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Effects of 8 Weeks of Mat Pilates Exercises on Body Composition and Physical Fitness Characteristics in Sedentary Elderly Women

Ebru CEVİZ[1] **Harun GENÇ**[*1]

[1] Bingöl University, Facultyof Sports Sciences, Bingöl, Türkiye

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ABSTRACT

The growing elderly population faces physical and mental decline that affects independence and quality of life, but Pilates offers a safe exercise option for people of all ages. This study aims to examine the effects of mat Pilates exercises on body composition and physical fitness characteristics in sedentary elderly women. A total of 24 inactive women participated in the study. The participants were randomly divided into two groups: the Mat-Pilates Exercise Group (MPG) and the Non-Pilates Group (NPG). The MPG performed 4 exercise sessions per week for 12 weeks. The participants' anthropometric characteristics, including body weight, BMI, circumference, and skinfold thickness, were evaluated before and after the 12-week exercise program, and physical fitness parameters such as grip strength, back-leg strength, vertical jump, and flexibility were also measured. The data obtained were statistically analyzed using SPSS 25.0. Independent samples t-test was used for between-group comparisons, and paired samples t-test was used to analyze within-group pre- and post-test differences. A p-value of less than 0.05 was considered statistically significant. When examining the pre-exercise measurements, no significant differences were observed in any of the characteristics ($p > 0.05$). When examining the post-test measurements, statistical differences were found in the upper right leg, upper left leg, hip circumference, and back strength values between groups ($p<0.05$). Significant differences were observed between the pre-test and post-test measurements for all fat tissue and physical fitness characteristics in the MPG group ($p<0.05$). As a result, mat Pilates exercises were found to improve physical characteristics and fitness levels in sedentary elderly women. Low-impact exercises like Pilates help reduce age-related physical decline and support elderly independence. Increasing exercise participation can also reduce social inequalities and age-related health issues. This research aligns with the UN Sustainable Development Goals, particularly "Good Health and Well-being" and "Reduced Inequalities."

Sedanter Yaşlı Kadınlarda 12 Haftalık Mat Pilates Egzersizlerinin Vücut Kompozisyonu ve Fiziksel Uygunluk Özellikleri Üzerine Etkileri

Makale Bilgisi

Geliş Tarihi:
Kabul Tarihi:
Yayın Tarihi:

Anahtar Sözcükler:
Sedanter Yaşlı Kadınlar,
Mat Pilates,
Kuvvet,
Dikey sıçrama,
Esneklik.

ÖZET

Artan yaşlı nüfus, bağımsızlık ve yaşam kalitesini etkileyen fiziksel ve zihinsel gerilemelerle karşı karşıya kalmaktadır, ancak Pilates her yaştan insanlar için güvenli bir egzersiz seçeneği sunmaktadır. Bu çalışma, hareketsiz yaşlı kadınlarda uygulanan mat Pilates egzersizlerinin vücut kompozisyonu ve fiziksel fitness özellikleri üzerindeki etkilerini incelemeyi amaçlamaktadır. Çalışmaya toplamda 24 hareketsiz kadın katılmıştır. Katılımcılar rastgele iki gruba ayrılmıştır: Mat-Pilates Egzersiz Grubu (MPG) ve Kontrol Grubu (NPG). MPG, 12 hafta boyunca haftada 4 egzersiz seansı yapmıştır. MPG 12 hafta boyunca haftada 4 egzersiz seansı yaparken, NPG bu süre zarfında herhangi bir egzersiz programına katılmamıştır. Katılımcıların vücut ağırlığı, BMI, çevre ölçüleri ve deri altı yağ kalınlığı gibi antropometrik özellikleri, 12 haftalık egzersiz programı öncesi ve sonrasında değerlendirilmiş, ayrıca fiziksel fitness parametreleri olan kavrama gücü, sırt-bacak gücü, dikey sıçrama ve esneklik de ölçülmüştür. Elde edilen veriler, SPSS 25.0 yazılım paketi ile istatistiksel olarak analiz edilmiştir. Gruplar arası karşılaştırmalar için bağımsız örneklem t-testi, grup içi ön-test ve son-test farkları için eşleştirilmiş t-testi uygulanmıştır. 0.05'ten küçük bir p-değeri anlamlı kabul edilmiştir. Egzersiz öncesi ölçümler incelendiğinde, hiçbir özellikte anlamlı bir fark gözlemlenmemiştir ($p > 0.05$). Post-test ölçümleri incelendiğinde, gruplar arası karşılaştırmalarda üst sağ bacak, üst sol bacak, kalça genişliği ve sırt kuvveti değerlerinde istatistiksel farklar bulunmuştur ($p<0.05$). Gruplar içindeki tüm değişiklikler için, MPG grubunda tüm yağ dokusu ve fiziksel fitness özellikleri arasında ön-test ve son-test ölçümleri arasında anlamlı farklar bulunmuştur ($p<0.05$). Sonuç olarak, mat Pilates egzersizlerinin, sedanter yaşlı kadınlarda fiziksel özellikler ve fitness seviyelerinde iyileşmeler sağladığını söyleyebiliriz. Pilates gibi düşük etkili egzersizler, yaşa bağlı fiziksel gerilemeyi azaltarak, yaşlı bireylerin bağımsızlıklarını korumalarına yardımcı olabilir. Egzersiz programlarına katılımın artırılması, toplumsal eşitsizliklerin ve yaşa dayalı sağlık sorunlarının azaltılmasına katkıda bulunabilir. Bu bağlamda, araştırma BM Sürdürülebilir Kalkınma Hedefleri ile ilişkilendirildiğinde ‘’Sağlık ve Refah ve Eşitsizliklerin Azaltılması’’ hedefleriyle doğrudan bağlantılıdır.

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***Corresponding Author:** Harun Genç, *hgenc@bingol.edu.tr*

INTRODUCTION

The number of elderly people has grown in the past century (Oliveira et al., 2024). As people age, both physical and mental abilities tend to decline (Bangsbo et al., 2019). These declines can lead to elderly individuals becoming dependent on others for daily needs, an increased risk of falls, and a decrease in overall quality of life (Yeung et al., 2019). Age-related physical decline is commonly associated with a reduction in muscle mass, lower aerobic capacity, diminished mobility, and other markers of fitness (Lange et. al., 2021). Thus, it is crucial to create and encourage interventions that enhance the physical abilities of the elderly population, thereby enhancing their quality of life.

One exercise method that can be safely applied across all age groups, including the elderly, is Pilates (Pucci et al., 2019). Pilates exercises engage every part of the body, allowing for coordinated movement of all areas in complete harmony (Yu & Lee, 2012). It is believed that Pilates exercises help individuals feel renewed and energized both physically and mentally (Byrnes et al., 2018). Additionally, Pilates is one of the few exercise methods that can improve balance, coordination, muscular endurance, and flexibility (Meikis et al., 2021). While Pilates doesn't fall under the category of traditional exercises like aerobic or resistance training (Bullo et al., 2015), it is a well-organized type of physical activity that has demonstrated benefits in enhancing muscle endurance, flexibility, and dynamic balance in younger and middle-aged individuals (Cruz-Ferreira et al., 2011).

It has been reported that women, starting from middle age, can reduce health risks by engaging in moderate-intensity exercise. The American College of Sports Medicine (ACSM) suggests focusing on resistance, strength, aerobic capacity, and flexibility exercises in training programs for individuals after middle age. Among these, the Pilates Method has been highlighted, emphasizing how brain cell activation stimulates the mind, which in turn positively affects the body (Özdemir & Uysal, 2019). Physical exercise is considered an effective tool for minimizing the harmful effects of aging (Valenzuela et al., 2019; Lavin et al., 2020). Studies on exercise-based programs, such as resistance training, high-intensity interval training, multi-component exercises, and Tai Chi, have shown significant benefits in the structural and functional changes of skeletal muscle. Among these types of physical training, Pilates has emerged as a promising method for alleviating or reversing the effects of aging.

Pilates exercises involve a holistic approach that requires the activation and coordination of multiple muscle groups simultaneously (Lima et al., 2021). The Pilates method was created by Joseph Pilates in the 1920s. Pilates has become more popular around the world with growing frequency, particularly among older women. Given its holistic approach, Pilates is presented as one of the most effective ways to achieve "Healthy Aging" goals. It includes exercises that focus on strength, muscular endurance, flexibility, as well as muscle control, posture, and breathing, particularly in the core region of the body, which is often referred to as the "power center." These exercises combine the mind-body connection (Buttelli et al., 2021; Pereira et al., 2022), focusing on lumbopelvic stabilization through activation of the deep muscles of the torso, and aim to create a full connection between the body and mind (García-Garro et al., 2020).

The Pilates method is based on six fundamental principles: center, concentration, control, precision, flow, and breathing. Its effectiveness is demonstrated by the fact that it can be performed individually or in groups, with equipment or on the floor, using only body weight (Buttelli et al., 2021; Pereira et al., 2022). Pilates provides psychomotor benefits and contributes to better functional capacity, enhancing individual independence and improving overall quality of life (García-Garro et al., 2020; Angeles et al., 2021). Pilates is a type of exercise program that involves structured movements, which can be performed on the floor (Mat Pilates) or with specialized equipment developed by its founder. Mat Pilates, which is performed using body weight, helps individuals achieve self-control and is ideal for group work due to its ease of applicability (Lett, 2011).

Although many studies have explored Pilates effects on middle-aged and younger individuals, research on sedentary older women—who are more prone to age-related declines in fitness and body composition—is limited. Additionally, the impact of accessible and practical mat Pilates programs on this group remains under-investigated. This study aims to address this gap by examining the effects of a 12-week mat Pilates program on body composition and physical fitness in sedentary older women. The results are expected to aid in developing effective exercise interventions that promote healthy aging and enhance quality of life.

This research seeks to explore the effects of 12 weeks of mat Pilates exercises on body composition and physical fitness in sedentary older Women.

MATERIALS AND METHODS

Study Group

Power analysis was conducted using G*Power 3.1.9.7 to determine the required sample size for this study. For an independent samples t-test, with a large effect size ($d = 0.80$), $\alpha = 0.05$, and power ($1-\beta$) = 0.80, the required total sample size was calculated to be 24 participants, with 12 in each group. The study included 24 female participants, aged 50 to 68, who were sedentary. The participants were split into two groups. The Mat-Pilates Exercise Group (MPG) (12 women) and the Non-Pilates Group (NPG) (12 women). All participants were briefed about the study and voluntarily expressed their willingness to participate by completing the consent form. It was determined that the participants had no injuries prior to the study. The participation criteria were determined as having no orthopedic, neuromuscular, or pathological issues, no medication dependency, and not taking any dietary supplements. All procedures adhered to the Declaration of Helsinki.

Inclusion Criteria:

- Being female
- Aged between 50 and 68
- Having a sedentary lifestyle (not engaging in regular physical activity)
- Having no orthopedic, neuromuscular, or systemic pathological conditions
- Not being dependent on any medications or dietary supplements
- Having no musculoskeletal injuries prior to the study
- Voluntarily agreeing to participate in the study and signing the informed consent form

Exclusion Criteria:

- Individuals who engage in regular exercise
- Those with orthopedic, neurological, or chronic diseases
- Individuals with any physical limitations that may prevent exercise
- Those who regularly use medication or dietary supplements
- Participants who did not consistently attend the exercise program during the study period
- Individuals who did not participate in the pre- or post-test measurements

Procedures

The MPG performed 4 exercise sessions per week for a duration of 12 weeks. The NPG was not

involved in any exercise program over the 12-week period. Before and after the 12-week exercise program, the participants' anthropometric characteristics, including body weight, BMI, circumference, and skinfold thickness measurements, were recorded. Physical fitness parameters such as grip strength, back-leg strength, vertical jump, and flexibility were also measured.

Exercise

2-Week Preparatory Mat Pilates Exercise Program

Mat Pilates sessions lasted 60 min, three days a week, for 12 weeks (Table 2). The Pilates exercise programs were conducted at the Bingöl Provincial Directorate of Youth and Sports Multi-Purpose Sports Hall. To ensure adaptation to the exercises and familiarize the participants with the movements, all participants were included in a 2-week preparatory exercise program (Table 1) before the commencement of the 12-week MPG exercise program. This preparatory period aimed to teach proper form, ensure familiarity with the exercises, and minimize injury risk. This preparatory program includes low-intensity exercises targeting all muscle groups (pelvic floor muscles, spine, hamstrings, back extensors, abdominals, quadriceps, biceps, triceps, deltoid muscles).

Table 1
2-Week Preparatory Mat Pilates Exercise Program

Exercises	Set	Repetitions	Tempo	Rest
Spine Twist Leg Lift Arm Circle Leg Circle Shoulder Bridge Bird Dog Single Leg Stretch Bridge Pilates Exercise-Saw Plank	1	8 reps or 5 sec	Low	40 s rest between each exercise

12-Week Mat Pilates Exercise Program

The MPG (Mat Pilates Group) performed 4 exercise sessions per week for a duration of 12 weeks, with each session consisting of a warm-up phase, a main phase, and a cool-down phase. Each session lasted approximately 60-90 minutes. The movements were performed in a smooth, moderate-paced manner. Throughout the exercise process, a 5-minute jog and 5-minute stretching exercises were incorporated at the beginning and end of each session as warm-up and cool-down phases to prevent any injuries. To adjust the relationship between load and rest and avoid overtraining, a minimum of 48 hours of rest was given between exercises (Miyamoto ve ark., 2018). The 12-week mat Pilates exercise program (Table 2) involved a gradual increase in exercise intensity and volume (Isacowitz, 2014; Rahimimoghadam ve ark., 2019). The control group continued their normal daily life without participating in any exercise program. Additionally, all participants in both the exercise and NPG was encouraged to maintain their typical daily routines and to avoid participating in any cardiovascular or strength training that could affect the results of the study.

Table 2
12-Week Mat Pilates Exercise Program

Exercises	1 and 2 Weeks reps	3 and 4 Weeks reps	5 and 6 Weeks reps	7 and 8 Weeks reps	9 and 10 Weeks reps	11 and 12 Weeks reps
Spine Twist	①	①	②	②	③	③
Leg Lift	①	①	②	②	③	③
Arm Circle	①	①	②	②	③	③
Leg Circle	①	①	②	②	③	③
Shoulder Bridge	①	①	②	②	③	③
Bird Dog	①	①	②	②	③	③
Single leg stretch	①	①	②	②	③	③
Bridge	①	①	②	②	③	③
Pilates Exercise-Saw	①	①	②	②	③	③
Rolling Like A Ball	-	①	②	②	③	③
Crunch	-	①	②	②	③	③
Superman	-	-	-	②	③	③
Hundred	-	-	-	②	③	③
Plank (10 sec)	-	-	-	-	③	③
Pilates Push-Ups	-	-	-	-	③	③

①: 1x10; ②: 2X10; ③: 3X10
Notes: The exercises were performed at a moderate tempo and smoothly. 40 seconds of rest were given between each movement, and 2 minutes of rest between sets.

Body Composition Measurements

Subjects underwent anthropometric testing both before and after the eight-week treatment period. Measurements were conducted following the protocol established by the International Society for the Advancement of Kinanthropometry (ISAK) (Norton and Olds, 1996). Body weight (BW) was recorded using a calibrated medical scale, accurate to 0.1 kg, while stature was measured to 0.01 cm precision using a standard wall-mounted stadiometer. Body Mass Index (BMI) and Body composition measurements, including the right arm (RA), left arm (LA), upper right leg (URL), lower right leg (LRL), upper left leg (ULL), and lower left leg (LLL), were obtained using the InBody 270, a bioelectrical impedance analyzer developed by a Japanese brand. Skinfold thickness measurements were taken with a skinfold caliper (Holtain, UK) applying 10 grams of pressure per 1mm² with an error margin of ± 2 mm. Waist (WC) and hip (HC) circumference measurements were taken using a Gulick-type anthropometric tape measure (Holtain, UK). Skinfold thickness measurements were taken from the biceps (BSFT), triceps (TSFT), subscapular (SubSFT), suprailiac (SupSFT), abdominal (ASFT), and calf areas (CSFT) on the right side of the participants. During the skinfold thickness measurement, the subcutaneous fat between the thumb and index finger was gently pinched and pulled upwards to a degree that would separate it from the muscle tissue. About 1 cm away from the fingers, the caliper was applied, and the pinched subcutaneous fat layer's thickness was quickly recorded in millimeters, based on the caliper's indicator, within 2-3 seconds (Harrison ve ark., 1988). Circumference measurements of the waist, abdomen, and hips were taken using a Gulick tape measure according to standard techniques. Two measurements were taken from each area, and the average was calculated. (Marfell-Jones, 1991). In the study, the body fat percentage of the women was calculated using the Yuhasz formula: % Fat = 5.783 + 0.153 (tr + ss + si + ab), where "tr" refers to triceps, "ss" to subscapular, "si" to suprailiac, and "ab" to abdominal skinfold measurements.

Physical fitness parameters

Handgrip strength

Handgrip strength measurements were applied to assess the strength of the forearm flexor muscles. The participants' handgrip strength were measured using a Takei Physical Fitness Test (Japan)

hand dynamometer (forces ranging from 0 to 100 kg). The participants' handgrip strength was measured while they were standing. Once the dynamometer was adjusted to fit the participant's hand size, the measurements of the maximum handgrip strength were taken while the participants' arms were positioned at a 10-15 degree angle from the shoulder, with their arms at their sides. The measurements were first taken from the right hand grip strength (RHGS), followed by the left hand left hand grip strength (LHGS), while the participants were in a relaxed state. After two trials for each hand, the best values were recorded handgrip strengths (Zorba, 2000; Tamer, 2000).

Back and leg strength

The back Strength (BS) and leg strength (LS) measurements of the volunteers were taken using the Takei TKK 5402, Japan dynamometer. The participants stood on the dynamometer platform with their knees fully extended. The participants' back strength was measured with their knees unbent, while the leg strength was measured with the knees approximately at a 130-degree angle. After securing their feet, the participants gripped the dynamometer bar tightly with their hands, keeping their arms extended, back straight, and torso slightly leaned forward. The participants pulled the bar vertically upwards to the maximum extent during the test. The test was performed with two repetitions, and the best result was considered for calculation.

Vertical jump test

During the vertical jump test (VJ), The participant stood sideways, ensuring their feet were in contact with the ground. They then raised their arm upwards without lifting their feet and touched the highest point they could reach with their fingertips. This point was recorded on the measuring tape suspended from the wall. Before the test, the participant's fingertips were dipped in chalk powder. After this step, the participant jumped and touched the highest point they could reach, and this point was recorded. At the beginning of the test, the distance touched with the fingertips (initial reach) and the distance reached by jumping at the end of the test were recorded in centimeters (Şipal, 1989). Each athlete was given two attempts for the test, and the a higher score was noted.

Flexibility test

The flexibility test in this study utilized a platform measuring 35 cm by 45 cm by 32 cm. Additionally, the upper surface had a measuring scale ranging from 0 to 50 cm. In a seated position on the floor, with legs extended, place the soles of the feet against the wall of the sit-and-reach box. Without bending the legs, the participant reaches forward on the bench, with both hands stacked on top of each other. At the end of the reach, the participant held the position for about 2 seconds, and the score was read in centimeter (Özkan ve ark., 2014).

Statistical analysis

The data from the study were analyzed statistically through the SPSS 25.0 software package. To evaluate the data, descriptive statistical techniques, including the mean and standard deviation, were used. The normality assumption for the comparison of pre- and post-exercise values of the groups was tested using the Kolmogorov-Smirnov test. Since the assumption of normality was satisfied, parametric tests were employed in the analysis. Specifically, the Independent Samples T-Test was used for comparing the differences between the experimental and control groups, while the Paired Samples T-Test was applied to assess pre- and post-test changes within each group. These statistical methods were selected in accordance with the experimental design of the study, which involved repeated measurements, and aimed to evaluate both the effectiveness of the intervention within each group and the differences between groups following the exercise program. A p-value smaller than 0.05 was deemed

significant.

RESULTS

Table 3
Demographic information of the subjects

Variables	MPG	NPG	TOTAL
Age (years)	59,25 ± 6,15	58,91 ± 6,33	59,03±6,21
Height (m)	1,59±0,08	1,58±0,06	1,58±0,07
BW (kg)	74,37 ± 7,22	75,48 ± 6,17	74,92±6,59
BMI (kg/m^2)	29,59+1,44	30,21+1,86	29,90±1,66

MPG: Mat Pilates Group; **NPG:** Non-Pilates Group; **BW**: Body weight; **BMI**: Body Mass Index

According to Table 3, the average age of the 12 sedentary women in the MPG group was 59.25 ± 6.15 years, with an average height of 1.59 ± 0.08 m, BW of 74.37 ± 7.22 kg, and BMI of 29.59 ± 1.44 kg/m². In the NPG group, which also consisted of 12 sedentary women, the average age was 58.91 ± 6.33 years, height of 1.58 ± 0.06 m, BW of 75.48 ± 6.17 kg, and BMI of 30.21 ± 1.86 kg/m².

Table 4
The mean scores of the pre-test and post-test and comparison results of selected physical anthropometric and physical fitness characteristics for MPG and NPG

Variables	Pre-test			Post-test		
	MPG	NPG	p-value	MPG	NPG	p-value
BW (kg)	74,37+7,22	75,48 ± 6,17	0,690	73,22+6,91	75,55+6,07	0,389
BMI (kg/m^2)	29,59±1,44	30,21±1,86	0,368	29,13±1,27	30,24±1,75	0,090
RA (cm)	34,25±2,73	35,33±3,39	0,398	33,41±2,87	35,33±3,33	0,146
LA (cm)	34,33±2,74	35,25±3,46	0,480	33,50±2,77	35,25±3,41	0,182
URL (cm)	62,66±4,27	64,16±2,51	0,306	59,66±5,53	64,16±2,44	**0,017***
LRL (cm)	37,91±2,67	37,75±1,71	0,858	37,25±2,30	37,74±1,72	0,552
ULL (cm)	62,50±4,23	64,00±2,33	0,294	60,33±4,71	64,08±2,23	**0,021***
LLL (cm)	37,91±2,67	37,73±1,73	0,858	37,25±2,30	37,75±1,70	0,552
Chest (cm)	102,41±6,00	104,50±5,50	0,385	99,41±6,05	104,41±5,61	**0,048***
WC (cm)	91,66+6,87	92,25±8,75	0,858	87,83±1,80	91,16±8,83	0,179
HC (cm)	109,08±5,82	110,66±4,57	0,467	104,91±6,18	110,50±4,18	**0,017***
BSFT (mm)	10,67±2,92	10,39±2,94	0,812	10,30±2,82	10,37±2,90	0,956
TSFT (mm)	15,21±2,42	15,15±2,34	0,940	14,77±2,23	15,21±2,28	0,689
ASFT (mm)	17,49±3,47	17,30±3,25	0,890	16,03±3,14	17,22±3,28	0,399
SubSFT (mm)	17,67±3,47	17,55±2,85	0,921	17,20±3,21	17,55±2,85	0,795
SupSFT (mm)	8,70±3,29	8,31±3,15	0,760	8,20±3,11	8,21±3,13	0,994
CSFT (mm)	10,67±2,92	10,39±2,94	0,968	10,30±2,82	10,37±2,90	0,781
RHGS (kg)	11,30±3,65	11,88 ± 3,89	0,713	12,03±3,37	11,73+3,72	0,844
LHGS (kg)	11,21±3,07	11,51+3,45	0,879	11,69±3,40	11,92+3,94	0,880
LS (kg)	39,65±6,14	40,05±6,66	0,513	42,95±7,25	39,97±6,59	0,083
BS (kg)	37,98±8,44	38,06±8,71	0,356	44,86±9,75	38,09±8,76	**0,004***
VJ (cm)	21,33±4,42	20,83±4,58	0,765	22,25±4,63	20,91±4,64	0,435
Flexibility (cm)	30,33±4,63	30,16±4,52	0,935	32,08±4,86	30,08±4,58	0,293

***p<0,05**
MPG: Mat Pilates Group; **NPG:** Non- Pilates Group; **BW:** Body Weight; **BMI:** Body Mass İndex; **RA:** Right Arm; **LA:** Left Arm; **URL:** Upper Right Leg; **LRL:** Lower Right Leg, **ULL:** Upper Left Leg; **LLL:** Lower Left Leg; **WC:** Waist Circumference; **HC:** Hip Circumference; **BSFT**: Biceps Skin Fold Thickness; **TSFT**: Triceps Skin Fold Thickness; **ASFT**: Abdominal Skin Fold Thickness; **SubSFT**: Subscapula Skin Fold Thickness; **SupSFT**: Suprailiac Skin Fold Thickness; **CSFT**: Calf Skin Fold Thickness; **RHGS:** Right Hand Grip Strength; **LHGS**: Left Hand Grip Strength; **LS**: Leg Strength; **BS**: Back Strength; **VJ**: Vertical Jump

When examining Table 4, no significant differences were found between the groups in any of the characteristics in the pre-test measurements ($p > 0.05$). However, in the post-test results, statistically

significant differences were observed in favor of the MPG group in the upper right limb (URL), upper left limb (ULL), chest, and hip circumference (HC) measurements ($p < 0.05$). When comparing the pre-test and post-test mean values of the selected anthropometric characteristics within each group, no significant changes were observed in either the MPG or NPG groups ($p > 0.05$). On the other hand, when comparing the pre- and post-test mean values of the selected physical fitness characteristics, a statistically significant improvement in back strength (BS) was observed in the MPG group in the post-test measurements ($p < 0.05$), while no significant differences were observed in other fitness parameters ($p > 0.05$).

Table 5

Changes in physical anthropometric and physical fitness characteristics before and after the test in MPG and NPG

Variables	MPG			NPG		
	Pre-test	Post-test	p-value	Pre-test	Post-test	p-value
BW (kg)	74,37+7,22	73,22+6,91	**0,001***	75,48 ± 6,17	75,55+6,07	0,499
BMI (kg/m^2)	29,59±1,44	29,13±1,27	**0,002***	30,21±1,86	30,24±1,75	0,557
RA (cm)	34,25±2,73	33,41±2,87	**0,002***	35,33±3,39	35,33±3,33	1,000
LA (cm)	34,33±2,74	33,50±2,77	**0,002***	35,25±3,46	35,25±3,41	1,000
URL (cm)	62,66±4,27	59,66±5,53	**0,005***	64,16±2,51	64,16±2,44	1,000
LRL (cm)	37,91±2,67	37,25±2,30	**0,005***	37,75±1,71	37,74±1,72	1,000
ULL (cm)	62,50±4,23	60,33±4,71	**0,000***	64,00±2,33	64,08±2,23	0,339
LLL (cm)	37,91±2,67	37,25±2,30	**0,005***	37,73±1,73	37,75±1,70	1,000
Chest (cm)	102,41±6,00	99,41±6,05	**0,000***	104,50±5,50	104,41±5,61	0,586
WC (cm)	91,66+6,87	87,83±1,80	**0,000***	92,25±8,75	91,16±8,83	0,674
HC (cm)	109,08±5,82	104,91±6,18	**0,000***	110,66±4,57	110,50±4,18	0,438
BSFT (mm)	10,67±2,92	10,30±2,82	**0,014***	10,39±2,94	10,37±2,90	0,658
TSFT (mm)	15,21±2,42	14,77±2,23	**0,026***	15,15±2,34	15,21±2,28	0,482
ASFT (mm)	17,49±3,47	16,03±3,14	**0,001***	17,30±3,25	17,22±3,28	0,095
SubSFT (mm)	17,67±3,47	17,20±3,21	**0,002***	17,55±2,85	17,55±2,85	1,000
SupSFT (mm)	8,70±3,29	8,20±3,11	**0,018***	8,31±3,15	8,21±3,13	0,317
CSFT (mm)	11,92+2,72	11,57+2,21	**0,017***	11,97±2,56	11,93±2,56	0,137
RHGS (kg)	11,30±3,65	12,03±3,37	**0,006***	11,88 ± 3,89	11,73±3,72	0,145
LHGS (kg)	11,21±3,07	11,69±3,40	**0,035***	11,51+3,45	11,92±3,94	0,347
LS (kg)	39,65±6,14	42,95±7,25	**0,000***	40,05±6,66	39,97±6,59	0,655
BS (kg)	37,98±8,44	44,86±9,75	**0,000***	38,06±8,71	38,09±8,76	0,908
VJ (cm)	21,33±4,42	22,25±4,63	**0,020***	20,83±4,58	20,91±4,64	0,777
Flexibility (cm)	30,33±4,63	32,08±4,86	**0,013***	30,16±4,52	30,08±4,58	0,723

***p<0,05**

MPG: Mat Pilates Group; **NPG:** Non- Pilates Group; **BW:** Body Weight; **BMI:** Body Mass İndex; **RA:** Right Arm; **LA:** Left Arm; **URL:** Upper Right Leg; **LRL:** Lower Right Leg, **ULL:** Upper Left Leg; **LLL:** Lower Left Leg; **WC:** Waist Circumference; **HC:** Hip Circumference; **BSFT**: Biceps Skin Fold Thickness; **TSFT**: Triceps Skin Fold Thickness; **ASFT**: Abdominal Skin Fold Thickness; **SubSFT**: Subscapula Skin Fold Thickness; **SupSFT**: Suprailiac Skin Fold Thickness; **CSFT**: Calf Skin Fold Thickness; **RHGS:** Right Hand Grip Strength; **LHGS**: Left Hand Grip Strength; **LS**: Leg Strength; **BS**: Back Strength; **VJ**: Vertical Jump

Looking at Table 5, all the physical characteristics in the MPG group showed statistically significant improvements ($p < 0.05$), whereas no significant changes were observed in the NPG group ($p > 0.05$). Similarly, all body fat analysis measurements in the MPG group improved significantly ($p < 0.05$), while no significant changes occurred in these parameters within the NPG group ($p > 0.05$). Furthermore, significant improvements were noted in all physical fitness measurements in the MPG group ($p < 0.05$), but none of these characteristics showed statistical changes in the NPG group ($p > 0.05$).

DISCUSSION

Regular exercise programs, when applied according to their objectives, provide numerous

significant positive effects on the human body. In order for the expected effects of exercise to be observed, the type, duration, frequency, and intensity of the exercises must be properly planned (Genç ve ark., 2023). In our study, the effects of regular mat exercises performed 4 days a week for 12 weeks, with an average duration of 90 minutes, on body composition and physical fitness characteristics in sedentary women were investigated.

The primary finding of this study was that the 8-week Pilates mat training program (two hours per week) resulted in significant improvements across nearly all physical and physiological variables. In our study, the average age of the 12 sedentary women in the MPG was 59.25 ± 6.15 years, height of 1.59 ± 0.08 m, BW of 74.37 ± 7.22 kg, and BMI of 29.59 ± 1.44 kg/m². In the NPG, which also consisted of 12 sedentary women, the average age was 58.91 ± 6.33 years, height of 1.58 ± 0.06 m, BW of 75.48 ± 6.17 kg, and BMI of 30.21 ± 1.86 kg/m² (Table 3).

In this study, no statistical differences were found in any of the characteristics in the pre-test measurement results (p>0,05). These outcomes point to the fact that, at the start of our study, the control and experimental groups had a homogeneous structure. As a result, the study was strengthened by effectively demonstrating the impact of mat Pilates exercises on body composition and physical fitness characteristics in sedentary women.

When examining the post-test measurement results for the physical characteristics of the groups, statistical differences were found in the URL, ULL, and HC values ($p<0.05$). Additionally, when examining the changes within the groups, differences between the pre-test and post-test measurements were found to be statistically significant for all characteristics in the MPG group ($p<0.05$). However, no differences were observed in the physical characteristics of the NPG group ($p>0.05$). In our study, it was determined that the mat Pilates exercises applied over eight weeks resulted in a significant decrease in BW and BMI ($p<0.05$). When looking at the literature, Seghatoleslami et al. (2018) aimed to investigate the effects of Pilates exercises on the motor control indices of inactive middle-aged women. They reported that Pilates exercises led to a decrease in BW and BMI. In the study conducted by Bastık and Cicioğlu (2020), they reported a statistically significant decrease in BW and BMI after applying mat exercises for 60-75 minutes, three days a week ($p<0.05$). These findings support our study. On the other hand, in another study, Borah et al. (2024) similarly reported that after a 6-week mat Pilates exercise program, conducted three times a week for 60 minutes, there was no significant difference in BMI values between the Pilates and control groups. This study does not support our findings.

In our study, a significant decrease was observed in RA, LA, URL, LRL, ULL, LLL, WC, and HC values in the MPG group ($p<0.05$). In the literature, in their 2024 study, İlçin and Kurt investigated the effects of an 8-week Pilates exercise program on 12 healthy women aged 18 to 45 with no prior sports background. They found a statistically significant difference in favor of the post-test results in the measurements of the shoulders, chest, waist, abdomen, hips, calves, right arm, and left arm. .In the study by Aslan (2019), which examined the effects of Pilates on body composition in women, it was reported that after 12 weeks of mat Pilates exercises, performed twice a week, a statistically significant decrease was observed in circumference measurements when comparing the pre-test and post-test values. In another study by Zaras et al. (2023), they reported a significant decrease in waist circumference after an 8-week mat Pilates exercise program, conducted twice a week for 60 minutes with 20 women with an average age of 48. These findings support our study.

In this study, no statistical difference was found between the pre-test and post-test values for subcutaneous fat measurements between the groups. However, when examining the changes within the groups, no changes were observed in the NPG for BSFT, TSFT, ASFT, SubSFT, SupSFT, and CSFT characteristics ($p>0.05$). In contrast, in the MPG, reductions in subcutaneous fat tissue were observed for all characteristics ($p<0.05$).

In their study, Garcia-Pastor et al. (2020) evaluated the effects of a 20-week Pilates program, performed twice a week, on body composition. Significant reductions were reported in the sum of six different skinfold measurements and in body fat percentage. These findings indicate that the Pilates method is effective in improving body composition. Vaquero-Cristóbal et al. (2015) examined the effects of a 16-week mat Pilates program on body composition and somatotype in women with previous Pilates experience. Their findings showed significant reductions in the skinfold thickness of the triceps, iliac crest, supraspinale, abdominal, front thigh, and medial calf regions. These studies support our work.

In our study a statistical difference was revealed between the groups in the post-test measurements for the BS characteristic ($p<0.05$). Additionally, the changes in physical fitness characteristics within the groups, statistical differences were observed in all values for the MPG ($p<0.05$). In contrast, the same table shows that no differences were observed in the physical fitness characteristics examined in the NPG ($p>0.05$). These results are interpreted as positive outcomes of the 12-week mat Pilates exercises applied in our study. Borah et al. (2024) reported that after a 6-week, 3 times per week, 60-minute mat Pilates exercise program, significant differences in flexibility and strength characteristics were observed in favor of the Pilates group when compared to the control group. In their study, Evangelou et al. (2021) investigated the effects of a three-month low-load–high-repetition group exercise program and Pilates on physical fitness and body composition in inactive women, and reported that the Pilates group showed significant improvements in flexibility and postural control. In another study, Barker et al. (2016) investigated the potential of Pilates exercises in reducing the risk of falls in elderly individuals. They found improvements in posture balance, lower extremity strength, and flexibility in the Pilates group compared to the control group. Kibar et al. (2016), in their 8-week study with two 60-minute Pilates sessions per week, reported that Pilates exercises led to statistically significant improvements in abdominal endurance, hamstring flexibility, and upper body muscular endurance. In addition to a reduction in waist circumference, improvements were also observed in balance and posture.

These studies highlight the positive effects of Pilates exercises on strength and flexibility, supporting the findings of our study.

CONCLUSION

As a result, it is believed that mat Pilates exercises, which are an aerobic exercise program with properly planned intensity, frequency, and duration, can have a significant impact on increasing physical fitness levels in sedentary older women without overloading the body. These types of exercises can lead to positive changes in physical fitness parameters, thereby improving the overall health of older individuals.

SUGGESTIONS

It can be suggested to inform elderly individuals about the physical and mental health benefits of regular exercise and to promote the widespread adoption of mat Pilates programs to improve the physical health of the elderly population.

Statement of Research and Publication Ethics

This article has been written within the framework of scientific research and publication ethics.

Ethics Committee Approval

The research was approved by the Health Sciences Scientific Research Ethics Committee of Bingöl University with the decision dated October 24, 2024, and numbered 24/17, 10.

Author Contributions

Research Design (CRediT 1) Author 1 (60%) - Author 2 (40%)

Data Collection (CRediT 2) Author 1 (100%)

Research - Data Analysis - Validation (CRediT 3-4-6-11) Author 2 (100%)

Manuscript Writing (CRediT 12-13) Author 1 (50%) - Author 2 (50%)

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Sustainable Development Goals (SDGs)

Sustainable Development Goals: 3 Health and Quality of Life

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