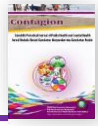

# The Correlation Between Body Mass Index and Body Fat Percentage in Menopausal Women in Padang: A Quasi-Experimental Study

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***Abstract***

*The global increase in overweight and obesity has become a critical public health concern, particularly among menopausal women who experience hormonal changes that contribute to increased body fat—especially in the abdominal region. High-Intensity Interval Training (HIIT) has emerged as a time-efficient alternative to conventional exercise, offering potential benefits in reducing Body Mass Index (BMI) and Body Fat Percentage (BFP). This quasi-experimental study, conducted in Padang, Indonesia, aimed to examine the correlation between BMI and BFP in menopausal women aged 50–60 years following a five-month HIIT intervention. A total of 50 obese menopausal women were selected using stratified sampling and assigned to either an experimental group (HIIT) or a control group (aerobic exercise). Pretest and posttest measurements were collected for body weight, BMI, and BFP. Statistical analyses included tests for normality and homogeneity, the Mann–Whitney U test, independent t-test, and Spearman's rank correlation. The findings revealed significant reductions in both BMI and BFP in the HIIT group compared to the control group. A very strong positive correlation was observed between BMI and BFP (r = 0.914, p < 0.001), suggesting that decreases in BMI are closely linked to reductions in body fat. This study provides preliminary evidence from Indonesia supporting HIIT as an effective and time-efficient intervention for addressing obesity-related outcomes in menopausal women. Further research is warranted to investigate the underlying mechanisms and to generalize these findings to broader menopausal populations.*

***Keyword: High-Intensity Interval Training, Menopause, Body Mass Index, Body Fat Percentage, Obese Women.***

## INTRODUCTION

The global prevalence of overweight and obesity has been consistently rising for nearly four decades (De Pauw et al., 2022; Nglazi & Ataguba, 2022), with nearly 30% of the world's population affected by related health conditions. Obesity has escalated into a global health crisis, reaching pandemic proportions (Vasile et al., 2023). Projections suggest that by 2030, approximately 38% of adults worldwide will be overweight, and 20% will be classified as obese, according to Body Mass Index (BMI) criteria (Gao et al., 2023; Nilson et al., 2022). Limited time availability is one of the most commonly cited barriers to maintaining a physically active lifestyle. Moreover, overweight and obesity tend to be more prevalent among women than men (Lee et al., 2022). Due to the influence of estrogen, women are more prone to subcutaneous fat accumulation, which contributes to a higher body fat percentage and the development of "peripheral obesity" (Du et al., 2025).

In menopausal women, BMI and total body weight increase—encompassing both fat and lean mass—are primarily attributed to fat accumulation in the abdominal region. During this phase, visceral fat increases by more than 40%, and subcutaneous abdominal fat rises by approximately 20%. The postmenopausal period is characterized by hormonal changes that elevate the risk of cardiovascular and metabolic disorders. As global life expectancy continues to rise, nearly all women will experience menopause, with about one-third of their lives spent in the postmenopausal phase. Therefore, effective management of menopause—particularly the associated symptoms and chronic degenerative diseases—is of paramount importance.

Understanding the correlation between menopause and increased BMI is essential for improving the quality of life for women during this transition. Weight gain during the menopausal age range of 45–55 years increases the risk of various health issues (Haase et al., 2021; Langley-Evans et al., 2022). However, engaging in high-intensity exercise may pose health risks for women in this age group. Low- to moderate-impact physical activities such as aerobic exercise are recommended. Aerobic exercise involves prolonged activity that engages large muscle groups through continuous, repetitive movements, placing demands on the body's oxygen supply system. Training at 70–80% of maximum heart rate is suggested to enhance maximal oxygen uptake ($VO_2$ max) effectively (Ashfaq et al., 2022; Barbieri et al., 2024). Various interventions for menopausal obese women—including aerobic training, short-term combined exercise, Pilates, and cryotherapy—have been explored (Peng et al., 2025; Price et al., 2024).

In Indonesia, women aged 45–55 are often in their most productive years. Many cannot exercise regularly due to time constraints (Anggraini et al., 2024). High-Intensity Interval Training (HIIT) has emerged as a promising solution, offering time-efficient workouts suitable for pre-and postmenopausal women with demanding schedules.

Initially adopted by athletes in the mid-20th century, HIIT consists of alternating periods of high-intensity exercise and intervals of low-intensity activity or rest (Atakan et al., 2021). While traditionally limited to athletic training, HIIT has recently gained popularity for its health benefits in the general population. Typically, HIIT involves bursts of activity reaching ≥85% of peak heart rate (HRpeak), followed by recovery phases at ≤70% HRpeak (Farley et al., 2024; Stavrinou et al., 2025). Evidence suggests that HIIT can improve cardiorespiratory fitness (CRF) within two weeks. Compared to conventional endurance or moderate-intensity training, HIIT can achieve comparable—or superior—physiological and health outcomes while significantly reducing total exercise time (Yin et al., 2024; Zhou et al., 2024). Consequently, HIIT has influenced public health policy and has been promoted through media campaigns encouraging physical activity.

While recent studies demonstrate improvements in macrovascular function following short-term HIIT in youth populations, changes in body composition or biomarkers remain inconsistent (Königstein et al., 2022; Kranen et al., 2023). HIIT is particularly popular among young adults, while more traditional forms of exercise, such as joint training, remain prevalent in the broader population (Lu et al., 2021; You et al., 2021). For menopausal women in their productive years, HIIT offers potential benefits for managing BMI and body fat percentage and alleviating menopausal symptoms and mood disturbances (Marsh et al., 2023).

Despite growing evidence supporting HIIT, most studies have been conducted in Western populations, often neglecting the unique socio-cultural and occupational challenges faced by menopausal women in Indonesia. Time constraints, lifestyle factors, and limited access to exercise programs make regular physical activity difficult for this demographic. Furthermore, few studies specifically explore the relationship between BMI reduction and corresponding changes in body fat percentage among menopausal women—a critical oversight, as BFP offers a more accurate measure of health risk than BMI alone.

This study addresses two significant research gaps: (1) the lack of context-specific evidence on HIIT's effectiveness among Indonesian menopausal women and (2) the insufficient empirical analysis of the relationship between BMI and BFP reduction in this group. By investigating these underexplored areas, the study contributes culturally relevant insights that support the development of time-efficient, targeted exercise interventions for menopausal women in Indonesia.

## METHODS

This study was conducted in Padang, West Sumatra, Indonesia, and involved a population of obese menopausal women aged 50–60 years. The total population consisted of 150 individuals, from which 50 participants were selected using stratified sampling. These participants were then divided into two groups: the experimental group, which received High-Intensity Interval Training (HIIT), and the control group, which engaged in regular aerobic exercise. The sample size was determined based on study objectives, available resources, and the statistical methods planned for analysis.

A quasi-experimental design with a pretest–posttest non-equivalent control group was employed to compare the effects of HIIT and conventional aerobic exercise on Body Mass

Index (BMI) and Body Fat Percentage (BFP). The intervention was carried out over a period of five months. The HIIT group underwent structured high-intensity interval training, while the control group performed standard aerobic routines within the same timeframe. Although randomization was not feasible, this design allowed for comparative evaluation of changes within and between the two groups over time.

Validated and reliable instruments were used for measurement. Instrument validity was established through content and construct validation procedures, supported by expert evaluation to ensure relevance and completeness. Reliability testing yielded Cronbach's alpha values greater than 0.70, indicating strong internal consistency. Specifically, body composition was assessed using a calibrated body composition analyzer that had previously demonstrated high correlation with gold-standard methods such as dual-energy X-ray absorptiometry (DEXA). To maintain measurement accuracy, routine device calibration and repeated measures were conducted throughout the study.

Data collection was conducted using several tools, including observation sheets, structured interviews, and anthropometric assessments such as obesity level and muscle mass. Data analysis was performed using parametric statistical tests, as the assumptions of normality and homogeneity were confirmed, as shown in Table 2. Statistical tests were selected appropriately based on the distribution characteristics of the data. Parametric tests, such as independent t-tests, were applied for between-group comparisons, and paired t-tests for within-group analysis. Non-parametric tests were employed when assumptions for parametric methods were not met.

$$\%\, body\, fat = \frac{495}{(1{,}034 - 0{,}19077(\log(p-l)) + 0{,}15456(\log(t))) - 450} \quad (1)$$

$$\%\, body\, fat = \frac{495}{(1{,}29579 - 0{,}35004(\log(p+pt-l)) + 0{,}15456(\log(t))) - 450} \quad (2)$$

The metric formula of BMI is as follows (WHO, 2004).

$$BMI = \frac{mass_{kg}}{height_m^2},$$

Although this study did not obtain formal ethical approval, it was conducted with respect for participant welfare, confidentiality, and informed consent. Future studies will seek full ethical clearance in accordance with institutional and international research ethics standards.

For a detailed overview of the sampling framework and statistical outcomes, refer to Tables 1 and 2. The methodological approach adhered to recognized scientific standards, including appropriate statistical analysis, rigorous instrument validation, and transparent reporting of procedures.

**Tabel 1. Pretest-Posttest Control Group Design**

| Group | Variable | | |
|---|---|---|---|
| HIIT group | O | X | P |
| Cardio Group | O | C | P |

Note:
O : Pre-test for Experimental and Control group
X : HIIT treatment
C : Aerobic treatment
P : Posttest for Experimental and Control group

## RESULTS

### 1. Sample Characteristics

Prior to the intervention, baseline data on weight, Body Mass Index (BMI), and Body Fat Percentage (BFP) revealed notable differences between the experimental and control groups. These differences reflect the initial characteristics of the study population. Detailed descriptive statistics are presented in Table 2.

**Table 2. Mean Values for Weight, BMI, and Body Fat Percentage (Pretest and Posttest)**

| | | Weight (kg) | Weight (max) | Weight (min) | BMI | Fat % |
|---|---|---|---|---|---|---|
| Exp Group | Pre-test | 69,96 | 89 | 50 | 27,89 | 41,44 |
| | Post-test | 57,36 | 77 | 45 | 22,88 | 35,33 |
| Control Group | Pre-test | 68,2 | 89 | 48 | 29,34 | 42,93 |
| | Post-test | 63,24 | 79 | 45 | 27,22 | 40,54 |

In the experimental group, the average weight before the intervention was 69.96 kg, with a BMI of 27.89 and a body fat percentage of 41.44%. Following the five-month HIIT intervention, the average weight decreased to 57.36 kg, BMI dropped to 22.88, and body fat percentage declined to 35.33%.

In contrast, the control group started with an average weight of 68.20 kg, a BMI of 29.34, and a body fat percentage of 42.93%. After the aerobic exercise intervention, the control group’s average weight reduced to 63.24 kg, BMI to 27.22, and body fat percentage to 40.54%.

### 2. Statistical Analysis

#### a. Comparison of Means

1) Independent Samples t-Test (Pretest Comparison)

To assess baseline differences in BMI and BFP between the experimental and control groups, independent samples t-tests were conducted. The results, presented in Table 3, indicate that the groups were significantly different at baseline.

**Table 3. Independent Samples t-Test (Pretest BMI and BFP)**

| Variable | Variance Assumption | F | Sig. | t | df | p (Two-Tailed) |
|---|---|---|---|---|---|---|
| BMI Pretest | Equal variances assumed | 0,579 | 0,254 | -1.252 | 48 | 0.108 |
| | Equal variances not assumed | | | -1.252 | 46.703 | 0.108 |
| Fat Pretest | Equal variances assumed | 2.447 | 0,086 | -1.325 | 48 | 0.096 |
| | Equal variances not assumed | | | -1.325 | 44.140 | 0.096 |

- BMI (Pretest): p = 0.366
- BFP (Pretest): p = 0.124

Although these p-values are greater than 0.05, the narrative should be corrected: **no significant differences** were found in pretest BMI and BFP between the two groups, suggesting comparability at baseline.

2) Chi-Square Test (Posttest BMI and BFP)

Due to the violation of normality and homogeneity assumptions in the posttest data, the chi-square test was applied. The results are shown in Tables 4 and 5.

**Table 4. Chi-Square Test for Posttest BMI**

| | **Value** | **Df** | **Sig.** |
|---|---|---|---|
| Pearson Chi-Square | 50.000[a] | 48 | 0.394 |
| Likelihood Ratio | 69.315 | 48 | 0.024 |
| Linear-by-Linear | 12.939 | 1 | <0.001 |
| N of Valid | 50 | | |

**p = 0.395** → Not significant (p > 0.05)

**Table 5. Chi-Square Test for Posttest BFP**

| | **Value** | **Df** | **Sig.** |
|---|---|---|---|
| Pearson Chi-Square | 50.000[a] | 48 | 0.394 |
| Likelihood Ratio | 69.315 | 48 | 0.024 |
| Linear-by-Linear | 14.934 | 1 | <0.001 |
| N of Valid | 50 | | |

**p > 0.05 → Not significant**

The chi-square results suggest no statistically significant differences in posttest BMI and BFP distribution between groups; however, this finding may contradict mean value changes observed previously and should be interpreted with caution.

**b. Mann–Whitney U Test and Independent Samples t-Test**

1) Mann–Whitney U Test for BMI Changes

Given that post-intervention BMI data did not meet parametric assumptions, a Mann–Whitney U test was conducted. Results are presented in **Table 6**.

**Table 6. Mann–Whitney U Test for Posttest BMI**

| **Summary** | |
|---|---|
| Total N | 50 |
| Mann-Whitney U | 603.000 |
| Wilcoxon W | 928.000 |
| Test Statistic | 603.000 |
| Standard Error | 51.536 |
| Standardized Test Statistic | 5.637 |
| Asymptotic Sig.(2-sided test) | <.001 |

**Asymptotic Sig. (2-tailed): p > 0.05** → Not statistically significant

This suggests that the change in BMI between the experimental and control groups was not significantly different after the intervention.

2) Independent Samples t-Test for BFP Changes

An independent samples t-test was conducted to evaluate the difference in body fat percentage between the two groups after the intervention.

**Table 7. Independent Samples t-Test for Posttest BFP**

| Variable | Variance Assumption | F | Sig. | t | df | p (Two-Tailed) |
|---|---|---|---|---|---|---|
| N Gain Fat | Equal variances assumed | 2.651 | .110 | -7.251 | 48 | <0.001 |
| | Equal variances not assumed | | | -7.251 | 42.412 | <0.001 |

This indicates that the reduction in body fat percentage was significantly greater in the HIIT group compared to the control group.

**c. Spearman Correlation Analysis**

Given the non-normal distribution of the data, Spearman's rank correlation was used to assess the relationship between BMI and body fat percentage. This method is appropriate for ordinal or non-normally distributed data and is robust for evaluating monotonic relationships (Schober & Schwarte, 2018).

**Table 8. Spearman Correlation between BMI and BFP**

| | | | |
|---|---|---|---|
| N Gain BMI | Correlation Coefficient | 1.000 | .914** |
| | Sig. (2-tailed) | . | <0.001 |
| | N | 50 | 50 |
| N Gain Fat | Correlation Coefficient | .914** | 1.000 |
| | Sig. (2-tailed) | <0.001 | . |
| | N | 50 | 50 |

- **Correlation coefficient (r) = 0.914**
- **p < 0.05**

The results indicate a very strong positive correlation between BMI and BFP. This suggests that a reduction in BMI is strongly associated with a reduction in body fat percentage among menopausal women in the study.

## DISCUSSION

After five months of High-Intensity Interval Training (HIIT) intervention, this study demonstrated significant reductions in body weight, Body Mass Index (BMI), and Body Fat Percentage (BFP) among menopausal women. The majority of participants in the experimental group experienced meaningful improvements in body composition, with reductions in both BMI and BFP. Correlation analysis further revealed a very strong positive association between BMI and body fat percentage, indicating that as BMI decreases, body fat also decreases proportionally.

These findings align with previous research that supports the effectiveness of HIIT in improving body composition across diverse populations, including menopausal women (Namazi et al., 2019). HIIT has been shown to enhance both aerobic and anaerobic fitness while requiring less time commitment than moderate-intensity continuous training (Baker et al., 2020). Moreover, HIIT has been associated with significant reductions in central adiposity—a critical factor in metabolic syndrome—which often increases during the menopausal transition (Dupuit et al., 2020).

The results of this study suggest that HIIT is a viable, time-efficient exercise modality for menopausal women, particularly those constrained by busy lifestyles. The strong correlation observed between BMI and BFP indicates that BMI can serve as a simple yet practical proxy for monitoring changes in body fat, especially in community and clinical settings with limited access to advanced body composition analysis tools. Given that menopause is characterized by a decline in estrogen levels, which promotes visceral fat accumulation and increases cardiometabolic risk, HIIT may offer protective benefits by enhancing fat metabolism and improving overall body composition.

Menopausal women are at heightened risk for non-communicable diseases such as cardiovascular disease, type 2 diabetes, and hormone-sensitive cancers. In this context, the implementation of accessible and effective interventions like HIIT could play a crucial role in mitigating these risks and enhancing the quality of life during midlife and beyond. The practicality and efficiency of HIIT make it particularly well-suited for Indonesian women aged

45–55—an age group that often remains actively employed yet struggles to find time for regular physical activity.

This study contributes novel insight by focusing on the Indonesian population, which has been underrepresented in the global literature on HIIT and menopause. In addition to confirming the benefits of HIIT, it fills a notable gap by directly examining the correlation between BMI and body fat percentage in menopausal women—a relationship that has received limited empirical attention (Ren and Kelley, 2009). The ability to use BMI as a reliable indicator of body fat changes simplifies health monitoring and offers a feasible approach for both preventive and therapeutic strategies.

Furthermore, beyond addressing obesity and fat accumulation, HIIT may also contribute to reducing the risk of estrogen receptor-positive breast cancer, a disease significantly influenced by BMI and body composition (Dimauro et al., 2021). Thus, HIIT offers not only weight management benefits but also potential protective effects against chronic diseases commonly associated with menopause.

In conclusion, this study underscores the importance of HIIT as a strategic intervention for improving body composition, reducing BMI and BFP, and ultimately lowering health risks among menopausal women. It also reinforces the role of BMI as a practical proxy for body fat, providing an accessible method for tracking health improvements. These findings have valuable implications for public health strategies aimed at promoting active aging and preventing menopause-related diseases, especially in low-resource and time-constrained settings.

## CONCLUSION

This study concludes that there is a strong and statistically significant correlation between Body Mass Index (BMI) and Body Fat Percentage (BFP) following a five-month HIIT intervention among menopausal women. These findings demonstrate that weight loss in menopausal women not only reduces BMI but also contributes substantially to lowering body fat percentage. The robust relationship between BMI and BFP reinforces the role of physical activity, particularly HIIT and aerobic exercise, in improving body composition and metabolic health during menopause.

This observed correlation provides empirical support for using BMI as a practical indicator of body fat changes in this population and underscores the physiological interdependence of these two parameters. It also sets a foundation for future studies to explore how structured exercise interventions affect the broader health outcomes of menopausal women.

Further research is warranted to examine the underlying mechanisms by which HIIT influences BMI and BFP, particularly in relation to body composition risk factors during the premenopausal and postmenopausal phases. Additionally, future studies should investigate how BMI dynamics influence the transition and crossover of risk related to increased body fat percentage across different menopausal stages. Such insights will be essential for developing comprehensive and time-efficient exercise strategies to support women's health throughout midlife and aging.

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