

ORIGINAL ARTICLE

The association of delivery application use, physical activity, and sleep duration with BMI among students

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ABSTRACT

Overweight and obesity are nutritional problems that are increasingly prevalent among college students. Lifestyle changes, such as the frequent use of food delivery application, consumption of high-calorie foods or beverages, low levels of physical activity, and insufficient sleep duration, are presumed to be associated with increases in Body Mass Index (BMI). This study aimed to analyze the relationship between these lifestyle factors and BMI among class 2022 students in the General Medicine Study Program, Faculty of Medicine, Jenderal Achmad Yani University.. This study employed a quantitative, analytical, cross-sectional design. Data were collected from 94 respondents using questionnaire and evaluated using logistic regression analysis. The results showed that most respondents had a high frequency of delivery application use (50.0%), ordered high-calorie menu items (96.8%), engaged in very light physical activity (66.0%), and had insufficient sleep duration (78.7%). The analysis indicated no significant relationship between BMI and the frequency of delivery application use ($P>0.05$), type of menu items ordered ($P=0.583$), physical activity ($P=0.247$), or sleep duration ($P=0.368$).. The absence of significant relationships may be influenced by homogeneous lifestyle patterns among the samples and other unexamined factors, such as genetic predisposition, stress levels, and total daily energy intake. Nevertheless, delivery application use, type of menu ordered, physical activity, and sleep duration remain important lifestyle factors relevant to BMI management.

Keywords: Body Mass Index, delivery application, physical activity, sleep duration, students

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INTRODUCTION

Abnormal nutritional status, including underweight and overweight is a risk factor for the increasing incidence of non-communicable diseases (NCDs) globally. The World Health Organization (WHO) states that the nutritional status of adults is assessed using the Body Mass Index (BMI), which is calculated as body weight divided by the square of height (kg/m^2). This method is widely used because it is simple and can be applied to large populations.¹ In addition to the WHO criteria, the Asia-Pacific classification is another recommended standard for BMI assessment in Asian populations.² Currently, obesity has become a global health problem. According to 2022 WHO data, approximately 2.5 billion adults aged 18 years and above were classified as overweight, of whom 890 million were obese.³ Based on data from the Survei Kesehatan Indonesia (SKI) 2023, the prevalence of obesity in Indonesia increased from 21.8% in 2018 to 23.4% in 2023.⁴ At the regional level, the prevalence of overweight and obesity among adults in West Java and Cimahi remained high between 2018 and 2023.⁵ These data indicate that lifestyle changes in society have contributed to an increased risk of long-term health problems, particularly among young adults who are in the phase of establishing lifestyle habits.⁶

College students, as a population of young adults, face various academic and social demands amidst rapid technological developments.⁷ Although technological advancements provides many conveniences, they may also lead to negative consequences, including the widespread use of food delivery applications, which expanded significantly during the mobility restrictions of the COVID-19 pandemic.⁸ However, foods ordered through these applications are generally high in energy, fat, and sugar, which may contribute to excessive daily energy intake.⁹ In addition, academic

activities that predominantly involve prolonged sitting, frequent elevator use, and academic fatigue contribute to low levels of physical activity among students. This combination of excessive energy intake and sedentary behavior can lead to overweight or obesity.¹⁰ Another factor influencing nutritional status is insufficient sleep duration due to academic workload and demanding schedules.¹¹ Sleep deprivation increases ghrelin levels and decreases leptin levels, which in turn stimulates appetite and promotes weight gain.¹²

Students of the General Medicine Study Program at the Faculty of Medicine, Universitas Jenderal Achmad Yani, represent a highly relevant population for investigation. They face demanding intensive academic schedules and rely heavily on food delivery applications, resulting in lifestyle patterns that can directly influence their nutritional status.

METHODS AND SUBJECT

This study aimed to analyze the relationship of frequency of food delivery application use, type of menu items ordered, physical activity, and sleep duration with BMI among students, with all study variables treated as primary endpoints. This investigation employed a quantitative, analytic, cross-sectional design was conducted at the Faculty of Medicine, Universitas Jenderal Achmad Yani from February 2025 to January 2026.

The study population consisted of 191 students from the Class of 2022 in the General Medicine Study Program at the Faculty of Medicine, Universitas Jenderal Achmad Yani. The sample size was determined based on the hypothesis test for two population proportions. The calculation yielded a minimum sample size of 38 respondents per group, resulting in a total minimum required sample of 76 respondents. Ultimately, participants were recruited using a purposive total sampling technique. To meet the inclusion criteria.

The inclusion criteria were students aged 19–23 years who live in boarding houses, and provided informed consent to participate in the study. The exclusion criteria included students with a history of chronic diseases, those undergoing intensive weight-management programs, and those using traditional, non-digital online catering services. This study used primary data collected via questionnaires alongside direct measurements of body weight and height obtained by the researcher.

Ethical approval for this study was obtained from the Research Ethics Committee of the Faculty of Medicine, Universitas Jenderal Achmad Yani

(Approval No. 041/UM1.08/2025). Data processing and analysis were performed using statistical software, which involved data editing, coding, entry, and cleaning. Univariate and bivariate analyses were performed using simple logistic regression with a significance level of $\alpha = 0.05$ to determine the Odds Ratio (OR) and 95% Confidence Interval (95% CI).

RESULTS AND DISCUSSION

Data were collected in September 2025 from 94 respondents who met the inclusion criteria.

Characteristics of Respondents

Table 1 presents the characteristics of respondents based on age and sex.

Table 1. Characteristics of Respondents by Age and Gender

Variable	Frequency (n)	Percentage (%)
Age		
19 years old	1	1.1
20 years old	12	12.8
21 years old	58	61.7
22 years old	20	21.3
23 years old	3	3.2
Gender		
Male	28	29.8
Female	66	70.2

According to Table 1, the majority of respondents were 21 years old (61.7%). Respondents aged 22 years accounted for 21.3%, followed by those aged 20 years (12.8%), 23 years (3.2%), and 19 years (1.1%). This finding is consistent with data from the *Survei Kesehatan Indonesia (SKI)* 2023, which reported a relatively high prevalence of overweight and obesity among adults older than 18 years in West Java Province.⁴ Regarding sex distribution, most respondents were female (70.2%), while male respondents accounted for 29.8%. This finding aligns with a previous study conducted in 2025 on BMI among Class of 2022 medical students at Malahayati University, which also reported that the majority of respondents were female

(73.9%). These findings reflect a broader trend in which by female students comprise the majority of the student population in medical education program.¹³ This distribution is also reflected in the General Medicine Study Program at the Faculty of Medicine, Universitas Jenderal Achmad Yani (Class of 2022), where the ratio of female to male students is 1.77:1.

Distribution of Food Delivery Application Use, Physical Activity, Sleep Duration, and BMI

Table 2 shows the distribution of respondents based on their frequency of food delivery application use, type of menu items ordered, physical activity levels, sleep duration, and BMI.

Table 2. Distribution of Food Delivery Application Use, Physical Activity, Sleep Duration, and BMI Among Respondents

Variable	Frequency (n)	Percentage (%)
The Frequency of Food Delivery Application Use		
Low (≤ 4 times per month)	15	16.0
Moderate (5–8 times per month)	32	34.0
High (> 8 times per month)	47	50.0
The Types of Food Ordered		
Moderate-calorie (100–399 kcal)	3	3.2
High-calorie (≥ 400 kcal)	91	96.8
Physical Activity		
Very light (1.20–1.39)	62	66.0
Light (1.40–1.69)	32	34.0
Sleep Duration		
Insufficient (< 7 hours)	74	78.7
Adequate (≥ 7 hours)	20	21.3
BMI		
Underweight (< 18.5)	9	9.6
Normal (18.5–22.9)	39	41.5
Risk (23.0–24.9)	20	21.3
Obesity I (25.0–29.9)	20	21.3
Obesity II (≥ 30.0)	6	6.4

According at Table 2, half of respondents showed a high frequency of food delivery application use (50.0%), followed by the moderate category (34.0%) and the low use category (16.0%).

The high frequency of food delivery application use observed in this study is consistent with a study conducted in Bandar Lampung (2024) among students living in boarding houses. That study similarly reported that most students were active users of food delivery services, with a usage rate of more than 15 times per month. This patters is associated with ease of access, time efficiency, and demanding academic activities, making food delivery applications a practical solution for students to meet their daily dietary needs.¹⁴

Regarding the type of menu items ordered, almost all respondents chose high-calorie menu option (96.8%), while only 3.2% selected moderate-calorie option. This finding is consistent with a 2025 study among nutrition students at Mulawarman University, which reported a tendency to select fast-food items that are high in fat and sugar but low in nutritional value. This

dietary pattern is influenced by time constraints from academic demands and the convenience of food delivery applications, which provide easy access to fast food options. Over time, the excessive consumption of these high-calorie food may critically increase the risk of developing overweight and obesity.⁹

Regarding physical activity, the majority of respondents fell into the very light category (66.0%), while the remaining 34.0% were classified into the light category. This finding is consistent with a 2022 study conducted in Bali , which similarly reported that most university students engaged in low levels of physical activity. Among final year students, this sedentary trend may be driven by substantial time spent completing their thesis, which involves prolonged sitting and extensive electronic device usage, thereby reducing opportunities for regular physical activity.¹⁵

In terms of sleep duration, the majority of respondents reported insufficient sleep (78.7%), whereas only 21.3% had adequate sleep duration.

This high prevalence of inadequate sleep duration among these medical students aligns with a previous study at the Faculty of Public Health, Airlangga University (2022), which reported that most students slept fewer than 7 hours per day.¹⁶

BMI values were classified into five categories: underweight, normal weight, at-risk, obesity class I, and obesity class II. The results revealed that the largest proportion of respondents fell within the normal weight category (41.5%). The at-risk and obesity class I categories each accounted for 21.3% of the sample, while, the underweight and obesity class II categories accounted for 9.6%

and 6.4%, respectively. This distribution is consistent with a study among medical students at Muslim University of Indonesia (2023), which reported that 10.4% of students were classified as at-risk, 15.6% as obesity class I, and 7.8% as obesity class II.¹⁷

The Relationship Between Frequency of Food Delivery Application Use and BMI

Table 3 presents the relationship between the frequency of food delivery application use and BMI among students in the General Medicine Study Program, Faculty of Medicine, Universitas Jenderal Achmad Yani, Class of 2022.

Table 3. The Relationship between Frequency of Food Delivery Application Use and BMI

Variable	BMI				OR (95% CI)	P value
	Abnormal		Normal			
	(≥23kg/m²)		(<23kg/m²)			
	n	%	n	%		
The Frequency of Food Delivery Application Use						
Low	7	46.7	8	53.3	Ref	0.844
Moderate	17	53.1	15	46.9	1.295 (0.379–4.428)	0.680
High	22	46.8	25	53.2	1.006 (0.314–3.224)	0.992

Reff=reference

As shown in Table 3, the logistic regression analysis revealed that all P-values exceeding 0.05, indicating no statistically significant relationship between the frequency of food delivery application use and BMI. However, the moderate-use category had an odds ratio (OR) of 1.295, and the high-use category had an OR of 1.006, indicating a tendency toward an increased risk of abnormal BMI compared with the low frequency category.

The results of this study are consistent with those of a previous study conducted among nutrition students at Makassar University (2025), which similarly reported no relationship between these variables ($P = 0.981$). As suggested in that investigation, students may balance their delivery app habits by meeting their dietary needs through direct food purchases or by preparing

meals independently. In addition, nutritional status may also be influenced by other factors, such as genetic predisposition, dietary patterns, and infectious diseases.¹⁸

This lack of association is also consistent with a similar study conducted among students in the Faculty of Health Sciences at Universitas Pembangunan Nasional Veteran Jakarta (2024), which reported no significant relationship between the frequency of food delivery application use and the incidence of overweight ($P = 0.676$). That study emphasized that genetic factors, particularly parental history of obesity, play a more dominant role in determining nutritional status. Specifically, a parental history of obesity increases a student's risk of becoming overweight by 1.8 times if the father is obese, and by 2.18 times if the mother is obese.¹⁹

In contrast, these findings differ from a previous study conducted in Semarang (2023), which reported a statistically significant relationship between the frequency of food delivery application use and overweight status, with a p-value of 0.007. That study concluded that high utilization of food delivery services among college students was driven by convenient access, which may increase the risk of excessive body weight.²⁰

In the present study, the absence of a significant relationship between the frequency of food delivery application use and BMI may be explained by the fact that

ordering frequency does not necessarily reflect the respondents' total daily energy intake. Medical students tend to have similar dietary patterns. Therefore, increased ordering frequency may not reflect higher energy intake.

The Relationship Between Type of Menu Ordered and BMI

Table 4 presents the relationship between the type of menu items ordered and BMI among students in the General Medicine Study Program at Faculty of Medicine, Universitas Jenderal Achmad Yani, (Class of 2022).

Table 4. The Relationship between Type of Menu Ordered and BMI

Variable	BMI				OR (95% CI)	P value
	Abnormal (≥23kg/m²)		Normal (<23kg/m²)			
	n	%	n	%		
	The Types of Food Ordered					
Moderate-calorie	1	33.3	2	66.7	Reff	0.583
High-calorie	45	49.5	46	50.5	1.957 (0.171–22.344)	

Reff=reference

As shown in Table 4, the logistic regression analysis yielded a p-value of 0.583, indicating that there was no statistically significant relationship between the type of menu items ordered and BMI. Respondents who ordered high-calorie items exhibited an odd ratio (OR) of 1.957, indicating that this group had approximately two times greater risk of having abnormal BMI compared to those who ordered moderate-calorie items.

The findings of this study are consistent with research conducted in Pekanbaru (2025), which reported no relationship between total caloric intake and obesity incidence ($P = 0.068$). That study concluded that individuals with high caloric intake do not necessarily develop obesity if the energy consumption is balanced by an equivalent level of energy expenditure.²¹

This finding is also supported by a study conducted in Jakarta (2019), which reported no significant relationship between caloric intake and the degree of obesity, with a P value of 0.135. Although caloric intake and BMI increased over time, a direct relationship could not be established. This suggests that obesity is influenced not only by caloric intake but also by overall dietary patterns, including meal frequency and meal timing.¹⁹

However, these findings differ from a study conducted in Semarang (2023), which found a significant relationship between food menu selection and overweight status ($P = 0.0001$). That investigation explained that food delivery services provide users with the freedom to choose the type and quantity of food, thereby facilitating access to high-calorie menu items through the wide range of available options. This convenience may have negative effects if it is not accompanied by adequate control over food choices.²⁰

In the present study, the absence of a statistically significant relationship between the type of menu items ordered and BMI may be due to the methodological limitation. Specifically, menu type was evaluated only based on calorie content per portion, without considering the actual consumption frequency or the respondents' overall dietary patterns. In addition, foods ordered through delivery applications are not the only source

of daily energy intake for the respondents.

The Relationship Between Physical Activity and BMI

Table 5 presents the relationship between physical activity and BMI among students within General Medicine Study Program at Faculty of Medicine, Universitas Jenderal Achmad Yani (Class of 2022).

Table 5. The Relationship between Type of Menu Ordered and BMI

Variable	BMI				OR (95% CI)	P value
	Abnormal (≥23kg/m ²)		Normal (<23kg/m ²)			
	n	%	n	%		
Physical Activity						
Very light	33	53.2	29	46.8	1.663 (0.701–3.946)	0.247
Light	13	40.6	19	59.4	Ref	

Reff =reference

According to Table 5, the logistic regression analysis yielded a P- value of 0.247, indicating no statistically significant relationship between physical activity and BMI. The odds ratio (OR) value of 1.663 indicates that respondents with very light physical activity had a 1.6-fold higher risk of having abnormal BMI compared with those with light physical activity.

The results of this study are consistent with research conducted in Tangerang (2025), which reported no significant relationship between physical activity and obesity incidence ($P=0.822$). These findings suggest that the influence of physical activity on obesity cannot be separated from nutritional intake patterns, particularly fat intake.²²

A similar study conducted in Jember (2023) also reported no significant relationship between physical activity and the incidence of obesity ($P=0.127$). The study reported that although obese students tended to have lower levels of physical activity, obesity results from an imbalance between energy intake and expenditure, particularly when low activity levels are

combined with excessive food intake.²³

However, these findings differ from a study conducted in Aceh (2023), which reported a significant relationship between physical activity and obesity ($P = 0.010$). The study explained that low levels of physical activity are a major factor contributing to obesity because they disrupt metabolic balance between energy intake and energy expenditure.²⁴

In the present study, the absence of a significant relationship between physical activity and BMI may be due to the homogeneity of physical activity levels among the respondents. The vast majority of students had relatively similar activity patterns dominated by very light to light physical activity, resulting in limited variability in physical activity levels.

The Relationship Between Sleep Duration and BMI

Table 6 presents the relationship between sleep duration and BMI among students within the General Medicine Study Program at Faculty of Medicine, Universitas Jenderal Achmad Yani (Class of 2022).

Table 6. The Relationship between Sleep Duration and BMI

Variable	BMI				OR (95% CI)	P value
	Abnormal (≥23kg/m ²)		Normal (<23kg/m ²)			
	n	%	n	%		
Sleep Duration						
Insufficient	38	51.4	36	48.6	1.583 (0.580–4.321)	0.368
Adequate	8	40.0	12	60.0	Reff	

Reff =reference

As shown in Table 6, the logistic regression analysis showed a P-value of 0.368, indicating that there was no statistically significant relationship between sleep duration and BMI. The odds ratio (OR) value of 1.583 indicates that respondents with insufficient sleep duration had a 1.5-fold higher risk of having abnormal BMI compared with those with adequate sleep duration.

These findings are consistent with research conducted among engineering students at Universitas Tarumanagara (2022), which reported no relationship between sleep duration and nutritional status ($P = 0.600$). That study concluded that unbalanced nutritional intake may influence sleep duration and trigger sleep disturbances.²⁵

Similarly, a study among medical students at the Islamic University of North Sumatera (2021) also reported no significant relationship between sleep duration and nutritional status, both among male respondents ($P \text{ value} = 0.077$) and female respondents ($P \text{ value} = 0.568$). The study suggested that overweight is influenced by genetic and environmental factors, such as parental obesity, excessive food intake, low physical activity, and general lifestyle habits. Therefore, sleep duration alone cannot be considered a determining factor for an increased BMI.²⁶

However, these findings contrast with a study conducted among medical students at the Universitas Lambung Mangkurat (2023), which reported a

significant relationship between sleep duration and obesity ($P = 0.002$). That study explained that insufficient sleep may lead to hormonal imbalance, characterized by increased ghrelin and decreased leptin levels. This hormonal shift can increase energy intake, disrupt metabolic balance, and ultimately contribute to weight gain.²⁷

In the present study, the absence of a significant relationship between sleep duration and BMI may be due to measurement limitations, as this study only assessed sleep duration without considering sleep quality. In addition, because the respondents belong to the early adulthood age group, they still have a relatively strong physiological capacity for metabolic compensation.

CONCLUSION

Based on the results of this study, it can be concluded that there are no statistically significant associations between the frequency of food delivery application use, the type of menu items ordered, physical activity levels, or sleep duration and BMI among the respondents. Despite these findings, students are encouraged to maintain healthy lifestyles by regularly monitoring their BMI, managing their use of food delivery applications, limiting their intake of foods high in sugar and fat, increasing physical activity, and ensuring adequate sleep. Educational institutions can support these efforts by implementing health programs that promote regular physical activity. Future research should explore additional variables that may influence BMI in this population, such as genetic factors, stress levels, and total daily energy intake.

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The authors declare that they have no conflicts of interest regarding the publication of this paper.

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