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Original article

Comparison of the effect of the mat and reformer pilates exercises on the waist-hips ratio and body compositions of the middle-aged sedentary women

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Abstract. *Study Objectives:* The aim of this study was to compare the effects of the 8-week mat and reformer pilates exercises on body composition and waist-hip ratios of middle-aged sedentary women. *Methods:* Fifty-eight volunteer women participated in the study. Body compositions of women were measured by bioelectrical impedance analyzer, and waist and hip circumference were measured a using tape measure. In the analysis of the obtained data, two-way repeated-measures ANOVA was used. In addition, Bonferroni post-hoc test was used to determine the source of the difference between the groups. In addition, the changes in waist-hip ratios and body compositions of adult women for eight-week exercises were determined using the formula %Δ = [(Post-test - Pre-test) / Pre-test * 100]. *Results:* Body mass index, body fat mass, fat-free mass, and waist-hip ratios of the exercise groups were found to be statistically different from the control group ($p < 0.01$). According to these results, the highest body mass index (-1.87%) and body fat mass reduction (-5.35%) were found in the reformer exercise group. In contrast, the highest waist-hip ratio reduction (-1.20%) was in the mat exercise group. Moreover, the highest fat-free mass increase (0.39%) was found to be in the mat exercise group. *Conclusion:* As a result, 8-week mat and reformer pilates exercises were found to have positive effects on waist-hip ratios and body compositions of middle-age sedentary women.

Key words: Mat pilates, Reformer pilates, Body composition, Waist-hip ratio

Introduction

Lack of physical activity causes adverse effects on the body as well as an increase in body weight. Societies that walk less distance and start to participate less in activities outside the home, while reducing the amount of energy they spend during the day, also live a life away from healthy eating (1).

In addition to adequate and balanced nutrition, a lifestyle maintained with a regular habit of physical activity is needed in maintaining body composition. Both underweight and obesity rates, which are outside the normal body weight limits, differ greatly in developed and developing countries. In countries with food shortages, underweight is seen as a major health problem, while in developed or developing countries, obesity is the first major health problem. Obesity is a global public health problem and also an economic problem. The prevalence of obesity is increasing all over the world and women are affecting this more (2). Body mass index (BMI) is a widely used method in calculating the prevalence of obesity. Although BMI is a practical method, it cannot report the fat mass (FM) in the body and its distribution in the organism. When BMI is classified according to the World Health Organization, it is defined as ≤18.5 kg/m^2 underweight, 18.6–24.9 kg/m^2 normal, 25.0-29.9 kg/m^2 overweight, and ≥30.0 kg/m^2 obese (3).

Waist-hip ratio (WHR) is the first anthropometric method developed from epidemiological research as an indicator of body fat distribution (2). WHR should not exceed 1.0 in men and 0.8 in women (4). Otherwise, an increase in abdominal adipose tissue, and thus an increase in WHR negatively affect health. Because the risk for diabetes has increased 3.7 times in obese women, while it has increased 10.3 times in obese women (5).

Physical activity regulates the body's energy balance, provides control in body weight, and determines the body composition (6). Recent research shows that pilates exercises spend calories as fast walking (7). Also, it is seen that pilates exercises decrease BMI and WHR measurements (8). However, pilates exercises have started to contain diversity with advances in technology. Individuals can perform pilates exercises with their body weights, or they can perform pilates exercises against resistance with the help of tools. In this context, in this study, we aimed to compare the effect of reformer and mat pilates exercises on the body composition and WHR of middle-age sedentary women to prevent a health problem such as obesity. Thus, the differences between two different pilates exercises will be revealed.

Material and Method

Participants

Sixty-six volunteers who have been working at Bursa Technical University between the ages of 25-50 and who have been 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. However, eight participants could not complete the research for various reasons (pregnancy, health problem, etc.), so they were excluded from the research and the research was completed with a total of 58 middle-aged sedentary women. At the beginning of the research, the participants were informed about the purpose, importance, method, and achievements of the research, informed volunteer consent forms were filled and their signed approvals were obtained. In addition, the ethics committee approval was obtained from the Ethics Committee of Gazi University for this study (Approval number: 77082166-604.01.02).

Experimental 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). Exercise groups were divided into two groups as a mat (n: 21) and reformer (n: 20) exercise groups. During the research, no diet program was applied and the participants continued their routine lives. All exercise programs were designed by the researcher 3 times a week for eight weeks and 60–75 minutes per exercise.

Exercise Protocols

Mat Pilates Exercise

Mat pilates exercises were carried out by pilates instructor as two sessions to groups of ten and eleven people. Before the main phase of each exercise, the warm-up was performed for 10 minutes with pre-pilates exercises (Breathing, Imprinting, Iso-Abs, Rib Cage Arms, Head Nods, Neck Curl, Knee Folds, Flight, Seated Tracking, and Goal Post Arms). Level 1 mat pilates exercises were applied for 45 minutes in the main phase of the exercise and daily exercise program was completed after 5 minutes of stretching.

Reformer Pilates Exercise

Reformer exercises were applied to the participants one-to-one by the pilates instructor in the reformer tool. During the warm-up phase of the exercise, pre-pilates exercises (Breathing, Imprinting, Iso-Abs, Rib Cage Arms, Head Nods, Neck Curl, Knee Folds, Flight, Seated Tracking, and Goal Post Arms) were performed on the mat for 10 minutes. Level 1 reformer pilates exercises were applied for

45 minutes in the main phase of the exercise and daily exercise program was completed after 5 minutes of stretching.

Repeat numbers for mat and reformer pilates exercises were as in Table 1 for the first four weeks of study. In the last four weeks of the study, the number of repetitions for each week in mat pilates exercises was increased by two for each movement except a hundred and in reformer pilates exercises were increased by one for each movement except a hundred.

Table 1. Contents of mat and reformer exercises (9,10).

Mat Pilates Exercises		Reformer Pilates Exercise	
Movements	Number of Repetition	Movements	Number of Repetition
Hundred	5+5 (10 Breathing) x 10	Pilates V –Toes	10 Rep
Roll up	10 Rep	Plantar Flexed –Arches	10 Rep
One leg circle	10 Rep (for both Legs)	Heels	10 Rep
Rolling Like a Ball	8 Rep	Calf Raise -Tendon Stretch	10 Rep
Single Leg Stretch	8 Rep	Slow Running	10 Rep
Double Leg Stretch	10 Rep	Hundred	5+5 (10 Breathing) × 10
Single Straight Leg Stretch	10 Rep	Arm Straight - Reach and Pull	10 Rep
Double Straight Leg Lower Lift	10 Rep	Triceps Press	10 Rep
Crisscross	10 Rep	Winning	10 Rep
Spine Stretch Forward	6 Rep	Arm Circle	8 Rep
Saw	6 Rep	Parallel-Hamstring Pull	10 Rep
Swan	6 Rep	Laterally Rotated –Frog	10 Rep
Seal	6 Rep	Leg Circle	10 Rep
Abduction	12 Rep (for both Legs)	Straight Back -Straight Arm Row	10 Rep
Leg Circle	8 Rep (for both Legs)	Biceps Curl	10 Rep
Side Kick	10 Rep (for both Legs)	Rowing 1	10 Rep
Swimming Prep.	8 Rep	T Position	10 Rep
Mermaid	4 Rep (for both Directions)	RollBack	10 Rep
Push up series	4 Rep	Long Stretch	8 Rep
		Round Back -Elephant	8 Rep
		Neutral Back	10 Rep
		Round Back	10 Rep
		Knee Pull	10 Rep
		Prone Pull	8 Rep
		Swan Dive Prep.	8 Rep
		Mermaid	4 Rep
		Adductor stretch	5 Rep × 10 sec.
		Thigh Stretch - Scooter	5 Rep × 10 sec.

Measurements of BMI and Body Composition

The body heights of the participants were measured with the Seca 213 (Germany) brand 1 mm precision portable stadiometer according to the protocols (11). In addition, BMI and body compositions were measured in a sedentary mode according to protocols of the TANITA MC 780 brand Bioelectric Impedance Analyzer (12).

Measurement of WHR

Waist and hip circumference of the participants were measured with a tape measure. Waist circumference measurements were measured from the umbilicus level, while hip circumference measurement was measured from the widest part of the hips. The WHR of the participants was calculated by dividing the measured values with each other (13).

Statistical Analysis

IBM SPSS Statistic 24 package program was used to analyze the obtained data. Two-Way repeated-measures ANOVA was used in the analysis of variables measured repeatedly (pre and post-test) between groups. In addition, 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] (14). The significance level was determined as $p < 0.05$ and $p < 0.01$.

Results

The effects of eight-week pilates exercises on BMI, FM, fat-free mass (FFM), and the WHR of the participants were explained in the result section.

When table 2 was examined, there was a statistically significant difference between pre- and post-test measurement times for BMI of participants ($F = 15{,}308$; $p < 0{,}01$). In addition, it was determined that there was a statistically different between exercise groups' BMI ($F = 19{,}582$; $p < 0{,}01$). According to this result, it was determined that there was a difference between the control group and the BMI values of the mat and reformer pilates groups ($p < 0{,}01$), while there was no difference between the mat and reformer pilates exercise groups ($p > 0{,}05$). In addition, the highest BMI reduction (−1,87 %) was in the reformer pilates exercise group.

In table 3, there was a statistically significant difference between pre- and post-test measurement times for the body FM of participants ($F = 8{,}608$; $p < 0{,}01$). In addition, it was determined that there was a statistically different between exercise groups' body FM ($F = 12{,}255$; $p < 0{,}01$). According to this result, it was determined that there was a difference between the control group and the body FM values of the mat and reformer pilates groups ($p < 0{,}01$), while there was no difference between the mat and reformer pilates exercise groups ($p > 0{,}05$). In addition, the highest body FM reduction (−5,38 %) was in the reformer pilates exercise group.

When table 4 was examined, there was no statistically significant difference between pre- and post-test measurement times for the body FFM of participants

Table 2. Comparison of BMI according to exercise groups and measurement times

Groups/ Times	N	Pre-test	Post-test	Total	F	P
		± S.D.	± S.D.	%Δ		
Control	17	29,16 ± 5,42	28,74 ± 5,55	−1,38[b]		
Mat	21	22,39 ± 3,44	22,08 ± 3,13	−1,44[a]	19,582	0,001**
Reformer	20	21,93 ± 2,70	21,52 ± 2,57	−1,87[a]		
Total	58	24,22 ± 5,02	23,84 ± 4,95	−1,57	Interaction	
F=15,308; p=0,001**					F = 0,141; p = 0,869	

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

Table 3. Comparison of body FM according to exercise groups and measurement times

Groups/ Times	N	Pre-test	Post-test	Total	F	P
		± S.D.	± S.D.	%Δ		
Control	17	26,40±10,40	26,09±10,68	1,17[a]		
Mat	21	15,90±6,98	15,10±6,35	-5,03[b]	12,255	0,001**
Reformer	20	16,35±4,36	15,47±4,42	-5,38[b]		
Total	58	19,13±8,73	18,45±8,79	-3,55	Interaction	
		F = 8,608; p = 0,005**			F = 0,723; p = 0,490	

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

Table 4. Comparison of body FFM according to exercise groups and measurement times

Groups/ Times	N	Pre-test	Post-test	Total	F	P
		± S.D.	± S.D.	%Δ		
Control	17	48,64±4,20	47,86±4,51	-1,60[a]		
Mat	21	43,79±4,72	43,96±4,07	0,39[b]	8,499	0,001**
Reformer	20	43,23±3,24	43,39±2,82	0,37[b]		
Total	58	45,02±4,68	44,91±4,23	0,24	Interaction	
		F = 1,052; p = 0,309			F = 4,432; p = 0,016*	

*p < 0,05; **p < 0,01; a,b: Different letters represent the difference between groups.

Table 5. Comparison of WHR according to exercise groups and measurement times

Groups/ Times	N	Pre-test	Post-test	Total	F	P
		± S.D.	± S.D.	%Δ		
Control	17	0,89±0,07	0,91±0,07	2,25[a]		
Mat	21	0,83±0,06	0,82±0,07	-1,20[b]	10,540	0,001**
Reformer	2	0,83±0,04	0,84±0,04	1,20[b]		
Total	58	0,85±0,06	0,85±0,07	-	Interaction	
		F = 1,435; p = 0,236			F=3,402; p = 0,040*	

*p < 0,05; **p < 0,01; a,b: Different letters represent the difference between groups.

(F = 1,052; p > 0,05). In addition, it was determined that there was a statistically different between exercise groups' body FFM (F = 8,499; p < 0,01). According to this result, it was determined that there was a difference between the control group and the body FFM values of the mat and reformer pilates groups (p < 0,01), while there was no difference between the mat and reformer pilates exercise groups (p > 0,05). In addition, the highest body FFM increase (0,39 %) was in the mat pilates exercise group.

When table 5 was examined, there was no statistically significant difference between pre- and post-test measurement times for WHR of participants (F = 1,453; p > 0,05). In addition, it was determined that there was a statistically different between WHR of the exercise groups (F = 10,540; p < 0,01). According to this result, it was determined that there was a difference between the control group and the WHR of the mat and reformer pilates groups (p < 0,01), while there was no difference between the mat and reformer pilates exercise groups (p > 0,05). In addition, the high-

est WHR reduction (-1,20%) was in the mat pilates exercise group.

Discussion

According to the main findings of this study, BMI, FM, and WHR values of the exercise groups decreased more than the control group, whereas FFM values increased higher. However, there was no statistically significant difference between the mat and reformer pilates exercises.

In general, it can be thought that BMI values will not decrease since pilates exercises are not based on the cardiovascular training method. However, pilates exercises also differ from each other. For example, mat exercises include movements performed by using one's body weight, whereas reformer exercises include exercises against resistance. It is known as the movements against resistance will cause us to spend more effort. Indeed, when the literature was examined, it was found that the effects of pilates exercises on BMI show contradictory results. While some studies reported that pilates exercise did not have a positive effect on BMI (15, 16, 17), other studies reported that it had a positive effect (18, 7, 19, 20, 21, 22). According to the results of this study, it was determined that exercise groups had higher BMI decrease compared to the sedentary group. In exercise groups, the highest BMI decrease was observed in the reformer exercise group as −1,87 %. This result shows that reformer pilates exercises cause more effective in reducing BMI than mat pilates exercises.

When body FM changes were examined, it has been reported by many studies that pilates exercises cause changes in individuals' body FM. (16, 17, 20, 23). According to the results of the current research, it was determined that there was a higher FM decreased in the exercise groups compared to the sedentary group. In exercise groups, the highest FM decrease was observed in the reformer exercise group as −5.38 %. This result shows that reformer pilates exercises will cause more effective results than mat pilates exercises in FM decrease. Moreover, it suggests that reformer exercises may cause more body fat burning in the individual because they are performed against resistance.

The results of the researches about the effects of pilates exercises on body FFM differ from each other. Çakmakçı (2011) reported that pilates exercises have no effect on FFM in obese women (24). Similarly, Wong et al. (2020) reported that 12-week pilates exercises in obese women did not make a significant difference to their FFM (25). In contrast, Vaquero-Cristóbal et al. (2015) and Marilia et al. (2015) reported that pilates exercises significantly reduced body FFM (21, 26). The reason for the contradiction can be the fact that the research groups are in different BMI classes or the pilates exercises are continued regularly for a longer period. When the current research results were examined, it was determined that there was a higher FFM increase in exercise groups compared to the sedentary group. In exercise groups, the highest FFM increase was observed in the mat exercise group as 0.39 % kg.

The distribution of adipose tissue in the body regions is as important as the amount of adipose tissue in the body (27), and it has been reported by the World Health Organization that the WHR can be used to evaluate the risk associated with obesity (28). When the effect of pilates exercises on WHR was examined, it was found that the results of the studies in the literature differ from each other. avkın (2014) observed that pilates exercises do not cause a significant change in WHR in middle-aged women (29). Similarly, Baylan (2008) formed a mat and control group and made pilates exercises among people between the ages of 18–25 and 40–50. They reported that there was no significant difference between the pre- and post-test results of the WHR of the exercise and control groups in both age ranges (30). Despite the results of these studies, Junges et al. (2012) found that pilates exercises caused a significant decrease in WHR (31). In another study, Eroğlu (2011) and Katasıfçı et al. (2014) found that 6-week mat pilates exercises significantly reduced WHR in sedentary women (32, 33). According to the results of this study, the highest WHR decrease was observed in the mat exercise group as −1.20 %.

Conclusion

As a result, it was observed that reformer exercises decrease the body FM of women and decrease

BMI values due to the decrease in body FM. On the other hand, it was found that women who performed mat exercises caused a lower decrease in their FFM values, although they caused a lower decrease in BMI. In this context, because of the muscle mass increases, it can be said that the mat group has a lower decrease in BMI than the reformer group. The fact that the most decrease in WHR is in favor of the mat pilates exercise group supports these results. These results suggest that women who want to decrease their body mass index should do reformer exercise and women who want to increase muscle mass should do mat exercise.

Aladro-Gonzalvo et al. (2012) reported that one of the main deficiencies of the groups performing pilates exercise was not controlling the nutritional status. They stated in their research that changes in body composition would increase energy expenditure (eg, exercise) and reduced energy intake (eg, diet) to achieve more effective results (34). For this reason, individuals who do pilates exercises should check their nutritional status during the exercise period to obtain a change in body composition. Nutrition and diet are some of the limitations of this research. With pilates exercises, more effective results can be obtained by applying diet. In addition, individuals may be advised to design pilates exercises as combined exercises, including mat and reformer exercises, so that parameters in body compositions can be developed in many ways.

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