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# The effect of cardio and tabata training methods in reducing body fat and increasing maximum aerobic capacity in obese students

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**Abstract**

This study aimed to determine the effect of cardio and tabata training on reducing body fat and increasing maximum aerobic capacity. This research is an experimental research with a pre and post-control group design. The research sample involved was twenty-seven obese male students (BMI>25.0) at Universitas Negeri Surabaya. The research sample was split into three groups, each with nine participants: the control group (K1), the cardio group (K2), and the Tabata group (K3), group division was carried out randomly on research subjects. K1 without any exercise, whereas K2 (cardio) is running and skipping at an intensity of 55% and 70% of one's maximum heart rate. K3 (Tabata) performs burpees and jogging with a 90% – 95% HR maximum intensity. For six weeks, the exercise intervention was done three times each week. A skinfold caliper was used to quantify body fat, and a 12-minute Cooper test was used to gauge maximum aerobic capacity. The Manova test was employed for data analysis, and a significance threshold 0.05 was used. The result of this study is that K3 had significantly less body fat than K1 and K2, and K2 had significantly less body fat than K1 (p 0.05). Comparing K3 and K2 to K1, aerobic capacity was substantially improved (p 0.05). In conclusion, six weeks of cardio and Tabata training impacted lowering body fat and raising maximum aerobic capacity. The Tabata training approach is comparable to the cardio training approach in any case.

**Keywords:** fat, maximum aerobic capacity, tabata, cardio.

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**Authors contribution:** a – Preparing concepts; b – Formulating methods; c – Conducting research; d – Processing results; e – Interpretation and conclusions; f - Editing the final version

## INTRODUCTION

Obesity has become an important concern in all countries and is severe in developing countries like Indonesia (Harbuwono et al., 2018). One indicator of a person being considered overweight or obese is by

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looking at BMI (Etchison et al., 2011). Body mass index (BMI) readings exceeding the normal threshold of 25 kg/m2 and falling inside the 95th percentile on the growth curve, as determined by age and sex, are indicative of obesity (Chiu et al., 2017). One that can cause obesity is a lack of physical activity. Lack of physical activity, such as exercise, can cause a pile of fat in the body due to excess energy (Taufikkurrachman et al., 2021).

Obesity is the condition of having an excessive buildup of bodily fat tissue, which negatively impacts health. Obesity can affect individuals of any age, including both males and females. However, teenagers, adults, and university students are the most commonly affected populations (Radzi et al., 2019). Several research suggests that students' socioeconomic situation is a significant contributing factor to obesity and overweight (Dinsa et al., 2012). Nevertheless, the study models about this matter need to be revised to provide information regarding the condition sources of the students. Stress has been identified as a significant contributing factor that is positively associated with obesity and overweight among university students (Kim, 2016). Stress is an adverse emotional encounter followed by physiological, behavioral, and biochemical alterations (Estrada et al., 2018). The prevalence of obesity among teenagers is attributed to their contemporary lifestyle, characterized by frequent breakfast skipping, a preference for fast food, and a sedentary way of life (Mauliza et al., 2020).

Obesity is regarded as the primary catalyst for metabolic syndrome, a significant predisposing factor for cardiovascular disease and type 2 diabetes, a condition that has reached epidemic levels in terms of the number of affected individuals. Obesity can lead to an abundance of free fatty acids, resulting in elevated lipid peroxidation levels. This, in turn, can initiate inflammation (Hendra et al., 2016).

One way to resolve obesity is by exercising (Philippou et al., 2019). Exercise will increase energy expenditure and lipolysis to decrease body weight (Swift et al., 2014). Exercise can improve fitness and well-being

besides losing weight and body fat (Abou Elmagd, 2016). One method of exercise that is believed to reduce body fat and improve fitness is cardio and tabata exercises (Hackett & Hagstrom, 2017; Komala et al., 2016).

Cardio exercise, also called aerobic exercise, is for cardiovascular health and fitness (Patel et al., 2017). Cardio exercises effective for losing fat are 20-60 minutes long with an intensity of 65% -75% of the maximum pulse (Andini et al., 2016). Cardio exercise for more than 45 minutes at low or moderate intensity is common in society and can burn fat and improve cardiovascular health and fitness (Taufikkurrachman et al., 2020).

Besides the cardio training method, another is tabata training. Izumi Tabata, a professor at Ritsumeikan University in Japan and a former researcher at the National Institutes of Health, developed the training technique known as "Tabata Training" in 1996. It is based on a 2:1 ratio of training work time to rest time (Tabata, 2019). Tabata training, which is high intensity, can raise lactate threshold, enhance body composition, and increase aerobic capacity (Emberts et al., 2013). A study by Ljubojević et al. (2023) conducted a study on inactive women who were in good health, using the Tabata training program for a duration of 4 months. The study found that the Tabata training exercise program, conducted over a period of 4 months, has been proven effective in reducing body fat. The body mass index (BMI) decreased to an average value of 22.11±2.59kg/m², with a significance level of p=0.04 and an effect size (ES) of 0.07. The percentage of fat tissue decreased to an average of 25.97±4.72, with a significance level of p=0.03 and an effect size (ES) of 0.08. Additionally, the amount of fat tissue decreased to an average of 17.52±5.11kg, with a significance level of p=0.02 and an effect size (ES) of 0.10. Domaradzki et al. (2020) found that Tabata exercise was efficacious in reducing body weight, waist-to-hip ratio, and body fat percentage exclusively among those classified as overweight.

Research on the difference in intensity of weight loss or body fat is still debated (Boutcher, 2011). According to Philippou et al. (2019), the most important thing in losing body fat with exercise is the duration, not the


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intensity. Hence, researchers are intrigued by investigating the effects of cardio and Tabata training techniques on body fat reduction and enhancement of maximum aerobic capacity (fitness) in obese men because obesity is not good for health.

The significance of this study arises from the prevalence of overweight or obesity among university students, who are expected to be in their prime productive years. Therefore, providing them with a suppression strategy, such as incorporating cardio and Tabata activities, is imperative. However, it is necessary to demonstrate the impact of this activity on body fat percentage and maximum aerobic capacity.

## METHOD

The method is used in this study as a basis for researching the impact of tabata and cardio exercise on reducing body fat and maximum aerobic capacity. This research is an experimental type with pre and post-design.

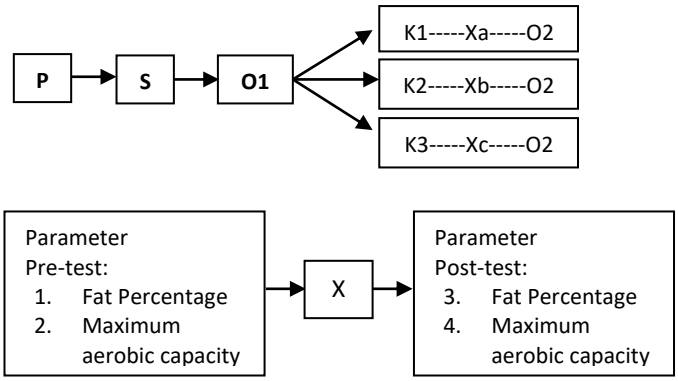


**Figure 1.** Research design

**Note:**

P: Population
S: Sample
O1 : pre-test
K1: Control group
K2: Cardio Group
K3: Tabata Group
O2 : post-test
X: Treatment
a: no treatment

b: Cardio method training
c: Tabata method training

27 Universitas Negeri Surabaya students who were obese (BMI>25.0) and male were recruited in this study. Subjects selected using purposive sampling techniques with inclusion criteria have a BMI of > 25, are male, non-athlete, and have sports student status with an age range of 19-23 years. Research subjects were divided into a control group (K1), a cardio group (K2), and a Tabata group (K3), and group division was carried out randomly on research subjects. K1 received no training intervention, while K2 engaged in cardio exercises such as jogging and skipping for 40 minutes at an intensity of 55% to 70% of their maximum heart rate (moderate intensity).

K3 received a Tabata method training intervention that involved burpees and skipping at an intensity of 90% to 95% of one's maximum heart rate. Skipping and burpees in the Tabata training method are done for eight sets with an exercise ratio of 2:1, which means 20 seconds of exercise and 10 seconds of rest. The Tabata training method is carried out for 20 minutes with an interval of 1 minute for each set. Exercises were carried out three times a week for six weeks.

Data collection was carried out twice through pre-test and post-test. The test carried out was to determine the fat percentage using a skinfold caliper with a Harpenden-type skinfold caliper and the Cooper test for 12 minutes to determine maximum aerobic capacity. The skinfold caliper measures the fat percentage in the subcutaneous area of the triceps, biceps, subscapular, and supra-iliac muscles. Data analysis in this study used Manova and LSD tests with the SPSS series 23 program.

## RESULT

Cardio and Tabata training intervention for six weeks caused changes in fat percentage and maximum aerobic capacity. To see the test results (pre-test and post-test) before and after the training intervention.


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**Table 1.** Change in fat percentage over the experimental period

| Group | Fat percentage (%) | | ΔFat percentage (%) | p |
|---|---|---|---|---|
| | Pre-test | Post-test | | |
| K1 (Control group) | 84.78 ± 16.57 | 85.00±17.89 | 0.22±2.39 | 0,787 |
| K2 (Cardio group) | 85.33 ± 8.34 | 80.22±9.71 | -5.11±2.32 | 0,000* |
| K3 (Tabata group) | 85.00 ± 10.21 | 77.33±9.79 | -7.67±2.65 | 0,000* |

*statistically significant difference (<0,05) ); Δ= represents the discrepancy between the scores obtained in the pre-test and post-test; Data were represented as mean ± SD

Based on Table 1, the pre and post-test fat percentage results in K2 and K3 were significant. Engaging in either aerobic or Tabata training for a duration of 6 weeks can effectively decrease body fat percentage. The mean change in fat percentage in the K1 group was 0.22 ± 2.39%, the K2 group -5.11 ± 2.32%, and the K3 group -7.67 ± 2.65%. The results of the Table 1 presentation can be seen through the diagram below.

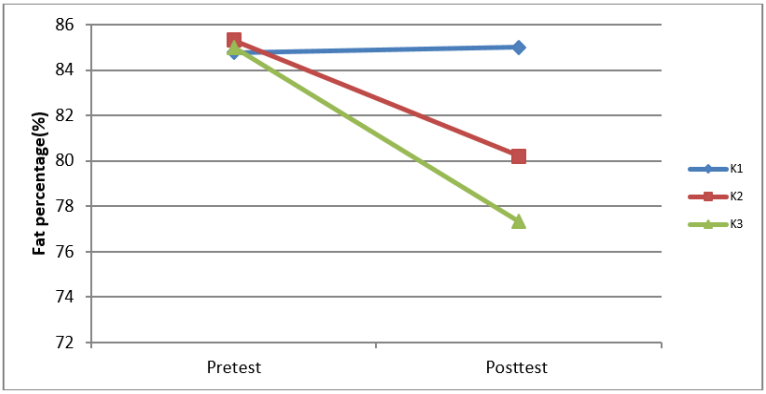


**Figure 2.** Change in fat percentage

Figure 2 shows a significant decrease in fat percentage in K2 and K3 groups up to the six weeks (p<0,05). Cardio and tabata exercises 3 times in 6 weeks have successfully reduced body fat percentage in the subcutaneous area of the triceps, biceps, subscapular, and supra-iliac muscles.

**Table 2.** Change in maximum aerobic capacity over the experimental period

| Group | Maximum Aerobic Capacity (m) | | Δ Maximum Aerobic Capacity (m) | p |
|---|---|---|---|---|
| | Pre-test | Post-test | | |
| K1 (Control group) | 2182.22 ± 96.83 | 2197.78 ± 91.31 | 15.56 ± 23.38 | 0,081 |
| K2 (Cardio group) | 2170.56 ± 165.61 | 2240.56 ± 125.58 | 70 ± 2.81 | 0,005* |
| K3 (Tabata group) | 2191.67 ± 126.66 | 2270.00 ± 106.62 | 78.33 ± 106.62 | 0,005* |

*statistically significant difference (<0,05) ); Δ= represents the discrepancy between the scores obtained in the pre-test and post-test; Data were represented as mean ± SD

Based on Table 2, the pre and post-test maximum aerobic capacity results in K2 and K3 were significant. That means cardio or tabata training method for 6 weeks can increase the maximum aerobic capacity. The mean change in maximum aerobic capacity in the K1 group was 15.56 ± 23.38 m, K2 group 70 ± 2.81 m, and K3 group 78.33 ± 106.62 m. Figure 3 shows a significant increase in maximum aerobic capacity in the K2 and K3 groups for six weeks (p<0,05).

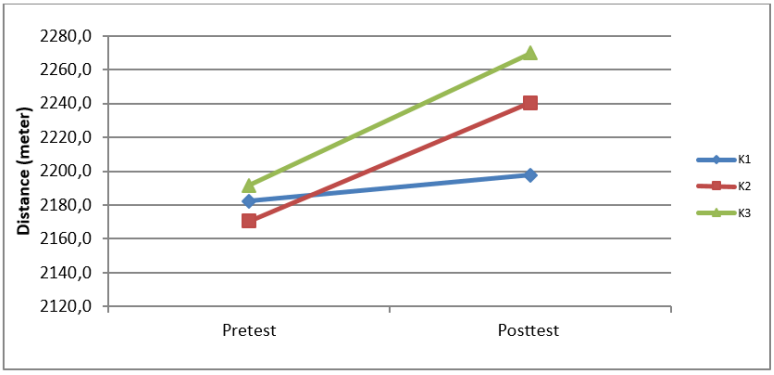


**Figure 3.** Change in maximum aerobic capacity

Manova test showed significant differences in fat percentage (p= 0,000) and maximum aerobic capacity (p=0,025). Furthermore, to determine the difference in fat percentage and lipid maximum aerobic capacity in each group, we performed an LSD test. The results of the LSD test are presented in Table 3.

**Table 3.** Effect of training method on fat percentage

| Group | Group | p | Mean±SD (%) |
|---|---|---|---|
| K1 | K2 | 0.000* | K1= 0,22±2.39 |
| | K3 | 0.000* | K2= -5,11±2,32 |
| K2 | K3 | 0.037* | K3= -7,67±2,65 |

*significant difference (p<0.05). K1=Control group; K2= Cardio training group; K3= Tabata Training group. Δ= represents the discrepancy between the scores obtained in the pre-test and post-test

6 weeks of exercise with a frequency of 3 times per week causes a decrease in fat percentage. Based on Table 3, the cardio and Tabata training methods showed a significant value (p <0.05) compared to no exercise. However, if the cardio and Tabata training methods were compared, then based on Table 3, the Tabata training method was better at reducing fat percentage (p = 0.037).


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**Table 4.** Effect of training method on maximum aerobic capacity

| Group | Group | P | Mean±SD (m) |
|---|---|---|---|
| K1 | K2 | 0.028* | K1= 15.56±23.38 |
| | K3 | 0.012* | K2= 70.00±55,57 |
| K2 | K3 | 0.723 | K3= 78.33±60.52 |

*significant difference (p<0.05). K1=Control group; K2= Cardio training group; K3= Tabata Training group. Δ= represents the discrepancy between the scores obtained in the pre-test and post-test

In the maximum aerobic capacity variable, there was an increase after doing the exercise for 6 weeks (p <0.05). However, the Tabata training method proved to be equally as effective as the cardiac training strategy (p = 0.723).

## DISCUSSION

### Effect of cardio and tabata training on fat percentage

Based on the study's results, it was found that engaging in cardio and Tabata exercises consistently for 6 weeks has the potential to decrease the percentage of body fat, in accordance with Fisher et al. (2015), which showed a significant decrease in the percentage of body fat in overweight and obese men who were given moderate and heavy intensity exercise. Other studies' findings on obese teens revealed a reduction in body fat percentage following moderate-intensity exercise (Buchan et al., 2011). In their study on male obesity among college students, Yuan and Hu (2023) found that a combination of aerobic exercise and high-intensity intermittent strength training can significantly enhance body shape and composition. The analysis of physiological indicators revealed that this intervention effectively improves and prevents obesity and its associated diseases. It also enhances blood lipid metabolism, improves blood vessel flexibility, increases cardiac output, and reduces cardiac strain. In a study conducted by Zhang et al. (2017), the researchers examined the efficacy of high-intensity exercise, namely Tabata (performed at 90% of $VO_2$max), compared to moderate-intensity exercise (performed at 60% of $VO_2$max), in reducing fat levels in obese female students. Following the 12-week intervention, individuals in the high-intensity training group observed

comparable decreases in percentage body fat (%BF) and total fat mass (FM) to those in the moderate-intensity continuous training (MICT) group.

Cardio exercise, also known as aerobic exercise, is an exercise that requires oxygen to burn energy (Permadi, 2019; Souza et al., 2020). Aerobic exercise can increase oxygen uptake and blood flow that contains hemoglobin as oxygen transport, and the pulse will be lower at rest. This can improve maximum aerobic capacity. Another benefit is that aerobic exercise can increase capillaries and fat-burning enzymes so that the amount of fat in the blood decreases (Puspodari et al., 2022).

Exercise can increase the responsiveness of β-adrenergic receptors in adipose tissue and reduce the anti-lipolytic sensitivity of α2 receptors (Rodrigues et al., 2018). The proliferation of skeletal muscle capillaries also plays a role in fat oxidation by increasing the release of fatty acids to muscles, an elevation in protein-bound fatty acids that govern the transportation of fatty acids in myocytes, in addition to an elevation in carnitine transferase, which facilitates the movement of fatty acids across the mitochondrial membrane (Mika et al., 2019).

Tabata training is a HIIT (High-Intensity Interval Training) training method (Tabata, 2019). Engaging in High-Intensity Interval Training (HIIT) at an intensity level of 90-95% for a duration of 6 weeks has been shown to enhance maximal oxygen uptake (VO2 max) and decrease both body fat percentage and body mass index (BMI) (Komala et al., 2016). The decrease in body fat after HIIT workouts results from an increase in fat oxidation by 75% (Chan & Burns, 2013; Astorino & Schubert, 2018). In addition, individuals who are obese have greater fat oxidation (Atakan et al., 2022). HIIT training is highly recommended for overweight, obese, and young adults (Fu et al., 2018). Tabata exercise, comprising high-intensity workouts, has enhanced aerobic capacity, improved body mass index (BMI), facilitated calorie and fat burning, and elevated lactate threshold (Emberts et al., 2013). Elevated growth hormone levels following high-intensity training can enhance energy expenditure and fat oxidation (Boutcher, 2011).


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**Effect of cardio and tabata training on maximum aerobic capacity**

This study found that cardio and tabata exercises can increase maximum aerobic capacity. Maximum aerobic capacity is an important indicator of sports achievement (Ranković et al., 2010). Aerobic exercise can increase maximal aerobic capacity by increasing cardiac output and stroke volume and decreasing resting pulse rates. Aerobic exercise by adult men aged 18-20 years for 30 minutes at a frequency of 4 times in 4 weeks can increase VO2 max (Watulingas, 2014). The Tabata training protocol, consisting of 8 sets of 20-second maximal repeated functional exercises followed by 10 seconds of rest, performed three times per week for a duration of 12 weeks, proved to be highly effective in enhancing cardiorespiratory fitness, reducing body fat, improving certain cardiometabolic health markers, and increasing habitual physical activity levels among university students (Lu et al., 2023).

Exercise will stimulate the heart to work harder to pump blood. Diligent effort of the heart will result in the enlargement of the heart muscle, known as hypertrophy. Muscle hypertrophy makes the heart pump more muscular to release more blood. Blood, especially oxygen, is needed when the muscles contract. A strong heart muscle will produce much oxygen to the muscle tissue so that exercise will increase the maximum aerobic capacity (Alim, 2012).

Forrest et al. (2010) stated that High-intensity exercise has been found to enhance Vo2 max by 7% in untrained men. Implementing a 12-week workout regimen utilizing the High-Intensity Interval Training (HIIT) approach has effectively diminished body fat and enhanced children's maximum aerobic capacity (Dias et al., 2018). There is an inverse relationship between fitness and body fat. The higher the body fat, the less fit the person is (Dewi & Kania, 2016).

**Comparison of cardio and tabata training method on fat percentage**

The findings demonstrated that the Tabata approach outperformed the cardio method in decreasing fat percentage. Research by Zhang et al. (2017) showed that high-intensity exercises such as Tabata can be better

at reducing the percentage of stomach leakage than moderate-intensity exercises.

Lipolysis is more pronounced during moderate-intensity exercise compared to high-intensity exercise. The process of fat burning is more efficient during moderate-intensity exercise. Nevertheless, engaging in high-intensity exercise requires more significant energy expenditure, resulting in a more efficient fat-burning process (Zhang et al., 2017). An increase will also follow increased exercise intensity in the release of lipolytic hormones, such as catecholamines, that are occurring. The catecholamine hormone activates lipolysis by binding to $\beta$-adrenoceptors, decreasing body fat (Valentine et al., 2022). In addition, high-intensity exercise such as Tabata will further increase the secretion of growth hormone, which is believed to increase lipolysis (Taufikkurrachman et al., 2020). Tabata training requires more energy. So that the possibility of glycogen reserves as the main energy source in high-intensity exercises such as tabata can be depleted, depletion of glycogen reserves will stimulate the adipose tissue to release fatty acids as energy. This causes body fat to decrease more in high-intensity training than in moderate or low-intensity training (Hausswirth et al., 2019).

**Comparison of cardio and tabata training method on maximum aerobic capacity**

The results of this investigation indicate no substantial disparity between the cardio and tabata exercise regimens in terms of their ability to enhance maximum aerobic capacity. These results differ from the results of research by Cao that high-intensity exercise is more effective in enhancing cardiorespiratory fitness (Cao et al., 2019). The same thing was stated by Wen et al. (2019): high-intensity exercise is more effective than moderate-intensity exercise in raising VO2 max in both normal and obese men (Wen et al., 2019).

Although the results of this study differ from those of these researchers, this can be explained. Carr (2011) stated that exercising with high intensity and moderate intensity for 4 weeks did not cause a different


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increase in VO2 max. This is probably because the test instrument is more aerobic, while the tabata exercise is more anaerobic. So, tabata training is no better at increasing maximal aerobic capacity (Carr, 2011).

Based on the data above, performing both cardio and tabata workouts three times a week for a duration of six weeks will effectively decrease body fat percentage and enhance maximum aerobic capacity. This is a suggestion for individuals who are overweight, particularly university students, to engage in regular tabata or cardiac activity three times a week as a means to lose weight.

This finding presents a promising alternative for effectively reducing body fat and increasing maximum aerobic capacity in obese students. This study is restricted to quantifying the proportion of subcutaneous fat and is conducted solely on male participants exhibiting obesity. The character of an individual and their body fat content can be influenced by various factors, which can be assessed by measuring body fat through the use of Bioelectrical Impedance Analysis (BIA) instruments. Moreover, it is crucial to investigate other exercise methods for reducing body fat and increasing maximum aerobic capacity in obese students. Despite these limitations, our research stands out due to its originality in comparing two exercise programs that can both decrease body fat and increase maximum aerobic capacity in obese students. The combination of exercise programs plays a crucial role in shaping our research findings, thus addressing the issue of obesity in adolescent students. This finding holds significant clinical relevance in enhancing understanding of obesity issues and exercise for reducing body fat and maximum aerobic capacity in obese students.

## CONCLUSION

Six weeks of training using cardio and Tabata methods had an impact on reducing body fat and increasing maximum aerobic capacity in Obese Students. However, the Tabata exercise method is similar to the cardio exercise method in reducing fat and increasing maximum aerobic capacity. The study was restricted to measuring the proportion of subcutaneous fat and was conducted exclusively on male college students

diagnosed with obesity. So that in the future, research can involve a more homogeneous gender to see its contribution. Then, future research can use other physical activity approaches that can reduce obesity in students. Research findings can be a reference for students to prioritize ideal body composition for their health.

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