



Relationship Between Physical Activity and Obesity Incidence Among Vocational School Students in Medan City in 2025

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Abstract

Obesity is an increasingly prevalent health problem with long-term impacts on quality of life. Lifestyle changes, particularly low levels of physical activity, contribute significantly to the rising incidence of obesity. This study aims to analyze the relationship between physical activity and the incidence of

obesity among vocational high school students in Medan City in 2025. This research is an observational study with a cross-sectional design, conducted in four vocational high schools selected through cluster random sampling from a total of 14 vocational schools. A sample of 320 students was selected using simple random sampling. Data were collected using a standardized questionnaire to assess physical activity levels and measurements of Body Mass Index (BMI) to determine obesity status. Bivariate analysis was performed using the chi-square test. The results showed a significant relationship between physical activity and the incidence of obesity ($p = 0.001$). These findings highlight the importance of interventions aimed at increasing physical activity among adolescents, both through structured school-based sports programs and the promotion of daily physical habits such as walking or cycling.

Keywords: physical activity, obesity, adolescents

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Introduction

Overweight and obesity are conditions characterized by excessive or abnormal accumulation of body fat that may be harmful to health (WHO, 2020). Obesity can negatively impact health by accelerating the aging process, impairing cognitive function, causing insulin resistance, and increasing the risk of various diseases, including cancer, osteoarthritis, and even premature death. Several factors contribute to the risk of obesity, including gender, age, education level, socioeconomic status, increased food intake, metabolic factors, energy expenditure, and genetic predisposition (Masrul, 2018).

The prevalence of obesity among adults in Indonesia has shown a consistent upward trend from 2007 to 2023, with the highest prevalence found in adults, followed by adolescents. In addition to obesity, overweight is also a nutritional problem that can progress into obesity. According to the Indonesian Health Survey, the prevalence of obesity and overweight in adults increased from 21.8% and 13.6% in 2018 to 23.4% and 14.4% in 2023, respectively. Meanwhile, among adolescents, the prevalence of obesity and overweight has slightly declined—from 4% obesity and 9.5% overweight in 2018 to 3.3% obesity and 8.8% overweight in 2023 (Indonesian Health Survey [SKI], 2023).

In North Sumatra Province, the prevalence of obesity and overweight among adolescents rose from 2013 to 2018, before decreasing in 2023 to 2.2% obesity and 9.6% overweight. In 2018, the prevalence reached 4.01% obesity and 10.91% overweight. Conversely, among adults, the prevalence of obesity declined from 25.8% in 2018 to 24.3% in 2023, while overweight prevalence increased from 14.8% to 16.6% during the same period. In Medan City—one of the regions in North Sumatra—the prevalence of adolescent obesity rose significantly from 2.5% in 2013 to 6.56% in 2018. In 2023, adolescent obesity was found more frequently in urban areas (3.8%) than in rural areas (2.6%) (Risksdas, 2018; SKI, 2023).

Several studies have indicated that the prevalence of obesity tends to rise during middle adolescence and continues into early adulthood. This increasing trend among adolescents has become a global public health concern (Jannah, Pamungkasari, & Prasetya, 2021). If not addressed, adolescent obesity is likely to persist into adulthood and contribute to the onset of chronic diseases. Therefore, early intervention targeting at-risk populations is crucial to mitigate the long-term consequences of adolescent obesity. In developing countries experiencing rapid economic growth, rising adolescent obesity poses a serious challenge to public health systems. Meanwhile, developed countries also report a continued increase in adolescent obesity, with higher rates of overweight and obesity compared to developing countries (Jebeile et al., 2022).

The Sustainable Development Goals (SDGs) emphasize the need to address adolescent obesity through multi-sectoral approaches. SDG 2 (Zero Hunger) focuses on ensuring access to



nutritious, balanced diets and reducing the consumption of ultra-processed foods that contribute to obesity. SDG 3 (Good Health and Well-Being) promotes healthy lifestyles and increased physical activity, alongside improved access to health services that monitor adolescent nutritional status. SDG 4 (Quality Education) plays a vital role in shaping healthy eating habits through nutrition education in schools, helping adolescents understand the importance of a balanced diet and the risks associated with unhealthy food choices.

Physical activity is a key factor in the development of obesity in adolescents. Adolescents who are physically inactive are 1.9 times more likely to experience overnutrition (Nisa et al., 2021). This finding is supported by other studies showing that the risk of obesity is three times higher in adolescents with low physical activity, especially when energy intake exceeds energy expenditure (Telisa, Hartati, & Haripamili, 2020).

A sedentary lifestyle is a significant contributor to adolescent obesity. Obesity occurs when calorie intake exceeds calorie expenditure. Technological advancements and improvements in transportation and household conveniences have made daily life easier, but they also contribute to a reduction in physical activity (Sembiring, Rosdewi, & Yuningrum, 2022). For example, many teenagers prefer using elevators over stairs, ordering food via delivery apps instead of buying it directly, and spending hours watching TV or using gadgets instead of engaging in physical exercise.

Vocational high school (SMK) students aged 16–18 are in a complex stage of emotional and psychological development and may be more vulnerable to stress from academic demands and preparation for the workforce. A preliminary survey conducted at SMK Negeri 1 Medan involving 35 students showed that 12 students (34.3%) were obese, 7 students (20%) were overweight, and 16 students (45.7%) had normal weight based on BMI-for-age (BMI/U) measurements. Additionally, 20 students (57.1%) reported insufficient physical activity, stating they preferred spending time on their phones or playing video games over physical activities. Many of these students developed a habit of engaging in sedentary behavior for several hours daily after school.

Methods

This study is an observational study with a cross-sectional design. The research was conducted at several vocational high schools (SMKs) in Medan City from April to May 2025. The study population included all 14 public vocational high schools in Medan City. Due to the broad population coverage, the researcher selected 30% of the schools using cluster random sampling, resulting in 4 schools: SMK Negeri 1, SMK Negeri 3, SMK Negeri 10, and SMK Negeri 11.

The total student population from the selected schools was 3,849 students. Based on this population and using a 5% margin of error, a sample size of 320 students was determined.



This research involved two main variables: the independent variable, which is physical activity, and the dependent variable, which is the incidence of obesity. Physical activity was assessed based on students' activities during school, sports, and leisure time over the past seven days, using the Physical Activity Questionnaire for Adolescents (PAQ-A). Obesity was defined as a Body Mass Index (BMI) greater than +2 standard deviations (SD) from the WHO growth standard for adolescents.

Univariate analysis was conducted to describe the distribution and frequency of each variable. Bivariate analysis was performed to examine the relationship between physical activity and obesity using the chi-square test, with data processed using statistical software.

Results

Univariate Analysis

Characteristics of Vocational High School Students in Medan City. The respondents in this study were vocational high school students, with characteristics assessed based on gender, age, nutritional status (using Body Mass Index/BMI according to weight and height), emotional eating, eating patterns, and physical activity.

A total of 320 students participated in the study, the majority of whom were 16 years old (194 students or 60.6%) and female (231 students or 72.2%). Based on BMI measurements according to weight and height, the majority of students had a non-obese nutritional status (221 students or 69.1%), while 99 students (30.9%) were categorized as obese.

Table 1. Frequency Distribution of Characteristics of Vocational High School Students in Medan City

Characteristics	n	%
Gender		
Woman	231	72.2
Man	89	27.8
Age		
16 years	194	60.6
17 years	112	35
18 years	14	4.4
IMT		
Obese	99	30.9
Not obese	221	69.1



Physical Activity of Vocational High School Students in Medan City.

Physical activity was assessed using the PAQ-A (Physical Activity Questionnaire for Adolescents), with responses reflecting the students' activity levels over the past week. Based on the study results, it was found that most vocational high school students in Medan City engaged in physical activity occasionally (1–2 times per week) during their free time.

The most frequently performed activity was walking for exercise, reported by 279 students (87.2%), followed by jogging or running by 264 students (82.5%), both with a frequency of 1–2 times per week. Other commonly reported activities included cycling (220 students or 68.8%) and gymnastics (175 students or 55%). Swimming was also reported by a considerable number of students—151 students (47.2%)—at the same frequency.

In addition, some students participated in activities such as dancing (130 students or 40.6%), badminton (121 students or 37.8%), table tennis (101 students or 31.6%), and futsal (96 students or 30%), although these were less evenly distributed across the sample.

Conversely, some physical activities had notably low participation rates. These included rope jumping (86 students or 26.9%), soccer (85 students or 26.4%), volleyball (98 students or 30.6%), and martial arts (92 students or 28.7%). These activities were mostly performed occasionally by a small portion of students, while the majority reported never engaging in them.

Basketball had the lowest participation, with 266 students (83.1%) reporting never playing, followed by roller skating (219 students or 68.4%), and baseball/softball, which was rarely played, with 223 students (69.7%) having never participated.

The high frequency of light to moderate activities such as walking, jogging, and cycling suggests that students tend to prefer accessible, low-cost activities that do not require special facilities. Meanwhile, low engagement in structured or team sports like soccer, volleyball, and basketball may reflect limited access to sports infrastructure or a lack of interest in competitive physical activity.

This pattern indicates that although a number of students engage in some form of physical activity, the intensity and diversity of activities still need to be improved to meet the recommended levels of daily physical activity for optimal adolescent health.



Table 2. Frequency Distribution of Physical Activity During Leisure Time Among Vocational High School Students in Medan City

Activities in PAQ-A	Never		1-2 times / week		3-4 times / week		5-6 times / week		7 times or more	
	n	%	n	%	n	%	n	%	n	%
Jump rope	234	73.1	86	26.9	0	0	0	0	0	0
Roller skating	219	68.4	101	31.6	0	0	0	0	0	0
Walking for exercise	41	12.8	279	87.2	0	0	0	0	0	0
Bicycle	100	31.2	220	68.8	0	0	0	0	0	0
Jogging or running	56	17.5	264	82.5	0	0	0	0	0	0
Exercise	144	45	175	55	0	0	0	0	0	0
Swim	169	52.8	151	47.2	0	0	0	0	0	0
Baseball, Softball	223	69.7	97	30.3	0	0	0	0	0	0
Dance	190	59.4	130	40.6	0	0	0	0	0	0
Football	224	70	96	30	0	0	0	0	0	0
Badminton	198	61.9	121	37.8	1	0.3	0	0	0	0
Football	235	73.4	85	26.4	0	0	0	0	0	0
Volleyball	222	69.4	98	30.6	0	0	0	0	0	0
Table tennis	219	68.4	101	31.6	0	0	0	0	0	0
Basketball	266	83.1	54	16.9	0	0	0	0	0	0
Martial arts (karate, silat, taekwondo)	228	71.3	92	28.7	0	0	0	0	0	0

Physical Activity of Vocational High School Students in Medan City. Based on the results of measuring students' physical activity over the past 7 days, it was found that the overall level of physical activity was low. In the context of physical education (PE) classes, 186 students (58.1%) stated that they only sometimes engaged in vigorous movement (e.g., playing, running, jumping, throwing). Meanwhile, 85 students (26.6%) reported being fairly active, and only 49 students (15.3%) said they were consistently active during PE classes.

During lunch breaks, the majority of students preferred light activity. 127 students (39.7%) reported just standing or walking around, and 40 students (12.5%) said they mostly sat during break time. However, some were more active: 67 students (20.9%) reported running or playing briefly, 53 students (16.6%) were active for longer periods, and 33 students (10.3%) were very active throughout most of the break time.

Regarding after-school physical activity, 137 students (42.8%) exercised once a week, and 65 students (20.3%) did so 2–3 times per week. A significant portion—112 students (35%)—



reported never doing any physical activity after school, and only 6 students (1.9%) exercised up to four times per week. No students reported doing physical activity five times or more per week. This highlights that after-school physical activity is generally low and not done routinely by most students.

In the afternoons, 167 students (52.2%) reported doing physical activity once a week, while 59 students (18.4%) did so 2–3 times a week, and 94 students (29.4%) reported never engaging in any afternoon physical activity. No students exercised more than 3 times a week during the afternoon, suggesting that although some students are active, the frequency remains limited.

On weekends, 241 students (75.3%) reported engaging in physical activity or active play once, and 59 students (18.4%) did so 2–3 times. Only 1 student (0.3%) reported doing physical activity 4–5 times, while 19 students (5.9%) did no physical activity at all. This indicates that weekends are not being optimally utilized by students to increase physical activity.

Students' perceptions of their physical activity habits over the past week also reflected low activity levels. 247 students (77.2%) stated they only engaged in physical activity sometimes (1–2 times per week), while 73 students (22.8%) reported doing it fairly often (3–4 times per week). No students reported engaging in physical activity very frequently (≥ 5 times per week).

Table 3. Frequency Distribution of Physical Activity Among Vocational High School Students in Medan City

Statement	n	%
In the past 7 days, during physical education (PE) class, how often did you engage in vigorous physical activity (e.g., playing actively, running, jumping, throwing)?		
• I did not attend physical education class	0	0
• Almost never	0	0
• Sometimes	186	58.1
• Quite often	85	26.6
• Always	49	15.3
In the past 7 days, what did you usually do during your lunch break?		
• Sit	40	12.5
• Stand or walk around	127	39.7
• Run or play for a short time	67	20.9
• Run or play for a long time	53	16.6
• Run and play for most of the break	33	10.3
• Rest	0	0



In the past 7 days, how many times in the afternoon did you do sports or engage in activities/games that involved a lot of movement?

• Never	94	29.4
• Once in the past week	167	52.2
• 2 or 3 times in the past week	59	18.4
• 4 times in the past week	0	0
• 5 times in the past week	0	0

In the past 7 days, how many times after school did you exercise or engage in activities/games that involved active movement?

• Never	112	35.0
• Once in the past week	137	42.8
• 2 or 3 times in the past week	65	20.3
• 4 times in the past week	6	1.9
• 5 times in the past week	0	0

During the past weekend, how often did you exercise or engage in activities/games that involved vigorous movement?

• Never	19	5.9
• Once	241	75.3
• 2–3 times	59	18.4
• 4–5 times	1	0.3
• 6 or more times	0	0

Which of the following statements best describes your physical activity over the past 7 days?

• I did very little physical activity	0	0
• I was active sometimes (1–2 times in the past week)	247	77.2
• I was often active (3–4 times in the past week)	73	22.8
• I was very often active (5–6 times in the past week)	0	0
• I was active every day (7 times or more in the past week)	0	0

Based on the measurement results, out of a total of 320 respondents, 41 students (12.8%) reported having been ill in the past week, while 279 students (87.2%) reported not experiencing any illness.



Table 4. Frequency Distribution of Illness Incidents Among Vocational High School Students in Medan City

Were you sick last week?	n	%
Yes	41	12.8
No	279	87.2

The distribution of physical activity levels shows that most adolescents fall into the moderate physical activity category, totaling 188 students (58.8%). Meanwhile, 132 students (41.3%) engage in light physical activity. These results indicate that the majority of adolescents have not yet achieved the recommended level of high physical activity needed to support optimal health. The predominance of moderate and light physical activity levels may contribute as a risk factor for the development of overweight or obesity.

Table 5. Frequency Distribution of Physical Activity Levels Among Vocational High School Students in Medan City

Physical Activity Level	n	%
Currently	188	58.8
Light	132	41.3

Bivariate Analysis

The Relationship Between Physical Activity and Obesity in Vocational High School Students in Medan City. The results of data analysis showed that among the 99 students who were obese, 11 students (3.4%) had moderate physical activity, while 88 students (27.5%) had light physical activity. In contrast, among the 221 students who were not obese, 177 students (55.3%) engaged in moderate physical activity, and 44 students (13.8%) engaged in light physical activity.

Based on the bivariate analysis, the p-value was 0.001 ($p < 0.05$), indicating a significant relationship between physical activity and obesity among vocational high school students in Medan City. Students with light physical activity were found to be 32.182 times more likely to experience obesity compared to those with moderate physical activity.



Table 6. Analysis of the Relationship Between Physical Activity and Obesity Incidence Among Vocational High School Students in Medan City

Physical activity	Obesity incident				Total		<i>p-value</i>	Exp(B)
	Obese		Not obese					
	n	%	n	%	n	%		
Currently	11	3.4	177	55.3	188	58.8	0.001	32.182
Light	88	27.5	44	13.8	132	41.3		

Discussion

Overview of Obesity Incidence in Vocational High School Students in Medan City

Obesity is a condition characterized by excess body weight due to the accumulation of body fat. The causes of obesity in adolescents are multifactorial, including excessive intake of macronutrients, frequent consumption of fast food, lack of physical activity, unbalanced diets, and a family history of obesity. Obesity occurs when energy intake exceeds the body's needs, and the surplus energy is stored as fat. Low levels of physical activity increase the risk of obesity because the number of calories burned is lower than the number consumed, leading to fat accumulation in the body (Rahma et al., 2025).

Based on BMI measurements, the study found that most adolescents (221 students or 69.1%) were not obese, while 99 students (30.9%) were classified as obese. This means nearly one-third of the students were obese, indicating a serious health concern among school-aged adolescents.

If not properly managed, obesity in adolescents can have long-term negative effects on health in adulthood. Globally, obesity-related deaths surpass those caused by underweight. Obesity is a major risk factor for numerous non-communicable diseases, such as diabetes mellitus, cardiovascular disease, stroke, cancer, sleep apnea, hypertension, and other complications (Lumbantoruan & Pasaribu, 2023).

Description of Physical Activity Among Vocational High School Students in Medan City

The World Health Organization (WHO) defines physical activity as any bodily movement produced by skeletal muscles that requires energy expenditure. It includes activities during leisure, transportation, work, and household tasks. Moderate to vigorous physical activity contributes to better health. Common forms include walking, cycling, sports, recreational activities, and games that are accessible and enjoyable for people of all fitness levels (WHO, 2024).

Based on the distribution of physical activity levels among vocational high school students in Medan City, 58.8% of students were in the moderate activity category, while 41.3% were categorized as having low physical activity. Although the majority engage in some form of activity, a substantial portion still falls below the recommended activity levels.



Low physical activity is a key risk factor contributing to mortality from non-communicable diseases. Individuals with insufficient activity are 20–30% more likely to die prematurely than those with active lifestyles (WHO, 2024).

Moderate physical activity indicates that students engage in exercise with adequate frequency and intensity but not at an optimal level. According to the Ministry of Health, adolescents aged 5–17 years are recommended to engage in at least 60 minutes of moderate to vigorous intensity physical activity daily to achieve optimal health benefits.

The Relationship Between Physical Activity and Obesity Among Vocational High School Students in Medan City

Physical activity includes all body movements produced by skeletal muscles that require energy. It can be carried out during leisure time, for transportation, or as part of work. Physical activity is crucial for maintaining physical and emotional health, as well as for achieving and maintaining a healthy body weight. It helps balance energy intake from food with energy expenditure, thereby supporting weight control (Pemayun et al., 2022). Based on bivariate analysis between physical activity and obesity incidence among vocational school students in Medan City, the study found a p-value of 0.001 ($p < 0.05$). This indicates a statistically significant relationship between physical activity level and obesity. Students who engage in less physical activity tend to accumulate more body fat due to unutilized energy, increasing their risk of obesity (Hanani et al., 2021). These findings are consistent with research by Paramita, Indonesiani, and Pradnyawati (2023), which demonstrated a significant association between physical activity and adolescent obesity ($p < 0.05$). Similarly, a study by Lathifah (2022) showed a relationship between physical activity and nutritional status among adolescents at SMAS IT Raudhatul Jannah, Cilegon City. The results indicated that lower levels of physical activity were associated with a higher likelihood of being overweight, while individuals with sufficient or high-intensity activity tended to maintain normal weight.

Conclusion

It was concluded that the average energy intake among female students was 2,289.11 kcal, with a minimum of 1,680.60 kcal and a maximum of 2,766.20 kcal. Meanwhile, male students had a higher average energy intake of 2,697.06 kcal, with a minimum of 2,345.76 kcal and a maximum of 3,077.90 kcal. The study found a significant relationship between physical activity and the incidence of obesity among adolescents in Medan City. It is recommended that schools implement and promote engaging extracurricular sports programs to regularly increase students' physical activity levels.



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