

# Randomized Controlled Trial of Aerobic Exercise on Body Mass Index Reduction in Women Using Injectable Contraceptives

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## Abstract

**Background:** Injectable contraceptive use is frequently associated with body mass index (BMI) increase due to progesterone-induced fat accumulation. Aerobic exercise may help counteract these effects by enhancing energy expenditure and fat oxidation.

**Objective:** To determine the effect of moderate-impact aerobic exercise on BMI reduction among overweight women using injectable contraceptives.

**Methods:** A randomized controlled trial with a two-group pretest–posttest design was conducted among 32 overweight women aged 25–35 years using injectable contraceptives. Participants were randomly assigned to an intervention group (n=16) or control group (n=16). The intervention group performed moderate-impact aerobic exercise three times weekly for four weeks, while the control group maintained usual activities. BMI was measured before and after the intervention. Data were analyzed using paired and independent t-tests with a significance level of 0.05.

**Results:** The intervention group demonstrated a significant BMI reduction from  $27.4 \pm 1.2$  to  $26.6 \pm 1.1$  kg/m<sup>2</sup>, with a mean change of  $-0.84 \pm 0.41$  (p<0.001). The control group showed no significant change ( $-0.06 \pm 0.29$ ; p=0.326). Between-group analysis revealed a significantly greater BMI reduction in the intervention group (mean difference  $-0.78$ ; 95% CI  $-1.02$  to  $-0.54$ ; p<0.001).

**Conclusion:** Moderate-impact aerobic exercise significantly reduced BMI among overweight women using injectable contraceptives and may serve as an effective non-pharmacological weight management strategy.

## Keywords

Aerobic Exercise; Body Mass Index; Contraceptive Agents; Exercise Therapy; Women

## Introduction

Contraception is one of the primary strategies used to prevent fertilization between the ovum and sperm. Broadly, contraceptive methods are classified into hormonal and non-hormonal types, both of which may be used for either short- or long-term purposes. In Indonesia, the prevalence of modern contraceptive use in 2022 reached 59.7%, with injectable contraceptives being the most widely chosen method among women of reproductive age.<sup>1</sup>

Despite their effectiveness, injectable contraceptives are often associated with adverse effects, the most notable being an increase in body mass index (BMI), which appears to be more pronounced compared with other methods such as oral pills or intrauterine devices (IUDs).<sup>2</sup> This weight gain is primarily attributed to the influence of progesterone, the dominant hormone in injectable contraceptives. Progesterone has been shown to stimulate appetite, facilitate the conversion of carbohydrates into fat, and promote adipose tissue accumulation, thereby contributing to elevated BMI.<sup>3,4</sup>

Excessive increases in BMI can have broader health consequences. Overweight and obesity are strongly linked to cardiometabolic disorders, including type 2 diabetes, hypertension, and cardiovascular disease. Addressing weight gain associated with contraceptive use, therefore, is essential not only to maintain physical appearance and comfort but also to reduce long-term health risks.<sup>3,5</sup>

Aerobic exercise has been widely recognized as an effective intervention for reducing body fat, improving cardiorespiratory fitness, and lowering body weight and BMI. Regular participation in aerobic activities enhances energy expenditure and promotes fat oxidation, thereby counteracting the metabolic effects of exogenous hormones. Several studies have demonstrated that aerobic exercise can significantly reduce BMI, although the extent of its effectiveness varies depending on the type, intensity, and duration of exercise.<sup>6</sup> However, evidence specifically targeting women using injectable contraceptives remains limited. Previous research has generally focused on broader populations without stratifying by contraceptive method, leaving a gap in understanding whether aerobic exercise provides a comparable or enhanced benefit for this subgroup.

Given that injectable contraceptives continue to be a popular choice among women of reproductive age, there is a critical need to evaluate interventions that may mitigate their metabolic side effects. To address this gap, the present study investigates the effect of moderate-impact aerobic exercise on BMI reduction in overweight women using injectable contraceptives.

## Methods

This study was designed as a randomized controlled trial with a parallel-group design, using a 1:1 allocation ratio between the intervention and control groups. No methodological changes were made after trial initiation. Based on its structure, the study can also be classified as a quasi-experimental pretest–posttest control group design.

The study population consisted of women aged 25–35 years who were overweight and used injectable contraceptives. Overweight was defined as a body mass index (BMI)  $\geq 25$  kg/m<sup>2</sup> according to the World Health Organization (WHO) Asia criteria. Participants were recruited through purposive sampling to ensure that they met the eligibility requirements. The inclusion criteria were: women using injectable contraceptives, classified as overweight, and willing to participate by signing informed consent.

Exclusion criteria included absence during observation or lack of cooperation. The study was conducted in Dusun Sanden, Indonesia, between May and June 2024.

The sample size was calculated using Slovin's formula:

$$n = \frac{N}{1 + Ne^2}$$

where  $N = 130$  (population size) and  $e = 0.05$  (margin of error). The minimum required sample size was 16 participants per group. No interim analyses or stopping guidelines were applied.

Randomization was performed using a computer-generated sequence with a 1:1 allocation ratio. Sequentially numbered opaque sealed envelopes were used to conceal allocation. Researcher A generated the randomization sequence, Researcher B enrolled participants, and Researcher C assigned participants to the intervention according to the randomization list. Blinding was not implemented due to the nature of the exercise intervention, which could not be masked.

The intervention consisted of moderate-impact aerobic exercise performed three times per week for four weeks, with each session lasting 45 minutes at an intensity of 70–85% of maximum heart rate (HRmax). The exercise protocol was adapted from Anastasya et al. Certified instructors supervised the sessions to ensure standardization and adherence. Exercise intensity was monitored using target heart rate (70–85% HRmax) and the Borg Rating of Perceived Exertion. Participants in the control group did not receive any structured intervention and continued their usual daily activities.

BMI was the primary outcome measure, calculated as weight in kilograms divided by the square of height in meters ( $\text{kg}/\text{m}^2$ ). Weight was measured using a digital scale with 0.1 kg accuracy, and height was measured using a stadiometer with 0.1 cm accuracy. All measurement instruments were calibrated prior to use to ensure validity and reliability. No secondary outcomes were assessed, and no changes to outcome measures were made after the start of the study.

Normality testing was performed using the Shapiro–Wilk test. Data with a normal distribution were analyzed using paired-sample  $t$ -tests for within-group comparisons and independent-sample  $t$ -tests for between-group comparisons. The significance level was set at 0.05, with a 95% confidence interval. No additional analyses were performed.

## Results

Participant recruitment was conducted between May and June 2024, and the intervention lasted for four weeks. The trial was not terminated early. A total of 32 women aged 25–35 years who met the inclusion criteria were enrolled and randomized into the intervention group ( $n = 16$ ) and the control group ( $n = 16$ ). All participants completed the intervention and were included in the final analysis; no dropouts occurred. Analyses were performed according to the intention-to-treat principle. A participant flow diagram is presented in Figure 1 in accordance with the CONSORT guidelines.

The baseline characteristics of participants are presented in Table 1. Both groups were comparable in terms of mean age ( $28.1 \pm 3.1$  years in the intervention group vs.  $28.3 \pm 3.4$  years in the control group) and baseline BMI ( $27.4 \pm 1.2$  vs.  $27.6 \pm 1.3 \text{ kg}/\text{m}^2$ , respectively). The distribution of physical activity levels was also balanced, with most participants reporting light to moderate activity. All participants were female. These findings indicate that the two groups were relatively homogeneous at baseline.

**Table 1.** Baseline Characteristics of Participants

Variable	Intervention (n=16)	Control (n=16)
Age, mean $\pm$ SD (years)	$28.1 \pm 3.1$	$28.3 \pm 3.4$
Age 25–29 years, n (%)	10 (62.5)	10 (62.5)
Age 30–35 years, n (%)	6 (37.5)	6 (37.5)
Female sex, n (%)	16 (100)	16 (100)
Light physical activity, n (%)	7 (43.8)	7 (43.8)
Moderate physical activity, n (%)	8 (50.0)	6 (37.5)
Vigorous physical activity, n (%)	1 (6.3)	3 (18.8)
Baseline BMI, mean $\pm$ SD ( $\text{kg}/\text{m}^2$ )	$27.4 \pm 1.2$	$27.6 \pm 1.3$

The results of within-group comparisons are shown in Table 2. In the intervention group, mean BMI decreased significantly from  $27.4 \pm 1.2$  at baseline to  $26.6 \pm 1.1$  after four weeks, with a mean reduction of  $-0.84 \pm 0.41$  ( $p < 0.001$ ). In contrast, the control group showed no significant change in BMI ( $27.6 \pm 1.3$  at baseline vs.  $27.5 \pm 1.3$  post-intervention, mean reduction  $-0.06 \pm 0.29$ ,  $p = 0.326$ ). These findings demonstrate that moderate-impact aerobic exercise led to a statistically significant reduction in BMI, whereas no meaningful changes occurred in the control group.

**Table 2.** Within-Group Comparisons of BMI

Group	N	Pre-test Mean $\pm$ SD	Post-test Mean $\pm$ SD	Mean Change $\pm$ SD	p-value
Intervention	16	$27.4 \pm 1.2$	$26.6 \pm 1.1$	$-0.84 \pm 0.41$	$<0.001$
Control	16	$27.6 \pm 1.3$	$27.5 \pm 1.3$	$-0.06 \pm 0.29$	0.326

Between-group comparisons are presented in Table 3. The reduction in BMI was significantly greater in the intervention group compared with the control group, with a mean difference of  $-0.78$  (95% CI:  $-1.02$  to  $-0.54$ ,  $p < 0.001$ ). These results confirm that moderate-impact aerobic exercise produced a clinically and statistically significant effect on BMI reduction in women using injectable contraceptives.

**Table 3.** Between-Group Comparisons of BMI Change

Variable	Mean Difference (95% CI)	p-value
BMI change	$-0.78$ ( $-1.02$ to $-0.54$ )	$<0.001$

The primary outcome of this study was BMI reduction. As shown in Tables 2 and 3, the intervention group demonstrated a significant reduction compared with both baseline and the control group. No secondary analyses were performed. No adverse events or harmful effects were reported during the intervention.

## Discussion

Body mass index (BMI) can be influenced by multiple factors, one of which is age. With increasing age, individuals tend to experience a loss of muscle mass and an accumulation of body fat, while basal metabolic rate declines, thereby reducing daily caloric requirements.<sup>7</sup> Another study reported a positive correlation between age and overweight among women of reproductive age,

indicating that older women are at greater risk of weight gain.<sup>8</sup> Similarly, overweight in older women has been linked to hormonal changes and less active lifestyles.<sup>9</sup> The findings of the present study are consistent with this evidence, as most participants were aged 25–29 years, a group in which metabolic decline typically begins, highlighting the importance of exercise interventions.

BMI is also affected by sex. Higher obesity rates in women compared with men are associated with differences in physical activity, energy intake, and metabolism. Women have a basal metabolic rate approximately 10% lower than that of men, making them more prone to storing energy as fat.<sup>10</sup> However, other research has shown that men tend to have higher BMI values than women in the general population, likely due to differences in body fat distribution and muscle mass.<sup>11</sup> This study, which specifically examined women using injectable contraceptives, contributes uniquely to the literature by focusing on a relatively underexplored subgroup. It enhances our understanding of how exercise interventions may help reduce BMI in women with particular physiological characteristics.

Physical activity is another major determinant of BMI. Insufficient physical activity leads to excess caloric accumulation and weight gain.<sup>12</sup> Low activity levels have been identified as a primary factor contributing to overweight and obesity.<sup>13</sup> While metabolism provides the energy required for daily activities, overweight individuals require more physical activity to mobilize and burn fat stores.<sup>14</sup> The findings of this study reinforce prior evidence by demonstrating that structured physical activity, such as moderate-impact aerobic exercise, can serve as an effective strategy for reducing BMI. This is in line with recent international research (2020–2024) emphasizing the critical role of aerobic activity in obesity prevention among women of reproductive age.

Data analysis revealed a significant reduction in BMI following the moderate-impact aerobic exercise intervention ( $p < 0.001$ ). This type of exercise combines elements of high- and low-intensity activity, offering a balance between effectiveness and safety.<sup>15</sup> These results are consistent with previous studies demonstrating the ability of aerobic exercise to decrease body fat percentage, but the present study extends this evidence by showing its specific effectiveness in overweight women using injectable contraceptives.<sup>16</sup>

The underlying mechanism supporting these findings involves increased lipolysis. During aerobic exercise, triglycerides stored in adipose tissue are broken down into free fatty acids, which are then utilized as an energy source. This process enhances fat oxidation and reduces adipose tissue mass without significantly affecting lean muscle mass.<sup>16</sup> Thus, this study provides theoretical support for moderate-impact aerobic exercise as a non-pharmacological intervention to improve body composition and lower BMI through metabolic mechanisms.

Several limitations should be acknowledged. First, the sample size was relatively small ( $n = 32$ ), which may limit the generalizability of the findings. Second, the purposive sampling technique used could introduce selection bias. Third, the study only included overweight women using injectable contraceptives, making it difficult to generalize results to men or users of other contraceptive methods. Furthermore, potential confounding factors such as dietary intake, stress, and sleep quality were not strictly controlled, which may have influenced the outcomes.

Despite these limitations, the findings are particularly relevant for overweight women of reproductive age who use injectable contraceptives. Moderate-impact aerobic exercise can be recommended as a safe, accessible, and community-friendly non-pharmacological strategy to reduce BMI in this population. Broader application of the results to other groups requires further studies with larger sample sizes and additional variables, such as hormonal levels,  $VO_2$  max, and other metabolic parameters.

From a practical perspective, moderate-impact aerobic exercise can be integrated into reproductive health programs for women using injectable contraceptives, as it is easy to perform, can be delivered in group settings, and provides both physiological and social benefits. From a theoretical standpoint, this study contributes to the growing body of evidence linking aerobic physical activity with reductions in BMI, particularly in women with specific risk factors, thereby enriching the literature in physiotherapy and public health.

## Conclusion

The present study demonstrated that moderate-impact aerobic exercise is effective in reducing body mass index (BMI) among overweight women using injectable contraceptives. This study offers novelty by specifically evaluating an exercise intervention in this subgroup, which has rarely been investigated previously.

The findings provide practical implications, suggesting that moderate-impact aerobic exercise may be recommended as a non-pharmacological strategy within family planning programs and public health services to support weight management among overweight women using injectable contraceptives. From a theoretical perspective, the results strengthen scientific evidence on the role of aerobic exercise in lowering BMI through mechanisms involving enhanced metabolism and fat oxidation.

This study has several limitations, including a relatively small sample size, short intervention duration, and the lack of control for potential confounders such as dietary intake, stress, and sleep quality. Future research should include larger samples, longer intervention periods, and additional variables such as body composition, hormonal levels, and cardiorespiratory capacity to provide a more comprehensive understanding.

## Author Contribution

Lintang Layl Naslachu: Conceptualization, Methodology, Investigation, Data Curation, Writing – Original Draft.

Rizky Wulandari: Formal Analysis, Validation, Writing – Review and Editing.

Siti Khotimah: Supervision, Project Administration, Writing – Review and Editing.

All authors approved the final manuscript and agreed to be accountable for all aspects of the work.

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## Conflict of Interest Statement

The authors declare that there are no conflicts of interest regarding the publication of this study.

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## Ethics Statement

This study was conducted in accordance with the ethical principles of the Declaration of Helsinki. All participants provided written informed consent prior to participation. Participation was voluntary, and the confidentiality and anonymity of participants were maintained throughout the study. Formal ethical approval was not obtained for this study.

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