternoon for an hour. Three tests were performed, initially in the first week, transiently after the eighth week, and the final test after the sixteenth week. During the initial testing, a trial test was first organized in order for the trainees to get acquainted with the way the tests would be performed. Then, an experimental test was performed in which each test was repeated three times, so the best result was taken for further analysis. A 20-minute warm-up was performed before each test. Seven tests were used to assess the level of mobility (http://www.topendsports.com/testing/tests/index.htm) which have been found to be reliable and valid for the assessment of the researched ability: Shoulder Circumduction Test (Lemmink, Kemper, de Greef, Rispens & Stevens, 2003), V Sit and Reach Test (Cuberek, Machová & Lipenská, 2013; Sporiš, Vučetić, Jovanović, Jukić & Omrčen, 2011), Groin Flexibility Test (Malliaras, Hogan, Nawrocki, Crossley & Schache, 2009), Back Scratch Test – left and right (Keith, Clark, Stump, Miller & Callahan, 2014) and Calf Muscle Flexibility Test – left and right (André, Carnide, Borja, Ramalho, Santos-Rocha & Veloso, 2016). In addition to flexibility tests, anthromoperative characteristics were measured as control variables in the study (height, mass), and then the body mass index (BMI) was calculated.

Statistical analyses

From the statistical descriptive parameters in the analysis, the arithmetic mean from the measures of central tendencies and the standard deviation from the measures of dispersion were used. From the comparative statistics, in order to obtain possible changes (differences) in three testings of flexibility in female exercisers, analysis of variance for dependent samples (repeated measures ANOVA) and post hoc analysis (Fisher LSD) were used to determine specific changes (differences) between tests. The significance level is $p < 0.05$.

Experimental program

Pilates trainings have been realized in the aerobics studio, three times a week (Tuesdays, Thursdays and Saturdays from 6 pm), for an hour. All training sessions were accompanied by music at a tempo of 60 to 80 bpm (beat per minute).

The structure of the training consists of three parts: introductory, main and final part of the training. The introductory part of the training consists of mobility exercises lasting 5 minutes and warm-up exercises lasting 10 minutes. At the beginning of each Pilates training, whole body mobility exercises are performed, so that the movements in the joints are performed with ease and their functionality is preserved. Each exercise is repeated 6 to 8 times, and the exercises are done either in isolation for a single joint or for several joints. In this part of the training, props such as

elastic bands, wooden sticks and massage rollers are used. The second part of the introductory part of the training includes warm-up exercises which prepare the body for the efforts in the main part of the training. All exercises are repeated 6 to 10 times.

The main part of the training lasts for 35 minutes, and the number of repetitions of each exercise is from 10 to 12. The exercises are aimed at strengthening and shaping certain muscle regions (arm muscles, gluteal region, lower extremity muscles, abdominal muscles and the back muscles. In this part, small and large balls, elastic weights and pilates hoops are used as props.

In the final part of the training, lasting 10 minutes, stretching exercises of large muscle groups and especially those muscles that were engaged in the main part of the training are applied. The emphasis in stretching exercises is to keep the extreme position to the limit of pain, for 20 to 40 seconds.

Results

In addition to the descriptive statistical parameters of all three testings, Table 1 presents the analysis of variance for dependent samples (repeated measures ANOVA) which calculated the changes in the mobility variables of Pilates female exercisers.

Table 1. *Descriptive statistics and significance of differences between testings*

	Descriptives (Mean±Std. Dev)			ANOVA	
Mobility variables	Pre-test	Mid-test	Post-test	F	Sig.
Shoulder Circumduction	46.88±16.21	44.31±14.85	40.06±12.4	34.28	.000*
V Sit and Reach Test	9.25±6.77	11.44±6.54	12.31±5.7	3.4	.047*
Groin Flexibility Test	7.13±4	5.63±3.2	3.94±1.61	18.89	.000*
Left Back Scratch Test	7.03±3.3	7.13±3.3	7.19±3.32	2.02	.150
Right Back Scratch Test	7.44±2.26	7.5±2.26	7.63±2.36	6.18	.006*
Left Calf Muscle Flex. Test	10.99±3.45	10.99±3.46	11.01±3.47	2.56	.094
Right Calf Muscle Flex. Test	10.94±2.62	10.95±2.63	10.96±2.64	1.55	.228

Statistically significant changes in the level of mobility were partially determined. In the variables Shoulder Circumduction (Sig. = .000), V Sit and Reach Test (Sig. = .047), Groin Flexibility Test (Sig. = .000) and Right Back Scratch Test (Sig. = .006) statistically significant changes are shown, while in other variables this was not the case.

In order to determine precisely between which testings there is a statistically significant change, an additional Post hoc analysis is approached using the Fisher LSD procedure for those variables in which statistical significance was recorded.

Table 2. *Post hoc results (Fisher LSD test)*

Shoulder Circumduction Test		Sig.	V Sit and Reach Test		Sig.
pre-test	mid-test	.004*	pre-test	mid-test	.081
	post-test	.000*		post-test	.017*
mid-test	post-test	.000*	mid-test	post-test	.475
	pre-test	.004*		pre-test	.081
post-test	pre-test	.000*	post-test	pre-test	.017*
	mid-test	.000*		mid-test	.475
Groin Flexibility Test		**Sig.**	**Right Back Scratch Test**		**Sig.**
pre-test	mid-test	.007*	pre-test	mid-test	.259
	post-test	.000*		post-test	.002*
mid-test	post-test	.003*	mid-test	post-test	.029*
	pre-test	.007*		pre-test	.259
post-test	pre-test	.000*	post-test	pre-test	.002*
	mid-test	.003*		mid-test	.029*

Table 2 shows the results of Post hoc analysis for mobility variables that show possible changes between each individual testing. In the Shoulder Circumduction Test and the Groin Flexibility Test, statistically significant changes were visible after the mid-test, and the changes intensified after the post-test. In the case of the V Sit and Reach Test, the Pilates program contributed to the changes only after the post-test, and only in relation to the beginning of the experimental treatment (Sig. = .017). The results in the Right Back Scratch Test show the progress in the second part of the Pilates program, because the changes are visible both in relation to the mid-test (Sig. = .029) and in relation to the pre-test (Sig. = .002).

Discussion

The application of the Pilates program in this study, in most tests positively affected the changes of mobility in female exercisers both in the upper part of the body, in the area of the shoulder girdle (Shoulder Circumduction Test – Sig. = .000; Right Back Scratch Test – Sig. = .006), and in the lower part of the body, in the area of the pelvic girdle and hip joint (V Sit and Reach Test – Sig. = .047; Groin Flexibility Test – Sig. = .000). A similar conclusion was reached by Rogers & Gibson (2009), who, after the eight weeks of Pilates exercise, found an improvement of mobility in the shoulder region (shoulder reach) and the pelvic region (sit-and-reach). They also noticed an improvement in the lower back extension.

It is interesting that in the Back Scratch Test only the right side showed a positive change after the program was performed, while in the left side this was not the case. This can be explained by the fact that all female exercisers are right-handed and that their right half of the shoulder region is more mobile, so the Pilates program also influenced better results in relation to the left side. In two tests that examined the mobility of the muscles that perform plantar flexion of the foot (Calf Muscle Flexibility Test), there were no statistically significant changes, although the results of plantar flexors of the left foot were close to statistical significance (Sig. = .094). It can be concluded that the duration of the Pilates program of 16 weeks was not enough to notice significant changes in this region of the body and that the results should be monitored over a longer period of time.

If the previous research on the topic of mobility under the influence of Pilates is analyzed, a number of similar results to this research can be seen, which indicate a positive effect of this type of exercise on mobility in different parts of the body. Pilates exercise has a positive effect on increasing the hamstring extensibility which further affects the increase in the inclination of the pelvis and trunk flexion (Vaquero-Cristóbal, López-Miñarro, Cárceles & Esparza-Ros, 2015; González-Gálvez, Marcos-Pardo,Trejo-Alfaro & Vaquero-Cristóbal, 2020). The improvement in the amplitude of the movement depends on the levels of stretching of the muscles that perform that movement. Under the influence of breathing techniques in Pilates exercise, an increase in the activity of the abdominal muscles during torso flexion is observed (Barbosa, Guedes, Bonifácio, Silva, Martins & Barbosa, 2015). Breathing technique in Pilates also helps patients with acute back pain who are subjected to operations of the back and have a restricted mobility (Tae-Sung-Hee & Joon, 2017). In addition to the mobility and endurance of the abdominal muscles, Pilates exercise also has a beneficial effect on the activity and mobility of the muscles of the lumbar region (Kibar et al., 2016).

It is believed that Pilates exercise through static stretching exercises has a positive effect on increasing of mobility in older women in the part of the trunk extension. (Oliveira, Oliveira & Pires-Oliveira, 2016). If a sample of older women is observed, Pilates exercise, in addition to torso mobility, also has a positive effect on the area of the upper extremities. Oliveira et al. (2017) found that Pilates exercise increases the isokinetic muscle strength of the flexors and extensors in the elbow joint in older women, which enables the functionality of the upper extremities. Pilates exercise also increases isokinetic muscle strength of flexors and extensors in the knee in older women (Oliveira, Oliveira & Pires-Oliveira, 2017), thus expanding its operations in lower extremities.

The positive effect of Pilates exercises can be seen in terms of isometric extension of the torso, as well as muscle strength during flexion in the hip joint (Kliziene et al., 2017). Based on the results of the research, it can be confirmed that in the period of 1–2 months after the end of the 16-week Pilates program as well, the endurance of the torso flexor muscles significantly depends on the endurance of the torso extensor muscles, which contributes to increased mobility of the observed region of the body.

Conclusion

Finally, it can be concluded that Pilates is an effective method of exercise to increase the mobility of different parts of the body. The research shows that increased levels of mobility as a result of Pilates can be seen in recreational athletes of different ages who exercise with the goal of improving physical abilities and well-being, but also in patients who have already had some postural disorder or some other type of health problem.

Regarding this paper, it was determined that the Pilates program improved the mobility of middle-aged women in most of the observed regions of the body, which was the goal of the research. The level of mobility was determined in the area of the shoulder and pelvic girdle and hip joint, as well as in the area of the lower leg and foot. After 16 weeks of Pilates exercises, there was an improvement in the shoulder and pelvic girdle and hip joint. However, it should be mentioned that in plantar flexors of the feet, a statistically significant improvement in mobility, under the impact of Pilates exercises, was not observed, which indicates the need for longer treatment of the applied Pilates program.

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