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Six-Week Treadmill and Resistance Training and Their Comparative Effects on Body Fat in Obese Women

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ABSTRACT

Background & Objective: The global rise in obesity has prompted extensive research on effective, non-pharmacological interventions. Exercise remains a cornerstone strategy, yet the comparative impact of short-term aerobic and resistance training specifically a 6-week duration designed to maximize programmatic feasibility and practical application on body composition in obese women remains underexplored. This study was conducted with aim to compare the effects of six weeks of treadmill-based aerobic training and resistance training on Body Weight (BW), Body Mass Index (BMI), and Body Fat (FAT) in young obese women.

Materials & Methods: This study was conducted as a pilot study on twenty-one otherwise healthy women, formally classified as obese according to the Asia-Pacific regional BMI cut-offs (aged 20-24 years; BMI 27-35 kg/m²). Participants were randomly allocated to control (K1), aerobic (K2), and resistance (K3) groups (n=7 each). The exercise intensity was set at 65-75% HRmax, performed three times weekly for six weeks. BW, BMI, and FAT were measured using a SECA Body Composition Analyzer before and after the intervention. Data were analyzed using one-way ANOVA followed by LSD post-hoc test. $P<0.05$ was considered statistically significant.

Results: Significant between-group differences were found in BW, BMI, and FAT ($P<0.001$). Both aerobic and resistance training significantly reduced BW, BMI, and FAT compared to the control.

Conclusion: Six weeks of moderate-intensity treadmill or resistance training effectively reduced BW, BMI, and FAT among obese young women. These findings support structured short-term exercise as a practical strategy for obesity management in young adults.

Keywords: Obesity, Aerobic training, Resistance training, Body composition

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1. Introduction

The rapid global rise in obesity prevalence across age groups significantly increases the rate of morbidity and mortality caused by cardiometabolic diseases **(1-3)**. Obesogenic environments accelerate these transitions, strengthening the epidemiological imperative for scalable, non-pharmacological interventions **(4,5)**. Consequently, public-health guidance strongly emphasizes physical activity and exercise as core treatment strategies **(6,7)**. Exercise elicits favorable shifts in body composition and resting metabolic rate, with endurance training effectively reducing adiposity and resistance training preserving lean mass **(8-10)**. However, despite these benefits, significant barriers to physical activity uptake remain **(6,11)**. Furthermore, clinical trials indicate that the effects of exercise on traditional anthropometric outcomes (e.g., BMI) vary considerably by intensity, duration, and participant's characteristics **(12,13)**. Therefore, global recommendations consistently position physical activity as central to obesity strategies while underscoring the urgent need for precise evidence on

the optimal dose, modality, and duration of such interventions **(14)**.

Despite numerous trials demonstrating that both aerobic and resistance exercise improve aspects of body composition over medium to long durations, important gaps remain when applying this evidence to short-term, programmatic interventions, particularly in young adult women. Several randomized and quasi-experimental trials show that 8-24 weeks of structured aerobic or combined programs can reduce weight and fat mass and sometimes BMI, but the results are heterogeneous and often confounded by concurrent dietary interventions or variable adherence **(15-18)**. Resistance training trials in obese women report favorable shifts in fat mass and muscular function over 12 weeks and longer **(19)**, while pilot studies of 8-week resistance programs have shown improvements in metabolic syndrome risk factors, though with limited power to detect consistent anthropometric change **(20)**.

Meta-analytic evidence and recent RCTs indicate modality-specific effects resistance training tends to preserve or increase lean mass (thereby sometimes blunting BMI reduction despite fat loss), whereas aerobic training more directly reduces fat mass implying that short interventions may change composition without large BMI shifts **(9,10,18,21)**. Moreover, contextually relevant studies from Indonesia and similar settings emphasize variability in baseline activity, dietary patterns, and program feasibility **(2,7,22,23)**, and implementation studies (e.g., circuit-style programs) show promise for time-efficient adaptations in fitness and fat mass **(24-26)**. Taken together, the literature suggests that (a) short-term, moderate-intensity exercise may produce meaningful fat-mass reductions even when BMI change is small, (b) modality influences the pattern of change, and (c) evidence for 6-week interventions especially direct comparisons of treadmill (aerobic) versus structured resistance training in young obese women is sparse. Addressing this gap is important because a targeted 6-week duration serves as a critical timeframe for establishing exercise adherence and programmatic feasibility, offering a highly practical, acceptable, and scalable strategy for many populations while still providing clinically relevant improvements in body composition and cardiometabolic risk **(3,19)**.

Therefore, to fill this evidence gap, this quasi-experimental, pretest-posttest study was conducted with aim to compare the effects of six weeks of supervised, moderate-intensity treadmill (aerobic) exercise versus circuit-style resistance training on body fat in otherwise healthy obese young women (aged 20-24 years). Drawing on physiological mechanisms (fat oxidation, changes in resting metabolic rate, and lean mass adaptation) and pragmatic program design considerations (time efficiency, caloric expenditure parity), this study tests whether a brief, 6-week program can produce clinically meaningful changes in body weight, BMI, and fat mass, and whether the two modalities differ in their effects. The study also situates its hypotheses within regional public-health priorities and prior evidence from both short- and longer-duration trials **(9,10,17,19,20)**, thereby providing both theoretical rationale and practical relevance for clinicians and program planners.

2. Materials and Methods

This research was designed as a pilot study. The subjects participating in this study were female university students formally classified as obese according to the Asia-Pacific regional BMI cut-offs. Sampling was performed using purposive sampling techniques. The inclusion criteria were: female students, aged 20-24 years, with BMI 27-35 kg/m², maintaining a strictly sedentary lifestyle without any prior athletic background, and willing to provide written informed consent. Exclusion criteria included: male students, outside the specified age (<20 or >24 years) and BMI (<27 or >35 kg/m²), and those refusing to provide informed consent. Participants were selected based on the inclusion criteria. Twenty-one healthy obese women were recruited for this pilot study who were randomly assigned to three groups (n=7 per group).

The data collection technique was measurement, which was carried out during the study. The pretest collected data was related to age, weight measurement, fat mass, height, blood pressure, pulse rate, and Oxygen Saturation level (SpO2) in obese women. The measurement of Body Weight (BW), Body Mass Index (BMI), and fat mass (kg) before treatment (pretest) and after treatment (posttest) was performed using a SECA Body Composition Analyzer, which was strictly recalibrated prior to data collection using standard reference weights in accordance with the manufacturer's recommended procedures to ensure validity and precision.

The exercise program was two types of exercise: aerobic exercise (Treadmill) and resistance training exercise. Aerobic exercise was carried out by running on a treadmill with moderate intensity (65-75% HRmax), with a volume of 45 minutes consisting of 5 minutes of warm-up, 35 minutes of the exercise, and 5 minutes of cool down for six weeks. Resistance training was also performed with a circuit model with 12 repetitions with a minimum of 5 sets to increase muscle mass using gym equipment with an intensity of (65-75% 1RM) for six weeks. All exercise programs were prepared and adjusted for each subject written in the exercise program form based on targets or training zones that have been determined with caloric expenditure equalized to approximately 250 kcal per session across the intervention groups, which was estimated and monitored continuously using heart rate telemetry and the integrated metabolic algorithms of the exercise equipment. The exercise intervention included a total of 45 minutes of exercise with 5 minutes of warming up 35 minutes of core exercise and

5 minutes of cool down 5 minutes cool down, with three times a week. The training program implemented was supervised by professional staff from the Atlas Sports Club Malang (Indonesia).

The normality of data was tested using the Shapiro-Wilk (P>0.05). Furthermore, the homogeneity test was carried out using the Test of Homogeneity of Variances Levene Statistic significant leves (P>0.05). Hypothesis testing was carried out to analyze the results using the SPSS 23 application. This study used a one-way ANOVA followed by LSD post-hoc test with significance (P<0.05). However, if the data is not normally distributed, a non-parametric Kruskal-Wallis test is performed, and the Mann-Whitney test is continued.

3. Results

There was no difference in characteristics among the three groups of (K1) control group, (K2) aerobic group, (K3) resisten gruop. More complete data can be seen in Table 1.

The results of the pre- and post-exercise intervention on BW, BMI, FAT and the differences among the three groups are presented in Figures 1-3 and Table 2.

Table 1. Research Sample Characteristics

Variables	Groups			P-value
	K1 (n=7) Mean±SD	K2 (n=7) Mean±SD	K3 (n=7) Mean±SD	
Age (yrs)	21.83±1.60	21.83±1.83	21.33±1.21	0.819
Weight (kg)	76.89±6.41	71.70±7.76	73.88±8.87	0.522
Height (cm)	1.59±0.06	1.56±0.07	1.57±0.02	0.730
BMI (kg/m^2)	30.56±3.36	29.33±2.04	29.66±2.46	0.732
Body fat (%)	40.57±5.36	43.13±2.55	42.74±2.45	0.247
SpO2 (%)	98.33±1.36	97.83±1.69	98.00±1.67	0.826
SBP (mmHg)	112.3±2.16	111.5±1.87	113.8±2.31	0.118
DBP (mmHg)	75.50±7.06	76.00±6.22	83.83±8.37	0.190

Notes: SpO2=Oxygen saturation; SBP: Systolic Blood Pressure; DBP=Diastolic Blood Pressure; BMI: Body Mass Index. Baseline homogeneity was confirmed across all groups (P>0.05). BMI categorization is strictly based on the Asia-Pacific regional cut-offs, which formally classifies the 27-35 kg/m² range as obese.

Table 2. Differences in BW, BMI, FAT among the three groups

Parameters	Groups			P-value
	K1 (n=7) Mean±SD	K2 (n=7) Mean±SD	K3 (n=7) Mean±SD	
Pre-Weight (kg)	76.88±6.42	71.70±7.76	73.88±8.87	0.470
Post-Weight (kg)	79.42±5.91	69.80±7.45[a]	70.51±7.92[a]	0.038
Δ-Weight (kg)	2.54±1.24	-1.90±0.54[a]	-3.37±1.55[ab]	0.000
Pre-BMI (kg/m2)	30.56±3.36	29.33±2.04	29.66±2.46	0.680
Post-BMI (kg/m2)	31.76±3.37	28.58±1.92[a]	28.62±2.53[a]	0.042
Δ-BMI (kg/m2)	1.20±0.69	-0.75±0.27[a]	-1.04±0.84[a]	0.000
Pre-FAT (%)	40.57±5.36	43.13±2.55	42.74±2.46	0.399
Post-FAT (%)	44.14±3.83	41.04±1.89[a]	39.89±1.51[a]	0.019
Δ-FAT (%)	3.57±2.57	-2.09±0.89[a]	-2.86±1.21[a]	0.000

Notes: a=Significant difference compared to the K1 (Control) group (P<0.05); b=Significant difference compared to the K2 (Aerobic) group (P<0.05). The P-values were obtained using a one-way ANOVA followed by an LSD post-hoc test.



Figure 1. Difference in body weight pre- and post-exercise intervention

Note: All data are shown as mean±standard deviation. P-value was obtained using paired sample t-test. *Significant at pre (P<0.05).



Figure 2. Difference in Body Mass Index (BMI) pre- and post-exercise intervention

Note: All data are shown as mean±standard deviation. p-value was obtained using paired sample t-test. *Significant at pre (P<0.05).

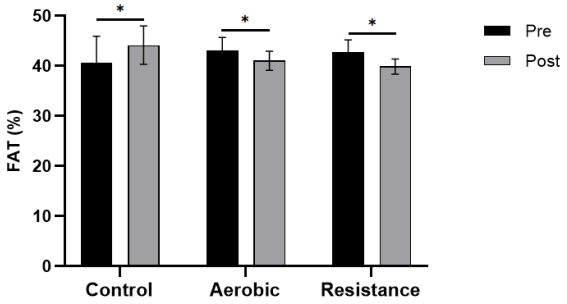


Figure 3. Difference in body fat (FAT) pre- and post-exercise intervention

Note: All data are shown as mean±standard deviation. P-value was obtained using paired sample t-test. *Significant at pre (P<0.05).

4. Discussion

The purpose of the present study was to compare the effects of six weeks of moderate-intensity treadmill (aerobic) and resistance training on body weight, fat mass, and Body Mass Index (BMI) among young obese women. The findings of this study demonstrated that both exercise modalities produced significant reductions in body weight and fat mass, whereas BMI showed no significant change. These outcomes confirm that structured exercise programs, even within a relatively brief six-week duration, can elicit meaningful improvements in body composition primarily through reductions in adiposity despite limited changes in overall body mass. This pattern is consistent with previous studies showing that aerobic and resistance training promote fat-mass reduction and metabolic improvement through distinct yet complementary physiological pathways **(15,18,27-29)**. Similar trends have been reported by Can et al., (2019) and Elgendy et al., (2022), who found that structured programs of moderate intensity performed three times weekly could effectively reduce body weight and adiposity within six to eight weeks, reinforcing that early adaptive responses can occur even before notable BMI changes **(30,31)**.

As the results of the present study showed, the reductions in body weight and fat mass observed in both exercise groups reflect the underlying metabolic adaptations associated with moderate-intensity training. Aerobic exercise primarily stimulates oxidative metabolism, enhances mitochondrial enzyme activity, and sustains caloric expenditure, thereby increasing lipid mobilization and oxidation **(8)**. Resistance exercise, on the other hand, increases muscle protein synthesis and post-exercise oxygen consumption, which elevate resting metabolic rate and promote greater energy turnover **(13,19)**. These physiological processes explain why BMI did not significantly change, as body-weight loss may have been offset by lean-mass preservation or gains in fat-free tissue. This observation underscores a critical limitation of relying solely on BMI for obesity management; since it inherently fails to capture body recomposition, it can inadvertently mislead patients into perceiving a lack of progress despite actual structural improvements, making direct fat-mass measurement a necessity for accurately representing exercise-induced metabolic adaptation **(3)**.

Although both aerobic and resistance training led to significant improvements in body composition, the mechanisms and trajectories of these effects differ. Aerobic exercise facilitates fat oxidation and enhances cardiovascular efficiency through prolonged oxygen consumption and sustained caloric deficit, while resistance training stimulates muscle hypertrophy and increases basal metabolic rate, which aids in long-term weight maintenance **(9,10,18)**. The comparable reductions in fat mass across both exercise modalities in the present study may be explained by the standardization of training intensity (65-75% HRmax) and session frequency, consistent with the findings reported by other studies **(32-34)**. These results emphasize that when intensity and duration are properly controlled, aerobic and resistance training can produce similar short-term benefits in reducing

adiposity, with resistance training offering the additional advantage of preserving muscle mass and metabolic health **(31)**.

The ability of these programs to produce measurable changes within six weeks underscores the body's responsiveness to consistent, moderate-intensity exercise, even over relatively short durations. While prior research typically applied eight- to twelve-week interventions to achieve significant reductions in body composition parameters **(15,35)**, the findings of the current study demonstrated that shorter interventions can already initiate favorable adaptations if training adherence and intensity are maintained. This finding carries practical relevance, particularly for obese women who may face barriers related to time, motivation, or access to exercise facilities. The six-week duration appears sufficient to trigger meaningful improvements in adiposity and may serve as an effective starting point for longer-term behavioral engagement in physical activity **(16,24-25)**.

This study contributes novel evidence that short-duration aerobic and resistance training interventions can effectively improve body composition in obese young women, a demographic often underrepresented in clinical exercise trials. The findings refine theoretical understanding of how brief, structured programs influence fat-mass dynamics and strengthen the argument for using composition-specific metrics rather than BMI as primary outcome indicators **(12,14)**. Practically, these results highlight the feasibility of implementing concise, moderate-intensity exercise regimens as time-efficient strategies for weight and fat-mass management. Such programs are especially relevant for women with limited time availability, as shorter interventions that yield visible results may enhance adherence and motivation, facilitating sustained lifestyle changes **(7,11)**.

In this study, several limitations must be acknowledged. The relatively small sample size restricts the statistical power and generalizability of the findings. A major limitation is the absence of stringent dietary control throughout the intervention period. Given that caloric intake remains the primary driver of weight loss regardless of the exercise modality employed, this lack of dietary monitoring constitutes a significant confounding factor that may have contributed to the observed interindividual variability in energy balance and adiposity reduction **(36)**. Additionally, the six-week duration, while sufficient to demonstrate initial adaptations, does not permit conclusions regarding the long-term sustainability of the observed effects. Future research should involve larger and more diverse populations, extend intervention periods beyond eight weeks, and integrate nutritional monitoring and physiological measurements such as resting metabolic rate and hormonal analysis to elucidate the mechanisms underlying body composition changes. Expanding these investigations to different age groups and incorporating combined or interval-based exercise models could also provide a clearer picture of the most effective modalities for obesity management across diverse populations.

5. Conclusion

The results of this study confirm that a six-week program of moderate-intensity treadmill (aerobic) and resistance training (65-75% HRmax, three sessions per week) can induce meaningful reductions in body weight and fat mass among young obese women, even though Body Mass Index (BMI) remains relatively unchanged. These outcomes highlight that measurable improvements in adiposity can occur within a short timeframe, reflecting beneficial changes in body composition rather than overall mass alone. The findings contribute to the growing body of evidence emphasizing that short-duration interventions can effectively modify fat-related health indicators and BMI may underestimate true physiological adaptations. This underscores the value of assessing specific components of body composition when evaluating exercise efficacy, thereby enriching the theoretical understanding of how aerobic and resistance modalities operate within brief intervention windows. The present study suggests that structured, time-efficient exercise programs can serve as accessible strategies for obesity management among young women, particularly those facing barriers to long-term adherence. Such models may enhance participation and program sustainability while still yielding measurable health benefits. Future studies should expand upon these results by employing longer intervention durations, integrating dietary or behavioral components, and investigating mechanistic pathways such as resting metabolic rate, hormonal modulation, and lean-mass adaptation. Establishing these links would strengthen the evidence base for designing scalable, evidence-informed exercise prescriptions tailored to diverse populations and clinical contexts.

6. Declarations

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Ethical Considerations

This research was conducted in accordance with the principles of the Declaration of Helsinki regarding the ethics of medical research involving humans and has received approval from the Health Research Ethics Commission of the Faculty of Medicine, Universitas Airlangga (No. 18/EC/KEPK/FKUA/2022).

Authors' Contributions

M.A.A.A.W. and E.R.S. contributed to conceptualization. M.A.A.A.W., T.H.K., and T. performed the methodology and wrote the original draft. N.S., A.A., and F.A. participated in the formal analysis. I.J. and A.P. contributed to writing, review, and editing. E.R.S. supervised the study process. All authors have read and approved the final manuscript and agree to be accountable for all aspects of the work.

Conflict of Interest

The authors declared no conflict of interest.

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