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The Effect of 10 Week Pilates Mat Exercise Program on Weight Loss and Body Composition for Overweight Turkish Women

Evrim Çakmakçı

School of Physical Education and Sport, Selcuk University, Konya, Turkey

Abstract: The aim of this study was to research the effects of 10-weeks pilates mat exercise program on weight loss and body composition parameters for sedentary overweight women. A total of 36 health sedentary overweight women volunteered to participate in this study. They were divided into two groups at random: pilates mat exercise program group (PMG; N=20) and control group (CG; N=16). A pilates mat exercise program was applied to the subjects one hour per day and three days per week for 10 weeks. The subjects in the control group did not participate in training. Body mass index (BMI), waist circumference (WC), waist-hip ratio (WHR), 4-site skin fold thickness (Biceps, Triceps, Supscapula and Iliac), fat percentage (FP), basal metabolic rate (BMR) and lean body mass (LBM) were evaluated before and after the pilates training program. After 10-week of pilates mat exercise program, significant differences were found on weight, BMI, body composition parameters, WHR, WC, FP, LBM and BMR in (PMG) (P<0, 05). There were not significant differences in the same measurements in the control group. Pilates mat exercises program contributed to decreasing of weight, FP, BMI and body composition parameters. Besides, there was thought that the quality of life increased for sedentary overweight women.

Key words: Body Mass Index · Fat Percentage · Physical Fitness · Public Health

INTRODUCTION

Overweight and obesity are conditions of excess body fat (National Health and Medical Research Council [1] and cause major public health problems (World Health Organization [2] such as cardiovascular diseases, diabetes, hypertension and other health disorders [3]. One's excessive weight is more closely associated with these health risks [4, 5]. Recent clinical guidelines showed that disease risk was best classified for overweight and obese person with both BMI and WC [3]. Besides, measurements for WC and WHR have been researched as an alternative to BMI and both measures were regularly used in the clinical and research settings. Also, WC has made clear that the best simple measure is of both intra-abdominal fat mass and total fat [6, 7].

The World Health Organization (WHO) defines weight status according to BMI, the ratio of weight (in kilograms) divided by height (in meters squared). A BMI of 20 to 25.9 as normal weight, 25 to 29.9 as overweight and equal to or greater than 30 as obesity are defined by the WHO [8].

Public health guidelines recommend physical activity [9] which can be easy to reach, limited time allocated to many sedentary individuals. Recent study puts forward that exercise accumulation combined with dietary modification may be effective at improving short-term exercise adherence and weight loss in overweight adults [10]. Exercise is the most important component of behavior interventions aimed at overweight and obese adults when combined with changes in dietary intake [11] and is one of the best long-term weight loss predictors. Besides, when it combined with dietary changes, it was seen to be important for improving short-term weight loss [12].

There are mentioned that after eight to 12 weeks step-aerobic exercise and dance programme, a reduction are in body weight and fat composition in a few studies

Corresponding Author: Evrim Çakmakçı, Selçuk University, School of Physical Education and Sport, Alaeddin Keykubat Campus, 42079, Selçuklu, Konya, Turkey.
Tel: +90 332 223 31 54, Fax: +90 332 241 16 08.

[13, 14]. Besides, it has been mentioned that physical training bring about to changes in weight and body composition by a few researchers [15, 16]. Additionally, there are examined the effects of three different exercise program on physical and physiological fitness parameters for 60 sedentary obese female subjects by Akdur *et al* (2007) The study groups consisted of three different group: 1. diet and step-aerobic exercise, 2.diet and walking exercise and 3. only diet. After the ten weeks in step aerobic exercise and walking exercise, they found that body weight, body mass index and total cholesterol changed significantly [17].

Ferreira *et al.* (2009) examined that the effects of three months of the Pilates-based mat exercise program on Body Composition. There were participated sixty eight women (aged 25-55 yrs) to Pilates-based mat exercise program during 12 weeks, for two day 60-minutes sessions per week in their studies. They have found that body composition improved, namely increased Lean Mass and decreased Fat Mass and the Percentage Fat Mass at upper and lower limbs level. Besides, it has been suggested that the Pilates training may be useful to Body Composition control by Ferreiera *et al.* (2009) [18].

Pilates is a series of low impact muscle contraction exercises. The activities develop the muscles in the core of the body (i.e. the abdomen, hips and back [19]. The exercises are typically done to strengthen the abdominal muscles, hips and back by lying down on a mat; these include a series of controlled movements of the arms and legs [20]. Pilates training is referred to as core strengthening that focuses on back extensors and the abdominal musculature, especially the transversus abdominus. Initially, the Pilates mat exercise used a wide truncal base of support in prone, side-lying, or supine positions, while moving the limbs to vary torque on truncal muscles [21]. Pilates is quite popular among women [19] and it has positive effects on their body mass, waist circumference and body composition. Chang states that there are practitioners over 5 million and in a simple search on the Internet there are videos over 200 available on the topic in USA. Besides, this study also has only exercise and control groups without a diet and it may be important to examine the cost-effectiveness of these exercise program in future weight loss studies. Therefore, the purpose of this study is to research the effects of 10-week modern Pilates mat exercise program on weight loss and body composition for overweight sedentary women.

MATERIALS AND METHODS

Subjects: In this study total 36 health sedentary Turkish women participated as volunteers from vocational training course in Konya. The subjects were randomly divided into experimental and control groups. All study procedures were approved by the Ethics Committee at the Faculty of Selcuklu Medical Sciences, Selcuk University in Konya, Turkey. The age and height averages of the experimental (EG) and control group (CG) were respectively 28.35±10.18 years for age, 161.65±6.08 cm for height (n=20) and 28.19±7.44 years for age, 159.93±4.11 cm for height (n=16). These subjects had no previous pilates experience, were chosen to participate in this study.

Data Collecting System: The study was performed at vocational training course in Konya (VTCK), from October to end of December. The dependent variables were selected depending on previous Pilates result claims. To measure these parameters, all subjects and controls performed a series of standard fitness tests to evaluate BMI, waist circumference, iliac crest, hip circumference, skinfold thicknesses which involve biceps (anterior surface of the biceps midway between the anterior auxiliary fold and the antecubital fossa), triceps (vertical fold on the posterior midline of the upper arm, halfway between the acromion and olecranon process), subscapular (fold on the diagonal line coming from the vertebral border to between 1 and 2 cm from the inferior angle of the scapulae) and suprailiac (diagonal fold above the iliac crest even with the anterior auxiliary line).

Pilates Mat Exercise Program: Individuals were informed about study; written informed consent was taken from all participants. The measurements were taken twice before and after pilates mat exercise program applied a 10-week series of one hour Pilates mat exercise three days per week. The control group did not participate in any activity in Pilates mat exercise during the ten-week period. All measurements were recorded at baseline and after the study at once.

Carvonen method was used for intensity of pilates mat exercise program [22]. Initially, According to Carvonen's formula, maximal heart rate was estimated to be 60-70 % of for pilates mat exercise program. The target then became to raise their heart rate to 80–85%.

Table 1: The Pilates Mat Exercise Program

	1-3 weeks	4-6 weeks	7-10 weeks
Monday	10 min. warm up	10 min. warm up	10 min. warm up
	40 min. Pilates Mat	45 min. Pilates Mat	50 min. Pilates Mat
	Exercises (8x2)	Exercises (8x3)	Exercises (8x4)
	10 min. cooling	10 min. cooling	10 min. cooling
Wednesday	10 min. warm up	10 min. warm up	10 min. warm up
	40 min. Pilates Mat	45 min. Pilates Mat	50 min. Pilates Mat
	Exercises (8x2)	Exercises (8x3)	Exercises (8x4)
	10 min. cooling	10 min. cooling	10 min. cooling
Friday	10 min. warm up	10 min. warm up	10 min. warm up
	40 min. Pilates Mat	45 min. Pilates Mat	50 min. Pilates Mat
	Exercises (8x2)	Exercises (8x3)	Exercises (8x4)
	10 min. cooling	10 min. cooling	10 min. cooling
Warm up	Pilates Mat Exercise	Repetitions (8)	Cooling
- Breathing	- The Hundred		
- Imprint and release	- The Shoulder Bridge		
- Spinal rotation	- Single Leg Circle		
- Cat stretch	- Swimming		
-Hip rolls	- One Leg Stretch		
- Scapula isolation	- Double Leg Stretch		-Flexibility exercise
- Arm circles	- Rolling Like a Ball		-Stretching exercise
	- The Saw		
	- Roll Up		
	- Spine Strech		
	- Leg Pull Down		
	- Leg Pull Up		
	- Push Up		
	- Pelvic Curl		
	- Side Bend		
	- Side Kick Front		
	- Side Kick Back		

The pilates mat exercise program consisted of 10-week series of one hour for three days per week [23, 24]. Exercises were performed on a mat. Each exercise session lasted for about 60 min and was led by a certified Pilates coach. Besides, The pilates mat exercise program was applied over a ten-week series of one hour sessions for three days per week. The subjects (EG) participated in three 40-minute sessions per week for three weeks followed by three 45-minute sessions per week for another three weeks and then three 50-minute sessions per week for another four weeks. For the first three weeks, each session consisted of 10 minutes for warming up, 40 minutes for pilates mat exercise program from 8x2 set followed by 10 minutes to cool down. For the following three weeks, 45 minutes of pilates mat exercise program from 8x3 set and for another four weeks, 50 minutes of pilates mat exercise program from 8x4 set, while the warming up and cooling down times remained the same. The coach showed each exercise and then provided verbal cues, physical assistance to provide accuracy of subject movements. The pilates training program was seen in (Table 1).

Measurements: Height was measured to the nearest 0.1 cm on a stadiometer for the shoeless participants. Body weight was measured within 0.1 kg on a calibrated beam balance platform scale (Continental Scale, Bridgeview, IL) and on a Tanita BIA instrument (model TBF-305; Tanita, Arlington Heights, IL). Subjects wore a dry swimsuit or lightweight shorts and a t-shirt.

Body Composition: BMI was calculated as weight in kilograms divided by the square of the height in meters. The BMI was then categorized according to the recommendations of the World Health Organization [25]. Below-normal weight (<18.5 kg/m^2), normal weight (18.5–24.9 kg/m^2), overweight (25.0–29.9 kg/m^2) and obesity (30.0–39.9 kg /m^2) and extreme obesity (40 kg/m^2).

During the subjects' minimal respiration, waist circumference was measured from the nearest 0.1 cm at the iliac crest [26]. When viewed from the side, hip circumference was evaluated at the level of maximum thigh extension and WSR was calculated as WC (cm)/height (m).

Skinfold thicknesses were defined with a total of four skinfold measurement by using the Holtain skinfold calliper. Skinfold thickness involved biceps (anterior surface of the biceps midway between the anterior auxiliary fold and the antecubital fossa), triceps (vertical fold on the posterior midline of the upper arm, halfway between the acromion and olecranon process), subscapular (fold on the diagonal line coming from the vertebral border between 1 and 2 cm to the inferior angle of the scapulae) and suprailiac (diagonal fold above the iliac crest even with the anterior auxiliary line).

Statistical Analysis: The SPSS statistical program (version 15.0) was used for data analysis. Standard statistical methods were used for the calculation of means and SD. The Kolmogorov-Smirnov test was used to determine if dependent variables were normally distributed. The Levene test was used to determine if there was homogeneity of variance. Paired t-tests were used to determine significant differences over time for some dependent variable. Unpaired t-tests were used to compare the experimental group and control groups for some dependent variables. Also, an analysis of covariance (ANCOVAs) was run on each dependent variable. For all analysis, the criterion for significance was set at an alpha level of $p< 0.05$.

Table 2: Data summary for the experimental group and control group (Mean ± SD)

Variables	Experimental group (n = 20)	Control group (n = 16)
Age (year)	28.35±10.18	28.19±7.44
Body height (m)	161.65±6.08	159.93±4.11
weight (kg)	66.06±7.69	60.50±8.40

RESULTS

As shown in Table 2, the mean (SD) age is 28.35±10.18 (years), body height is 161.65±6.08 (m), weight is 66.06±7.69 (kg) for the experimental group. The mean (SD) age is 28.19±7.44 (years), body height is 159.93±4.11 (m) and weight is 60.50±8.40 (kg) for the control group. We found significant differences between pretest and posttest for weight, body mass index, waist circumference, biceps, triceps, subscapula and iliac in the experimental group ($p < 0.05$). Also, There was not significant differences between pretest and posttest for weight, body mass index, waist circumference, biceps, triceps, subscapula and iliac in the control group in Table 3 ($P>0. 05$).

As shown in Table 5, it indicates descriptive statistics of posttest values according to experimental and control groups. Besides we determined significant differences with covariance analysis on effect of plates training for waist-hip ratio, fat percentage, basal

Table 3: Comparison of the statistical significance between groups in the pretest and posttest

			Pre-test			Post-test		
Variables	Groups	n	Mean ± SD	t	p	Mean ± SD	t	p
Weight (kg)	Experimental group	20	66.06±7.69	2.070	0.046	64.02±7.55	0.969	0.340
	Control group	16	60.50±8.40			61.50±8.01		
Body mass index	Experimental group	20	25.33±2.96	1.726	0.093	24.54±2.90	0.542	0.591
	Control group	16	23.62±2.94			24.02±2.83		
Waist circumference	Experimental group	20	77.95±8.97	2.847	0.007	74.95±8.03	1.719	0.095
	Control group	16	70.12±7.09			70.50±7.29		
Waist-hip ratio	Experimental group	20	0.76±0.07	-24.271	0.000	0.7543±0.07	-21.465	0.000*
	Control group	16	1.41±0.09			1.392±0.10		
Biceps	Experimental group	20	11.35±2.45	-0.286	0.776	10.25±1.78	-1.203	0.237
	Control group	16	11.75±5.63			11.81±5.48		
Triceps	Experimental group	20	18.25±5.03	-1.885	0.068	15.20±3.37	-3.962	0.000*
	Control group	16	22.12±7.29			22.37±7.19		
Supscapula	Experimental group	20	17.45±4.65	-0.484	0.632	15.50±3.84	-1.634	0.112
	Control group	16	18.37±6.80			18.44±6.81		
Iliac	Experimental group	20	17.80±4.08	-0.142	0.888	15.50±2.69	-1.555	0.129
	Control group	16	18.06±6.93			18.12±6.94		
Fat percentage	Experimental group	20	30.30±2.45	-2.670	0.012	28.64±2.09	-4.386	0.000*
	Control group	16	33.43±4.48			33.63±4.53		
Basal metabolic rate	Experimental group	20	1156.95±84.47	-9.591	0.000	1137.44±83.13	-11.003	0.000*
	Control group	16	1397.45±60.27			1407.01±57.78		
Lean body mass	Experimental group	20	44.21±3.51	-6.211	0.000	43.31±3.54	-6.805	0.000*
	Control group	16	50.65±2.43			50.70±2.80		

Table 4: Comparison of the pretest and posttest relative physical with respect to experimental group and control groups

		Pretest	Posttest		
Groups	Variables	Mean ± SD	Mean ± SD	t	p
E.G. (n=20)	Weight	66.06±7.69	64.02±7.55	9.575	0.000
	BMI	25.33±2.95	24.54±2.91	9.303	0.000
	WC	77.95±8.97	74.95±8.03	3.091	0.006
	Biceps	11.35±2.45	10.25±1.77	3.803	0.001
	Triceps	18.25±5.02	15.20±3.36	4.495	0.000
	Supscapula	17.45±4.65	15.50±3.84	5.325	0.000
	Iliac	17.80±4.08	15.50±2.68	4.159	0.001
C.G. (n=16)	Weight	60.50±8.39	61.50±8.00	-1.936	0.072
	BMI	23.62±2.93	24.02±2.83	-2.005	0.063
	WC	70.12±7.09	70.50±7.29	-1.695	0.111
	Biceps	11.75±5.63	11.81±5.47	-.565	0.580
	Triceps	22.12±7.29	22.37±7.19	-2.236	0.041
	Supscapula	18.37±6.80	18.44±6.81	-1.000	0.333
	Iliac	18.06±6.93	18.12±6.95	-1.000	0.333

Table 5: Descriptive statistics of the posttest points with respect to experimental group and control groups

Groups	Variables	Mean±SD (s)	Estimate Marginal Means (s)
E. G.	WHR	0.75±0.07	1.026
	Fat perc.	28.64±2.09	29.93
	BMR	1137.44±83.13	1239.82
	LBM	43.31±3.54	46.28
C.G.	WHR	1.39±0.10	1.053
	Fat perc.	33.63±4.53	32.007
	BMR	1407.00±57.78	1279.04
	LBM	50.71±2.80	47.001

Table 6: ANCOVA results of the posttest points corrected in pretest according to experimental group and control groups

Variables	Source of variance	Type III Sum of Squares	Mean quare	f	p
WHR	Covariate	0.19	0.19	83.20	0.000
	Effect of Experiment	0.000	0.000	0.16	0.691
FP(%)	Covariate	360.98	360.98	394.14	0.000
	Effect of Experiment	31.56	31.56	34.46	0.000*
BMR	Covariate	174302.89	174302.89	811.74	0.000
	Effect of Experiment	3691.50	3691.50	17.19	0.000*
LBM	Covariate	349.04	349.04	1411.72	0.000
	Effect of Experiment	2.18	2.18	8.82	0.006*

metabolic rate and Lean Body Mass in the experimental and control groups in Table 6 ($p < 0.05$). Therefore, there was seen the effect of pilates training method on waist-hip ratio, fat percentage, basal metabolic rate and lean body mass in Table 6 ($P<0.05$).

DISCUSSION

Pilates exercises can be performed in group or private settings with and without apparatus. Mat exercises focus upon the core musculature, e.g. abdominals, back, hips and shoulder girdle. The movements rely upon correct positioning of the body relative to gravity as well as lever (limb) length alterations to develop the core musculature [27]. This study examined the effects of 10-week modern pilates mat exercise program on weight loss and body composition for overweight sedentary women.

Difference between the means of the pre-and post-tests of waist-hip ratio, fat percentage, basal metabolic rate and lean body mass of the exercise group was proved to be higher compared to the control group. Besides, there was a significant difference between pre- and post-measurements in exercise and control groups ($p<0.05$) (Table 3). Segal *et al.* (2004) noted that LBM, truncal LBM and fat mass did not change during the course. Because they had pilates training program that was 1-hour Pilates class each week during a 6-month period. In our study, we implemented pilates mat exercise

program as a ten-week series of one hour sessions for three days per week, exercises were done in difficulty during the 4-6 and 7-10 week periods of training. It was thought that their results were not similar to our study [28].

The other important findings of this study were important developments on weight, BMI and body composition parameters, so we found significant differences between pretest and posttest in experimental group. Also, we did not find significant differences between pretest and posttest for weight, BMI and body composition parameters in the control group ($P>0.05$) (Table 4). In particular, it was observed that Pilates training had a positive effect on weight, BMI and body composition parameters in experimental group. Because the control group had sedentary lives, BMI and weight increased in overweight CG.

Kloubec (2010) found significant decreases on BMI in experimental group after the pilates training program [29]. Slentz *et al*. (2004) found relationships between three different exercise amount and weight loss, body composition changes and reduction in the abdominal, waist circumference compared with the without exercise group in this study [30].

Another study is to research the effect of a 12-week functional exercise program for overweight women. This study participants were n=13 exercisers, n=13 controls among overweight women for exercise session twice each week during 12 weeks. They found LBM, BMI and skin-fold thickness decreased significantly for overweight women in the exercise group. Their results indicated that a functional exercise program had the potential to improve performance in a number of physiological variables for overweight women [31]. These results were similar to our study. Because they had similar subject group (overweight women), variables and training time as in our study.

In our study, it was also observed that a minimum exercise of 60 min/wk of throughout the 10 -week pilates mat exercise program enhanced WHR, BMR and LBM and fat loss compared with the control group. These results could be seen in the ANCOVA test, statistically significant differences were found in pretest-posttest comparison of WHR, FP, BMR and LBM at exercise group ($p<0.05$) (Table 6). In this study, the effect of Pilates mat exercise program was very different at the end of ten weeks. Because we thought that weight change appeared to have a strong impact on WHR, FP, BMR and LBM. Ramezankhany and *et al*. (2010) compared the aerobic, pilates exercises and low calorie diet in sedentary women. They found significant changes in experimental groups (aerobic, pilates and low calorie diet) on WHR and Weight loss [33].

Jakicic, *et al*. (1999) examined the effect of intermittent, traditional continuous exercise on weight loss, adherence and fitness and the effect of combined intermittent exercise by using home exercise equipment. A total of 148 sedentary overweight women participated, as mean±SD 36.7± 5.6 years for age, in a university based weight control program but 115 subjects completed 18 months. They used eighteen monthly behavioral weight control program with 3 groups: long-bout exercise (LB), multiple short-bout exercise (SB), or multiple short-bout exercise with home exercise equipment (SBEQ) by using a treadmill. They found significant changes in percentage of body fat, fat mass and lean body mass over time for overweight women [32]. It was determined that they had results of these study findings. However, we had obtained more progress in a short time. Because we had pilates coach and pilates mat exercise program having different frequencies and intensities.

Ferreira, *et al*., (2009) examined the effect of pilates exercise on body composition for sedentary women. This study included sixty eight women, aged 25-55 years, as exercise group (n=43, 41.0±7.2 yrs) in 12-week classes of 60 minutes, twice per week and a control group (n=25, 40.0±7, 7) years. They did not found statistically significant differences between exercise group and control group at baseline [18]. It was thought that the frequency and intensity may be cause of the pilates mat training program (two hours in a week pilates exercise). Due to fat loss and increase in muscle mass, pilates can not be expected to contain fundamental isometric exercises. The absence of changes in body composition may be related to subjects participating in the Pilates program only 2 hours in each week. But their study demonstrated that women's exposure to Pilates mat exercise program for two 60-minutes sessions per week during 12 weeks improved Body Composition, increased Lean Mass and decreased Fat Mass and the Percentage Fat Mass at upper and lower limbs level and they suggested that The Pilates mat exercise program may be useful for Body Composition control. Our study has determined that ten-week Pilates mat exercise was effective in body composition parameters, we found statistically significant differences between exercise group and control group. Besides, Ferreira *et al*., (2009) had supportive results for our study. Because in our study it was thought that they had similar subject group (overweight women), variables and training program as in our study. In our study, the effect of Pilates mat exercise program amount was very

clear in weight, fat percentage, BMI and body composition parameters for sedentary overweight women [18].

In conclusion, the experimental group had significantly better change scores than the control group on weight change, LBM, FP, body compositions parameters and WHR. This study showed that Modern Pilates mat exercises contributed to increase quality of life for sedentary overweight women through improvements in weight, FP, BMI and body composition parameters. We thought that the results of this study had impacts for prescription of exercise for sedentary, overweight adults engaging in weight loss efforts. Besides, this study proved that overweight women can develop health with relatively high levels of exercise per week.

Following suggestions can be made for more efficient studies in accordance with the results of this research;

- The period of training program can be protracted in future studies.
- A more extensive study can be beneficial by application of this study on other owerweight groups.

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