

The Effect of Upper-Extremity Muscular Endurance Training on Upper-Extremity Fat Mass Reduction in Premenopausal Women

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Abstract. This study investigated the effect of upper-extremity muscular endurance training on upper-extremity fat mass in premenopausal women. An experimental approach with a one-group pretest–posttest design was employed. The study involved 20 premenopausal women participating in a fitness program at Body Fit Station Pulomas–Kelapa Gading. Participants were recruited using purposive sampling based on predetermined eligibility criteria. Upper-extremity fat mass was assessed before and after the intervention using a Joil Machine based on Bioelectrical Impedance Analysis (BIA), with identical measurement procedures applied at both assessment points. The intervention was implemented for four weeks at a frequency of two sessions per week. Each session comprised a warm-up, 40 minutes of upper-extremity muscular endurance exercises, and a cool-down. Training loads were prescribed based on 1RM and maintained at 60% 1RM. Data were analyzed using descriptive statistics, the Shapiro–Wilk test, and the Wilcoxon Signed-Rank Test. Mean fat mass decreased from 134.0900 to 115.3925, representing a reduction of 18.6975 units. The Wilcoxon analysis demonstrated a significant pretest–posttest difference ($Z = -3.659$; $p < 0.001$). Thus, the training program was associated with reduced upper-extremity fat mass. Further controlled studies are recommended.

Keywords: upper-extremity fat mass; muscular endurance training; premenopausal women; body composition; resistance training



INTRODUCTION

Physical health and fitness are important aspects of maintaining quality of life, particularly among premenopausal women. Physical fitness is not only related to an individual's ability to perform daily activities without excessive fatigue but also reflects the optimal functioning of the cardiovascular, respiratory, muscular, and metabolic systems. In premenopausal women, physical fitness may gradually decline due to physiological and hormonal changes that occur during the transition toward menopause (Bondarev et al., 2021; Marlatt et al., 2022; Ruiz-Rios & Maldonado-Martin, 2022).

Premenopause is a transitional period preceding menopause that is generally experienced between the ages of 40 and 50 years and is characterized by declining ovarian function and changes in estrogen and progesterone production. Changes in estrogen levels affect not only the reproductive system but also energy metabolism, body fat distribution, muscle mass, bone density, and cardiovascular function (Zhu et al., 2023). These changes may increase the risk of alterations in body composition among premenopausal women compared with women of reproductive age (Kodoth et al., 2022).

One of the notable changes during the premenopausal period is the accumulation of body fat (Kodoth et al., 2022; Szeliga et al., 2026). Changes in estrogen levels may contribute to alterations in lipid metabolism, fat oxidation, and fat distribution. Fat distribution may gradually shift from a predominantly gynoid pattern, characterized by accumulation around the hips and thighs, toward a more central and upper-body pattern (Patel et al., 2025). This condition may contribute to increased fat accumulation in the abdominal region and upper extremities, including the arms.

In addition to hormonal changes, increased body fat accumulation may be influenced by declining physical activity. As age increases, physical activity levels may decrease due to occupational demands, changes in physical condition, and reduced motivation to exercise (Pataky et al., 2021). An imbalance between energy intake and energy expenditure may result in excess energy being stored as adipose tissue, thereby increasing body fat. Low levels of physical activity have been associated with increased body mass index and body fat percentage among middle-aged women (Niezgoda et al., 2025).

A decline in basal metabolic rate may also contribute to increased body fat accumulation among premenopausal women (Huang et al., 2025). Aging is associated

with reductions in muscle mass, which may decrease energy requirements at rest. When this condition is not accompanied by adequate physical activity and healthy dietary habits, fat accumulation may increase. Dietary patterns characterized by high fat and sugar intake and low fiber consumption may further increase the risk of obesity and metabolic disorders among premenopausal women (Zhang et al., 2023).

Excessive fat accumulation may negatively affect health. High levels of body fat are associated with an increased risk of obesity, hypertension, type 2 diabetes mellitus, dyslipidemia, cardiovascular disease, and metabolic syndrome (Powell-Wiley et al., 2021). In addition to physical health consequences, increased body fat may also affect psychological well-being, including self-confidence, body dissatisfaction, and quality of life (Powell-Wiley et al., 2021). Therefore, maintaining healthy body composition is an important aspect of promoting health among premenopausal women.

Changes in body fat distribution among premenopausal women may also occur in the upper extremities, particularly the upper arms (Shi et al., 2020). Fat accumulation in the upper arms may result in a larger and less toned appearance due to increased adipose tissue and reductions in muscle mass and strength. This condition may be of concern not only because of its potential relationship with physical function but also because of its influence on body appearance and body image. Physiologically, these changes may be associated with alterations in estrogen levels, redistribution of body fat toward the upper body, and age-related reductions in muscle mass (Orioli et al., 2026).

The selection of upper-extremity fat mass as the focus of this study was also supported by preliminary findings at the research site. A preliminary survey conducted at Body Fit Station Pulomas–Kelapa Gading found that the upper-arm region was one of the body areas that participants most wanted to reduce. Of the 33 respondents surveyed, 27 respondents (81.8%) selected the area involving the upper arms as a body region in which they desired fat reduction. This finding was further supported by brief interviews with several members who reported that fat accumulation in the upper arms was a concern because it was perceived as difficult to reduce despite regularly engaging in physical activity. These findings indicate that reducing upper-extremity fat mass is a relevant issue to be investigated among premenopausal women.

Regular and appropriately structured physical activity is one of the strategies that can be used to improve body composition and reduce body fat. Physical activity increases

energy expenditure, improves metabolic function, promotes fat oxidation, and contributes to the maintenance of muscle mass (Kolnes et al., 2021). One form of exercise that may be relevant for premenopausal women is muscular endurance training (Lopez et al., 2022a).

Muscular endurance training is generally performed using repeated contractions with relatively light to moderate loads over a specific period. This type of training can improve muscular endurance and induce physiological adaptations, including increased capillarization, mitochondrial function, and oxidative enzyme activity. These adaptations may improve the muscle's ability to utilize energy substrates during physical activity and contribute to increased energy expenditure (Schoenfeld et al., 2021). In premenopausal women, muscular endurance training may also help maintain muscle mass, which tends to decline with aging and hormonal changes.

Upper-extremity muscular endurance training specifically emphasizes the ability of the muscles of the arms and shoulders to perform repeated contractions over a period of time. Training involving the upper extremities may improve muscular endurance and increase the metabolic demand of the exercised musculature (Aida & Sulaiman, 2018). Regular training may therefore contribute to improvements in body composition and reductions in fat mass when combined with an appropriately structured exercise program (Lopez et al., 2022a).

Although a substantial body of prior research has consistently demonstrated that muscular endurance training and resistance-based exercise significantly contribute to overall improvements in body composition, general reductions in body fat percentage, and favorable changes in anthropometric markers such as body mass index and waist circumference, investigations addressing localized outcomes remain surprisingly scarce. Specifically, empirical evidence examining the direct effect of upper-extremity muscular endurance training on regional fat mass reduction among premenopausal women is still relatively limited in the current scientific literature. Furthermore, data tracking physiological adaptations and fat mass changes in specific upper-body depots following a structured endurance protocol continue to exhibit notable gaps, clearly demonstrating a distinct area that warrants thorough academic exploration.

Motivated by this background and the identified lacuna in existing literature, comprehensive research is required to evaluate the precise impact of upper-extremity

muscular endurance training on localized fat reduction in premenopausal women. Consequently, this study aims to determine whether a systematic, structured upper-extremity muscular endurance exercise program—implemented at Body Fit Station Pulomas–Kelapa Gading—effectively influences the reduction of upper-extremity fat mass within this demographic cohort. Ultimately, the empirical findings and insights generated by this research are expected to provide robust scientific guidance for fitness instructors, health professionals, and premenopausal women, enabling them to design and implement highly targeted, evidence-based exercise programs aimed at optimizing body composition and reducing localized upper-extremity fat mass.

METHOD

This study employed an experimental method using a one-group pretest–posttest design. The study was conducted to determine the effect of upper-extremity muscular endurance training on upper-extremity fat mass reduction in premenopausal women. The participants underwent an initial measurement (pretest) before the intervention and a final measurement (posttest) after completing the training program. The intervention consisted of a structured upper-extremity muscular endurance training program conducted for four weeks. The changes in upper-extremity fat mass were determined by comparing the pretest and posttest measurements.

The participants were premenopausal women who participated in the training program at Body Fit Station Pulomas–Kelapa Gading. The sampling technique used was purposive sampling, in which participants were selected based on predetermined criteria relevant to the research objectives. The inclusion criteria were: (1) women aged 40–50 years and in the premenopausal phase; (2) having fat accumulation in the upper extremities or upper arms; (3) being in a healthy condition and able to participate in physical exercise; (4) being willing to participate in the entire research program; and (5) not undergoing a strict diet program or specific hormonal therapy. The study included 20 participants in the upper-extremity muscular endurance training group.

The upper-extremity muscular endurance training program was conducted at Body Fit Station Pulomas–Kelapa Gading for four weeks. The training was performed twice a week, with each session lasting approximately 60 minutes. Each session consisted of a 10-minute warm-up, 40-minute main exercise, and 10-minute cool-down.

The training program used relatively light to moderate loads with repeated movements to develop muscular endurance. The exercises targeted the muscles of the arms and shoulders, including the biceps, triceps, deltoids, pectoralis muscles, and supporting shoulder muscles. The training program consisted of nine exercises: Dumbbell Biceps Curl, Triceps Extension, Shoulder Press, Lateral Raise, Modified Push-up (Drop/Knee Push-up), Front Raise, Bent Over Row, Straight Arm Pulldown, and Upright Row. The exercise intensity was determined based on the one-repetition maximum (1RM) measurement, with the training load maintained below 60% of 1RM. The program applied the principle of progressive overload through gradual increases in training volume, particularly repetitions and sets, while maintaining the training intensity within the light-to-moderate range.

Table 1. Muscular endurance training program.

Week	Warm-Up (10 minute)	Core (40 menit)	Intensity	Reps	Set	Cool-Down (10 menit)
1	Arm circle, shoulder rotation, dynamic stretching, marching	Dumbbell Biceps Curl, Triceps	60% 1RM	20	2	Static stretching for biceps,
2		Extension, Shoulder Press, Lateral Raise,	60% 1RM	20	2	triceps,
3		Modified Push-up (drop), Front raises,	60% 1RM	20	3	deltoids, and
4		chair dips, bent over, straight arm pulldown	60% 1RM	20	3	shoulders, along with breathing relaxation.

Measurment Instrument

Upper-extremity fat mass was measured using the Joil Machine based on Bioelectrical Impedance Analysis (BIA). The measurement was conducted before and after the four-week training program. The same instrument and measurement procedures were used for both the pretest and posttest to maintain consistency throughout the data collection process. Data collection consisted of pretest measurement, implementation of the training program, and posttest measurement. Before the pretest, participants were instructed not to perform strenuous physical activity for at least 12 hours, avoid heavy meals for 2–3 hours before measurement, maintain adequate hydration, urinate before measurement, and avoid wearing metal accessories.

Prior to the intervention, a 1RM test was conducted to determine the appropriate training load. The initial upper-extremity fat mass measurement was then performed using the Joil Machine based on BIA. The participants subsequently completed the upper-

extremity muscular endurance training program for four weeks. After completing the training program, upper-extremity fat mass was measured again using the same instrument and procedures as the pretest.

All data analysis was carried out using IBM SPSS Statistics software. Descriptive statistics were applied to summarize the characteristics of the data, which included mean values, standard deviations, as well as minimum and maximum values of upper extremity fat mass at the initial (pretest) and final (posttest) measurements. Given that the sample size is less than 50 people, the data normality test uses the Shapiro-Wilk method, provided that the data distribution is considered normal if the value of $p > 0,05$.

Hypothesis testing was carried out through the Paired Samples t-test if the assumption of normality was met, in order to evaluate the significance of the difference in upper extremity fat mass before and after the intervention. Conversely, if the distributed data is abnormal, the analysis is followed by the Wilcoxon Signed-Rank Test. All statistical test decisions are set at a significance level of $\alpha = 0,05$, where the value indicates a statistically significant difference.

RESULT AND DISCUSSION

Result

Descriptive Analysis

Descriptive statistics were used to summarize the upper-extremity fat mass measurements obtained before and after the upper-extremity muscular endurance training intervention. The analysis consisted of the sample size, minimum and maximum scores, mean, and standard deviation. The dataset comprised 20 participants who completed both measurements.

Table 2. Descriptive Statistics of Upper-Extremity Fat Mass.

Measurment	N	Minimum	Maximum	Mean	Std. Deviation
Pretest	20	66.70	388.30	134.0900	69.28931
Posttest	20	27.70	376.30	115.3925	71.77885
Valid N (listwise)	20				

Based on the descriptive results in Table 2, the average upper-extremity fat mass at the pretest was 134.0900 ± 69.28931 , with individual values ranging from 66.70 to 388.30. After completion of the training program, the mean value declined to 115.3925 ± 71.77885 , while the observed measurements ranged between 27.70 and 376.30. The

decrease in the mean value indicates a reduction in upper-extremity fat mass following the intervention. The comparison between the pretest and posttest means indicates a decrease of 18.6975 units in upper-extremity fat mass, from 134.0900 to 115.3925. The standard deviation values were relatively similar between the pretest and posttest measurements, indicating a comparable degree of data variability before and after the intervention.

Normality Test

The normality of the upper-extremity fat mass measurements was examined using the Shapiro–Wilk test. This statistical procedure was applied because the study involved 20 participants, which is below the recommended threshold of 50 subjects for this test.

Table 3. Shapiro–Wilk Normality Test.

Measurment	Statistic	df	Sig.
Pretest	.684	20	.000
Posttest	.694	20	.000

The results presented in Table 3 indicate that the significance level for both the pretest and posttest measurements was .000 ($p < 0.001$). These values are lower than the predetermined significance level of 0.05, indicating that neither dataset met the assumption of normality. Consequently, the data were considered non-normally distributed, and subsequent statistical analyses were performed using non-parametric tests.

Wilcoxon Signed-Rank Test

The Wilcoxon Signed-Rank Test was performed to examine the difference in upper-extremity fat mass between the pretest and posttest measurements. This non-parametric test was selected because the data did not meet the assumption of normality.

Table 4. Wilcoxon Signed-Rank Test of Upper-Extremity Fat Mass.

Comparison	Z	Asymp. Sig. (2-tailed)
Posttest- Pretest	-.3.659	<0.001

The Wilcoxon Signed-Rank Test yielded a Z score of -3.659 with an Asymp. Sig. (2-tailed) value of <0.001 . Because the obtained significance level was lower than 0.05, the null hypothesis was rejected, indicating a statistically significant difference in upper-extremity fat mass between the pretest and posttest measurements.

The descriptive results further demonstrated a decline in the mean upper-extremity fat mass, from 134.0900 at pretest to 115.3925 at posttest. When considered together with the significant Wilcoxon test result, these findings suggest that the upper-extremity muscular endurance training program contributed to a significant decrease in upper-extremity fat mass among the premenopausal women included in the study.

Discussion

The findings demonstrated a significant change in upper-extremity fat mass following the implementation of the upper-extremity muscular endurance training program. The difference between the pretest and posttest measurements was considered statistically significant. The descriptive analysis also revealed a decline in the average upper-extremity fat mass, decreasing from pretest to posttest. These results indicate that the upper-extremity muscular endurance training program was accompanied by a meaningful reduction in upper-extremity fat mass among the participants.

These findings are consistent with previous research indicating that resistance-based exercise can contribute to improvements in body composition and reductions in body fat. Westcott (2012) Reported that regular resistance training can increase muscle mass, improve resting metabolic rate, and contribute to reductions in body fat. Increased energy expenditure associated with resistance training may support greater utilization of energy substrates and contribute to improvements in body composition over time (Kirk et al., 2009).

The findings are also Lopez et al. (2022b), who reported in a systematic review that resistance training can be an effective exercise strategy for reducing fat mass while maintaining or increasing fat-free mass in adults. Unlike aerobic exercise, in which energy expenditure is predominantly observed during the exercise session, resistance training may also produce metabolic responses during the post-exercise recovery period. The increased physiological demand associated with exercise and recovery may contribute to overall energy expenditure and subsequent changes in body composition (Wang et al., 2025).

The present findings are also relevant to premenopausal women because this period is accompanied by physiological and hormonal changes that may affect body composition. Changes in estrogen levels during the menopausal transition may be associated with alterations in fat distribution, muscle mass, and metabolic function. These

changes may increase the tendency for fat accumulation and reductions in lean tissue among women approaching menopause (Zhu et al., 2023). Therefore, structured exercise that incorporates muscular endurance may be beneficial for supporting favorable body composition during this period.

Physiologically, repeated muscle contractions performed during muscular endurance training require continuous energy production (Hughes et al., 2018). Regular exercise may stimulate adaptations in skeletal muscle, including improvements in mitochondrial function, oxidative capacity, and the ability to utilize energy substrates. These adaptations may contribute to increased energy expenditure during exercise and recovery and, when performed consistently, may support reductions in body fat (Kirk et al., 2009). In addition, muscular endurance training may contribute to the maintenance of muscle mass (Aida & Sulaiman, 2018). Maintaining skeletal muscle is particularly relevant among premenopausal women because age-related changes may gradually reduce muscle mass and physical capacity (Zhang et al., 2023). Improvements in or preservation of muscle mass may help maintain energy expenditure and contribute to a more favorable balance between fat mass and fat-free mass (Cava et al., 2017). Although the training program in this study focused specifically on the upper extremities, the reduction in upper-extremity fat mass should not be interpreted as evidence of localized fat burning. Fat mobilization and energy metabolism are systemic physiological processes. The observed reduction in upper-extremity fat mass may reflect the overall metabolic effects of regular exercise and changes in body composition, while the upper-extremity training provided a specific muscular stimulus to the arms and shoulders.

The findings are therefore relevant to the needs identified among members of Body Fit Station Pulomas–Kelapa Gading, particularly premenopausal women who were concerned about fat accumulation in the upper-arm region. The observed reduction in upper-extremity fat mass after the training program suggests that a structured upper-extremity muscular endurance program may be a practical exercise option for supporting improvements in body composition in this population. However, the findings should be interpreted with caution. This study used a one-group pretest–posttest design without a control group. Therefore, although a statistically significant pretest–posttest difference was observed, the results cannot establish that the training program alone caused the reduction in upper-extremity fat mass. Other factors, such as dietary intake, daily physical

activity, energy balance, and individual physiological variation, may also have contributed to the observed changes. Further studies using a control group, larger samples, and longer intervention periods are recommended to strengthen the evidence regarding the effect of upper-extremity muscular endurance training on upper-extremity fat mass in premenopausal women.

CONCLUSION

Based on the results of the study, the administration of upper-extremity muscular endurance training showed a decrease in upper-extremity fat mass in premenopausal women who participated in the exercise program at the Body Fit Station Pulomas-Kelapa Gading. The average value of upper-extremity fat mass decreased in the pretest to in the posttest. The decrease showed a change in body composition in the upper extremities after participants participated in the exercise program. The results of the analysis upper-extremity fat mass showed significant difference between the results of the measurement before and after the exercise. This shows that after following the upper-extremity muscular endurance training program, there was a statistically significant change in upper-extremity fat mass. These findings indicate that structured upper extremity muscle endurance exercises can support improved body composition in premenopausal women. Repetitive exercises can increase muscle activity and energy expenditure, potentially contributing to a decrease in fat mass. However, because this study used a one-group pretest–posttest design without a control group, these results cannot be considered definitive cause-and-effect evidence. The changes that occur can also be influenced by other factors, such as diet, physical activity outside of exercise, and the lifestyle of the participants. Thus, the results of the study can be concluded that there is a significant decrease in upper-extremity fat mass after the administration of upper-extremity muscular endurance training. Nonetheless, studies with control groups and control of confounding factors are needed to ascertain the specific effect of exercise programs on upper-extremity fat mass changes.

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