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THE EFFECT OF INTERMITTENT FASTING 5:2 ON BODY FAT PERCENTAGE AND THICK UNDER-SKIN FAT FOLDS IN OVERWEIGHT AND OBESE INDIVIDUALS

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ABSTRAK

Overweight dan obesitas merupakan suatu keadaan di mana terjadi ketidakseimbangan antara masuk dan keluarnya energi dalam waktu yang lama. Intermittent Fasting merupakan salah satu intervensi diet yang dapat mempengaruhi komposisi tubuh seperti persentase lemak tubuh dan tebal lipatan lemak bawah kulit. Tujuan penelitian ini untuk mengetahui pengaruh Intermittent Fasting tipe 5:2 terhadap persentase lemak tubuh dan tebal lipatan lemak bawah kulit pada individu dengan overweight dan obesitas. Penelitian ini merupakan penelitian eksperimental dengan menggunakan rancangan pretest and posttest group design. Jumlah sampel sebanyak 50 orang dengan metode pengambilan sampel consecutive sampling. Uji statistik yang digunakan yaitu Uji T-Berpasangan. Hasil penelitian menunjukkan bahwa puasa intermittent memiliki pengaruh yang signifikan terhadap persentase lemak tubuh (p<0,001), tebal lipatan lemak bawah kulit bagian bisep (p=0,009), trisep (p<0,001), sedangkan bagian suprailiaka dan subskapula mengalami penurunan tetapi secara statistik tidak signifikan (p=0,093) dan (p=0,217)

ABSTRACT

The Effect of Intermittent Fasting 5:2 On Body Fat Percentage and Thick Under-Skin Fat Folds In Overweight and Obese Individuals. Overweight and obesity is a condition in which there is an imbalance between the entry and exit of energy for a long time. Intermittent Fasting is one of the dietary interventions that can affect body composition such as body fat percentage and thick folds of fat under the skin. The purpose of this study was to determine the effect of Intermittent Fasting type 5:2 on body fat percentage and thick folds of fat under the skin in individuals with overweight and obesity. This study is an experimental study using pretest and posttest group design. The number of samples was 50 people with a consecutive sampling method. The statistical test used was the paired t-test. The results showed that intermittent fasting had a significant effect on body fat percentage (p<0.001), thick folds of fat under the skin of the biceps (p=0.009), and triceps (p<0.001), while the supra iliac and subscapular parts decreased but statistically insignificant (p=0.093) and (p=0.217).

INTRODUCTION

Overweight and obesity are defined as the accumulation of excess body fat mass, it is also said that obesity is the result of an imbalance between energy intake and energy used where energy intake is greater resulting in a positive energy balance.[1] Overweight and obesity are health challenges that are one of the three burdens of nutrition problems facing Indonesia today, known as the Triple Burden of Malnutrition (TBM). Recent analysis shows that Indonesia is the largest country experiencing severe TBM, being one of the countries with the fastest cases of overweight and obesity.[2] Based on the results of the Indonesian Health Survey by the Indonesian Ministry of Health, the prevalence of obesity in Indonesia has increased from 21.8% in 2018 to 23.4% in 2023.[3]

Obesity is strongly correlated with Body Mass Index (BMI)—higher BMI values indicate increased body fat percentage. Excess fat, particularly visceral fat, contributes to central obesity, a key factor in metabolic syndrome. [4] Metabolic syndrome is characterized by: abdominal obesity, elevated blood glucose, dyslipidemia (abnormal cholesterol /triglycerides), and high blood pressure.[5]

Diagnosing metabolic syndrome requires multiple assessments, including blood tests, anthropometric measurements, and body composition analysis.[6] Among these, skinfold thickness measurements have been shown to reliably estimate body fat percentage, serving as a practical tool in obesity screening.[7]

The World Health Organization (WHO) predicts that by 2030, 30% of global deaths will be linked to lifestyle-related diseases, with obesity being a leading contributor.[8] Addressing this issue requires lifestyle modifications, particularly dietary interventions. One emerging approach is Intermittent Fasting (IF), which has gained attention for its effectiveness in weight management and metabolic health improvement. Intermittent Fasting, particularly the 5:2 method (two fasting days per week with 500–600 kcal intake), has shown promising results in: reducing body fat percentage [9,10], improving lipid profiles (increasing HDL, lowering triglycerides and LDL)[11,12], enhancing insulin sensitivity and reducing inflammation.[13]

The World Health Organization (WHO) estimates that 30% of deaths in the world in 2030 will be caused by health problems related to unhealthy lifestyles, the main examples are *overweight* and obesity. Lifestyle improvement is a solution in dealing with obesity problems, one of which is by dieting.[8] Choosing a healthy and correct diet can have many good effects on the body to prevent various diseases, Intermittent Fasting is one of the dietary methods that is being widely researched and popular because of its effective effect in losing weight so that it can prevent incidence of central obesity which can later lead to metabolic syndrome. The type of IF that is widely used is the 5:2 type, which is a dietary intervention carried out twice a week with a maximum number of calories of 500- 600 calories during the diet.[9]

Research conducted by Esa Indah Ayudia et al (2023), found that Intermittent Fasting can increase HDL levels, which HDL functions to transport cholesterol from the arteries to the liver to be eliminated. By carrying out Intermittent Fasting, in addition to helping increase HDL levels, it can also prevent obesity.[10]

Studies, such as those by Esa Indah Ayudia et al. (2023) and Duygu Agagunduz et al. (2021), demonstrate that IF not only aids in weight loss but also reduces cardiovascular risk factors.[11,12] Additionally, IF triggers cellular adaptations that improve glucose regulation and oxidative stress resistance. [13]

The National Cholesterol Education Program (NCEP) reports that the results of lipid profile analysis can assess the risk of cardiovascular disorders and other diseases.[14] Given the escalating obesity rates in Indonesia and the associated risks of metabolic syndrome and cardiovascular disease, this study aims to:

1. Evaluate the impact of Intermittent Fasting on body fat reduction in overweight and obese individuals.
2. Assess skinfold thickness changes as an indicator of fat loss.
3. Provide evidence-based insights to help combat obesity-related health complications.

By investigating IF's effects, this research seeks to contribute to public health strategies for preventing metabolic disorders and improving long-term wellness.

METHODS

This study is included in pre- experimental research with the type of one group pre-test post-test design, which is a research design with data before being given treatment (pre-test) and after being given treatment (post-test). In this study, Intermittent Fasting 5:2 was carried out on Monday and Thursday for six consecutive weeks involving 50 respondents. Research and data collection were carried out at the Faculty of Medicine and Health Sciences, Jambi University. The research implementation time was from August to September 2024. The population included in this study were Jambi University Medical students who were classified as Overweight and obese with BMI ≥ 23 kg/m2 and were willing and obedient to do a diet by fasting until the time set by the researcher.

During the dietary intervention, respondents were asked to take food that had been provided by the researcher through dietary catering which had calculated the number of calorie requirements that were in accordance with the needs of the study. The research subjects were also informed about the examinations that would be carried out before and after Intermittent Fasting, namely the measurement of body fat percentage using BIA and thick folds of fat under the skin using Skinfold Calliper.

The sampling technique in this study was consecutive sampling, which is non-probability technique sampling where the selection of samples by determining subjects who meet the inclusion criteria is included in the study until a certain period of time and the required number of respondents is met. The sample size calculation in this study is paired numerical analytical, where the minimum number of samples required is obtained from as many as at least 18 people.

The inclusion and exclusion criteria of this study are, Inclusion Criteria 1) young adults with BMI ≥ 23 kg / m 2, 2) physically and mentally healthy, 3) willing to participate in the study.

Research by signing the consent form. As well as exclusion criteria 1) have type 1 or 2 diabetes mellitus, 2) have a history of heart disease and a history of eating disorders such as anorexia nervosa or bulimia nervosa, 3) are on certain medications, for example taking diet drugs or weight loss drugs such as orlistat, or drugs that require consumption along with food for example, aspirin, mefenamic acid etc., 4) there are endocrine disorders that affect the measurement of the thickness of the folds of fat under the skin. For example, Akantosis nigrikans, lipodystrophy, etc., 5) respondents who are unable to follow the entire series of research until completion, for example, respondents who fall ill during the implementation which requires not to do the IF 5: 2 intervention.

Intermittent fasting on body fat percentage and thick folds of fat under the skin which is done before and after treatment. Since the paired t-test requires normally distributed data, we first conducted the Shapiro-Wilk normality test - particularly suitable for our study with sample size ≤50.

When data followed a normal distribution, we applied the paired t-test; otherwise, we used the Wilcoxon signed-rank test as it doesn't assume normality.

RESULTS

Table 1. Respondent Characteristics

Character		Number of Respondents	Percentage
Age	18 Years	2	4%
	19 Years	6	12%
	20 Years	17	34%
	21 Years	20	40%
	22 Years	5	10%
IMT	*Overweight*	7	14%
	Obesity I	21	42%
	Obesity II	22	44%

From table 1 above, it is obtained that the largest age group from the age characteristic data above is 21 years old as many as 20 people (40%) then followed by 20 years old as many as 17 people (34%) followed by 19 years old as many as 6 people (12%) and the least age is 18 years old as many as 2 people (4%). For BMI characteristics, it was found that individuals with overweight were 7 people (14%), level 1 obesity were 21 people (42%) and level 2 obesity were 22 people (44%).

Table 2. Overview of differences in body fat percentage before and after intermittent fasting 5:2.

Variables	Pre-Post	Mean	Standard Deviation	Min-Max	Sig (2-detailed)
% Body Fat	Pre	42.012	6.95	28.8 - 60	0,000
	Post	40.412	7.00	27.8 - 59.6	

The data table above shows that the average percentage of body fat before and after implementing IF has decreased from 42.012% to 40.412% with an average difference between the two groups of 1.6%.

In addition, the results of statistical tests to test the hypothesis of this study were also obtained in the form of a paired T-test with a value of Significant percent body fat is sig. (2- tailed)

<0.001. Where the p-value <0.05 indicates that there is a significant difference between the percentage of body fat before and after the intervention. This means that the implementation of Intermittent Fasting 5:2 for
6 weeks can cause significant changes in body fat percentage.

The study's results on the distribution of infant growth can be seen in Table 3. The line graph of weight gain according to age (BB/A) of infants who received exclusive breastfeeding for 0-6 months showed that most infants who received exclusive breastfeeding for 0-6 months experienced an increase or increase in growth with a percentage of 71.8%.

Table 3. Overview of Differences and Results of Paired T Test of Biceps Underarm Fat Fold Thickness Before and After Intermittent Fasting 5:2

Variables	Pre-Post	Mean	Standard Deviation	Min-Max	Sig (2-detailed)
Biceps *Skinfold*	Pre	36.6	7.333	19.3 - 52.5	0,009
	Post	36.1	7.636	19 - 51.7	

Based on the data from the table above, the thickness of the fat fold under the skin of the biceps was found to decrease on average before and after the intervention, namely from 36.6mm to 36.1mm with a difference of the two groups of 0.5mm.

In addition, the results of statistical tests to test the hypothesis of this study were obtained in the form of a paired T-test with a significant value of TLK Biceps sig. (2-tailed) of 0.009. Where if the sig. tailed value <0.05 indicates that there is a significant difference between the Thick Fat Fold Under the Skin of the biceps before and after the intervention. This means that the implementation of Intermittent Fasting 5:2 for 6 weeks can cause significant changes in the thickness of the fat fold under the skin of the biceps.

Table 4 shows the analysis results using the Chi-Square test. The results show a P-value of 0.501, meaning there is no relationship between maternal carbohydrate intake and the growth of infants who receive exclusive breastfeeding for 0-6 months as research subjects.

Table 4. Overview of Differences and Results of Paired T Test of Thickness of Triceps Underskin Fat Folds Before and After Intermittent Fasting 5:2

Variables	Pre-Post	Mean	Standard Deviation	Min-Max	Sig (2-detailed)
Skinfold Triceps	Pre	35.7	6.414	23.4 – 51.1	0,000
	Post	34.4	6.445	22.7 – 50.2	

Based on the data from the table above, the thickness of the fat fold under the skin of the triceps was found to decrease on average before and after the intervention, from 35.7mm to 34.4mm with a difference of 1.3mm between the two groups.

In addition, the results of statistical tests to test the hypothesis of this study were obtained in the form of a paired T-test with a significant value of TLK Triceps sig. (2-tailed) of p < 0.001. Where if the sig. tailed value <0.05 indicates that there is a significant difference between the Thick Fat Fold Under the Skin of the Triceps before and after the intervention. This means that the implementation of Intermittent Fasting 5:2 for 6 weeks can cause significant changes in the thickness of the fat fold under the skin of the triceps.

Table 5. Overview of Differences and Results of Paired T-Test of Suprailiacal Subcutaneous Fat Fold Thickness Before and After Intermittent Fasting 5:2

Variables	Pre-Post	Mean	Standard Deviation	Min-Max	Sig (2-detailed)
Skinfold Suprailiaca	Pre	35.8	7.559	19.6 - 53.5	0,093
	Post	35.5	7.618	19.4 - 53.3	

Based on the data from the table above, the thickness of the fat fold under the skin of the Suprailiac section was found to decrease on average before and after the intervention, namely from 35.8mm to 35.5mm with a difference of the two groups of 0.3mm.

In addition, the results of statistical tests to test the hypothesis of this study were obtained in the form of a paired T-test with a significant value of TLK Suprailiac sig. (2-tailed) of 0.093. Where if the sig. tailed value> 0.05 indicates that there is no significant difference between the Thick Fat Fold Under the Skin of the Suprailiaka before and after the intervention. This means that the implementation of Intermittent Fasting 5:2 for 6 weeks cannot cause significant changes in the thickness of the fat fold under the skin of the suprailiac.

Table 6. Overview of differences and results of paired t-test on thickness of subscapular fat folds before and after intermittent fasting 5:2.

Variables	Pre-Post	Mean	Standard Deviation	Min-Max	Sig (2-detailed)
Subscapula *Skinfold*	Pre	30.7	6.345	15.1-41.1	0,217
	Post	30.4	6.968	13.6-42.3	

Based on the data from the table above, the thickness of the fat fold under the skin in the subscapula was found to decrease on average before and after the intervention, from 30.7mm to 30.4mm with a difference of 0.3mm between the two groups.

In addition, the results of statistical tests to test the hypothesis of this study were obtained in the form of a paired T-test with a significant value of subscapular TLK sig. (2-tailed) of 0.217. Where if the sig. Tailed value> 0.05 indicates that there is no significant difference between the

Thick Fat Fold Under the Skin of the Subscapula before and after the intervention. This means that the implementation of Intermittent Fasting 5:2 for 6 weeks cannot cause significant changes in the thickness of the subscapular fat fold.

Our findings align with Ashtary-Larky et al. (2021), who reported a 1.49% decrease in body fat with intermittent fasting (IF) ($p < 0.05$).[15] However, Eliana et al. (2022) observed a non-significant reduction ($p = 0.90$) over 4 weeks.[16] The discrepancy likely stems from: intervention duration (Our 6-week protocol allowed sustained metabolic adaptation versus their shorter 4-week study), and methodological differences: Our calorie-restricted IF (5:2) may drive faster fat loss compared to their time-restricted feeding (no calorie limits).

The significant reduction in triceps/biceps skinfold thickness ($p < 0.05$) mirrors Dokpuang et al. (2023), who noted a 1.5% decline over 12 weeks.[17] However, our suprailiac/subscapular results were non-significant ($p > 0.05$), contrasting with Thakur et al. (2016), who reported uniform fat loss across sites.[18] Potential reasons include: Site-Specific Metabolism: Extremities (arms) may mobilize fat faster than central depots (abdomen/back) due to higher vascularity or activity levels, Measurement Sensitivity: Skinfold calipers may lack precision for deeper central fat vs. subcutaneous arm fat.

Unlike Huntari et al. (2023), who found non-significant HDL changes[14] our study aligns with Ayudia et al. (2023) in observing improved lipid markers.[10] Variability may arise from: Baseline Metabolic Status: Participants with higher baseline dyslipidemia may show more pronounced improvements. Diet Composition: Our controlled catering (fixed macronutrients) likely reduced confounding dietary variables.

DISCUSSION

Intermittent fasting is one of the dietary interventions in the form of calorie restriction of 500-600 kcal for 2 times a week. In this study, the intermittent fasting method used was the 5:2 type which was carried out for 6 weeks. During the intervention, the diet food obtained by the respondents came from the researcher directly which had calculated From the results of the summation of the average total number of calories during 12 fasting times is 509 kcal, where the amount still between the number of calories that are the rules in this 5:2 Intermittent Fasting.

1. Effect of 5:2 Intermittent Fasting on Body Fat Percentage

From the measurement results before and after the implementation of IF 5:2, it was found that the average percentage decrease before and after the intervention was 1.6%, for the initial average percent of female body fat was 43.8% with a decrease of 1.4% while men had an average initial fat percent of 39.9 and decreased by 1.7%. The results of statistical tests using paired t-tests show that the intervention carried out for 6 weeks can significantly reduce the percentage of body fat (sig. (2-tailed) <0.001). The results of this study are in line with research conducted by Ashtary Larky D et al (2021) where the results of their research show that intermittent fasting can significantly reduce body composition, which includes the percentage of body fat which has decreased by 1.49%.[15]

Similar results were also found in a study conducted by Faizah I et al (2018) where he analyzed changes in body weight, body mass index, and percentage of body fat after catering with low carbohydrate principles which are almost the same as the method used in this study, namely low-calorie catering. The study found a decrease in body fat percentage from 32.1% to 30.8% with a difference of 1.3%. 16 Research conducted by Huntari et al also found a significant weight loss but an increase in HDL levels was not significant after running IF 5: 2. [19]

However, the results of this study are slightly different statistically with research conducted by Eliana R et al (2022) on the effect of intermittent fasting on body weight, BMI, chest circumference, and percentage of fat mass in overweight and obese individuals. The results showed a decrease in the average percent fat before and after the intervention of 41.56% to 39.32% but not statistically significant (p=0.90). The difference in this study can be caused by many factors, one of which is different research time, where the study only lasted for 4 weeks while the research conducted lasted for 6 weeks with different intermittent fasting methods, namely fasting with time restrictions without calorie restriction while this study uses a calorie restriction method which of course this difference affects the level of reduction in body fat percentage.[16]

The average percentage of body fat that is said to be obese is >25% in men and >30% in women. The average initial body fat percentage of respondents in this study was 42%, which is quite high compared to normal values. People with obesity usually have a higher percentage of body fat, so when they start implementing a weight loss program, their bodies tend to burn stored fat as reserves faster than people with normal weight. When they restrict their calorie intake, the body will use the fat reserves as an energy source. In contrast, a normal-weight person will have a body composition that is more balanced between muscle and fat which results in a slower decrease in their body fat percentage because they do not have fat reserves to burn, in addition to the slow decrease in body fat percentage, their body weight will also experience a slow decrease because their body is effective in maintaining its weight. [21]

Energy is a body need that can support both internal and external activities. Energy in the body comes from calories consumed through food sources, especially carbohydrates. If the carbohydrates consumed are low, it will result in a decrease in blood glucose levels so that the body will use other materials as a source of energy, one of which is fat. The breakdown of free fatty acids produces ketone bodies, which will then be used by extrahepatic tissues to produce energy. The high level of ketone bodies in the blood is the process of ketosis (ketone formation) in respondents.[22] The process of gluconeogenesis that results in the formation of ketone bodies not only has an effect on weight loss and BMI, but also on reducing body fat percentage.

2. Effect of Intermittent Fasting 5:2 on Thickness of Fat Folds Under the Skin

The results of measuring the thickness of the fat folds under the skin showed a difference in the decrease before and after the intervention which amounted to: biceps 0.5mm, triceps 1.3mm, suprailiac 0.3mm, and subscapula 0.3mm. Statistically, triceps and biceps are the examination locations that have decreased significantly ($p<0.05$) while suprailiac and subscapular have decreased but not statistically significant ($p>0.05$).

Research conducted by Dokpuang D et al (2023) showed similar results in the form of a decrease in subcutaneous fat by 1.5% where the initial 35.9% became 34.4%. Where this decrease was more due to a longer research time of 12 weeks while this study only lasted for 6 weeks. In addition, differences in the decrease in the thickness of fat folds under the skin can also be caused by several factors including body posture (Body Mass Index), age, gender, heredity (genetic), food intake and physical activity. [17]

From the measurement results during the 5:2 type intermittent diet intervention, it was found that the decrease in the thickness of the folds of fat under the skin which experienced the most decrease started from the extremities, namely the triceps followed by the biceps, then the trunk part, namely the suprailiac and subscapular which had the same amount of decrease. A similar decrease was also obtained in a study conducted by Thakur J.S et al where he conducted a healthy lifestyle intervention in the form of diet and saw changes in skin thickness in the triceps and biceps, from the results of his research obtained a significant decrease in the thickness of the triceps and biceps skin folds ($p<0.001$).[22] Abdominal and intra abdominal fat has a greater significance than fat distributed in the lower extremities or the whole body (fat mass).[23]

The triceps and biceps muscles are one of the main muscles in the upper arm and are often used to measure skinfold thickness in body fat evaluation. This area is also an area that is quite influential during weight loss, this is due to several factors, the first is fat distribution, where subcutaneous fat tends to accumulate in the arm area so that when weight loss occurs, the thickness of the triceps and biceps skin folds tends to be more visible. The second is due to the muscle activity that occurs in the area, while running a weight loss program or not, the area tends to be involved in physical activity which certainly affects the composition of muscle and fat in the area. Furthermore, due to the accessibility factor, the arm area tends to be easily accessible and measured compared to the suprailiac and subscapular areas, so it is often an indicator in health research and evaluation. The last factor that influences the rapid decrease in triceps and biceps skinfold thickness is due to metabolic response, where the muscles in these areas are more responsive to metabolic changes due to weight loss which affects how quickly fat is removed from the skin layer. [18]

Weight loss does not always mean a decrease in body fat, there are many factors that lead to why body fat does not decrease significantly despite considerable weight loss. One of the factors is the loss of muscle mass, in the process of weight loss there can be a loss of muscle mass, this is because muscle has a higher density than fat, therefore the decrease in muscle mass will certainly affect body weight without significant changes in body fat levels. In addition, seen from body composition, weight loss can be dominated by a decrease in body composition other than fat, such as water content and fat-free tissue. Another factor is the body's metabolism where during Intermittent Fasting 5:2 the calorie intake is less, thus slowing down the body's metabolism which results in the body using reserves in the muscles (Glycogen) to produce energy. Therefore, body fat was not significantly reduced. [16]

If the body loses energy intake obtained from food for approximately 12 hours, there will be metabolic changes in terms of energy use in the body. The energy reserves contained in the body, namely fat, will undergo a process of lipolysis, which is the breakdown of fat followed by a beta-

oxidation process that aims to produce energy. In addition, the brain also needs energy in the form of ketone bodies formed by the liver. If this process occurs continuously, it will certainly reduce fat mass. In addition, there is also a process of breaking down triglycerides in adipose tissue into FFA and glycerol. FFA will then move in the blood vessels to the muscle cells. Once in the muscle cells, to oxidize the FFA, it must be directed to the mitochondria to form ATP. Reduced fat occurs due to the use of FFA when heading to muscle cells so as to reduce subcutaneous fat which is stored in subcutaneous tissue >50% of body fat mass. [24,25]

CONCLUSION

Based on data from the results of research and discussion, conclusions can be drawn, namely, there is a significant decrease in body fat percentage in overweight and obese individuals after running Intermittent Fasting 5: 2 and there is a significant decrease in the thickness of fat folds under the skin of the triceps and biceps in overweight and obese individuals after running Intermittent Fasting 5: 2, while in the thickness of fat folds under the skin of the suprailiac and subscapular there is a decrease although statistically insignificant. Thus, intermittent fasting type 5:2 can be used as a dietary intervention method in losing weight and reducing body fat in order to improve quality of life.

This study on the 5:2 intermittent fasting method demonstrated significant reductions in body fat percentage and skinfold thickness in overweight/obese individuals but has several limitations. The sample consisted primarily of obese medical students (86%) aged 18-22, limiting generalizability to broader populations. Methodological constraints include the use of skinfold calipers and BIA for fat measurement, which may lack precision for visceral fat assessment. The 6-week intervention period was relatively short, and the lack of a control group makes it difficult to isolate IF's effects from other variables. Individual factors like genetics, activity levels, and metabolic differences were not accounted for, suggesting results may vary across populations. While promising, these findings require validation through longer-term studies with more diverse samples and rigorous body composition measurements to better understand IF's effectiveness for different demographic groups.

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