



Effect of Pilates Exercises on the Body Composition of Fasting Females

Oruç Tutan Kadınlarda Pilates Egzersizinin Vücut Kompozisyonu Üzerine Etkisi

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ABSTRACT

Objective: This study aimed to evaluate the changes in the body composition of individuals who fasted and did Pilates at least twice a week during Ramadan versus those who fasted but did no Pilates.

Methods: This was an experimental study conducted on 60 healthy women who were admitted to the Noi Pilates in İstanbul Turkey, which was a private Pilates studio. The study was carried out on 60 grown-up, healthy women between 18 and 65 years of age who fasted in Ramadan 2019, some of whom did Pilates and some who did not. The women involved in the study had been doing Pilates for 6 months prior to Ramadan and did Pilates at least 3 times a week during Ramadan.

Results: Significant increases were observed in body mass index (BMI), triceps skin-fold thickness (SFT), muscle mass and fat percentage in the fasting and non-pilates group ($p<0.05$). Our study found the change in the percentage of triceps SFT and fat in women who did Pilates to be more than those who did not. BMI, muscle mass, waist circumference and hip circumference of women who did Pilates and who did not do Pilates during Ramadan did not differ compared to the first measurements, and neither of the two methods dominated in terms of these variables.

Conclusion: While a long period of fasting in Ramadan leads people to inactivity, personalized exercise and nutrition programs planned by experts may result in weight loss, especially for obese and slightly overweight people.

Keywords: Ramadan, pilates, diet, healthy nutrition, exercise, weight management

ÖZ

Amaç: Bu çalışmanın amacı, ramazan ayında oruç tutup haftada en az 2 kez pilates yapan ve sadece oruç tutup pilates yapmayan bireylerin vücut kompozisyonundaki değişimlerin değerlendirilmesidir.

Yöntemler: Bu çalışma, İstanbul, Türkiye’de özel bir pilates stüdyosu olan Noi Pilates’e başvuran 60 sağlıklı kadın üzerinde yapılan deneysel bir çalışmadır. 2019 Ramazan ayında oruç tutan, pilates yapan ve yapmayan 18-65 yaş arası 60 yetişkin sağlıklı kadın çalışmaya dahil edilmiştir. Çalışmaya ramazan ayı öncesinde 6 aydır pilates yapan ve ramazan ayında da haftada en az 3 kez pilates yapan kadınlar dahil edilmiştir.

Bulgular: Oruç tutup pilates yapmayan grupta beden kitle indeksi (BKI), triceps deri kıvrım kalınlığı (DKK), kas kütlesi ve yağ yüzdesinde anlamlı artışlar gözlenmiştir ($p<0,05$). Bizim çalışmamızda pilates yapan kadınların triceps DKK ve yağ yüzdesindeki değişim sadece oruç tutan kadınlara kıyasla üstün bulunmuştur. Pilates yapan ve yapmayan kadınların ramazan ayında BKI, kas kütlesi, bel çevresi ve kalça çevresi son ölçümlerinin ilk ölçümlere göre farklılaşmadığı ve bu değerler açısından iki yöntemin birbirine üstün olmadığı görülmüştür.

Sonuç: Ramazan ayında uzun süren açlık süresi kişileri inaktiviteye yönlendirirken, kişilere özel uzman eşliğinde planlanan egzersiz ve kişiye özgü beslenme programları ile Ramazan ayı özellikle obez ve hafif kilolu kişiler için ağırlık kaybı ile sonuçlanabilir.

Anahtar Sözcükler: Ramazan, pilates, diyet, sağlıklı beslenme, egzersiz, ağırlık yönetimi

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Introduction

One to 1.5 billion of the world's population consists of Muslims. Healthy and grown-up members of this religion make up approximately 18 to 25% of the total population who fast during a holy month, Ramadan (1,2). Fasting is not mandatory for everyone. Pregnant women, women going through menstruation, women in lactation, mentally challenged individuals, children who have not reached puberty, individuals with chronic illnesses who are unable to fast, and senile people are exempt from this religious duty (3).

The timing of Ramadan is determined according to the Muslim calendar, and it takes place at different times over a 33-year cycle (3). Fasting for around 14 hours a day during this month, Muslims do not eat or drink anything from the dawn called "sahur" until the sunset called "iftar". Smoking, drinking water, and taking medicine are also prohibited during fasting. Nonetheless, there are no restrictions from iftar to sahur and fasting people are allowed to eat and drink as they wish during this period of time (4,5).

Previous studies have demonstrated that during the period of fasting, eating habits change significantly, and the type and amount of food consumed are very different from the rest of the year. It is known that in some countries special dishes with more sugar are preferred, unlike regular eating habits (3). Also, during this month, the decrease in the frequency of meals of people who eat and drink at night after iftar leads to an increase in free fatty acid concentrations in the body (6). The long time gap between main meals when fasting affects appetite, hormonal responses to food, energy, and glucose metabolism. Studies have revealed that particularly the lack of breakfast is associated with low exercise-induced thermogenesis and causes impaired insulin sensitivity in people with diabetes (7).

During this worship considered sacred by Muslims, alterations in weight are observed depending on the levels of energy taken and consumed. A meta-analysis obtained from 35 studies has put forward that fasting causes a statistically significant weight loss. Other than its impact on weight, the way it affects body composition cannot be interpreted clearly (8). Biochemical studies have confirmed that blood glucose decreases significantly with the decrease in total energy intake during Ramadan. At the same time, compared to the period before Ramadan, significant decreases in the total serum cholesterol by 7.9% and triglycerides by 30% have been observed. While there has been a significant increase in high-density lipoprotein (HDL) cholesterol, a decrease has been observed in low-density lipoprotein (LDL) cholesterol (9). Another study conducted on active and inactive men examined the effects of fasting and physical activity on biochemical parameters and found a significant increase in HDL cholesterol in both groups. Additionally, hematocrit level, red blood cell count, LDL, very LDL, and total cholesterol greatly decreased after fasting (10).

Although it was confirmed that fasting affected physical performance and activity, in a study conducted on inactive

individuals, the heart rate was found to be lower in moderate aerobic exercises while fasting. In these individuals, a significant decrease in performance was also observed. Likewise, a study conducted on combat pilots demonstrated that fasting during Ramadan had negative effects on muscle performance and lowered physical performance scores (11). Measurements done during the Ramadan period revealed a decrease in the total body mass of sportspersons regularly performing general aerobic training, footballers, elite athletes, referees, and rugby players, alongside dehydration and negative energy balance (12).

Several studies have emphasized that due to the consumption of food and liquids late at night, the changes in sleeping duration and habits, as well as less fluid intake deteriorate performance in sports during Ramadan (12). That is why sportspersons are advised to track their dehydration levels regularly. In order to avoid dehydration or over-hydration, athletes must consume 1.5 times the amount of fluid they have lost through exercise. In the case of excessive consumption, sleep will be interrupted by the need to urinate and sleep quality will be negatively impacted (13).

In a study investigating the effects of fasting on aerobic performance, maximum oxygen intake was directly measured using a treadmill. No difference was observed in the highest oxygen-carrying capacity in the period before and during Ramadan. Although there was a decrease in maximum oxygen intake in the first week of Ramadan, the values in the fourth week returned to normal (14).

Most of the studies on aerobic and anaerobic performances during Ramadan have focused on individual sports, and those examining team sports have mostly studied football. A study conducted on basketball players concluded that fasting did not make a significant difference in aerobic and anaerobic performance based on the results of small games and repeat sprint ability (15). For this study, Pilates was picked on the grounds that it favored lymphatic and blood drainage, ameliorated posture, increased flexibility, and expanded motion range and muscular strength, improved cardiometabolic parameters, and augmented blood glucose (16,17).

While team sports or individual sports are generally examined to evaluate performance during Ramadan, there is no study on Pilates in the literature. This study aimed to evaluate the changes in the body composition of individuals who fasted and did Pilates at least twice a week during Ramadan versus those who fasted but did no Pilates.

Methods

This was an experimental study conducted on 60 healthy women who were admitted to the Noi Pilates in İstanbul Turkey, which was a private Pilates studio. The study was carried out on 60 grown-up women who fasted during Ramadan 2019, some of whom did pilates and some of whom did not. The participants in the study were 18-65 years old and were healthy adults who had been doing Pilates for 6 months prior to Ramadan and did Pilates at least 3 times a week during Ramadan. Individuals

aged <18 or >65, not fasting or fasting less than twice a week in Ramadan did not take part in the study.

The women were divided into 2 groups by random sampling using simple randomization. Participants were randomly allocated to the Pilates exercise group (PL) or control group (No PL), with 30 participants in each (simple allocation using www.random.org). The ethical review committee of İstanbul Kültür University approved the study (number: 2019.04). All participants provided written consent in accordance with the declaration of Helsinki and informed consent was obtained from each participant before participation.

The Evaluation of Nutritional Status

To identify the dietary habits of the patients, a food consumption frequency form was applied. To determine the dietary status of the patients, a three-day food consumption form was used at the beginning of the study.

The researcher provided the participants who got trained about portions with consumption forms and they were instructed to write down on the form the food and drinks they consumed for three days, including a weekend and two weekdays, in the morning, afternoon, and evening, with the details of time and place. The portion education was given to the participants through the food and nutrition catalog (18). The average daily intake of participants' macro and micronutrients were analyzed by the National Food Composition Database (Türkomp).

Assessment of Anthropometric Measurements

The height measurement was done with a Seca-206 height meter (Hamburg, Germany). While the height measurement was done, the standing position and head at the Frankfurt plane were noted. The body analysis of the patients was done using a regularly calibrated Tanita SC-330 analyzer (Tokyo, Japan). BMI can be determined with the weight/height² equation (19). While evaluating the results of BMI, the BMI classification of WHO was used (20). The smallest waist circumference between bottom costa and processus spina iliaca anterior superior was measured and saved with a measure parallel to the ground from navel by the researcher. Two measurements, at the beginning and end of the study, were done.

Subcutaneous fat thickness was measured in 3 body parts, including the triceps, thigh, and above the pelvis; the subcutaneous fat was measured by caliper (Saehan skinfold caliper, SH5020, Korea). Triceps skin-fold thickness (SFT) was measured on the right arm bent 90° from the elbow by locating and marking the bump between the acromion (shoulder) and olecranon (elbow). The arm was positioned loosely and the skin fold was held 1 cm above the mark between the index finger and thumb of the left hand. The measurement was done on the marked spot by the right hand with a caliper. The participant was standing upright while the measurement was done (21,22). All measurements were done on the right side of the body. All body parts (to the nearest 0.1 mm) were measured with three rotational measurements. The caliper measurements were read 4 seconds later than releasing the folding handle. To obtain

reliable and accurate measurements, they were carried out at a certain time of the day, preferably in the afternoon. The SFT of all participants was measured by a specialist. Jackson-Pollock nomogram was used in measurements, and the final step was to measure the ratio of the waist-to-hip circumference.

Training Program

As diaphragmatic breathing was an effective method for improving glycemic parameters in participants, a trained physiotherapist taught patients diaphragmatic breathing before leading the effects of pilates based mat exercise (PBME) program (23). During Ramadan 2019, Pilates participants performed PBME at 11 a.m. every Monday, Wednesday, and Saturday. All of the sessions took place in a private Pilates studio in Istanbul. The sessions were initially 50 minutes long. There were three stages of the Pilates exercise: 1) warm-up and stretching; 2) Moderate Pilates to train arms, legs, and body; 3) cool-down and relaxing. The participants were monitored in case of any possible complications, such as fatigue, dizziness, headache, feeling light-headed, shortness of breath, decreased reflexes, numbness in hands or feet, any sort of pain, and cold sweating.

Statistical Analyses

The Turkomp program was used to calculate the data related to nutrients. Then, the nutrient data and other anthropometric data were coded into the statistics program. Mean and standard deviation analyses were used to describe the anthropometric measurements before and after Ramadan for the PL and non-PL groups. Minimum and maximum values, mean, and standard deviations were calculated for the number of meals and nutrient variables. Mann-Whitney U Test and Wilcoxon Signed Rank Test were used to compare the pre- and post-Ramadan anthropometric measurements of the PL and non-PL groups. Analyses were made with the SPSS 20 program. A p-value less than 0.05 was accepted statistically significant.

Results

The means of anthropometric variables and standard deviation values of the PL and non-PL groups are given in Table 1. Accordingly, anthropometric values of the PL group before and after Ramadan were 28.77±3.14 and 27.59±3.22 kg/m² for BMI, 26.31±1.87 and 25.13±1.93 for triceps SFT, 35.21±4.80 and 32.23±4.16 for fat percentage, 24.07±1.27 and 23.03±1.77 kg for muscle mass, 79.52±5.80 and 78.88±14.37 cm for waist circumference, and 111.69±7.20 and 110.88±8.30 cm for the hip circumference, respectively. In the non-PL group, anthropometric values before and after Ramadan were 28.60±2.94 and 29.13±3.10 kg/m² for BMI, 26.23±1.19 and 26.77±1.25 mm for triceps SFT, 34.68±3.26 and 36.03±3.54 for fat percentage, 23.47±2.11 and 23.87±2.22 kg for muscle mass, 77.15±6.30 and 78.07±6.33 cm for waist circumference, and 108.30±9.49 and 107.37±9.62 cm for hip circumference, respectively.

Table 2 shows the number of meals and nutrient values of all participants. The daily average of meals was 2.33. Also, 1.51 liters

Table 1. The means and standard deviations of the anthropometric variables of the groups

Variable	PL group		No PL group	
	Before Ramadan	After Ramadan	Before Ramadan	After Ramadan
BMI (kg/m ²)	28.77±3.14	27.59±3.22	28.60±2.94	29.13±3.10
Triceps skin-fold thickness (mm)	26.31±1.87	25.13±1.93	26.23±1.19	26.77±1.25
% fat	35.21±4.80	32.23±4.16	34.68±3.26	36.03±3.54
Muscle mass	24.07±1.27	23.03±1.77	23.47±2.11	23.87±2.22
Waist circumference (cm)	79.52±5.80	78.88±14.37	77.15±6.30	78.07±6.33
Hip circumference (cm)	111.69±7.20	110.88±8.30	108.30±9.49	107.37±9.62

PL: Pilates exercise group

Table 2. The mean of meal number and dietary nutrient values of all participants

Variable	Min	Max	X ± SD
Number of meals	1.00	3.00	2.33±0.71
Water consumption (lt)	1.00	2.50	1.51±0.42
Energy	544.50	2,102,00	1,274.98±457.56
% protein	13.30	26.69	18.52±3.09
% carbohydrates	26.00	60.40	42.68±7.53
% fat	22.40	53.00	38.89±6.40
Fiber (g)	3.20	13.50	6.27±2.33
Cholesterol (mg)	100.60	416.00	223.39±81.71

Min: Minimum, Max: Maximum, SD: Standard deviation

of water, 1,274.98 kcal of energy, 6.27 g of fiber, and 223.39 g of cholesterol were consumed. The nutrient distribution was as follows: 42.68% carbohydrates, 18.52%, and 38.89% fat.

The comparison of the preliminary measurements of the PL and non-PL groups are shown in Table 3. The groups had to be equal at the beginning (in terms of preliminary measurements). In experimental models, the groups were organized equivalently to determine the role of application in the difference. In the

preliminary measurements, no significant difference was found between anthropometric variables of fasting women who did pilates and did not do Pilates (p>0.05).

Table 4 shows the comparison of the final measurements of the test and control groups. This demonstrated that there was a significant difference between the fat percentage and triceps SFT of fasting women who did pilates and who did not do pilates (p<0.05). According to the final measurements, the two groups did not differ in terms of BMI, muscle mass, waist circumference, and hip circumference (p>0.05).

Table 5 shows the comparison of the preliminary and final measurements of the PL group. Based on these results, fasting when combined with Pilates led to a significant decrease in the fat percentage and triceps SFT (p<0.05). In terms of other variables, there was no significant difference between the preliminary and final measurements (p>0.05).

Table 6 shows the comparison of the preliminary and final measurements of the non-PL group. According to this table, in those who fasted without doing Pilates, BMI, triceps SFT, muscle mass, and fat percentage increased significantly (p<0.05). There was no significant difference between the preliminary and final measurements in terms of waist and hip circumference (p>0.05).

Table 3. The comparison of the preliminary measurements of the test and control groups

Variable	Group	Mean rank	Sum of rank	U	p
BMI (kg/m ²)	PL	31.06	1,025.0	427.0	0.783
	No PL	29.81	805.0		
Triceps skin-fold thickness (mm)	PL	30.06	992.0	431.0	0.829
	No PL	31.04	838.0		
% fat	PL	30.59	1,009.5	442.5	0.964
	No PL	30.39	820.5		
Muscle mass (kg)	PL	34.17	1,127.5	324.5	0.071
	No PL	26.02	702.5		
Waist circumference (cm)	PL	32.92	1,086.5	365.5	0.232
	No PL	27.54	743.5		
Hip circumference (cm)	PL	32.74	1,080.5	371.5	0.270
	No PL	27.76	749.5		

Table 4. The comparison of the final measurements of the test and control groups

Variable	Group	Mean rank	Sum of ranks	U	p
BMI (kg/m ²)	PL	26.71	881.5	320.5	0.063
	No PL	35.13	948.5		
Triceps skin-fold thickness (mm)	PL	23.47	774.5	213.5	0.001
	No PL	39.09	1,055.5		
% fat	PL	23.86	787.5	226.5	0.001
	No PL	38.61	1,042.5		
Muscle mass (kg)	PL	30.14	994.5	433.5	0.858
	No PL	30.94	835.5		
Waist circumference (cm)	PL	31.17	1,027.5	424.5	0.754
	No PL	29.72	802.5		
Hip circumference (cm)	PL	34.29	1,031.5	320.5	0.063
	No PL	25.87	689.5		

Discussion

This study aimed to evaluate the changes in the body composition of individuals who fasted and did Pilates at least twice a week during Ramadan versus those who fasted but did no Pilates. According to the American Diabetes Association (ADA), the daily energy intake of a healthy adult should consist of 50-60% carbohydrates, 10-20% protein, and <30% fat, whereas Turkey Dietary Guidelines (TÜBER-2015) advises 55-60% of daily energy should be provided from carbohydrates, 10-15% from protein, and <30% from fat (23-25). Three-day food consumption records provided by the women participating in this study showed they consumed an average of 2 meals during Ramadan and took in 1,270 kcal

of energy. When their diet pattern was examined, 18.5% of the energy was provided from protein, 42.6% from carbohydrates, and 38.8% from fat. It was presumed that the increase in the consumed protein rate during Ramadan caused an increase in dietary fat. In the study conducted by Hsouna et al. (26), they monitored 20 healthy and exercising men throughout Ramadan. They found that the men participating in the study consumed more fat as a result of the increasing carbohydrate amount in their diet, and the dietary protein ratios were lower compared to their regular levels until the end of Ramadan. In another study, the components of individuals' diets were examined during Ramadan (the first 10 and the last 10 days) and it was found that people

Table 6. The comparison of the preliminary and final measurements of the group who did not do pilates

Variable	Rank	Mean rank	Sum of rank	z	p
BMI (kg/m ²)	Negative	5	9.20	-3.29	0.001
	Positive	21	14.52		
	Same	1			
Triceps skin-fold thickness (mm)	Negative	2	4.75	-4.32	0.000
	Positive	25	14.74		
	Same	0			
% Fat	Negative	0	0.00	-4.53	0.000
	Positive	27	14.00		
	Same	0			
Muscle mass (kg)	Negative	7	12.43	-2.25	0.024
	Positive	19	13.89		
	Same	1			
Waist circumference (cm)	Negative	11	12.27	-1.64	0.102
	Positive	8	6.88		
	Same	8			
Hip circumference (cm)	Negative	12	17.13	-1.60	0.111
	Positive	12	7.88		
	Same	3			

Table 5. The comparison of the preliminary and final measurements of the group who did Pilates

Variable	Ranks	2	Mean rank	Sum of rank	z	p
BMI (kg/m ²)	Negative	33	17.00	561.00	-5.01	0.000
	Positive	0	0.00	0.00		
	Same	0				
Triceps skin-fold thickness (mm)	Negative	31	17.13	531.00	-4.48	0.000
	Positive	2	15.00	30.00		
	Same	0				
% fat	Negative	31	17.52	543.00	-4.69	0.000
	Positive	2	9.00	18.00		
	Same	0				
Muscle mass (kg)	Negative	25	14.46	361.50	-1.83	0.068
	Positive	7	23.79	166.50		
	Same	1				
Waist circumference (cm)	Negative	22	13.50	297.00	-0.62	0.535
	Positive	10	23.10	231.00		
	Same	1				
Hip circumference (cm)	Negative	13	15.27	198.50	-0.41	0.680
	Positive	16	14.78	236.50		
	Same	4				

consumed more carbohydrates at the beginning of Ramadan, and the amount decreased significantly during the last 10 days (27). In this study, contrary to the literature, an increase was found in the rate of dietary fat consumption. This may have occurred because the people gave priority to protein foods in order to stay full for a long time during Ramadan. A study by Lessan et al. (28) evaluated basal metabolic rates and activity pace of 29 individuals who were healthy, non-obese, and fasting during Ramadan. Basal metabolic rate was found to be 2,200 kcal and 2,100 kcal during and after Ramadan, respectively. While there were no significant fluctuations observed in basal metabolic rate during Ramadan, the results showed that it was associated with fasting, decreased activity levels, and sleep duration. Another study evaluated the performance and eating habits of adolescent football players during Ramadan. A performance decrease was seen in the athletes during Ramadan; however, this decrease could not be associated with low calorie intake or change in sleep times (29).

Changes in eating habits may influence liquid consumption adversely. Inadequate fluid intake causes dehydration, especially in athletes during Ramadan. That is why tracking hydration levels is important during Ramadan (12,13). This study showed that people consumed 1.5 liters of water on average.

In one of the studies on sportpersons' performance in Ramadan, there was no deterioration observed in the aerobic exercise performance and body composition of the football players who had been regularly training before Ramadan (30). This study compared the body compositions of women who did Pilates and who did not do Pilates during Ramadan. BMI, triceps SFT

measurements, and fat percentage decreased significantly in women who did Pilates during Ramadan when compared to those who did not. The change in the triceps SFT and fat percentage of women who did Pilates were superior to only that of those who fasted without Pilates. BMI, muscle mass, waist circumference, and hip circumference of women who did Pilates and who did not do Pilates during Ramadan did not differ in the final measurements, and neither of the two methods dominated in terms of these variables. In another study, the body composition of athletes was evaluated during Ramadan. It found that athletes' post-Ramadan BMI and body fat ratio were lower, and muscle and water mass did not change (31). According to a meta-analysis, fasting causes a statistically significant decrease in weight, but its effect on body composition cannot be interpreted clearly (8).

Thirty-four volunteers practicing karate and Taekwondo were divided into 2 groups in a study. One group exercised an hour before iftar and the second group exercised 3 hours later. Their anthropometric measurements were evaluated. The study revealed that training before or after iftar during Ramadan did not affect agility and power performance (32). In this study, the diet and exercise programs of women were planned individually, and no distinction was made duration-wise. A meta-analysis evaluated the physical performance of athletes during Ramadan in the morning and afternoon. The results showed that the performance of the participants was not affected during the day. It is concluded that as long as sleep and diet programs are planned individually by considering iftar and sahur during Ramadan, physical performance will not be adversely affected (33).

Study Limitations

Although the limitation of this study on Ramadan and Pilates was that it was conducted only on women, this study was a first in its field. Evaluating anthropometric measurements such as food consumption, body analysis and SFT together were the strengths of the study. With these features, it is thought that this study will shed light on future studies.

Conclusion

People's diets change during Ramadan. However, a balanced diet pattern to provide sufficient energy should be preserved. While a long period of fasting in Ramadan leads people to inactivity, personalized exercise and nutrition programs planned by experts may result in weight loss, especially for obese and slightly overweight people.

Acknowledgments

The experiments complied with the current laws of the country where they were performed. The authors have no conflict of interest to declare.

Ethics

Ethics Committee Approval: The ethical review committee of İstanbul Kültür University approved the study (number: 2019.04).

Informed Consent: All participants provided written consent in accordance with the declaration of Helsinki.

Peer-review: Externally peer reviewed.

Authorship Contributions

Concept: N.B., Design: N.B., A.E., Data Collection or Processing: S.E., D.G., Analysis or Interpretation: N.B., S.K., Literature Search: N.B., S.S., A.E., D.G., Writing: N.B., S.K., S.S., A.E., D.G.

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