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# Effect of Pilates versus Aerobic Exercises on Anthropometric Measurements in Anemic Obese Women

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## Abstract

***Background***: Obesity represents a chronic condition defined by an excess of adipose tissue, a complex secretory organ with various metabolic functions. Obesity causes physiological disturbances, structural abnormalities, and functional disorders, increases the risk of other chronic diseases and a rise in early mortality, and has a negative influence on quality of life. Increased BMI constitutes a significant predictor of mortality. Physical exercise, when combined with a proper diet, can significantly impact weight reduction and management. ***Objective***: Our study aim was to compare the impacts of Pilates and aerobic exercise on anthropometric measurements in anemic obese women. ***Methods***: Ninety anemic obese premenopausal women with a Hemoglobin level range of 9–11g/dL were equally divided at random into three groups: A, B, and C. Group (A) received Pilates exercise along with a low-calorie diet rich in iron and iron supplement (feroglobin); Group (B) received aerobic exercises furthermore a low-calorie diet rich in iron and iron supplement (feroglobin). Group (C), the control group, received only an iron supplement (feroglobin) and a low-calorie diet rich in iron. The assessment involved measures of weight, height, BMI, waist circumference (WC), and waist-height ratio (WHrT).

***Results***: Our results revealed a statistically significant decrease ($P < 0.05$) in weight, BMI, WC, and WHrT. However, higher improvement in WC and WHrT was observed in the Pilates exercise group (A), followed by the aerobic exercise group (B), and then the control group (C).

***Conclusion***: Twelve weeks of training with Pilates exercise or aerobic training interventions are more effective in reducing anthropometric measurements in obese females than diet, but Pilates training is more effective in body composition in comparison with aerobic training.

**Keywords**: Anthropometric measurements; Obesity; Pilates and aerobic exercise

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## Introduction

Obesity is rapidly becoming a worldwide health issue. Obesity, as identified by the World Health Organization (WHO), indicates excessive body fat accumulation. Obesity is more common in females, especially middle-aged females than in males [1]. Individuals who have a body mass index (BMI) ≥ 25 are recognized as overweight, and those with a BMI of ≥ 30 are classified as obese [2]. Obesity has presented a serious public health issue in recent decades, and its prevalence has dramatically risen and has been referred to be an epidemic [3].



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Simple body fat distribution assessments, such as circumference (WC) or waist-to-hip ratio, are more significantly related to visceral adipose tissue than BMI. The WHO and the National Heart, Lung, and Blood Institute stated that additional measurements should be taken in persons with a BMI between 25.0 and 34.9 to define central obesity, with suggested cutoffs of 102 cm in males and 88 cm in females for WC and 0.95 in males and 0.80 in females for waist-to-hip ratio [4]. The waist-height ratio (WHtR) has emerged recently as an indicator of an elevated cardiovascular and metabolic risk; therefore, it is advisable to keep the WC of any individual less than half of their height to be protected from these diseases. The majority of them demonstrated that it is at least comparable, if not superior, to WC measurement for estimating cardiovascular risk [5].

Adipose tissue represents a complex secretory organ with a broad range of metabolic functions. Moreover, acting as a lipid reservoir, it can regulate calorie expenditure, bone metabolism, hunger, insulin sensitivity, reproductive and endocrine processes, immunity, and inflammation. An elevated risk of CVD and diabetes is correlated to visceral adiposity instead of a high BMI [6]. Expanding adipose tissue, now recognized as an endocrine organ, leads to increased production of pro-inflammatory cytokines, including interleukin-6 (IL-6), resulting in persistent low-grade inflammation [7]. Elevated circulating IL-6 concentrations in obesity raise hepatic hepcidin production from the liver [8]. The reason for iron deficiency in obese people is obesity-related inflammation, which is identified by raised levels of hepcidin, lowered absorption of iron in the intestines, and inhibited iron uptake by ferroportin, a cellular iron exporter from liver cells, macrophages, and enterocytes [9]

Many studies have found a link between low hemoglobin and lowered function, raised hospitalization, and worse quality of life [10]. Physical weakness, exhaustion, dyspnea, headache, dizziness, pale skin, weaker immune system, greater prenatal mortality, low birth weight, and premature newborns are all symptoms of iron deficiency and anemia. Several studies suggested that Obesity-related inflammation has been correlated with iron deficiency [9]. Overweight and obesity are related to a raised coronary artery disease (CAD) risk and heart failure. For each 4 kg/m$^2$ increase in BMI, the coronary heart disease (CHD) risk elevates by 26%, and for each 1 kg/m$^2$ increase in BMI, the heart failure risk elevates by 5% in males and 7% in females. Obese people are twice as likely to suffer a stroke, either ischemic or hemorrhagic [11].

The most significant medication for weight loss is exercise. The majority of medical therapy is focused on the formation of a training plan, the selection of a



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suitable exercise, and the participation in various sports. Due to physical activity, the body undergoes several positive changes such as weight loss, enhancement of glucose tolerance and lipid profile, a decrease of body fat, strengthening of bones and joint structures, a decrease of hyperglycemia in diabetic people, Lower blood pressure, improvement fitness, and physical fitness, and therefore boosted self-esteem, and enhanced mental state [12].

Aerobic exercise is low to moderate-intensity physical activity. The term "aerobic" refers to the existence of oxygen to fulfill needs during activity. Light to moderate-intensity exercises that are well affirmed by aerobic metabolism may usually be done for long times [13]. Aerobic exercises are the most successful in obesity treatment; the aerobic metabolism dominance employs primarily fats and, to a lesser extent, glucose for oxidative metabolism [12]. Walking and other aerobic activities have been shown to increase aerobic fitness, mood problems, and quality of life. Nevertheless, compliance with these types of exercises may be limited, particularly among obese people, as a result of exhaustion and difficulties associated with performing weight-bearing activities [14].

Pilates exercise, which began in the 1920s as mind-body training, mainly consists of isometric contractions of the core muscles of the body, according to six key principles of centering, concentration, control, accuracy, flowing motions, and breathing. Pilates places a greater emphasis on awareness, breathing, and core muscles, resulting in a high level of focus on the muscular core, which promotes this exercise approach in clinical practice to enhance body weight and composition. In overweight or obese individuals, Pilates caused significant reductions in body weight, BMI, and BFP [2].

Pilates exercise is recognized as a safe and efficient exercise for middle-aged females who find it hard to conduct high-intensity exercise by modulating the exercise level and performing a wide range of movements to prevent hurting the muscles. It has a good impact on body composition Due to the rise in basal metabolism [15].

Accordingly, we hypothesize that no significant difference will be found between Pilates and aerobic exercise on anthropometric measurements in anemic obese women. Therefore, our aim was to compare the impacts of Pilates and aerobic exercise on anthropometric measurements in anemic obese women.



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## Materials and Methods

### *Participants*

Single-blind study was organized pre-and post-test group randomized controlled trial (RCT). The study was conducted from 30 September 2021 to 22 August 2022. Participants were aware of detailed information about the study's objectives as well as any potential risks that they may encounter before participation. The Physical Therapy Faculty Ethical Committee, Cairo University, authorized the study (P.T.REC/012/003418), with all participants signing informed consent. Ninety anemic obese premenopausal women with a Hemoglobin level range of 9–11 g/dL, age 25–35 years, and a BMI of 30–39.9 Kg/m$^2$ referred by an internal medicine physician were selected from Helwan University Hospital. The practical part of our study was performed in the Physical Therapy Department. In this study, we excluded participants who had neuropsychiatric conditions, diabetes, hypertension, endocrine disorders, cancer and followed chemotherapy, immune, inflammatory or infectious diseases, inflammatory bowel diseases, autoimmune gastritis, Crohn’s diseases, cardiopulmonary diseases, kidney or liver disorders, menstrual disorders or others types of anemia, and vitamins deficiency, as well as subjects under medication that could interfere with our results. Moreover, we excluded participants who were pregnant and had lactation, blood donation, surgery, or history of trauma within the last four months, blood transfusion of packed cells or whole blood in the last six months, females who were smokers and had orthopedic, neurological problems or peripheral vascular disease that interfered with exercises, passing worms in stools, and Gastric bypass surgery.

### *Procedures*

Pre-intervention, a qualified physiotherapist conducted a physical assessment of all participants to establish if they were eligible to participate. A survey was employed for gathering demographic data. Each participant's height (cm) and weight (kg) were documented, and BMI was determined.

Randomization to receive Pilates training or aerobic exercise or only medication and a low-calorie diet was performed by a closed envelope comprising numbers created by a random number generator (n = 30/group). The patients had an equal chance of being allocated to the three groups. A blinded researcher selected the envelope and allocated the patients according to their groups **(Fig. 1)**.



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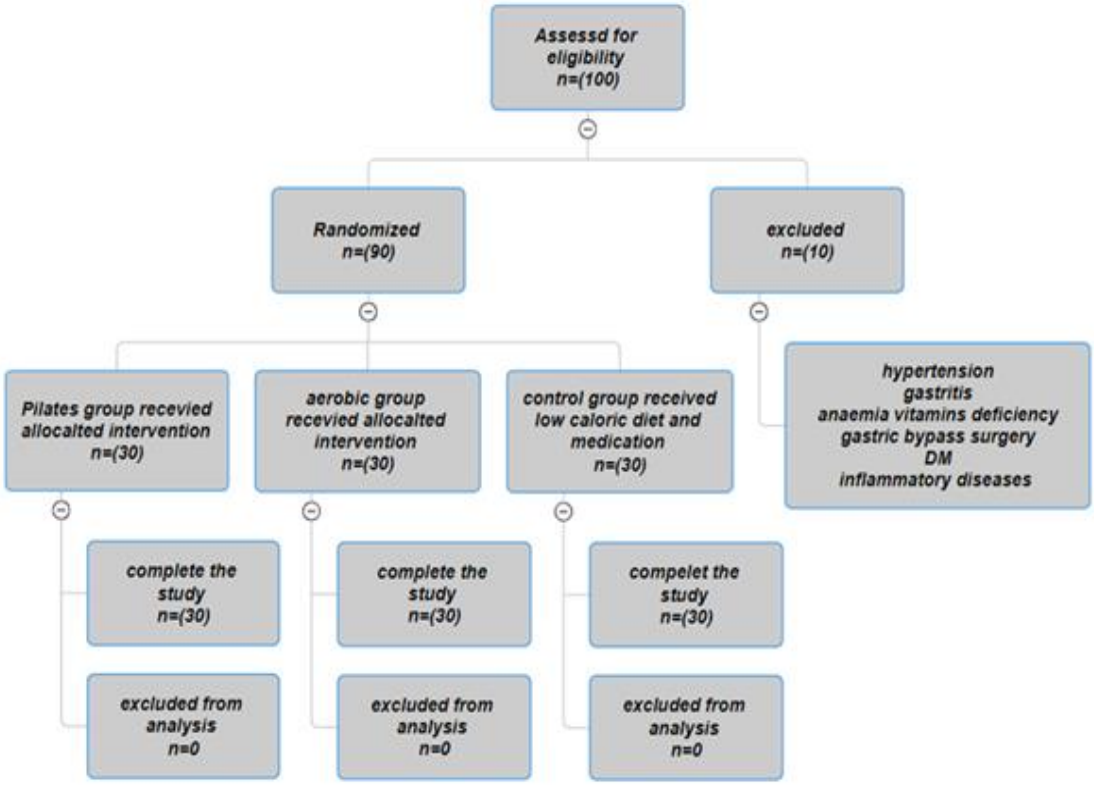


**Fig 1.** Study flow chart.

*Outcome measures*

**Weight and BMI**

A standard weight and height scale was utilized for the purpose of measuring weight and height and calculating the BMI of each patient, thereby ensuring that they followed the inclusion criteria of the study, which specified a BMI range of 30–39.9 kg/$m^2$ [4].

**Waist circumference (WC)**

The tape measurement was positioned halfway between the iliac crest and the lowest rib to calculate WC. The hip circumference was measured from the broadest position, with the person doing the measurement positioned beside the participant [16].

**The measurement of WHtR**

WHtR was calculated by dividing WC (in cm) by height (in cm) [17].

*Interventions*

**The Pilates mat exercise group**

This group included Hundred, Roll up, Single straight leg stretch, Single leg kick, Leg circles, Criss-cross, Double straight leg stretch, Double leg kick, Side kick, Mermaid, Spine stretch, and Spine twist, all exercises that could be


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performed for 60 min each, three times/week for 12 weeks, along with iron supplement (feroglobin) and low-calorie diet in the first week with 10 repetitions for each position and reached (20-25) repetitions in the 12-week to comply with the overload principle followed an incremental progression. Exercise intensity increased by about 5% per week, from 50% to 55% of maximum heart rate (max HR) in the first week to (75%–80%) of max HR in the 12-week. To effectively regulate exercise intensity, it was recommended to employ the max HR formula, which calculates the peak HR by subtracting the individual's age from 220. Additionally, the utilization of HR monitoring is advised. Each session comprised pre-pilate warm-up exercises, consisting of 10 min duration dedicated to Breathing, the Bridge, Roll-up, and Quadruped. This session was followed by 40 min Pilates session, focusing on mat Pilates exercises suitable for individuals at beginner, intermediate, and advanced levels. Finally, the session concluded with 10 min cool-down period involving Side kick, Mermaid, Spine stretch, and Spine twist [18].

**The Aerobic exercise group**

Participants received aerobic exercises in the form of walking on the electrical treadmill for 60 min, in addition to an iron supplement (feroglobin) and a low-calorie diet, three sessions/week, for 12 consecutive weeks. The following Karvonen formula was used to compute a moderately intense aerobic workout (at 60%–75% of HR max): (Max HR = 220 age in years). The duration was 60 min (10 min for warming up, 40 min for the active stage, and 10 min for cooling down). All participants used an HR monitor (pulse oximeter) to track their HRs throughout each training session, and coaches constantly checked in to make sure the HR was staying within the desired range [14].

**The Control group**

The participants received an iron supplement (feroglobin) plus a low-calorie diet.

**Nutritional recommendations for three groups**

A calorie deficit was created by lowering current caloric intake by 500–750 kcal while taking into consideration total energy expenditure (TEE), baseline BMI, and the existence of any related comorbidities. TEE was calculated by multiplying the resting metabolic rate (RMR) by a suitable activity factor (both general and specialized activity). RMR was best predicted by the Cunningham equation, followed by the Harris-Benedict equation [19, 20]. The percentages of protein (20%–25%), fat (30%–40%), and carbs (40%–50%) were estimated. Fruits and vegetables, in particular, are rich in antioxidants that reduce oxidative stress, and a high-fiber diet was advised. Salt, sugar, and fast food intake should be restricted. Women should drink at least 2 L of water every day and adopt good



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eating habits, including eating five to six small and regular meals throughout the day. Anemic women were recommended to consume rich sources of hem iron and non-hem iron to enhance the iron status of the body.

Ascorbic acid (vitamin C), folic acid, cyanocobalamin, and other B vitamins were used for increasing iron absorption. Coffee, tea, citric, tartaric, and malic acids have a negative influence on iron absorption with minerals such as Ca, P, and Mg. Iron supplements were taken at night or at least 1 h before eating to ensure maximum absorption. They should avoid milk as it prevents the absorption of iron and should consume fruit juice containing ascorbic acid together with an iron supplement to increase iron absorption. One-on-one dietary behavioral counseling was used to aid the participants in continuing to the proper energy intake and encouraged them to sustain the program [21].

### *Statistical analysis*

The statistical SPSS Package program version 25 for Windows (SPSS, Inc., Chicago, IL) was deployed to perform the statistical analysis. Herein, we implemented quantitative descriptive statistics data involving the mean and standard deviation for age, weight, height, WC, WHrT, and BMI variables and analysis of variance (ANOVA-test) to compare the groups for age variables. Multivariate analysis of variance (MANOVA) was utilized to compare the tested major variables of interest at various tested groups and measuring periods. A mixed design 3 x 2 MANOVA test was employed; the first independent variable (among subject factors) was the tested group with three levels groups (A, B, and C). The second independent variable (within the subject factor) was measuring periods with two levels (pre-training vs. post-training). The tested dependent variables were weight, height, WC, WHrT, and BMI. Finally, the Bonferroni correction test was utilized to compare pairwise within and between groups of the tested variables, which F was significant from the MANOVA test. $P \leq 0.05$ was set as statistically significant.

## Results

The mean values of age for all patients showed no significant variances in the three groups ($p = 0.869$, Table 1).

**Table 1.** Mean values of age (years) among groups.

| Items | Age (Year) |
|---|---|
| **Group A (n=30)** | 30.47 ± 4.2 |
| **Group B (n=30)** | 29.87 ± 4.31 |
| **Group C (n=30)** | 30.20 ± 4.6 |
| **F-value** | 0.14 |
| **P-value** | 0.869 |
| **P < 0.05** | NS |

Data are expressed as mean ± standard deviation; P-value: probability value; NS: non-significant



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**Table 2** presents significant variations between pre and post-measures in all groups for weight, BMI, WC, and WHrT (*p* = 0.001*) except for the height, which was non-significant in all groups. Furthermore, significant variations existed between groups in the post-training assessment for weight, BMI, WC, and WHrT (*p* = 0.001*). However, no significant variances were observed in the pre-assessment measures between all groups.

**Table 2.** Mean, within, and between-group comparisons.

x̄: Mean; MD: Mean difference; p-value: Probability value; SD: Standard Deviation; S: Significant; NS: Non-significant

| **Variable** | | **Group A N = 30** | **Group B N = 30** | **Group C N = 30** | **Between-group comparison** | | |
|---|---|---|---|---|---|---|---|
| | | **x̄ ± SD** | **x̄ ± SD** | **x̄ ± SD** | **F-value** | **p-value** | **Sig** |
| **Weight** | **Pre** | 92.68 ±8.83 | 94.38 ±9.43 | 94.74 ±8.33 | 0.46 | 0.632 | NS |
| | **Post** | 72.91 ±9.09 | 79.27 ±9.91 | 86.5 ±7.91 | 17.09 | 0.001 | **Sig** |
| | **MD** | 19.77 | 15.11 | 8.24 | | | |
| | **% change** | 21.33% | 16.01% | 8.70% | | | |
| | **p-value** | 0.001 | 0.001 | 0.001 | | | |
| | **Sig** | **Sig** | **Sig** | **Sig** | | | |
| **Height** | **Pre** | 165.51 ± 4.56 | 165.6 ± 4.53 | 165.51 ± 4.36 | 0.01 | 0.990 | NS |
| | **Post** | 165.51 ± 4.56 | 165.6 ± 4.53 | 165.51 ± 4.36 | 0.01 | 0.990 | NS |
| | **MD** | 0 | 0 | 0 | | | |
| | **% change** | 0 | 0 | 0 | | | |
| | **p-value** | 1 | 1 | 1 | | | |
| | NS | NS | NS | NS | | | |
| **BMI** | **Pre** | 33.74 ±2.26 | 34.32 ±2.06 | 34.53 ±1.96 | 1.11 | 0.334 | NS |
| | **Post** | 26.52 ±2.48 | 28.79 ±2.4 | 31.52 ±1.87 | 36.52 | 0.001 | **Sig** |
| | **MD** | 7.22 | 5.53 | 3.01 | | | |
| | **% change** | 21.40% | 16.11% | 8.72% | | | |
| | **p-value** | 0.001 | 0.001 | 0.001 | | | |
| | **Sig** | **Sig** | **Sig** | **Sig** | | | |
| **Waist circumference** | **Pre** | 99.66 ±10.3 | 100.9 ±10.6 | 99.9 ±10.1 | 0.13 | 0.882 | NS |
| | **Post** | 81.76 ±7.54 | 88.3 ±10.8 | 94.46 ±9.65 | 13.56 | 0.001 | **Sig** |
| | **MD** | 17.9 | 12.6 | 5.44 | | | |
| | **% change** | 17.96% | 12.49% | 5.45% | | | |
| | **p-value** | 0.001 | 0.001 | 0.001 | | | |
| | **Sig** | **Sig** | **Sig** | **Sig** | | | |
| **Waist height ratio** | **Pre** | 0.6 ±0.08 | 0.604 ±0.08 | 0.602 ±0.09 | 0.01 | 0.986 | NS |
| | **Post** | 0.458 ±0.07 | 0.532 ±0.08 | 0.587 ±0.09 | 17.42 | 0.001 | **Sig** |
| | **MD** | 0.142 | 0.072 | 0.015 | | | |
| | **% change** | 23.67% | 11.92% | 2.49% | | | |
| | **p-value** | 0.001 | 0.001 | 0.001 | | | |
| | **Sig** | **Sig** | **Sig** | **Sig** | | | |

The post hoc test (Bonferroni) for pairwise comparison revealed significant differences between all pairs for weight, BMI, WC, and WHrT. The Pilates group had a significant variance more than the aerobic and the control group in weight,



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BMI, WC, and WHrT. Moreover, the aerobic group had a significant variance in weight, BMI, WC, and WHrT more than the control group (**Table 3**).

A significant variation was recognized in weight value after training between pairwise groups: A versus C (MD = 13.59; *p* = 0.001), B versus C (MD = 7.23; *p* = 0.008), and A versus B (MD = 6.36; *p* = 0.023). A significant difference was recognized in BMI value after training between pairwise groups: A versus C (MD = 5; *p* = 0.001), B versus C (MD = 2.73; *p* = 0.001), and A versus B (MD = 2.27; *p* = 0.001). Furthermore, a significant difference was identified in WC value after training between pairwise groups: A versus C (MD = 12.7; *p* = 0.0001), B versus C (MD = 6.16; *p* = 0.040), and A versus B (MD = 6.54; *p* = 0.026). Finally, a significant variation was found in WHrT value after training between pairwise groups: A versus C (MD = 0.129; *p* = 0.0001), B versus C (MD = 0.055; *p* = 0.043), and A versus B (MD = 0.74; *p* = 0.003) (**Table 3**).

**Table 3.** Multiple pairwise comparisons between groups.

| Variable | Pairwise group | | MD | P-value | Significance |
|---|---|---|---|---|---|
| **Weight** | **Pre** | A vs. B | 2.06 | 1.000 | NS |
| | | A vs. C | 1.7 | 1.000 | NS |
| | | B vs. C | 7.23 | 1.000 | NS |
| | **Post** | A vs. B | 6.36 | 0.023 | **Sig** |
| | | A vs. C | 13.59 | 0.001 | **Sig** |
| | | B vs. C | 7.23 | 0.008 | **Sig** |
| **Height** | **Pre** | A vs. B | 0 | 1.000 | NS |
| | | A vs. C | 0.09 | 1.000 | NS |
| | | B vs. C | 0.09 | 1.000 | NS |
| | **Post** | A vs. B | 0.09 | 1.000 | NS |
| | | A vs. C | 0 | 1.000 | NS |
| | | B vs. C | 0.09 | 1.000 | NS |
| **BMI** | **Pre** | A vs. B | 0.79 | 0.463 | NS |
| | | A vs. C | 0.58 | 0.878 | NS |
| | | B vs. C | 2.73 | 1.000 | NS |
| | **Post** | A vs. B | 2.27 | 0.001 | **Sig** |
| | | A vs. C | 5 | 0.000 | **Sig** |
| | | B vs. C | 2.73 | 0.000 | **Sig** |
| **Waist circumference** | **Pre** | A vs. B | 0.24 | 1.000 | NS |
| | | A vs. C | 1.24 | 1.000 | NS |
| | | B vs. C | 6.16 | 1.000 | NS |
| | **Post** | A vs. B | 6.54 | 0.026 | **Sig** |
| | | A vs. C | 12.7 | 0.000 | **Sig** |
| | | B vs. C | 6.16 | 0.040 | **Sig** |
| **Waist height ratio** | **Pre** | A vs. B | 0.002 | 1.000 | NS |
| | | A vs. C | 0.004 | 1.000 | NS |
| | | B vs. C | 0.055 | 1.000 | NS |
| | **Post** | A vs. B | 0.074 | 0.003 | **Sig** |
| | | A vs. C | 0.129 | 0.000 | **Sig** |
| | | B vs. C | 0.055 | 0.043 | **Sig** |

Group (A): Pilates exercise group; Group (B): aerobic exercise group; Group (C): control group; Data are expressed as mean ± standard deviation; MD: Mean difference; P-value: probability value


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## Discussion

Recently, obesity has grown to be a significant public health issue. The incidence rate has sharply grown, and it has been called an epidemic. Obesity has demonstrated that gaining weight and becoming more adipose is linked to a number of non-communicable diseases (NCDs), comprising type 2 diabetes, cardiovascular disease, cerebrovascular disease, asthma, and cancer. Iron deficiency and anemia are related to adiposity [3].

Our study aimed to compare the impact of Pilates and aerobic exercise with diet and an iron supplement (feroglobin) on anemic obese women patients. Body weight, BMI, WC, and WHrT were the main outcome measures. The results demonstrated significant enhancement in body weight, BMI, WC, and WHrT in the Pilates exercise group, followed by the aerobic exercise and control groups.

Pilates exercise for eight weeks significantly lower anthropometric parameters indices (body weight, BMI, WC, pelvic circumference, hip circumference, and arm circumference) in obese middle-aged women [1]. Additionally, a study on body composition in 20 sedentary women observed that Pilates workouts for eight weeks significantly reduced fat % and BMI in older women [22].

A previse study concluded that Pilates workouts for eight weeks three times/week effectively reduced anthropometric indices in 20 obese females with normal menstrual cycles and BMI (25-30) [23].

The findings of the prior investigation demonstrated that a 12-week Pilates mat workout three times a week for 60 min resulted in beneficial changes in fat and body composition such as weight, BMI, body fat percentage, and lean mass [4], in addition, another study with the same program of Pilates exercise found a significant reduction in waist-to-hip ratio, fat percentage, BMI, and weight of all participants [18].

Furthermore, the present study was consistent with previous studies, showing that the Pilates group had a significant improvement in lean mass and a decline in fat mass, indicating that the changes caused by Pilates were higher than those caused by aerobic training. This study revealed that Pilates could be a good alternative to traditional aerobic exercise in terms of improving body composition as WC and BMI [24].

Pilates exercise is a complementary resistance-based exercise approach that, in overweight and obese people, primarily through short-term training (4–12 weeks). The Pilates training(a mat-based, three sessions/week, 60 min/session)



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induced psychophysiological adaptations associated with improved body weight, body fat percentage, BMI, lean body mass, WC, and various markers related to cardio-metabolic health [25].

Another study elucidated no significant variations in body weight, BMI, or WHrT; however, after Pilates exercise for eight weeks, it revealed a significant reduction in fat mass ($P < 0.05$) [26]. Furthermore, five weeks of Pilates exercise showed no significant alterations in BMI and body fat measurements due to a short period of exercise and no diet restriction [27].

Weight and adiposity reductions are most effective when merging aerobic exercise with dietary energy restriction. Weight reduction requires at least moderate-intensity aerobic exercise for 300–420 min each week [28]. Guo et al. recommended more activity (volume and/or intensity) and a restricted diet to reduce body mass. A 50-min session of brisk walking four times weekly and moderate-intensity aerobic exercise for 12 weeks failed to detect a significant decrease in fat mass percentage [29].

Overweight or obese may have a little decrease in WC and visceral adipose tissue (VAT) when they engage in regular aerobic exercise, even in the insignificant weight loss case, and strong aerobic activity may be more beneficial than those involving moderate exercise [30]. Twenty-five published RCTs have found that regular aerobic exercise lowers WC, and VAT but no substantial weight reduction. Consequently, high volume and frequency of aerobic training are recommended for weight loss [30].

## Conclusion

Our findings reveal the importance of incorporating various types of exercise, including Pilates and aerobics, to reduce the anthropometric measurements among anemic obese women.

## Limitations

This study was limited because some patients found certain Pilates positions challenging. The COVID-19 pandemic impacted patients' commitment and exercise abilities, leading to their exclusion from the study and, in some cases, their decision to adhere to nutritional advice solely.

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## Authors' contributions

Asmaa Hassan, Nagwa Bader, Gehad AbdElhaseeb, and Alaa El-Moatasem contributed to the manuscript's conceptualization, methodology, investigation, and drafting. Nagwa Bader, Gehad AbdElhaseeb, and Alaa El-Moatasem contributed to supervising and reviewing the manuscript. All authors read and approved the final manuscript.

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## Availability of data and material

The data are available upon request.

## Consent for publication

Not applicable.

## Conflict of interest

No conflicts of interest.

# References

1. Hushmandi K, Jamali J, Saghari S, et al. The effect of eight weeks of pilates exercises on anthropometric indices and subjective well-being in obese middle-aged women. Open Public Health J. 2023;16.
2. Wang Y, Chen Z, Wu Z, et al. Pilates for overweight or obesity: A meta-analysis. Front Physiol. 2021;12:643455.
3. El-Mallah CA, Beyh YS, Obeid OA. Iron fortification and supplementation: Fighting anemia of chronic diseases or fueling obesity? Curr Dev Nutr. 2021;5(4):nzab032.
4. Nimptsch K, Konigorski S, Pischon T. Diagnosis of obesity and use of obesity biomarkers in science and clinical medicine. Metabolism. 2019;92:61-70.
5. Bayoumi M. Nurses' practices toward applying infection control measures using notice checklists at a dialysis unit. Connect: The World of Critical Care Nursing. 2019;13.
6. Khanna D, Welch BS, Rehman A. Pathophysiology of obesity. Statpearls. Treasure Island (FL). StatPearls Publishing. Copyright © 2024, StatPearls Publishing LLC.; 2024.
7. da Cruz Fernandes IM, Pinto RZ, Ferreira P, et al. Low back pain, obesity, and inflammatory markers: Exercise as potential treatment. J Exerc Rehabil. 2018;14(2):168-74.
8. Stoffel NU, El-Mallah C, Herter-Aeberli I, et al. The effect of central obesity on inflammation, hepcidin, and iron metabolism in young women. Int J Obes (Lond). 2020;44(6):1291-300.
9. Kuriri FA, Ahmed A, Alanazi F, et al. Red blood cell alloimmunization and autoimmunization in blood transfusion-dependent sickle cell disease and β-thalassemia patients in al-ahsa region, saudi arabia. Anemia. 2023;2023(1):3239960.
10. Karoopongse E, Srinonprasert V, Chalermsri C, et al. Prevalence of anemia and association with mortality in community-dwelling elderly in thailand. Sci Rep. 2022;12(1):7084.
11. Silva-Lalucci M, Ghiraldi M, Valdés Badilla P, et al. Obesity as a risk factor for complications and mortality in individuals with sars-cov-2: A systematic review. Nutrients. 2024;16:1-17.



Print ISSN 2636-3224
Online ISSN 2636-3232

12. Golus A, Bielejewska M, Ciecierska D, et al. The role of the rehabilitation in the prevention and treatment of obesity – an editorial article. J. Educ. Health Sport. 2018;8(7):364-73.
13. Cichoń J, Ostapiuk-Karolczuk J, Cieślicka M, et al. Effect of an acute exercise on early responses of iron and iron regulatory proteins in young female basketball players. BMC Sports Sci Med Rehabil. 2022;14(1):69.
14. Alizadeh R, Zolfaghari Z, Nosratzehi S, et al. Effect of pilates on anxiety, depression, and anthropometric indices of women with type 2 diabetes. Medsurg Nurs J. 2023;12.
15. Soon-Gi B. The effect of 12weeks pilates mat exercise on body composition and lipid metabolism in obese middle-aged women. J Ind Converg. 2020;18(5):108-17.
16. Tekin T, Çiçek B, Konyalıgil N, et al. Increased hip circumference in individuals with metabolic syndrome affects serum nesfatin-1 levels. Postgrad Med J. 2020;96(1140):600-5.
17. Filgueiras MS, Vieira SA, Fonseca PCA, et al. Waist circumference, waist-to-height ratio and conicity index to evaluate android fat excess in brazilian children. Public Health Nutr. 2019;22(1):140-6.
18. Thorp A, Stine JG. Exercise as medicine: The impact of exercise training on nonalcoholic fatty liver disease. Curr Hepatol Rep. 2020;19(4):402-11.
19. Chopra S, Sharma KA, Ranjan P, et al. Weight management module for perimenopausal women: A practical guide for gynecologists. J Midlife Health. 2019;10(4):165-72.
20. McKensy-Sambola D, Rodríguez-García MÁ, García-Sánchez F, et al. Ontology-based nutritional recommender system. App Sci. 2022 doi: 10.3390/app12010143.
21. Shubham K, Anukiruthika T, Dutta S, et al. Iron deficiency anemia: A comprehensive review on iron absorption, bioavailability and emerging food fortification approaches. Trends Food Sci Technol. 2020;99:58-75.
22. Batrakoulis A. Psychophysiological adaptations to pilates training in overweight and obese individuals: A topical review. Diseases. 2022;10(4).
23. Khosravi A, Keshvari M, Tahramuzi M. The effect of eight weeks pilates training on plasma irisin levels and anthropometric parameters in overweight women. Med. J. Tabriz Univ. Med. Sci. Health Serv. 2019;41:38-46.
24. Rayes ABR, de Lira CAB, Viana RB, et al. The effects of pilates vs. Aerobic training on cardiorespiratory fitness, isokinetic muscular strength, body composition, and functional tasks outcomes for individuals who are overweight/obese: A clinical trial. PeerJ. 2019;7:e6022.
25. Batrakoulis A, Fatouros IG. Psychological adaptations to high-intensity interval training in overweight and obese adults: A topical review. Sports (Basel). 2022;10(5).
26. Corson AE, MacDonald M, Tzaneva V, et al. Breaking boundaries: A chronology with future directions of women in exercise physiology research, centred on pregnancy. Adv Exerc Health Sci. 2024;1(2):67-75.
27. Dos Reis AL, de Oliveira LC, de Oliveira RG. Effects of stretching in a pilates program on musculoskeletal fitness: A randomized clinical trial. BMC Sports Sci Med Rehabil. 2024;16(1):11.
28. Johnson NA, Sultana RN, Brown WJ, et al. Physical activity in the management of obesity in adults: A position statement from exercise and sport science australia. J Sci Med Sport. 2021;24(12):1245-54.
29. Guo Z, Li M, Cai J, et al. Effect of high-intensity interval training vs. Moderate-intensity continuous training on fat loss and cardiorespiratory fitness in the young and middle-aged a systematic review and meta-analysis. Int J Environ Res Public Health. 2023;20(6).
30. Armstrong A, Jungbluth Rodriguez K, Sabag A, et al. Effect of aerobic exercise on waist circumference in adults with overweight or obesity: A systematic review and meta-analysis. Obes Rev. 2022;23(8):e13446.



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