

## ORIGINAL ARTICLE

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# Effect of aerobic and resistance exercises on body composition and quality of life in overweight and obese women: a randomized control trial

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## ABSTRACT

**BACKGROUND**

Obesity has become a major health issue in the world and directly reduces the quality of life. The aim of this study was to compare the effect of aerobic and resistance exercises on body composition and quality of life (QoL) in overweight and obese women.

**METHODS**

An experimental study involving 90 overweight/obese women aged between 20-45 years participated in the study voluntarily and were randomized into control (n=30), aerobic exercise (AE) (n=30), and resistance exercise (RE) (n=30) groups. Either AE or RE groups performed exercise for 60 minutes per day for 10 weeks, whereas the control group did not perform any exercise. The body composition and QoL of the women were measured before and after the exercise.

**RESULTS**

Body weight, BMI, fat mass, and waist and hip circumferences decreased significantly in both AE and RE groups after the exercise intervention compared to the control group ( $p < 0.05$ ). In addition, quality of life sub-dimensions including physical health, psychological health, social relationship, and environment sub-dimensions improved significantly in the AE and RE groups compared to the control group ( $p < 0.001$ ). Post hoc Tukey test showed that AE was as effective as RE for improving body composition parameters and QoL sub dimension compared to control group.

**CONCLUSION**

This study demonstrated that both AE and RE were effective in improving body composition and thereby increasing the QoL in overweight and obese women. Both AE and RE programs are effective and should be considered within any multicomponent therapy program in overweight and obese women.

**Keywords:** Obese women, aerobic exercise, resistance exercise, quality of life

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## INTRODUCTION

Obesity is defined as abnormal or excessive fat accumulation due to excessive food intake and might impair health because of the high increase in adipose tissue.<sup>(1)</sup> Weight gain causes an increase in body mass index (BMI) which is calculated by dividing weight in kg by the square of height in meters.<sup>(2)</sup> While BMI between 25 to 30 kg/m<sup>2</sup> is classified as overweight, BMI above 30 kg/m<sup>2</sup> is classified as obese.<sup>(1)</sup> Obesity is a complex, multifactorial, chronic disease affected by genetic, metabolic, behavioral, physiological, and psychological components, and social determinants.<sup>(3)</sup> Obesity has been accepted as a serious problem for public health all over the world due to the related complications.<sup>(4)</sup> The gradual increase in the prevalence of obesity has prompted more research into the risks associated with excess fat gain and/or being overweight.<sup>(5)</sup> Overweight or obese individuals are at increased risk for serious diseases such as type 2 diabetes, cardiovascular disease, metabolic disease, and cancer.<sup>(6,7)</sup> Moreover, studies have shown that obesity has been associated with a variety of negative psychological disorders, including depression, motivational disorders, low self-esteem, emotional and behavioral disorders and poor quality of life.<sup>(8,9)</sup>

Quality of life (QoL) focuses on the physical and mental health and functional performance of individuals, thus it is an important component in assessing people's overall health.<sup>(10)</sup> On the other hand, BMI is an indicator of health<sup>(11)</sup> and the association with QoL has been studied in detail in previous research.<sup>(12,13)</sup> Findings of previous studies showed contradictory results for the relationship between BMI and QoL. Although some studies stated that obesity has been associated with reduced QoL, even if the comorbid disease has been taken under control, other studies argue that being overweight has been associated with improved QoL.<sup>(14,15)</sup> Overall health-related QoL decreases among obese individuals but appears to increase in overweight individuals,<sup>(16)</sup> thus there is no consistent

explanation for the association between high or low BMI and health-related QoL.<sup>(17)</sup>

Physical inactivity is one of the main factors associated with obesity, whereas low physical fitness is an independent risk factor for premature death.<sup>(18)</sup> In contrast, exercise is an important strategy for managing the health risks of obesity and is considered as a milestone of the weight loss program.<sup>(19,20)</sup> Therefore, various types of exercise at different intensities might be used as complementary therapies in the treatment of obesity.<sup>(21)</sup> Several studies have suggested that aerobic exercise (AE) is probably the most effective exercise type for the treatment and prevention of excessive weight gain and obesity-related morbidities, as it can be easily administered to obese individuals and provides high energy expenditure.<sup>(22,23)</sup>

Resistance exercise (RE) is the gold standard exercise mode for accrual of lean muscle mass, but the isolated effect of resistance training on body fat is unknown.<sup>(24)</sup> The American College of Sports Medicine position stand on physical activity for weight loss and prevention of weight regain<sup>(25)</sup> states that RE will not promote clinically significant weight loss, and may increase loss of body fat mass only when combined with aerobic exercise.<sup>(25)</sup> A systematic review and meta-analysis showed that reductions in regional adiposity and body weight measures were also observed following combined RE and AE programs including caloric restriction.<sup>(26)</sup> On the other hand, some studies have highlighted that RE is also safe and effective for the treatment of overweight and obesity, especially in increasing lean body mass and physical fitness components related to muscle strength.<sup>(20,22,24)</sup> Epidemiologic studies noted specific relationships between physical activity and health outcomes that include increased cardiorespiratory and muscle fitness<sup>(27)</sup> as well as decreased risk of all-cause mortality and cardiovascular disease.<sup>(28)</sup> Physical training is an effective strategy for improving quality of life and emotional health status<sup>(29)</sup> and can diminish morbidities associated with obesity, such as depression and anxiety.<sup>(15)</sup>

Studies have shown that physically active individuals have higher scores for certain sub-dimensions of QoL domains compared to physically inactive individuals.<sup>(30,31)</sup> At the same time, physical activity helps to improve one's physical, psychological and emotional health<sup>(32)</sup> and might positively affect the personal perception of QoL and well-being.<sup>(33)</sup> In this context, the aim of this study was to evaluate the effect of a 10-week RE and/or AE program on body composition and QoL in overweight and obese women.

## METHODS

### Research design

This study was carried out on the Hitit University campus in the province of Çorum in Turkey as a randomized control trial with parallel group design according to CONSORT guidelines. The study was conducted between September and December 2022 in Turkey.

### Study subjects

Subjects recruited for this study were selected through advertising flyers displayed on supermarket doors and around the university campus. A total of 214 participants responded to the advertisement and were invited to the campus for face-to-face interviews. After the interview for inclusion and exclusion criteria, 87 participants were not eligible for the study due to having menopause, smoking, alcohol consumption, exercising regularly for the last 6 months, having BMI below 25 and over 35 kg/m<sup>2</sup>, leaving 127 potential participants, who were asked to sign a written informed consent statement. Inclusion criteria were age 20 to 45 years, sedentary (exercising  $\geq 1$ –2 times/week), and overweight or moderately obese (body mass index 25–35 kg/m<sup>2</sup>). Subjects were nonsmokers without a history of diabetes, hypertension, or coronary artery disease. Before the initial clinical evaluation, they underwent health examinations to ensure that they were not taking any medications for heart disease, and respiratory, metabolic or inflammatory

disorders, and not suffering from chronic disease related to carbohydrate and lipid metabolism.

### Sample size determination

In order to generalize the research results, the size of the sample was determined using Gpower 3.9.1. In order to determine the effect of aerobic and resistance exercises on body composition and quality of life in overweight and obese women, the total number required for the expectation of an effect size ( $f=0.60$ ) to be statistically significant ( $\alpha=0.05$ ;  $1-\beta=0.80$ ) was 30 for each group.

### Randomization of subjects

After written informed consent was obtained and baseline tests were completed, all subjects were asked to maintain their current lifestyle for a ten-week run-in period followed by pre-exercise testing, with subsequent randomization. Both stratified and block randomization strategies were combined for grouping participants. Initially, participants were stratified into overweight or obese according to their BMI and subsequently grouped in blocks of six which were determined using randomly generated numbers.

Ninety eight subjects started the run-in period and were then randomized into three groups: control group ( $n=30$ ), AE group ( $n=33$ ), and RE group ( $n=35$ ) while the assignment of a greater number of participants to the intervention groups was due to the risk of dropouts. Participants not joining the exercise for 4 times in total and 2 times consecutively were excluded from the study, therefore the final numbers of participants were equal in all three groups, each having 30 participants for analysis. Both AE and RE groups participated in their respective exercise intervention programs for 10 weeks, whereas the control group did not participate in any exercise program.

The exercise groups performed 10 weeks of physical training. Aside from the training, all subjects were instructed to maintain the physical activity that they had been practicing previously without any caloric restriction. At baseline and

after the 10 weeks of physical training, anthropometric and body composition measurements as well as quality of life parameters were determined in all of the groups.

### **Exercise training protocols**

The study groups were 1) AE; 2) RE; and 3) Control. The 10-week intervention consisted of a physical exercise program, including 3 sessions of training per week (on Mondays, Wednesdays, and Fridays). A total of 30 training sessions were carried out for groups AE and RE. All exercise sessions were supervised by the same trained physical education professional. Training was performed under the supervision of a qualified and certified fitness instructor. Women participated three times per week at an intensity of 60% of maximal heart rate for 60 minutes for 10 weeks in either aerobic or resistance exercises according to their groups. All participants performed aerobic exercises during the warm-up for 10 minutes before the main part of the exercise protocol at each exercise session, whereas both target heart rate and exercise intensity was calculated for each participant separately. The main part of the AE group was a 40-minute walk at an intensity of 60% of maximal heart rate. For the RE group, the 10-week program was performed three times per week at nonconsecutive days, totaling 30 sessions with duration of 40 min each. Resistance loads were 60% of one repetition maximum testing (1RM) that a person can lift only for 1 repetition for all major muscle groups. The ten different types of resistance exercises were leg press, leg curl, leg extension, lat pulldown, chest press, bench press, shoulder press, biceps curl, triceps extension and basic crunch. Movements were performed in 10 repetitions and for 2 sets with 1-minute rest intervals. Each exercise session ended with a 10-minute cool-down period including stretching for both exercise groups.

### **Anthropometrics and body composition**

Height was measured to the nearest 0.1cm on a stadiometer when the participants were shoeless. The body weights of participants in bare

feet, t-shirts, and tights were measured by the weighing instrument in kilograms  $\pm 0.01$  kg. BMI was calculated as  $\text{weight/height}^2$  ( $\text{kg/m}^2$ ). The participants were asked to breathe out for measurement of their waist circumference, which was measured to the nearest 0.1cm at the iliac crest. When viewed from the sagittal plane, hip circumference was evaluated at the level of the maximum extension of the thigh, and the waist-hip ratio equals the waist circumference divided by the hip circumference.

The “Tanita Body Composition Analyzer BC-418” bioelectrical impedance analyzer was used to determine the body fat percentage of the subjects participating in the study. In order to determine the body compositions of the subjects, after their height, age, gender, and clothing weight were recorded and entered as data on the analyzer screen, the subjects were asked to stand on the platform with bare feet. The assessment was performed after overnight fasting, early in the morning on an empty stomach and urinary bladder.

### **Quality of life (QoL)**

The QoL was assessed using the validated Turkish version of WHOQOL-BREF that had been translated and adapted into Turkish by Fidaner et al.<sup>(34)</sup> The WHOQOL-BREF contains 26 items, with each item representing one facet. The four main domains and their respective facets are as follows: (1) physical health domain: to be free of any pain, sleep and rest, mobility, having energy, mobility, activities of daily living, to be free of dependence on medication and treatments, and work capacity; (2) psychological health domain: happiness and enjoyment of life, to be able to concentrate, feeling positive about yourself, body image and appearance, to be free of negative feelings, and religion/spirituality/personal beliefs; (3) social relationships: sexual activity, personal relationships, and social support; (4) environment: feeling physical safety and security, home environment, financial resources, to be able to access adequate health care, chances of getting new information and

knowledge, participation in recreation/leisure, adequate transport, and physical environment. All items on the WHOQOL-BREF are scored on a 5-point Likert scale with total scores ranging from 25 to 125 points and higher scores representing a greater QoL.<sup>(34)</sup>

### Statistical analysis

Statistical analysis was performed by using SPSS 23.0 software while the normality of data distribution was checked by using Kolmogorov–Smirnov test and homogeneity of variances were determined with Levene’s test. One-way ANOVA was used to compare group differences for body composition in terms of weight, BMI, fat mass, waist and hip circumferences, waist-to-hip ratio, and for the QoL sub-dimensions of physical and psychological health, social relationship, and environment. Significant differences among groups were further tested by Tukey post hoc analysis (honestly significantly difference, HSD). All statistical analysis tests were performed at the significance level of  $p < 0.05$  and  $p < 0.01$ .

### Ethical clearance

Ethics committee approval of this study, which was planned in accordance with the Helsinki Principles, was obtained from Hitit University Non-Invasive Ethics Committee (Acceptance Number: 2022-GOAEK-0072).

## RESULTS

Of the 127 subjects who entered the 10-weeks run-in phase of the study, 98 (77.1%) were randomized to one of three exercise groups. There was a 8.2% dropout rate from the exercise intervention across all groups, leaving 90 to complete the study intervention and testing. The flow diagram showing the patients participating in the study is shown in Figure 1.

A total of 90 obese women aged between 20 and 45 years were included in the controlled randomized experimental study, with a mean age of  $35.49 \pm 4.21$  years for all participants. Mean

age for the groups were  $32.80 \pm 0.75$  years (95% CI: 31.26-34.34) for control,  $37.53 \pm 0.34$  years (95% CI:36.84-38.22) for AE, and  $36.13 \pm 0.85$  years (95% CI:34.39-37.88) for RE groups. The mean height of all participants was  $160.21 \pm 5.85$  cm, while the mean height for groups were  $161.17 \pm 1.13$  cm (95% CI:158.85-163.48) for control,  $159.03 \pm 0.99$  cm (95% CI:156.99-161.07) for aerobic exercise, and  $160.43 \pm 1.07$  cm (95% CI:158.24-162.62) for resistance exercise respectively. Baseline demographic variables in terms of body composition measured as weight, BMI, fat mass, waist circumference, hip circumference, waist-to-hip ratio, and the QoL sub-dimension physical health, psychological health, social relationship and environment scores for AE, RE and the control groups were analyzed by ANOVA and shown in Table 1. None of these variables showed a significant difference, indicating that the randomization of participants into groups had been successfully performed ( $p > 0.05$ ) (Table 1).

At the end of the 10-week exercise intervention program, differences among AE, RE and control groups in terms of body composition parameters were analyzed with ANOVA, the results of which are shown in Table 2. According to the results, weight ( $p=0.003$ ), BMI ( $p=0.009$ ), fat mass ( $p=0.016$ ), waist circumference ( $p=0.005$ ), hip circumference ( $p=0.008$ ) variables were significantly different among the groups, whereas waist-to-hip ratio ( $p=0.535$ ) did not show any significant difference among the groups (Table 2).

Variables that showed significant differences among groups were further analyzed with Tukey’s HSD test for post hoc analysis and pairwise comparisons revealed statistically significant differences between control and AE ( $p=0.002$ ) and between control and RE ( $p=0.045$ ) groups for weight, whereas the difference between AE and RE was not statistically significant ( $p=0.563$ ). Moreover, fat mass was found to be significantly different between control and AE ( $p=0.024$ ) and between control and RE ( $p=0.048$ ), but not between AE and RE ( $p=0.961$ ).

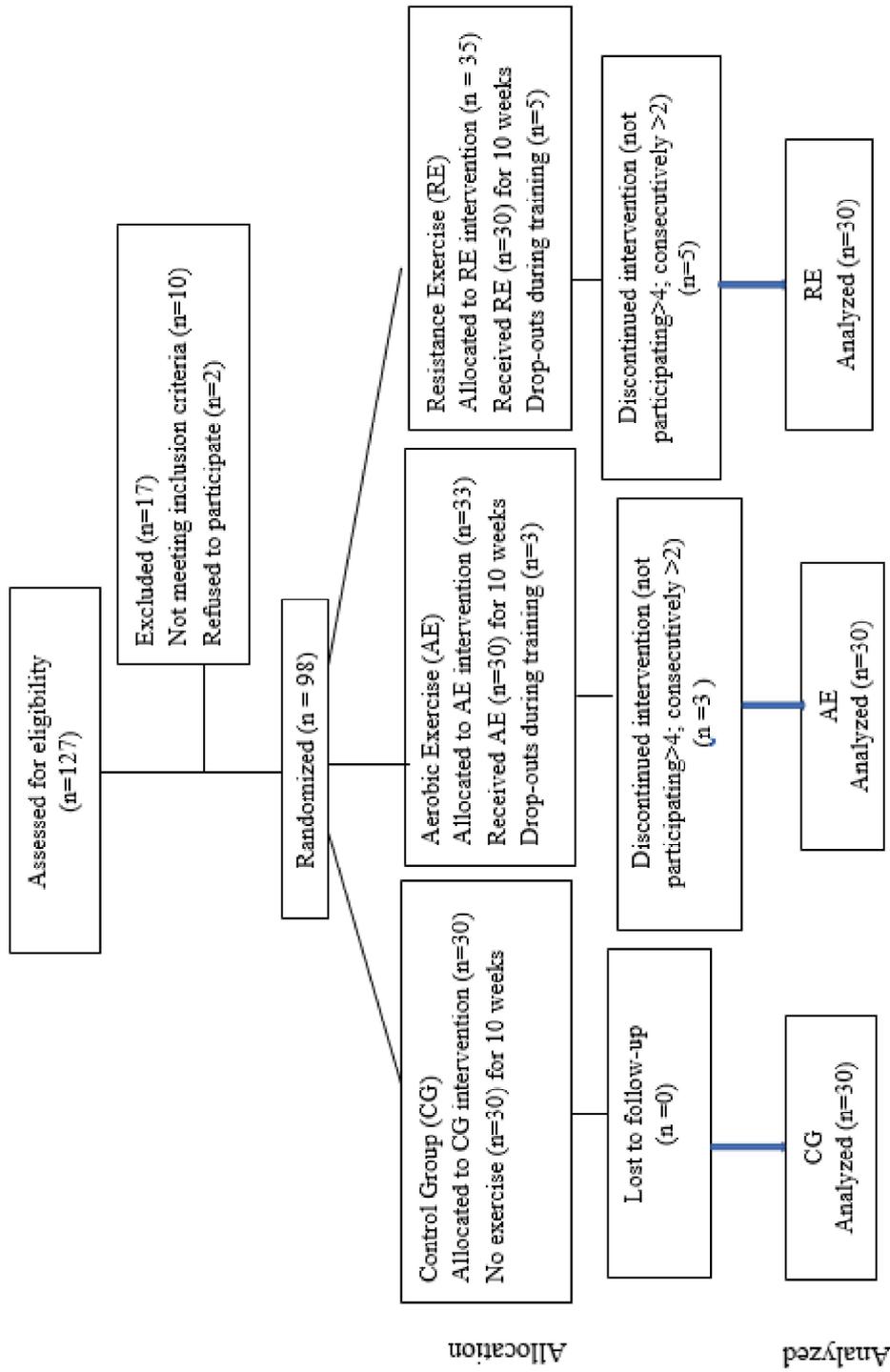


Figure 1. Flowchart of the participants.

Table 1. Baseline demographics and exercise prescription by treatment groups

Variables	AE (n=30)	RE (n=30)	C (n=30)	p value
Body composition				
Weight (kg)	77.52 ± 11.59	79.42 ± 7.91	81.20 ± 9.20	0.343
BMI (kg/m <sup>2</sup> )	30.55 ± 3.55	30.96 ± 3.76	31.24 ± 2.82	0.734
Fat mass (kg)	36.75 ± 6.80	38.27 ± 4.28	34.76 ± 5.16	0.052
Waist (cm)	94.17 ± 8.82	93.10 ± 8.47	94.07 ± 8.59	0.870
Hip (cm)	112.67 ± 7.90	112.13 ± 8.11	112.83 ± 7.97	0.939
Waist/Hip ratio	0.83 ± 0.71	0.83 ± 0.60	0.83 ± 0.05	0.918
WHOQOL-BREF				
Physical health	19.67 ± 2.56	18.80 ± 2.63	19.73 ± 2.99	0.342
Psychological health	15.87 ± 3.04	16.83 ± 3.91	14.93 ± 2.91	0.091
Social relationship	7.03 ± 2.24	7.97 ± 1.77	6.97 ± 1.75	0.087
Environment	19.07 ± 3.88	20.30 ± 4.16	19.07 ± 3.54	0.366

\*Significance level is at p<0.05

Note: Data presented as mean ± SD; AE: aerobic exercise; RE: resistance exercise; C: control; BMI: body mass index

Table 2. Comparison of body composition parameters weight, BMI, fat mass, waist and hip circumferences, and waist-to-hip ratio by treatment groups after 10 weeks intervention

Variables	Treatment groups			p value
	AE (n=30)	RE (n=30)	C (n=30)	
Weight (kg)	72.20 ± 11.54	74.79 ± 8.08	80.72 ± 9.42	0.003**
BMI (kg/m <sup>2</sup> )	28.45 ± 3.58	29.16 ± 3.79	31.12 ± 2.81	0.009**
Fat mass (kg)	32.52 ± 6.48	33.87 ± 3.24	35.02 ± 4.96	0.016*
Waist (cm)	89.98 ± 7.97	89.30 ± 8.27	94.27 ± 8.71	0.005**
Hip (cm)	109.07 ± 8.01	108.67 ± 7.94	113.20 ± 8.14	0.008**
Waist/Hip	0.83 ± 0.07	0.82 ± 0.62	0.83 ± 0.05	0.535

\*Significance level is at p<0.05, \*\*Significance level is at p<0.01

Note: Data presented as mean ± SD; AE: aerobic exercise; RE: resistance exercise; C: control; BMI: body mass index

Table 3. Pairwise comparisons of post hoc analysis for control and exercise intervention groups for body composition parameters BMI, fat mass, waist and hip circumferences

Variables	Treatment groups		Mean difference	p value
Weight	AE	RE	2.590	0.563
		C	8.70	0.002**
	RE	C	6.14	0.045*
BMI	AE	RE	0.626	0.699
		C	2.65	0.009**
	RE	C	3.27	0.001**
Fat mass	AE	RE	0.350	0.961
		C	3.50	0.024*
	RE	C	3.15	0.048*
Waist	AE	RE	0.633	0.953
		C	6.60	0.008**
	RE	C	5.97	0.018*
Hip	AE	RE	0.067	0.999
		C	5.60	0.018*
	RE	C	5.53	0.020*

\*Significance level is at p<0.05, \*\*Significance level is at p<0.01

Note: AE: aerobic exercise; RE: resistance exercise; C: control; BMI: body mass index

Table 4. Comparison of QoL sub-scales physical, psychological, social, and environmental health by treatment groups after 10 weeks intervention

Variables	Treatment group			p value
	AE (n=30)	C (n=30)	RE (n=30)	
WHOQOL-BREF				
Physical health	26.33 ± 3.14	25.23 ± 4.93	20.17 ± 2.93	<0.001**
Psychological health	24.77 ± 3.47	24.43 ± 4.05	14.90 ± 3.16	<0.001**
Social relationship	11.10 ± 1.99	10.97 ± 1.97	7.37 ± 1.77	<0.001**
Environment	28.77 ± 3.40	28.80 ± 3.97	19.23 ± 3.29	<0.001**

\*\*Significance level is at  $p < 0.01$

Note: AE: aerobic exercise; RE: resistance exercise; C: control

Also, BMI was significantly different between control and AE ( $p=0.009$ ) and between control and RE ( $p=0.001$ ) but not between AE and RE ( $p=0.699$ ). According to the results of Tukey's post hoc analysis, waist and hip circumferences were significantly different between control and AE ( $p=0.008$ ) and between control and RE ( $p=0.018$ ) groups, but not between AE and RE groups ( $p=0.953$ ) (Table 3).

According to ANOVA results of QoL after the 10-week exercise intervention programs, physical health ( $p < 0.001$ ), psychological health ( $p < 0.001$ ), social relationship ( $p < 0.001$ ) and environment ( $p < 0.001$ ) sub-dimensions showed statistically significant differences among the groups (Table 4).

Pairwise comparison according to Tukey's HSD test performed for post hoc analysis revealed statistically significant differences

between control and AE ( $p < 0.001$ ) and between control and RE ( $p < 0.001$ ) groups for physical health, psychological health, social relationship and environment, whereas the difference between AE and RE was not statistically significant for physical health ( $p=0.499$ ), psychological health ( $p=0.931$ ), social relationship ( $p=0.961$ ) and environment ( $p=0.999$ ) (Table 5).

## DISCUSSION

The findings of this study showed that RE intervention for 10 weeks was as effective as AE intervention for improvement not only in body composition parameters such as weight, BMI, fat mass and waist and hip circumferences but also for QoL subdimensions in overweight and obese women. Interestingly, waist-to-hip ratio did not show any significant differences among groups,

Table 5. Pairwise comparisons of post hoc analysis for control and exercise intervention groups for QoL subdimensions

Variables	Treatment group		Mean difference	p value
Physical health	AE	RE	0.433	0.499
		C	-6.07	<0.001**
	RE	C	-5.63	<0.001**
Psychological health	AE	RE	0.333	0.931
		C	-9.87	<0.001**
	RE	C	-9.53	<0.001**
Social relationship	AE	RE	0.133	0.961
		C	-3.73	<0.001**
	RE	C	-3.60	<0.001**
Environment	AE	RE	0.033	0.999
		C	-9.53	<0.001**
	RE	C	-9.57	<0.001**

\*\*Significance level is at  $p < 0.001$

Note: AE: aerobic exercise; RE: resistance exercise; C: control

although waist and hip circumference showed significant differences according to the ANOVA results after the 10-week exercise intervention. The literature states that AE is the preferred exercise type for weight loss and improving body composition, whereas RE is more effective in gaining lean mass without weight loss.<sup>(24,25)</sup> Resistance exercise was as effective as AE such that BMI, fat mass, waist and hip circumferences of women were similar after the exercise intervention and did not show any statistically significant difference. In the light of our findings, RE can be an alternative exercise to AE for weight loss, improving BMI and reducing fat mass in overweight and obese women (Tables 2 and 3).

Previous studies support these findings in that regular aerobic and strength exercises lead to significant reductions in body composition parameters such as body weight, BMI, fat mass, and waist and hip circumference.<sup>(35-37)</sup> Skrypnik et al.<sup>(38)</sup> found a decline in body weight, BMI, waist and hip circumference values in women with abdominal obesity after three months in both groups who performed either only endurance exercise or a combined exercise program with endurance and strength training. In addition, Marandi et al.<sup>(39)</sup> found that both light and moderate aerobic exercises improved body composition parameters in obese and overweight women. Aerobic exercises are low-impact physical activities recommended for obese individuals with weak physical strength<sup>(40)</sup> and are recognized as the most effective strategy for improving body weight and fat mass parameters.<sup>(41)</sup> A combined exercise program might be effective in the treatment of obesity since cardiovascular exercises burn fat stored in adipose tissue, while resistance exercises increase basal metabolism by increasing muscle mass.<sup>(42)</sup> Additionally, resistance training leads to a stable resting metabolic rate, resulting in an increased likelihood of weight loss in obese individuals.<sup>(8)</sup>

Reviews clearly state that exercise programs improve body weight and composition in overweight or obese adults due to a decline in

body weight, total body fat and visceral adipose tissue. While the effect on weight and fat loss is relatively small and limited to only a few kilograms, reduction of visceral fat is likely to improve cardiometabolic health in these patients.<sup>(43)</sup> According to the European Clinical Practice Guidelines of the European Society for the Study of Obesity (EASO), moderate but gradually increasing intensity aerobic endurance exercise should be performed for 30-60 minutes a day and most days of the week in all ages, tailored to the patient's health status and ability.<sup>(44)</sup> On the other hand, recent research shows that strength training might be an alternative in the treatment of obesity due to numerous potential benefits of resistance exercises including increased muscle strength, prevention of sarcopenia with aging, preservation of bone mineral density and reduction of body fat.<sup>(38,45)</sup> The findings of the present study are in accordance with the literature supporting that RE have a positive effect and show improvements in body composition in overweight and obese females.

Quality of life is a multidimensional construct that includes psychological, physical, social and environmental domains. It has been stated that physical activity is associated with an improved perception of the physical aspect of QoL, as well as other domains such as the social, emotional or psychological aspects of QoL.<sup>(46)</sup> A recent randomized clinical trial showed that moderate or high-intensity exercise training programs help improve the QoL among obese adults.<sup>(47)</sup> In contrast, in a meta-analysis that focused on post-intervention outcomes, but not on the mean change in physical, psychological, mental, social and environment QoL domains, improvement was reported only in the physical health subdimension due to exercise, but not in any other QoL subdimension.<sup>(48,49)</sup> The findings of the present study in terms of QoL sub-dimensions including physical health, psychological health, social relationship and environment show that exercise intervention, either aerobic or resistance exercise, for 10 weeks causes an increase in QoL in overweight and obese females. At the beginning of the study,

physical health, psychological health, social relationship, and environment were similar for each group, while all sub-dimensions showed significant differences according to comparisons of groups after 10 weeks of exercise intervention (Table 4). Pairwise comparisons with the Tukey post hoc test showed that the control group had significantly lower scores compared to both aerobic and resistance exercise groups for physical health, psychological health, social relationship and environment sub-dimensions of QoL. However, physical health, psychological health, social relationship and environment, were not significantly different between AE and RE (Table 5). The findings of the study are in accordance with the literature which shows that physical exercise has a positive effect on QoL in obese individuals.<sup>(50)</sup> As a crucial therapeutic strategy for improving physical and mental health, exercise training that includes aerobics, strength, stretching and balance exercises improves QoL in the general population and is consistently among the top health and wellness trends.<sup>(51,52)</sup>

However, psychological problems can lead to weight gain,<sup>(53)</sup> while weight loss can lead to better psychological outcomes, which may contribute to maintaining successful weight loss.<sup>(54)</sup> The detrimental effect of obesity on physical and psychological QoL domains has already been demonstrated by normal-weight adults showing better QoL compared to overweight and morbidly obese individuals.<sup>(55)</sup> Longitudinal and cross-sectional studies have shown a positive relationship between physical activity and perception of better mental health and QoL.<sup>(56)</sup> Findings of the present study showed that exercise interventions, both aerobic and resistance exercise for 10 weeks, had a positive effect on all QoL sub-dimensions and resulted in an increase in psychological health, social relationship and even in environment, whereas control group scores remained the same throughout the study for all sub-dimensions. The current findings provide evidence of the effectiveness of both aerobic and resistance exercise components which might be used in

combination in overweight and/or obese females in the context of weight loss. It seems that inclusion in an aerobic and resistance exercise program can result in improvements in health-related QoL independent of changes in weight.<sup>(8)</sup> As a result, different types of physical activity can contribute to improving QoL. In addition, the mental and emotional benefits may be motivating factors in people's perception of physical activity programs, especially for overweight/obese individuals.<sup>(15)</sup>

Obesity is also associated with reduced life expectancy.<sup>(16)</sup> Pimenta et al.<sup>(57)</sup> found an inverse relationship between BMI and all sub-dimensions of QoL. In addition to physical and psychological scores, also total scores for QoL showed a linear decrease with increasing BMI. Global scores demonstrated in the literature found a negative linear relationship between QoL and high BMI.<sup>(16,58)</sup> Based on previous studies, scores of psychological sub-dimension including self-esteem, body image and emotions showed that QoL decreases with weight gain.<sup>(59,60)</sup> Pimenta et al.<sup>(57)</sup> stated that higher BMI is associated with lower general QoL in Brazilian males and females, based on lower scores in the physical health, psychological health, social relationship and environment sub-dimensions. Most studies show that physical activity has a positive effect on subjective well-being in terms of happiness and life satisfaction.<sup>(61,62)</sup> The findings of our study are in accordance with the literature showing that physical activity improves body composition and increases QoL, which might have positive outcomes throughout life span.<sup>(61-63)</sup> The main goal of weight loss interventions in overweight individuals or obesity treatment is to lose weight and improve physical, physiological, and psychological health, often defined as the indicator of success.<sup>(53)</sup>

A few limitations of this study need to be acknowledged such as dietary intake and life habits. Participants were advised not to change their daily physical activity level and eating habits, however, they were not strictly controlled for their diet and might have reduced their caloric intake

due to positive effect of exercise on behavioral eating. In addition to the drop-outs, the selection of participants who were particularly motivated to increase physical activity before undergoing a conventional weight loss may reduce the generalizability of study results. Another limitation is the single gender and the single obesity type 1 included in the study.

From a practical point of view, it might be appropriate to inform patients with overweight and/or obesity that resistance training improves not only BMI and body composition, but also QoL as effectively as does aerobic exercise. Since overweight and obese women get tired in a shorter time period and might be shy due to their appearance, resistance training might be a possible choice to exercise at home with a resistance band and for shorter times than walking and running outdoors.

Future studies should include mixed methods such as resistance training at different intensities and caloric restriction, and a complete program should be evaluated for the most effective intensity and duration according to different obesity types for both gender.

## CONCLUSION

It can be concluded that AE and RE improve body composition and QoL in overweight and obese women. Exercise intervention for 10 weeks might cause a decline in body weight, BMI, fat mass, and waist and hip ratios in overweight and obese females. Also, QoL components such as physical health, psychological health, environment and social relationship are improved by both aerobic and resistance exercise. Unlike previous studies, this study showed the positive effect of exercise on body composition and quality of life parameters without diet or calorie restriction.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

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## AUTHOR CONTRIBUTIONS

GC and RHOS: conceived and designed the experiments. GC and RHOS : recruited participants and collected study data. RHOS: analysed and interpreted the study data. GC and RHOS wrote the manuscript. All authors have read and approved the final manuscript. 

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