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ORIGINAL ARTICLE

Investıgatıon of the effect of Pilates Exercıses on the Functıonal Parameters of Middle Age Sedantery Women

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ABSTRACT

This study aimed to investigate the effects of 8-week mat and reformer pilates exercises on functional movement skills, flexibility of adult healthy sedentary women. 58 [reformer exercise group (n: 20), mat exercise group (n: 21) and control group (n: 17)] volunteer women participated in the study. Functional Movement Screen test (FMS), sit and reach test, Trunk lateral flexion test, Quadriceps Femoris and M.Iliopsoas flexibility test were applied to the participants. Two-way repeated measures ANOVA was used in the analysis of the obtained data. Additionally, Bonferroni test, one of the multiple comparison tests, was used to determine the source of the difference between groups. Moreover, the percentage changes of eight-week exercises on FMS scores, flexibility and strength parameters of adult women were determined by using the formula %Δ= [(Post-test - Pre-test) / Pre-test*100]. According to the results of the study, it was determined that there was a statistically significant difference in the total FMS mean scores and flexibility test results of the exercise group and the control group. There was a higher increase in FMS scores and lower extremity flexibility values of the reformer group compared to the mat group, on the other hand, upper extremity flexibility levels of the mat group were found to be higher than the reformer group. As a result, it was determined that 8-week mat and reformer pilates exercises had a positive effects on some functional movement skills and flexibility parameters in adult healthy sedentary women.

Keywords: Mat pilates, Reformer pilates, Functional movement screen

INTRODUCTION

The human movements are classified into four categories as displacement, push and pull, level change, and rotation. These four fundamental movements organize bodily movements in daily life (Juan, 2016). The functional movement was the ability to maintain balance by maintaining the kinetic chain interaction between stability and mobility while applying fundamental movement patterns (Mills et al., 2005). Strength, flexibility, endurance, coordination, balance, and movement efficiency were essential components for implement successfully functional movement (Cook, 2001). It is known that Pilates exercises have positive effects on physical fitness, physiological and physical parameters. In this context, it is important to be able to predict possible injuries by detecting the asymmetry and weak connections in the person to reach the intended goal as soon as possible. (Perry and Koehle, 2013). Trainers can create a personalized training program and reach the determined goal more quickly and without injury according to muscle asymmetry and weaknesses. This study will be a guide for the trainers who will apply the Pilates exercises in terms of revealing the changes caused by the mat and reformer exercises in the performance of the person and the correct selection of the Pilates exercise method to be applied.

This study aimed to find a difference between the Functional Movement Screen (FMS) test, and flexibility characteristics between middle-aged sedentary women doing mat and reformer exercises.

MATERIAL and METHODS

Population and Sample: 58 sedentary women, who were working at Bursa Technical University between the ages of 25-50 and sedentary for at least 2 years, participated in the study. The modified physical activity readiness questionnaire was used as the criterion for inclusion in the research. Also, the ethics committee approval was obtained from the Ethics Committee of Gazi University for this study (Approval number: 77082166-604.01.02).

Research Design: The experimental design model was used in the research. In the study, all measurements were measured twice, before and after the eight-week pilates exercise program. Middle-age sedentary women were divided into three groups. The first group did not participate in any exercise program as a control group (n: 17, age; 36,18±6,54 year, BKI; 29,16±5,42 kg/m2). Exercise groups were divided into two groups as a mat (n: 21, age; 35,33±7,38 year, BKI; 22,39±3,44 kg/m2) and reformer (n: 20, age; 35,40±7,56 year, BKI; 21,93±2,7 kg/m2) exercise groups. All exercise programs were designed by the researcher 3 times a week for eight weeks and 60–75 minutes per exercise.

Data Collection Tool:

Mat Pilates Exercise: Mat Pilates exercises performed by pilates instructor as two sessions to groups of ten and eleven people. Level 1 mat pilates exercises were applied the daily exercise program.

Reformer Pilates Exercise: Reformer exercises were applied to the participants one-to-one by the pilates instructor in the reformer tool. Level 1 reformer pilates exercises were applied the Daily exercise program.

Functional movement screen (FMS) test measurement: FMS was determined the stability, mobility, limitation of function, muscle asymmetry, and limitations in a person's joint and movement patterns. Each move was scored between 0-3 points. The points from each move were added together and the person's total FMS score was calculated. The score that the participants can obtain from the test was between 0-21 (Cook et al., 2010).

Sit-Reach Flexibility: 45cm. wide, 32cm. in height, and 35cm. length platform's surface divided into centimeters. Participants were asked to reach as far as possible from the body in a long sitting position without bending their

knees on the platform with the upper surface 15cm outside. The furthest point where her fingers reach measured in cm. The best grade was recorded by performing three repetitions (Tamer, 2000).

Trunk Lateral Flexion Test: The test was performed while standing, with feet slightly apart and parallel to each other, arms beside the body. First, the place of the distal end of the middle finger of the right hand on the thigh was marked, and then the person was asked to lean her body sideways by sliding her hand down on the thigh. The last point was marked again, the distance to the first point was measured with a tape measure, and the best of three attempts was recorded in cm. The same process was repeated on the left side.

Quadriceps Femoris ve M.Iliopsoas flexibility test: The participant was laid prone, the leg to be tested was brought to 90 degrees of flexion from the knee joint, and was asked to lift the leg from the ground without breaking this position. The distance between the knee and the ground was measured with a tape measure, and the best of three attempts was recorded in cm. (Vergili, 2012).

Statistical Analysis: Two-Way repeated measures ANOVA was used in the analysis of variables measured repeatedly (pre and post-test) between groups. Also, Bonferroni post-hoc test was used to determine the source of the difference between the groups. Moreover, the percentage changes between the measurement times of the measured variables were calculated with the formula % Δ = [(Post-test - Pre-test) / Pre-test * 100] (Işık and Doğan, 2018). The significance level was determined as $p < 0.05$ and $p < 0.01$.

RESULTS

Table 1. Comparison of FMS point according to exercise groups and measurement times

Groups / Times	N	Pre-test $\overline{X}$ ±SD	Post-test $\overline{X}$ ±SD	Total %Δ	F	p
Control	17	12,47±2,45	12,18±2,46	-2,33b	9,722	0,001**
Mat	21	13,90±2,84	16,90±2,76	21,58a		
Reformer	20	13,40±2,11	16,40±1,31	22,39a		
		F=91,182; p=0,001**			Interaction F=28,567; p=0,001	

**p < 0,01; a,b: Different letters represented the difference between groups.

In Table 1, it was determined that there was a statistically significant difference between the total FMS score pre-test and post-test means of the participants (F = 91,182; p <0.01). Also, it was determined that the total FMS score means of the exercise groups were statistically different (p <0.01). Accordingly, the highest total FMS score increase (22.39%) was in the "Reformer exercise" group.

Table 2. Comparison of sit and reach (flexibility) point according to exercise groups and measurement times

Groups / Times	N	Pre-test $\overline{X}$ ±SD	Post-test $\overline{X}$ ±SD	Total %Δ	F	p
Control	17	21,82±5,98	21,82±6,52	0,00	0,211	0,810
Mat	21	19,00±6,58	26,76±8,69	40,84		
Reformer	20	17,25±9,80	29,35±6,26	70,14		
		F=93,075; p=0,001			Interaction F=25,198; p=0,001	

**p < 0,01; a,b: Different letters represented the difference between groups.

When Table 2 was examined, it was determined that the flexibility means of the exercise groups were not statistically different (p> 0.05). Also, a statistically significant difference was determined between the flexibility pre-test and post-test averages of the participants (p <0.01). Accordingly, the highest increase in flexibility (70.14%) was in the "Reformer exercise" group.

Table 3. Comparison of gövde lateral right flexion point according to exercise groups and measurement times

Groups / Times	N	Pre-test $\overline{X}$ ±SD	Post-test $\overline{X}$ ±SD	Total %Δ	F	p
Control	17	14,12±3,57	13,35±3,77	-5,45[b]	14,057	0,001
Mat	21	14,48±3,89	19,71±3,07	36,12[a]		
Reformer	20	16,35±3,34	21,10±2,47	29,05[a]		
		F=44,865; p=0,001			Interaction F=14,057; p=0,001	

**p < 0,01; a,b: Different letters represented the difference between groups.

When Table 3 was examined, a statistically significant difference was found between the mean trunk lateral right flexion pre-test and post-test of the participants (F = 44.865; p <0.01). Also, it was determined that the mean trunk lateral right flexion of the exercise groups was statistically different (p <0.01). Accordingly, the highest increase in trunk lateral right flexion (36.12%) was in the "Mat exercise" group.

Table 4. Comparison of gövde lateral sol fleksiyon point according to exercise groups and measurement times

Groups / Times	N	Pre-test $\overline{X}$ ±SD	Post-test $\overline{X}$ ±SD	Total %Δ	F	p
Control	17	14,46±5,27	14,2±3,85	-5,45[b]	8,305	0,001
Mat	21	14,48±3,68	19,90±3,40	37,43[a]		
Reformer	20	16,70±3,21	20,93±2,42	25,33[a]		
		F=41,894; p=0,001			Interaction F=14,230; p=0,001	

**p < 0,01; a,b: Different letters represented the difference between groups.

In Table 4, a statistically significant difference was determined between the trunk lateral left flexion pre-test and post-test averages of the participants (F = 41.894; p <0.01). Also, it was determined that the mean trunk lateral left flexion of the exercise groups was statistically different (p <0.01). Accordingly, the highest increase in trunk lateral left flexion (37.43%) was in the "Mat exercise" group.

Table 5. Comparison of M. Quadriceps Femoris ve M. Iliopsoas esneklik testi (sağ) point according to exercise groups and measurement times

Groups / Times	N	Pre-test $\overline{X}$ ±SD	Post-test $\overline{X}$ ±SD	Total %Δ	F	p
Control	17	8,71±2,76	11,24±3,85	-29,05[b]	20,645	0,001
Mat	21	10,71±3,39	17,76±3,77	65,83[a]		
Reformer	20	10,80±3,35	20,60±3,01	90,74[a]		
		F=160,903; p=0,001			Interaction F=16,438; p=0,001	

**p < 0,01; a,b: Different letters represented the difference between groups.

When Table 5 was evaluated, a statistically significant difference was found between the M. Quadriceps Femoris and M. Iliopsoas pre-test and post-test averages of the participants (F = 160.903; p <0.01). Accordingly, the highest increase in flexibility (90.74%) of M. Quadriceps Femoris and M. Iliopsoas (right) was in the "Reformer exercise" group.

Table 6. Comparison of M. Quadriceps Femoris ve M. Iliopsoas esneklik testi (sol) point according to exercise groups and measurement times

Groups / Times	N	Pre-test $\overline{X}$ ±SD	Post-test $\overline{X}$ ±SD	Total %Δ	F	p
Control	17	8,47±2,74	12,53±6,24	47,93[b]	12,563	0,001
Mat	21	10,57±3,37	18,05±3,56	70,77[a]		
Reformer	20	10,35±3,20	19,20±3,62	85,51[a]		
		F=91,381; p=0,001			Interaction F=3,786; p=0,029	

**p < 0,01; a,b: Different letters represented the difference between groups.

Table 6 showed a statistically significant difference between the M. Quadriceps Femoris and M. Iliopsoas pre-test and post-test averages of the participants (F = 91,381; p <0.01). Also, it was determined that the average flexibility (left) of the M. Quadriceps Femoris and M. Iliopsoas exercise groups were statistically different (p<0.01). Accordingly, the highest increase in flexibility (left) of M. Quadriceps Femoris and M. Iliopsoas (85.51%) was in the "Reformer exercise" group.

DISCUSSION

According to the results, it was determined that there was a statistically significant difference between the total FMS score pre-test and post-test means of the participants and the total FMS score means of the exercise groups (p <0.01). While there was an increase observed in the FMS scores of the exercise groups, a decrease was observed in the control group. When the studies on FMS in the literature were examined, it was reported that pilates exercises generally show positive results in the FMS scores of the individuals (Magdolna et al,, 2013; Marilia et al., 2015; Bertoli et al., 2016). According to the results of the this study, the highest total FMS score increase (22.39%) was observed in the "Reformer exercise" group. Reformer exercises consist of movements against the resistance provided by the springs. To keep the springs under control during the application of the movement, the stabilization and mobilization parameter in the joints was activated. The positive development of these parameters also increases the functional movement capacity. According to the results of this study, sedentary individuals who want to improve their functional movement capacity can apply the reformer exercise method.

Flexibility was one of the important features for the joints, muscles, and bones to work in harmony and perform functional movements at the right angles.

In this study, a statistically significant difference was determined between the flexibility pre-test and post-test averages of the participants (p <0.01), while the interaction between the flexibility values of the exercise groups and the measurement time was found to be statistically significant (F = 25.198; p = 0.001). The highest increase in flexibility (70.14%) was in the "Reformer exercise" group. While reformer exercises consisted of exercises against resistance (springs), mat exercises include movements performed by using one's body weight. When the literature was examined; It was reported that pilates exercises show positive results on the flexibility parameter. Many

researchers was reported that pilates exercises improve the flexibility parameter positively (Lee et al., 2016; Sinzato et al., 2013; Salla and Fachineto, 2021). The results of these studies support this study. Also, the flexibility tests applied to M. Quadriceps Femoris and M. Iliopsoas reported a positive improvement. In the literature, according to the results of the study conducted by Eroğlu (2011) and Vergili (2012), Right and Left M. Quadriceps Femoris and M. Iliopsoas found a significant difference in flexibility levels; in this context, the results of this study support the results of our study. According to the results, it was reported that reformer exercises can be applied to improve lower extremity flexibility.

In this study, according to the results of the trunk lateral flexion flexibility test, the highest increase was in the mat exercise group. According to the studies conducted by Eroğlu (2011) and Junges et al. (2012), while there was a significant increase occurred according to the results of the trunk right and left lateral flexion test of the Pilates exercise group, a decrease observed in the control group.

According to the measurement results of the flexibility parameter, reformer exercises can be applied to increase the flexibility of the lower extremities and mat pilates exercises can be applied to increase the flexibility of the upper extremities.

CONCLUSION

As a result, it was observed that women who performed reformer exercises showed higher levels of improvement in FMS scores, abdominal strength increase, and lower extremity flexibility values compared to the group that did the mat exercise. It was reported that upper extremity flexibility values of women who do mat exercises show an improvement compared to the reformer group. Also, it might be suggested that individuals design pilates exercises as combined exercises that include mat and reformer exercises to develop functional and flexibility parameters in a versatile way. In this context, combined pilates exercises can provide more effective results in protecting the individual from pain, posture disorders, and injuries by accelerating the functional and motor development of the individual.

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