

HUBUNGAN INDEKS MASA TUBUH DENGAN TINGKAT KEBUGARAN KARDIOVASKULER SISWA SEKOLAH MENENGAH PERTAMA

RELATIONSHIP BETWEEN BODY MASS INDEX AND CARDIOVASCULAR FITNESS LEVELS OF JUNIOR HIGH SCHOOL STUDENTS

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Abstrak

Penelitian ini bertujuan untuk mengetahui apakah terdapat hubungan antara Indeks Massa Tubuh (IMT) dengan tingkat kebugaran kardiovaskular siswa SMP IT Darul Wahdah Gerung Tahun 2025. Penelitian ini menggunakan metode kuantitatif dengan desain korelasional. Teknik pengumpulan data dilakukan melalui pengukuran berat badan dan tinggi badan untuk menentukan nilai IMT, serta tes Cooper 12 menit untuk mengukur tingkat kebugaran kardiovaskular siswa. Analisis data menggunakan uji korelasi Pearson. Hasil penelitian menunjukkan bahwa; 1) Terdapat hubungan yang signifikan antara Indeks Massa Tubuh (IMT) dengan tingkat kebugaran kardiovaskular siswa, yang dibuktikan dengan nilai koefisien korelasi sebesar -0,689 dan nilai signifikansi 0,005 ($p < 0,05$), sehingga H_0 ditolak dan H_1 diterima. 2) Nilai koefisien korelasi yang negatif menunjukkan adanya hubungan negatif yang signifikan, yang berarti semakin tinggi nilai IMT siswa, maka semakin rendah tingkat kebugaran kardiovaskularnya, dan sebaliknya.

Kata Kunci: Indeks Masa Tubuh, Kebugaran, Kardiovaskuler, Siswa, Sekolah Menengah Atas

Abstract

This study aims to examine the relationship between Body Mass Index (BMI) and cardiovascular fitness levels among students at SMP IT Darul Wahdah Gerung in 2025. A quantitative approach with a correlational research design was employed. Data were collected by measuring students' body weight and height to calculate BMI, as well as administering the 12-minute Cooper test to assess cardiovascular fitness levels. Pearson's correlation test was used for data analysis. The results revealed that; (1) there was a significant relationship between Body Mass Index (BMI) and students' cardiovascular fitness levels, as indicated by a correlation coefficient of -0.689 and a significance value of 0.005 ($p < 0.05$). Therefore, the null hypothesis (H_0) was rejected, and the alternative hypothesis (H_1) was accepted. (2) The negative correlation coefficient indicates a significant inverse relationship, meaning that higher BMI values are associated with lower cardiovascular fitness levels, and vice versa.

Keywords: Body Mass Index, Cardiovascular Fitness, Students, Junior High School

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INTRODUCTION

The adolescent phase at the junior high school level represents a critical phase characterized by accelerated physical growth and development. The establishment of healthy lifestyle habits during this period has substantial long-term implications for individuals' health quality in adulthood (Sulhan, 2024). Nevertheless, rapid technological advancement and modern lifestyles have introduced new challenges in maintaining students' health (Irmayanti, 2023). Sedentary behavior and imbalanced dietary patterns have become increasingly prevalent within school environments.

An imbalance between nutritional intake and physiological requirements directly influences students' nutritional status (Zahrani, 2025). Body Mass Index (BMI) is a widely used and practical indicator that assesses the relationship between body weight and height to determine nutritional status (Adha et al., 2019). In educational settings, BMI functions as an early screening tool for evaluating students' physical health profiles (Prihatmoko, 2019). A BMI within the normal range reflects an optimal metabolic condition that supports healthy growth and development.

Deviations in BMI, whether classified as underweight or overweight, may lead to various physiological dysfunctions (Wulandari et al., 2023). Insufficient BMI levels can weaken immune function and reduce muscular strength, whereas excessive BMI increases the risk of metabolic disorders and hypertension. One of the health components most closely associated with nutritional status is cardiovascular fitness. The effectiveness of the cardiovascular and respiratory systems in delivering oxygen to working muscles is strongly influenced by body composition (Hasibuan & Susanto, 2019).

Cardiovascular fitness plays a fundamental role in enabling students to optimally engage in both academic and physical activities (Syam, 2025). Adequate cardiopulmonary endurance allows students to sustain learning activities without experiencing excessive fatigue (Wahyudi et al., 2025). Moreover, students with higher fitness levels tend to demonstrate better concentration, motivation, and learning persistence (Taufiqurrahman, 2025). In contrast, low fitness levels often hinder students' ability to maintain prolonged focus, thereby affecting academic performance.

From a theoretical perspective, BMI is closely associated with cardiovascular system efficiency in adolescents. Students with ideal body composition tend to experience reduced cardiac workload, enabling the circulatory system to function more efficiently (Putra, 2024). However, external factors such as physical activity intensity and dietary habits remain influential determinants of cardiovascular fitness (Prasetyo & Winarno, 2019). Empirical evidence consistently indicates that deviations in body weight, including both underweight and obesity, contribute to diminished physical endurance.

Previous empirical studies further support the relationship between nutritional status and cardiovascular fitness. Sunarni et al. (2019) reported that students with normal BMI exhibited significantly higher fitness levels. Conversely, overweight and obese students were found to have a negative association with cardiovascular endurance (Welay et al., 2023). Persistent abnormalities in BMI have been identified as strong predictors of reduced physical capacity during fitness performance tasks (Dewangga & Amarseto, 2023).

The novelty of the present study lies in its specific focus on students at SMP IT Darul Wahdah Gerung, a population that has not been previously examined. This research integrates nutritional status and cardiovascular fitness as comprehensive indicators for evaluating physical education outcomes. By adopting this approach, the study aims to generate empirical data that can inform the development of health-oriented curricula in secondary education. Concentrating on a single institutional context allows for a more precise assessment of students' physical health intervention needs.

Preliminary observations conducted at SMP IT Darul Wahdah Gerung in 2025 revealed

considerable variation in students' cardiovascular fitness levels. Several students exhibited early fatigue during moderate-intensity physical activities, such as long-distance running and team sports. These disparities in performance were accompanied by noticeable differences in students' physical appearance, suggesting variations in nutritional status that may influence aerobic capacity.

The convergence of theoretical frameworks and empirical observations underscores the necessity for systematic scientific investigation. Objective analysis is required to determine the extent to which Body Mass Index influences students' cardiovascular fitness levels. The findings of this study are expected to provide a scientific basis for schools in designing targeted health promotion programs. Ultimately, improving students' physical health is anticipated to support enhanced academic achievement and overall educational outcomes.

METHOD

This study employed a quantitative approach using numerical data obtained through objective and systematic measurement procedures. This approach was selected to enable statistical analysis of the relationship between variables, thereby ensuring scientifically valid interpretation of the findings. A correlational research design was applied to identify the existence, direction, and strength of the relationship between variables without introducing any experimental intervention (Rukminingsih & Latief, 2020). The independent variable in this study was nutritional status, represented by Body Mass Index (BMI), while the dependent variable was cardiovascular fitness.

A cross-sectional design was adopted, with data collected simultaneously to capture participants' actual physical conditions at a single point in time. The sampling technique used was total sampling (census sampling), considering the relatively small population size. Accordingly, all 15 eighth-grade students at SMP IT Darul Wahdah Gerung in 2025 were included as research participants. This approach was intended to minimize sampling bias and ensure accurate representation of the population.

Anthropometric data were collected using calibrated digital scales to measure body weight (in kilograms) and a stadiometer to measure height (in centimeters), ensuring measurement accuracy and data validity (Nafisah, 2025). Height measurements were conducted following standardized procedures, including an upright posture and forward gaze (Sulistyawati, 2019). Height data were subsequently converted into meters to meet the requirements for BMI calculation.

Body Mass Index (BMI) was calculated using the standard formula that integrates body weight and height measurements (Situmorang, 2015). The resulting BMI values were categorized to determine students' nutritional status, which served as the basis for correlational analysis. Accurate BMI classification is essential, as it provides an objective indicator of physical health that can be associated with students' cardiovascular fitness capacity.

Cardiovascular fitness was measured using the Cooper 12-Minute Run Test as the primary instrument (Sudrajat et al., 2025). In this test, students were instructed to cover the maximum possible distance within 12 minutes on a standardized track, serving as an indicator of aerobic endurance. The Cooper Test was selected due to its practicality and effectiveness in assessing cardiovascular fitness among adolescents. The distance achieved by each student was recorded and converted into cardiovascular fitness categories for analysis.

To address potential limitations related to facility availability or weather conditions, the Harvard Step Test was prepared as an alternative assessment instrument (Yusuf, 2018). This test involves stepping onto a bench at a fixed rhythm, followed by measurement of recovery heart rate to calculate a fitness index. The availability of this alternative ensured continuity and objectivity in data collection under varying field conditions. All measurement results were

systematically recorded using structured observation sheets.

Data collection techniques included observation, documentation, and physical fitness testing to enhance the validity of the findings. After data collection was completed, correlational statistical analysis was conducted to examine the direction, strength, and significance of the relationship between BMI and cardiovascular fitness. The results were expected to provide empirical evidence regarding the influence of body composition on students' physical capacity at SMP IT Darul Wahdah Gerung.

RESULTS

The data tabulation was compiled based on individual measurement results from 15 students at SMP IT Darul Wahdah Gerung. The data were organized sequentially, beginning with anthropometric measurements and followed by cardiovascular fitness test outcomes. This systematic arrangement facilitated both descriptive and inferential statistical analyses. The working data table included subject number, body weight (kg), height (m), BMI (kg/m²), BMI category, Cooper Test distance (meters), and VO2Max values. This presentation enabled observation of distribution patterns and trends related to nutritional status and cardiovascular fitness.

Tabel 1. Data Tabulation

No.	Names	Height (m2)	Weight t (kg)	BMI (Body Mass Index)	Cooper Test Score (m)	VO2 Max
1	Haipul Ardian Maulana	1,8496	31	16,76038062	2500	44,6
2	Ahmad Afandi Saputra	1,96	38,5	19,64285714	2080	35,21
3	Ahmad Efendi	2,4025	43,5	18,10613944	2215	38,23
4	M. Nabil Saputra	2,0736	36	17,36111111	2400	42,36
5	Ilman Hadi Saputra	2,25	46,3	20,57777778	2115	35,99
6	Lalu Kevin Sandika	1,69	32	18,93491124	2285	39,79
7	Muh. Nazwan Maliki	2,1025	38,5	18,31153389	2180	37,44
8	Muhammad Noval Rizki	1,7689	35,3	19,9559048	2135	36,44
9	Rehan Aprilian	1,9321	48,5	25,10222038	2015	33,76
10	Muhammad Rafael Jaunardi	1,7424	31,5	18,0785124	2140	36,55
11	Rangga	2,2801	47,5	20,83241963	1880	30,74
12	Muhammad Saifullah	2,2201	48	21,62064772	2250	39,01
13	Abdul Kholid	2,4025	50,4	20,97814776	2000	33,42
14	Bayu Sukma	2,4649	51,5	20,89334253	2005	33,53
15	Zainul Akbar	2,0736	35,3	17,02353395	2300	40,13

In this study, Body Mass Index (BMI) was analyzed using descriptive statistical measures, including minimum, maximum, mean, and standard deviation values, to identify trends and variability among respondents. A total of 15 students were included in the analysis, and all data were deemed valid. The minimum BMI value was 17, while the maximum was 25, indicating variation in students' nutritional status. The mean BMI value of 19.61 suggests that, on average,

students were classified as underweight. The standard deviation of 2.186 reflects moderate variability in BMI values, remaining within an acceptable range. This variation indicates differences in students' physical conditions, which may influence cardiovascular fitness and therefore warranted further hypothesis testing.

Based on the data processing results, it is known that most of most students at SMP IT Darul Wahdah Gerung fell into the underweight and severely underweight categories. Specifically, 8 students (53.3%) were classified as underweight, while 6 students (40.0%) were classified as severely underweight. Consequently, 93.3% of the respondents had BMI values below the normal range. Only one student (6.7%) was classified as obese, and no students were categorized as having normal BMI. These findings indicate that the overall nutritional status of the respondents tended to be suboptimal, suggesting potential nutritional concerns that require attention.

Overall, the predominance of underweight BMI categories reflects less-than-optimal nutritional status among the students and constitutes an important consideration for further analysis, particularly in examining the relationship between BMI and cardiovascular fitness levels.

To assess students' cardiovascular fitness levels, descriptive statistical analysis was conducted using minimum, maximum, mean, and standard deviation values. The results showed that the mean cardiovascular fitness score was 37.15, with a minimum value of 31 and a maximum value of 45. The standard deviation of 3.672 indicates considerable variability in cardiovascular fitness levels among students, confirming the suitability of the data for further statistical analysis.

Subsequent classification of cardiovascular fitness levels revealed that 7 students (46.7%) were in the good category. In addition, 4 students (26.7%) were categorized as having low fitness levels, 3 students (20.0%) were in the good category, and 1 student (6.7%) was in the very good category. No students were classified as having very low cardiovascular fitness. Although several students demonstrated good to very good fitness levels, a notable proportion remained in the low category, indicating that overall cardiovascular fitness had not yet reached an optimal level.

Based on descriptive statistics and fitness classification, the cardiovascular fitness of students at SMP IT Darul Wahdah Gerung can be generally described as good but still requiring improvement through structured physical activity and fitness training programs. These cardiovascular fitness data were subsequently used as the basis for hypothesis testing to examine their relationship with BMI.

Prerequisite Tests

Normality Test

Normality testing was conducted using the Shapiro–Wilk test with SPSS to assess whether BMI and cardiovascular fitness data were normally distributed. Data were considered normally distributed if the significance value exceeded 0.05. The results showed significance values of 0.218 for BMI and 0.989 for cardiovascular fitness, both of which were greater than 0.05. Therefore, both variables were normally distributed and met the assumptions required for parametric statistical analysis.

Homogeneity Test

The homogeneity test was conducted to determine whether the data came from a population with the same variance (homogeneous). The homogeneity test in this study used Levene's Test with the help of SPSS. The data was declared homogeneous if the significance value was greater than 0.05. Based on the Levene test results, a significance value of 0.081 was obtained, which was greater than 0.05. This indicates that the data has a homogeneous variance, thus fulfilling the requirements for hypothesis testing using parametric tests.

Hypothesis Testing

After the data was declared normal and homogeneous, hypothesis testing was performed using Pearson Product Moment correlation to determine the relationship between Body Mass Index (BMI) and the cardiovascular fitness level of students.

Hypothesis Formulation

The hypotheses proposed in this study are as follows; H_0 : There is no significant relationship between Body Mass Index (BMI) and the cardiovascular fitness level of students at SMP IT Darul Wahdah Gerung. H_a : There is a significant relationship between Body Mass Index (BMI) and the cardiovascular fitness level of students at SMP IT Darul Wahdah Gerung.

Criteria for Decision Making

The criteria for decision making in Pearson's correlation test are as follows; If the Sig. (2-tailed) value is < 0.05 , then H_0 is rejected and H_1 is accepted. If the Sig. (2-tailed) value is ≥ 0.05 , then H_0 is accepted and H_1 is rejected.

Decision Making and Interpretation

Based on the results of the Pearson correlation test, a correlation coefficient value of -0.689 with a significance value of 0.005 was obtained. The significance value is less than 0.05, so H_0 is rejected and H_1 is accepted. This shows that there is a significant relationship between Body Mass Index (BMI) and the cardiovascular fitness level of students. A negative correlation coefficient value indicates that the relationship between the two variables is opposite in direction, which means that the higher the students' BMI, the lower their cardiovascular fitness level, and vice versa. Based on the relationship strength criteria, a correlation value of -0.689 is classified as a moderate relationship.

Hypothesis Test Conclusion

Based on the hypothesis testing results, it can be concluded that there is a significant negative relationship between Body Mass Index (BMI) and the cardiovascular fitness level of students at SMP IT Darul Wahdah Gerung. Thus, Body Mass Index (BMI) plays a role as one of the factors related to students' cardiovascular fitness level.

Determination Test

The determination test is used to determine the contribution or influence of independent variables on dependent variables. In this study, the determination test aims to determine the contribution of Body Mass Index (BMI) to the cardiovascular fitness level of students. The determination test is used to determine the contribution or influence of independent variables on dependent variables. In this study, the determination test aims to determine the extent of the contribution of Body Mass Index (BMI) to the cardiovascular fitness level of students at SMP IT Darul Wahdah Gerung.

Based on the data processing results, a correlation coefficient (R) value of 0.689 was obtained, indicating a strong relationship between the Body Mass Index (BMI) variable and cardiovascular fitness levels. The R Square (R^2) value of 0.475 indicates that 47.5% of the variation in cardiovascular fitness levels can be explained by the Body Mass Index (BMI) variable. Meanwhile, the Adjusted R Square value of 0.434 indicates that after adjusting for the sample size, the contribution of BMI to cardiovascular fitness is 43.4%. The remaining 52.5% is influenced by factors other than BMI, such as physical activity level, diet, genetic factors, exercise habits, and students' health conditions.

The Std. Error of the Estimate value of 2.762 indicates that the level of estimation error in the regression model is relatively small, so that the regression model used is quite good at predicting cardiovascular fitness levels based on BMI. Based on the results of the determination test, it can be concluded that Body Mass Index (BMI) contributes significantly to students' cardiovascular fitness levels, although it is not the only determining factor.

DISCUSSION

The results of the descriptive statistical analysis in this study paint a rather concerning

picture of the nutritional status of students at SMP IT Darul Wahdah Gerung. The average Body Mass Index (BMI) of the students was recorded at 19.61, a figure that generally places most respondents in the underweight or very underweight categories. In detail, the data show that there were 8 respondents, or about 53.3%, in the underweight category, and 6 respondents, or 40.0%, in the severely underweight category. The combined total of these two percentages reveals that most students—93.3%—have a BMI below the established normal standard. Conversely, only 1 respondent, or 6.7%, was in the overweight category, and no students were found to have a BMI in the normal or obese categories. This high prevalence of undernutrition warrants special attention as it occurs during the critical developmental phase of school-age children.

The high percentage of students with a BMI below the normal range can be analyzed in depth using the Energy Balance Theory proposed by Hill et al. (2012). According to this theory, an individual's nutritional status is fundamentally determined by the dynamic balance between total energy intake from food consumption and total energy expended by the body. This expended energy is used to support basal metabolic processes and fuel daily physical activities. When energy intake is consistently lower than the energy expended on activities, the body automatically enters a state of chronic energy deficit. To compensate for this deficiency, the body is forced to break down fat reserves and muscle mass as alternative fuel sources. It is this prolonged catabolic process that directly triggers drastic weight loss, causing the BMI to fall into the underweight and severely underweight categories.

A BMI falling into the underweight and severely underweight categories during early adolescence is closely linked to inadequate nutritional intake and an unbalanced activity load. School-aged adolescents often have diets that lack variety, are nutritionally unbalanced, and tend to skip important meals due to the demands of school activities. On the other hand, the high volume of physical activity at school, when not balanced by adequate calorie intake, accelerates the onset of an energy deficit. In addition to behavioral factors, biological factors such as the rapid growth spurt currently experienced by early adolescents also play a significant role. During this phase, nutrients absorbed by the body are often prioritized to support rapid height growth, so that body mass growth tends to lag if daily nutrient intake is not proportionally increased.

The empirical findings regarding low BMI among students in this study are highly consistent with the results of a study published by Hamdiana et al. (2025). In her research, Hamdiana revealed that in addition to the threat of overweight issues, junior high school students in both urban and suburban areas are highly vulnerable to energy malnutrition. This malnutrition is generally triggered by unhealthy lifestyle behaviors, such as skipping breakfast, irregular eating patterns, and adolescents' limited knowledge regarding the macro- and micronutrient needs required during the growth period. The study strongly emphasizes that the mismatch between the body's biological needs and actual daily calorie intake has an immediate impact on the decline in adolescents' nutritional status. Thus, structural issues related to poor eating habits are one of the root factors perpetuating low BMI status among the student population.

Support for these findings also comes from a study conducted by Desi et al. (2023), which focused on the analysis of macronutrient intake among adolescents. Through her research, Desi found that groups of students with low BMI generally exhibited energy and protein consumption patterns that fell below the recommended nutritional adequacy levels. Interestingly, this deficiency persisted even though their physical activity levels were classified as moderately active. This finding indicates an important conclusion: evaluations of children's nutritional status should not solely focus on how active they are but must also consider the quality and quantity of food consumed daily. Without sufficient protein for new tissue synthesis

and adequate calories for metabolism, efforts to maintain an ideal body weight in adolescents will be difficult to achieve.

In addition to individual student factors, school and family environments were also identified as having a strong correlation with this malnutrition, as reported by Hartanti et al. (2024). Based on her findings, Hartanti concluded that poor nutritional status among secondary school students is strongly correlated with a lack of nutrition education and weak supervision of eating habits both at home and in the school environment. Many schools have not yet integrated an understanding of balanced nutrition into the curriculum in an applied manner, so students tend to choose snacks with low nutritional value. In addition, parents' busy schedules often result in suboptimal supervision of their children's meal regularity. Therefore, the study underscores the importance of the strategic role of the school institution in serving as a facilitator in providing balanced nutrition education programs to support the long-term health of students.

By integrating research data, physiological theoretical foundations, and support from previous studies, a comprehensive conclusion regarding the nutritional status at SMP IT Darul Wahdah Gerung can be synthesized. The low average BMI and the predominance of the underweight and severely underweight categories among students result from a complex interaction between inadequate nutrient intake, physical activity demands, and an unsupportive environment. Empirically, the figures presented in the results chapter indicate a massive and evident trend of malnutrition among most of the respondent population. Theoretically, this condition can be validated by the law of energy balance, where the failure of caloric intake to meet the body's minimum threshold requirements is directly reflected in a decrease in an individual's BMI value. Therefore, the underweight condition among students in this study is not an isolated phenomenon but rather the result of the accumulation of various interrelated variables.

Based on this comprehensive portrait of BMI status falling into the suboptimal category, concrete action in the form of structured and sustained preventive interventions is required. School administrators, in collaboration with health professionals, must immediately design educational programs on the principles of balanced nutrition targeting both students and their parents. Monitoring of the types of food and snacks available in the school cafeteria must be tightened to ensure students' nutritional needs are met while at school. Additionally, the management of the intensity of students' physical activities in both extracurricular and daily routines must be handled wisely to prevent excessive energy expenditure without adequate caloric intake to compensate. These early intervention efforts are crucial to support optimal biological growth and prevent broader adverse effects on students' cardiopulmonary fitness and future health status.

The second part of this study evaluated students' cardiorespiratory fitness levels, measured objectively using the 12-minute Cooper Test. Based on the data obtained, the average cardiorespiratory fitness score achieved by students at SMP IT Darul Wahdah Gerung was 37.15. The categorization results showed a varied distribution of abilities, with the largest group—46.7% of students—falling into the "adequate" fitness category. Meanwhile, approximately 20% of students were classified as "good," and only 6% achieved "very good" performance. However, a significant challenge remains, as 26.7% of students were categorized as having low fitness levels. Overall, these findings suggest that the cardiovascular endurance capacity of most seventh-grade students is at a decent level, although the percentage of students with low fitness should not be overlooked.

Physiologically, cardiorespiratory fitness reflects the combined functional capacity of several vital organ systems in the human body. Bompá and Buzzichelli (2019) explain that cardiorespiratory fitness is the integrated ability of the heart, lungs, and circulatory system to

efficiently absorb, transport, and supply oxygen to working muscles during physical activity. This level of fitness does not occur spontaneously but is largely determined by the history of frequency, intensity, and duration of physical activity or exercise performed regularly. The presence of a group of students with low-level cardiorespiratory fitness serves as a biological indicator that their cardiac and pulmonary endurance systems have not received optimal stimulation. Without consistent training, the functional capacity of the circulatory system to distribute oxygen will remain at a minimal level.

When linked to exercise theory, the findings regarding variations in fitness levels in this study are highly relevant to aerobic exercise theory and the overload principle proposed by Sharkey and Gaskill (2013). In their literature titled *Fitness & Health*, it is emphasized that an increase in cardiorespiratory capacity can only be achieved if the body is subjected to a programmed, progressive, and continuous aerobic workload. Through structured aerobic exercise, the heart is forced to adapt by increasing its stroke volume so that oxygen-rich blood can flow more smoothly. Adolescents who rarely or never engage in physical activity of moderate to high intensity will not receive sufficient exercise stimulus to trigger this functional adaptation. The consequence of the absence of this challenging stimulus to the circulatory system is stagnant cardiovascular performance that fails to develop toward greater efficiency.

The results of the cardiorespiratory fitness evaluation in this study are also strongly supported by several empirical studies conducted by previous researchers. Anggraeni Yulia Maharani et al. (2025) found a consistent pattern in their study, where students with low daily activity levels automatically recorded low VO₂Max scores and low cardiorespiratory fitness as well. Another study by Adhianto and Arief (2023) expands on these findings by stating that low cardiorespiratory fitness among junior high school students is influenced by their minimal participation in physical activities outside of mandatory physical education classes. A similar assertion was made by Supriadi et al. (2026), who concluded that a sedentary lifestyle places adolescents at a significantly higher risk of reduced cardiorespiratory capacity compared to their peers who are physically active. All this supporting research reinforces the argument that an active lifestyle is the primary driver of fitness.

Through the synthesis of empirical research data, the theoretical foundation of fitness, and a comparison of previous studies, a conclusion regarding the fitness profile of students at this school can be formulated. The variations and dynamics in the level of cardiorespiratory fitness demonstrated by students at SMP IT Darul Wahdah Gerung are largely driven by differences in habits regarding the regular performance of aerobic physical activities. Limitations in the allocation of time and the intensity of physical activity—whether occurring during Physical Education, Sports, and Health (PJOK) class hours or in independent activities outside of school—directly impact the suboptimal cardiovascular endurance of some students. Although the overall fitness profile falls into the “adequate to good” category, improvement measures must still be taken, particularly to support students in the low category. A practical solution can be achieved by designing more dynamic, progressive, and enjoyable PJOK lessons, while simultaneously fostering a culture of walking or exercising within the school environment.

Turning to the correlational analysis, the results of the Pearson correlation test showed a correlation coefficient of -0.689 with a significance level of 0.005 ($p < 0.05$). These statistical figures confirm a significant negative relationship between the Body Mass Index (BMI) variable and students' cardiorespiratory fitness levels. The direction of this negative relationship indicates an inverse pattern: the higher a student's BMI, the lower their cardiorespiratory fitness level tends to be, and vice versa.

From the perspectives of biomechanics and exercise physiology, this phenomenon can be easily explained. Individuals with greater body weight or a higher BMI require significantly

more energy expenditure simply to move their limbs during physical activity. Consequently, the heart and lungs are forced to work extra hard from the start of the activity, leading to reduced oxygen utilization efficiency by muscle tissue and accelerating the onset of fatigue.

This explanation of the negative correlation aligns with the classical view of Fox and Mathews (1981) in the book *The Physiological Basis of Physical Education and Athletics*, which states that excess fat tissue acts as a mechanical and metabolic burden that impedes cardiovascular system performance. This condition forces cardiac efficiency to drop drastically when the body engages in intense physical activity. These findings are further supported by studies by Aziz et al. (2025) and Gantarialdha (2021), which identified a similar negative relationship in a school-age adolescent population.

However, the results of the coefficient of determination in this study provide a broader perspective with an R Square value of 0.475. This value indicates that variations in BMI account for 47.5% of the variation in cardiorespiratory fitness, while the remaining 52.5% is influenced by other factors outside the scope of this study, such as daily nutritional status and daily exercise intensity (Nurmitasari et al., 2020). This multifactorial nature is further emphasized by Aulia et al. (2025) and Muzakki and Hariyoko (2023), who state that BMI functions as a predisposing factor influencing organ efficiency but does not automatically guarantee fitness in the absence of physical activity habits. In conclusion, although BMI contributes significantly, efforts to improve students' cardiorespiratory fitness should not be approached in isolation but must be managed comprehensively through the integration of proper nutrition management and the consistent adoption of an active lifestyle in schools.

CONCLUSION

Based on the results of research and discussion regarding the relationship between Body Mass Index (BMI) and cardiovascular fitness levels of students at SMP IT Darul Wahdah Gerung, it can be concluded that there is a significant relationship between Body Mass Index (BMI) and cardiovascular fitness levels of students. This is evidenced by the results of the Pearson correlation test, which shows a correlation coefficient value of -0.689 with a significance value of 0.005 ($p < 0.05$). Thus, H_0 is rejected and H_1 is accepted. A negative correlation coefficient value indicates a significant negative relationship between BMI and cardiovascular fitness levels. This means that the higher the students' BMI, the lower their cardiovascular fitness levels, and vice versa. In addition, BMI contributes 47.59% to the variation in students' cardiovascular fitness levels, while the remaining 53.5% is influenced by factors other than BMI, such as physical activity levels, exercise habits, lifestyle, and nutritional consumption. This shows that cardiovascular fitness is a multifactorial condition and is not determined by BMI itself.

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