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Relationship between visceral fat level and total blood cholesterol among medical students at Pasundan University 2024/2025

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ABSTRACT

Background: Modern lifestyle changes characterized by high-fat dietary intake and reduced physical activity have increased the prevalence of obesity and lipid abnormalities among young adults. Visceral fat is considered metabolically active and has been associated with dyslipidemia and cardiovascular risk. However, findings regarding the relationship between visceral fat and total cholesterol levels in young adult populations remain inconsistent. Previous studies have predominantly involved older or metabolically compromised populations and frequently relied on advanced imaging methods such as CT scan or MRI, while evidence among apparently healthy university students using practical field-based measurements remains limited. Objective: Therefore, this study aimed to determine the relationship between visceral fat level and total blood cholesterol among medical students at the Faculty of Medicine, Pasundan University (2024/2025). Methods: This correlational analytical study employed a cross-sectional design involving 111 eligible medical students. Visceral fat level was measured using Bioelectrical Impedance Analysis (BIA) with the Omron HBF-375 device, while total cholesterol level was assessed using a portable rapid cholesterol test device. Data were analyzed using Spearman's correlation test. Results: The results showed that most respondents had normal visceral fat levels (79.3%) and normal total cholesterol levels (67.6%). Spearman correlation analysis demonstrated no statistically significant association between visceral fat level and total cholesterol ($r = -0.060$; $p = 0.529$). Conclusion: In conclusion, visceral fat accumulation was not significantly associated with total blood cholesterol levels among medical students. These findings suggest that cholesterol status in young adults may be influenced more by overall lifestyle and metabolic factors than by visceral fat accumulation alone. This study highlights the importance of early lifestyle-based prevention strategies to reduce future cardiometabolic risk.

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INTRODUCTION

Hypercholesterolemia is defined as an increase in blood cholesterol levels. In the long term, this condition can accelerate atherosclerosis and contribute to cardiovascular diseases. The prevalence of hypercholesterolemia in Indonesia reaches 48% among men and 54.3% among women (Kementerian Republik Indonesia, 2016). Cholesterol in the body originates from exogenous sources, namely food intake, and endogenous synthesis in the liver from excess carbohydrates, fats, and proteins. Excessive caloric intake and lipid accumulation contribute significantly to the development of hypercholesterolemia and other metabolic disorders (Hall, J. E., & Hall, 2021; Setiati, 2014).

Lifestyle is one of the most important factors influencing health status. Modern lifestyle changes characterized by high-calorie diets, increased fast-food consumption, and reduced physical activity contribute to obesity and dyslipidemia. Technological developments have also reduced daily physical activity, resulting in lower energy expenditure and greater fat accumulation. These conditions increase the risk of obesity, hypercholesterolemia, and cardiovascular disease (Rachman, 2018; Widyastuti, N., & Setiawan, 2020).

Excess energy intake and insufficient physical activity promote fat accumulation in adipose tissue, particularly visceral fat located within the abdominal cavity surrounding internal organs such as the liver, pancreas, and intestines. Visceral fat differs from subcutaneous fat because it is metabolically active and plays an important role in lipid metabolism and endocrine regulation (Hall, J. E., & Hall, 2021; Sherwood, 2016). Excess visceral fat accumulation is associated with metabolic syndrome, insulin resistance, dyslipidemia, type II diabetes mellitus, and cardiovascular disease (Gotera, 2024; Setiati, 2014).

Several studies have demonstrated that increased visceral fat is associated with abnormal lipid profiles and cardiometabolic risk. Chen, J., Lin, F., Zhu, L., & Yang (2024), Nazar, A. D., Lestari, R., & Widodo (2024), and Wu, W., Zhang, F., Wen, S., & Qiu (2025) reported that visceral adiposity was positively correlated with dyslipidemia, elevated LDL cholesterol, triglycerides, and cardiovascular disease risk. However, other studies involving younger populations have shown weaker or non-significant associations, suggesting that the metabolic effects of visceral fat may vary depending on age, metabolic status, and lifestyle characteristics (Gunawan, 2023; Nabila, 2024). These inconsistent findings indicate that the relationship between visceral fat and cholesterol levels remains unclear, particularly among young adults.

Another important issue concerns methodological differences in previous studies. Many studies assessing visceral adiposity have relied on imaging techniques such as computed tomography (CT scan) and magnetic resonance imaging (MRI), which are considered gold-standard methods for measuring visceral fat. However, these methods are expensive, less practical, and difficult to implement in large-scale or field-based studies. In contrast, Bioelectrical Impedance Analysis (BIA) offers a simpler, non-invasive, and more accessible alternative for estimating visceral fat levels (Healthcare, 2019; Kyle, Bosaeus, 2004; Lin, J.-H., Liang, M., Fang, C., & Teng, 2021). Nevertheless, evidence regarding the relationship between visceral fat measured using BIA and total cholesterol levels among healthy university students remains limited, especially in Indonesia.

Levels of LDL cholesterol, triglycerides, and fasting blood glucose are positively correlated with visceral fat levels, whereas HDL (High-Density Lipoprotein) levels show a negative correlation. This indicates that higher visceral fat levels are associated with lower HDL levels, which may worsen metabolic conditions. Because visceral adipose tissue functions hormonally and can produce various proinflammatory cytokines and hormones that contribute to insulin resistance and metabolic disturbances, this condition potentially increases the risk of metabolic syndrome,

central obesity, and cardiovascular disease (Chen, J., Lin, F., Zhu, L., & Yang, 2024; Nazar, A. D., Lestari, R., & Widodo, 2024; Wu, W., Zhang, F., Wen, S., & Qiu, 2025).

University students represent a relevant population for investigating early metabolic risk factors because lifestyle changes during university life such as irregular eating habits, increased fast-food consumption, academic stress, sedentary behavior, and reduced physical activity may contribute to visceral fat accumulation and lipid abnormalities. Medical students, in particular, often experience demanding academic schedules that may negatively influence dietary and lifestyle patterns.

Therefore, this study was conducted to determine the relationship between visceral fat levels and total blood cholesterol among medical students at the Faculty of Medicine, Pasundan University, during the 2024/2025 academic year.

RESEARCH METHOD

Study Design

This study employed a descriptive and analytical research method with a quantitative approach using a cross-sectional design. A cross-sectional approach was selected because it allows simultaneous assessment of visceral fat levels and total cholesterol levels within a defined population at a single point in time. This design is appropriate for identifying potential associations and early metabolic patterns among young adults, although it does not establish causal relationships.

Study Location and Period

The study was conducted among medical students at the Faculty of Medicine, Pasundan University. Data collection was carried out from February to May 2025.

Population and Study Subjects

The target population in this study consisted of medical students at the Faculty of Medicine, Pasundan University, Bandung, who represented a relatively homogeneous young adult population with similar academic and lifestyle characteristics.

Inclusion and Exclusion Criteria

Inclusion criteria were medical students of the Faculty of Medicine, Pasundan University, aged 17–25 years, who were willing to participate in the study. Exclusion criteria included individuals diagnosed with diabetes mellitus and individuals with liver function disorders such as liver cirrhosis, chronic alcohol consumption, or those currently suffering from hepatitis.

Sample Size and Sampling Technique

The sampling technique used in this study was purposive sampling, in which subjects were selected based on predefined inclusion and exclusion criteria until the required sample size was achieved. To minimize selection bias, all eligible students who met the inclusion and exclusion criteria during the study period were invited to participate. Recruitment was conducted across multiple academic levels to obtain a more representative sample of the medical student population. Data regarding students who declined participation were not formally analyzed; however, recruitment was conducted openly across eligible student groups to reduce potential participation bias.

Research Variables

The independent variable in this study was visceral fat level, while the dependent variable was total blood cholesterol level. Controlled variables included sex and age. Confounding variables such as diabetes mellitus and liver function disorders were addressed through the exclusion criteria to minimize bias.

Operational Definitions and Measurements

Visceral fat was defined as body fat accumulated in the central region of the body surrounding internal organs. Visceral fat levels were measured using a non-invasive digital scale equipped with Bioelectrical Impedance Analysis (BIA) technology (Omron Karada Scan Body Fat Composition Monitor HBF-375). Visceral fat levels were categorized as normal (0.5–9.5), high (10–14.5), and very high (15–30).

Total blood cholesterol levels were measured using a portable rapid cholesterol test device. Cholesterol levels were classified as normal (<200 mg/dL), borderline high (200–239 mg/dL), and high (≥240 mg/dL). Both variables were analyzed on an ordinal scale.

Bioelectrical Impedance Analysis (BIA) using the Omron HBF-375 has been widely utilized in population-based studies and demonstrates acceptable validity for estimating visceral fat levels compared with standard imaging techniques, although it is less precise than computed tomography (CT scan) or magnetic resonance imaging (MRI) (Kyle, Bosaeus, 2004; Healthcare, 2019). Similarly, portable cholesterol testing devices provide practical field-based screening with acceptable clinical accuracy; however, laboratory-based enzymatic assays remain the gold standard for cholesterol measurement.

Research Procedure

Measurements of visceral fat levels and total cholesterol levels were conducted under standardized conditions during scheduled examination sessions to maintain consistency across participants.

Data Analysis

Data analysis was performed using statistical software. Univariate analysis was conducted to describe the distribution of each variable, presented as frequencies and percentages. Bivariate analysis was used to examine the relationship between visceral fat levels and total cholesterol levels. A Chi-square test was applied to analyze the association between the two categorical variables. If more than 20% of the expected cell counts were less than five, Fisher's exact test was used as an alternative.

Ethical Considerations

Ethical approval for this study was obtained from the Research Ethics Committee of Pasundan University. Ethical principles applied in this study included respect for persons, beneficence, non-maleficence, justice, and confidentiality. Participation was voluntary, and informed consent was obtained from all participants. The confidentiality of participant data was maintained by using initials instead of full names in all research records.

RESULTS AND DISCUSSIONS

This study was conducted at the Faculty of Medicine, Pasundan University, involving active medical students who met the inclusion criteria during the study period. Data were collected through direct measurements performed at the research location.

Characteristics of Respondents

A total of 111 medical students from the Faculty of Medicine, Pasundan University, participated in this study. The majority of respondents were aged 17–20 years (75.7%), while 24.3% were aged 22–24 years. Most participants were male (66.7%), and female respondents accounted for 33.3%. Based on academic level, the largest proportion of respondents were from the third year (33.3%), followed by the second year (32.4%), fourth year (21.6%), and first year (12.6%).

Table 1. Characteristics of respondents

Respondent Characteristics	Category	Frequency (n=111)	Percentage (%)
Age	17 - 20 Year	84	75,7

Respondent Characteristics	Category	Frequency (n=111)	Percentage (%)
	22 - 24 Year	27	24,3
Gender	Man	74	66,7
	Women	37	33,3
College Level	Level 1	14	12,6
	Level 2	36	32,4
	Level 3	37	33,3
	Level 4	24	21,6

Distribution of Total Blood Cholesterol Levels

The distribution of total blood cholesterol levels showed that most respondents had normal cholesterol levels. A total of 75 respondents (67.6%) were classified as having normal total cholesterol levels. Meanwhile, 20 respondents (18.0%) were categorized as having borderline high cholesterol, and 16 respondents (14.4%) were classified as having high total cholesterol levels.

Table 2. Distribution of total blood cholesterol levels

Criteria	Frequency (n=111)	Percentage (%)
Normal	75	67,6
Threshold	20	18
Tall	16	14,4
Total	111	100

Distribution of Visceral Fat Levels

The majority of respondents had visceral fat levels within the normal range. A total of 88 respondents (79.3%) were categorized as having normal visceral fat levels. Respondents with high visceral fat levels accounted for 13.5% (15 individuals), while those with very high visceral fat levels comprised 7.2% (8 individuals).

Table 3. Distribution of visceral fat levels

Criteria	Frequenci (n=111)	Percentage (%)
Normal	88	79,3
Tall	15	13,5
Very High	8	7,2
Total	111	100

Distribution of Body Mass Index (BMI)

Based on BMI classification, most respondents were in the normal BMI category (34.2%). Underweight respondents accounted for 17.1%, while overweight respondents constituted 10.8%. Additionally, 21.6% of respondents were classified as obese class I, and 16.2% were classified as obese class II.

Table 4. Distribution of body mass index (BMI)

BMI	Frequency	Percent
Underweight	19	17.1
Normal	38	34.2
Overweight	12	10.8
Obesitas I	24	21.6
Obesitas II	18	16.2
Total	111	100.0

Relationship Between Visceral Fat Levels and Total Blood Cholesterol

The relationship between visceral fat levels and total blood cholesterol was analyzed using Spearman's correlation test. The analysis yielded a correlation coefficient (r) of −0.060, indicating a very weak negative correlation. The p-value obtained was 0.529 ($p > 0.05$), suggesting that there

was no statistically significant association between visceral fat levels and total blood cholesterol levels among the respondents.

Table 5. Correlation between visceral fat levels and total blood cholesterol

Spearman's rho	N	P-Value
-0,060	111	0,529

The Spearman correlation analysis demonstrated a very weak negative correlation between visceral fat level and total blood cholesterol ($r = -0.060$) that was not statistically significant ($p = 0.529$). These findings indicate that visceral fat accumulation did not meaningfully influence total cholesterol levels among the respondents. The absence of a significant association may reflect the relatively young age and metabolically homogeneous characteristics of the study population, in which compensatory metabolic mechanisms may still maintain lipid homeostasis despite variations in visceral adiposity.

Although most respondents had normal visceral fat and cholesterol levels, a considerable proportion already demonstrated elevated visceral fat or borderline-to-high cholesterol levels. This finding is clinically important because early metabolic abnormalities in young adults may increase future cardiometabolic risk if unhealthy lifestyle patterns persist. Therefore, the present study highlights the importance of early screening and preventive interventions targeting lifestyle modification among university students.

Discussion

The present study found no statistically significant relationship between visceral fat levels and total blood cholesterol among medical students at Pasundan University. Although several respondents demonstrated elevated visceral fat and borderline-to-high cholesterol levels, the overall correlation between the two variables was very weak ($r = -0.060$; $p = 0.529$). These findings suggest that visceral fat accumulation among young adults may not yet exert a substantial metabolic effect on cholesterol homeostasis, particularly in relatively healthy and homogeneous populations.

The absence of a significant association in this study differs from several previous studies reporting positive correlations between visceral adiposity and lipid abnormalities (Chen, J., Lin, F., Zhu, L., & Yang, 2024; Gotera, 2024). However, similar findings have also been reported in younger populations with relatively preserved metabolic compensation mechanisms (Gunawan, 2023; Nabila, 2024). These inconsistent findings suggest that the metabolic consequences of visceral fat accumulation may vary depending on age, lifestyle, body composition, and overall metabolic status.

The results of this study showed that the majority of medical students had visceral fat levels within the normal range, while a smaller proportion exhibited high and very high visceral fat levels. This finding indicates that most respondents had controlled intra-abdominal adiposity, which may be related to their relatively young age and preserved metabolic compensation mechanisms. Similar findings have been reported in other studies involving young adult populations, where normal visceral fat levels predominate but a subset already shows elevated visceral adiposity that may predispose individuals to future cardiometabolic disorders (Gunawan, 2023; Nabila, 2024). Physical activity and sedentary behavior are known to play a significant role in visceral fat accumulation, as demonstrated by Salsabila (2021), who reported that low physical activity levels and prolonged sedentary behavior among university students were associated with increased visceral fat. Furthermore, Muhdar et al. (2025) emphasized that insufficient physical activity contributes significantly to increased visceral fat and adverse cardiometabolic profiles among young adults.

Triglycerides stored in adipose tissue are mobilized through lipolysis during the post-absorptive state, releasing free fatty acids that are transported to the liver via the portal circulation.

In the liver, these fatty acids contribute to triglyceride synthesis and the formation of very low-density lipoprotein (VLDL), which subsequently affects total blood cholesterol levels. Cholesterol homeostasis is regulated by a balance between dietary intake, endogenous synthesis, and excretion through bile acids, and disruption of this balance may result in hypercholesterolemia (Hall & Hall, 2021; Sherwood, 2016). In this study, most respondents had normal total cholesterol levels, while a considerable proportion were categorized as having borderline high or high cholesterol levels. These findings suggest that although the majority of students were metabolically healthy, a substantial number already exhibited lipid profiles that may increase the risk of cardiovascular disease in the future.

Previous studies have shown that unhealthy lifestyle patterns, including excessive caloric intake, high-fat diets, and low physical activity, are strongly associated with increased cholesterol levels. Rahman (2022) found a significant relationship between lifestyle factors and total cholesterol levels among obese employees, while Andayani et al. (2023) reported that abdominal obesity indicators were associated with elevated cholesterol levels in primary healthcare patients. Clinical guidelines emphasize that dyslipidemia in young adults should not be underestimated, as early lipid abnormalities may progress into atherosclerosis and cardiovascular disease later in life (Makbul Aman, 2019; Patel, S., & Wong, 2024). Data from the Centers for Disease Control and Prevention (2023) further indicate that elevated cholesterol levels are present even in younger age groups, highlighting the importance of early prevention.

Theoretically, excessive visceral fat increases the flux of free fatty acids to the liver, enhancing triglyceride synthesis and VLDL production, which may elevate total cholesterol levels. In addition, visceral adipose tissue functions as an active endocrine organ that secretes proinflammatory cytokines and adipokines, contributing to insulin resistance, dyslipidemia, and metabolic syndrome (Chen, J., Lin, F., Zhu, L., & Yang, 2024; Setiati, 2014). However, the present study did not demonstrate a statistically significant relationship between visceral fat levels and total blood cholesterol. This finding suggests that in a relatively young and homogeneous population, such as medical students, the metabolic impact of visceral fat accumulation may not yet be sufficiently pronounced to influence total cholesterol levels.

Several factors may explain the absence of a significant association. First, the young age of the respondents may indicate that compensatory metabolic mechanisms are still functioning effectively, thereby maintaining lipid homeostasis despite variations in visceral fat levels. Second, the proportion of respondents with high and very high visceral fat levels was relatively small, which may have limited the statistical power to detect an association. Third, unmeasured confounding factors such as dietary patterns, physical activity intensity, genetic predisposition, and stress levels may have influenced cholesterol metabolism (Dewi, 2020; Islami, 2019). In contrast, studies conducted in older or more metabolically heterogeneous populations have reported significant correlations between visceral fat and lipid profiles. Gotera et al. (2024) demonstrated that visceral fat measured using Bioelectrical Impedance Analysis (BIA) was significantly associated with serum lipid profiles and fasting blood glucose levels, while Abdullah et al. (2025) reported that reductions in visceral adiposity were associated with improvements in cardiometabolic markers following lifestyle interventions.

In this study, visceral fat was measured using Bioelectrical Impedance Analysis, a non-invasive method widely used to estimate body composition. Kyle et al. (2004) reported that BIA provides reliable estimates of body fat distribution when standardized measurement procedures are applied. The use of the Omron HBF-375 device has been widely adopted in population-based studies due to its practicality and acceptable accuracy (Healthcare, 2019). Total cholesterol levels were measured using a portable cholesterol testing device, which is suitable for field-based screening. However, such devices may be influenced by recent dietary intake and fasting status, which could contribute to variability in results.

Although no significant relationship was found between visceral fat levels and total blood cholesterol in this study, the presence of respondents with elevated visceral fat and cholesterol levels underscores the importance of early preventive strategies. Lifestyle modifications, including balanced nutrition, regular physical activity, and reduced sedentary behavior, are essential to prevent the progression of metabolic disorders. Excessive food intake and unhealthy dietary patterns have consistently been identified as major contributors to obesity and hypercholesterolemia (Rachman, 2018; Widyastuti, N., & Setiawan, 2020). Therefore, early intervention among university students is crucial to reduce the long-term risk of cardiovascular disease.

This study contributes to the growing evidence that visceral fat accumulation among young adults does not always correspond directly with alterations in total cholesterol levels. The findings emphasize that cardiometabolic risk assessment in university populations should consider broader lifestyle and metabolic factors rather than relying solely on visceral fat estimation.

CONCLUSION

This study concludes that the majority of medical students at the Faculty of Medicine, Pasundan University had visceral fat levels and total blood cholesterol levels within the normal range. Statistical analysis showed no significant relationship between visceral fat levels and total blood cholesterol among the respondents. These findings suggest that, in relatively young and metabolically homogeneous populations, visceral fat accumulation may not yet exert a substantial influence on cholesterol homeostasis.

The main contribution of this study is the provision of additional evidence regarding the relationship between visceral fat and cholesterol levels among university students using practical field-based measurements through Bioelectrical Impedance Analysis (BIA). The findings highlight that cardiometabolic risk among young adults may be influenced by multiple interacting factors beyond visceral fat accumulation alone, including lifestyle behaviors, dietary patterns, and physical activity. Therefore, early preventive strategies focusing on healthy lifestyle modification remain essential among university students to reduce future metabolic and cardiovascular risk.

This study has several limitations. First, the cross-sectional design limits causal interpretation between visceral fat and cholesterol levels. Second, lifestyle-related variables such as dietary intake, physical activity, and stress levels were not directly measured and may have acted as confounding factors. Third, visceral fat and cholesterol measurements were performed using field-based instruments rather than gold-standard laboratory or imaging techniques. Future studies are recommended to involve larger and more diverse populations, incorporate biochemical and lifestyle assessments, and utilize more comprehensive metabolic measurements to better understand cardiometabolic risk factors among young adults.

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