



Mapping Early Health Risks: Fast-Food Consumption, Body Mass Index, and Blood Pressure among Adolescents

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Abstract: Obesity and hypertension among adolescents are increasingly alarming public health problems globally and nationally. The World Health Organization (WHO) reported a sharp increase in the number of overweight children and adolescents aged 5–19 years, reaching approximately 390 million by 2022. This study aims to determine the relationship between the frequency of fast-food consumption and the incidence of obesity and elevated blood pressure. Using an analytical cross-sectional design, the study involved adolescents in grades 8 and 9 at SMP Muhammadiyah 3 Medan. Participants were selected using proportionate stratified random sampling, and data were collected through interviews on fast-food consumption frequency, anthropometric measurements, and blood pressure measurements. The prevalence of obesity, including overweight, among the respondents was 35.7% (obesity alone was 16.7%). Fast food consumption was categorized as high, with 82.1% of respondents identified as "frequent" consumers. Fisher's Exact Test found no statistically significant association between the frequency of fast-food consumption and obesity ($p=0.557$) or elevated blood pressure ($p=0.384$). Thus, the frequency of fast-food consumption is not statistically associated with obesity or elevated blood pressure in this student population. Despite these findings, the high prevalence of frequent fast-food consumption and overweight highlights the importance of promoting balanced nutrition, regular physical activity, and routine monitoring of adolescents' nutritional status and blood pressure.

Keywords: adolescents, blood pressure, body mass index, fast food, obesity

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INTRODUCTION

Adolescence represents a critical period of physical and cognitive development that requires high nutritional support (Wijayati et al., 2024). However, this phase is often marked by a shift toward a poorer-quality diet, characterized by increased intake of processed foods and high-calorie snacks, which contributes significantly to the escalating global health crisis of adolescent obesity (Shaumi & Achmad, 2019).

The prevalence of obesity in Indonesia's adult population remains a serious issue, with figures exceeding national averages in certain regions, including Medan (23,8% for ages 18-25 and 21,8% for ages 26-45) (Purba et al., 2019; Siregar, 2019). This nutritional imbalance during adolescence is a major precursor to non-communicable diseases that typically manifest in adulthood, most notably hypertension (Sanyaolu et al., 2019). Global figures indicate that approximately 8% to 10% of adolescents suffer from hypertension, a rate associated with the increasing obesity epidemic (Islam et al., 2025).

Fast food consumption is a key driver of this energy imbalance (Sakir et al., 2024). These foods are typically high in calories, saturated fats, and, importantly, sodium, which contributes to weight gain and elevated blood pressure by increasing blood volume and potentially causing vascular dysfunction (Andriani et al., 2021; Rachmi et al., 2021). The convenience, palatability, and affordability of fast food have made it a preferred choice among adolescents (Kazi et al., 2020). Given the high rates of obesity and hypertension in the broader region, this study specifically aims to investigate the relationship between the frequency of fast food consumption and the incidence of obesity and elevated blood pressure among urban junior high school students at SMP Muhammadiyah 3 Medan.

METHODS

Design, Time, and Place

This study was conducted at SMP Muhammadiyah 3 Medan in July 2025 using an analytical observational, cross-sectional design. This design allowed simultaneous measurement of the independent variable (fast food consumption frequency) and the dependent variables (obesity status and blood pressure) at a single point in time.

Population and Sample

The target population included all students in grades 8 and 9. The sample size was determined using Slovin's formula. With a total population of 516 individuals (252 in grade 8 and 264 in grade 9), the calculation yielded a minimum sample size of 83.76, which was subsequently rounded up to 84 participants. Participants were selected using proportionate stratified random sampling to ensure adequate representation across classes.

Research Procedure and Instrument

The data collection procedure was conducted at a single time point, involving two main methods: interviews and clinical/anthropometric examinations. Each research instrument was tailored to measure its intended variable.

*Variables and Measurements*Fast Food Consumption Frequency (Independent Variable)

Measured using a structured, validated ($P > 0.05$) and reliable ($\alpha = 0.974$) food frequency questionnaire (FFQ), with responses categorized into "Frequent" or "Infrequent". The "Frequent" category included respondents with an FFQ score ≥ 45 , whereas the "Infrequent" category included those with a score < 45 . The total score was calculated by summing scores for 30 food items: 1 point (0–2 times/month), 2 points (3–4 times/month), and 3 points (2–7 times/week). The FFQ items were fried chicken, hamburgers, hot dogs, pizza, sandwiches, spaghetti, French fries, chicken nuggets, sausages, fritters (gorengan), doughnuts, fried or grilled meatballs (bakso goreng/bakar), fried noodles (mi goreng), instant noodles, steamed fish dumplings (siomay), chicken porridge (bubur ayam), mixed vegetable salad with peanut sauce (gado-gado/pekal), rice cakes in vegetable curry (lontong sayur), meatball noodle soup (mi bakso), seasoned satay (sate bumbu), Padang rice (nasi padang), canned food, carbonated drinks, sushi, kebabs, chips (keripik), fried rice (nasi goreng), waffles, pancakes, and Indonesian stuffed pancakes (martabak). These foods are fast foods high in macronutrients (fat) and micronutrients (sodium and MSG).

Obesity (Dependent Variable)

Determined using anthropometric measurements of weight and height to calculate the Body Mass Index (BMI). Nutritional status was classified based on the CDC 2000 BMI-for-Age charts, with obesity defined as a BMI above the 95th percentile ($> P95$).

Blood Pressure (Dependent Variable)

Measured using a sphygmomanometer. Readings were categorized as "Normal" or "Elevated Blood Pressure" according to established clinical cut-offs for the adolescents' specific age, sex, and height percentile (The American Academy of Pediatrics/AAP 2017).

Data Processing and Analysis

Data were processed using standard procedures, including editing, coding, and data entry. Descriptive statistics were used to analyze demographic characteristics and prevalence rates, while Fisher's Exact Test was used for bivariate analysis to assess the presence and strength of associations between the independent and dependent variables. Additionally, statistical significance was defined as $p < 0.05$.

RESULTS

Based on Table 1, most of the 84 respondents were female (48 respondents, 57.1%), and the largest age group was 13-year-olds (40 respondents, 47.6%). For lifestyle factors, most respondents reported 'frequent' fast food consumption (69 respondents, 82.1%). Furthermore, 42 respondents (50.0%) had normal nutritional status, while 60.7% had elevated blood pressure.

Table 1*Characteristics of Respondents*

Characteristics of respondents	N	%
Gender		
Male	36	42.9
Female	48	57.1
Age (Year)		
12	6	7.1
13	40	47.6
14	36	42.9
15	2	2.4
Grade of Junior Highschool		
VIII (eight)	41	48.8
IX (nine)	43	51.2
Fast Food Consumption Frequency		
Infrequent	15	17.9
Frequent	69	82.1
Nutritional Status		
Underweight	12	14.3
Normal	42	50.0
Overweight	16	19.0
Obesity	14	16.7
Blood Pressure		
Normotension	33	39.3
Elevated blood pressure	18	21.4
Type I hypertension	26	31.0
Type II hypertension	7	8.3
Total	84	100

As shown in Table 2, the median (min–max) values were 45,1 kg (25,0–87,0 kg) for weight, 153,0 cm (132,0–174,0 cm) for height, 113,5 mmHg (84,0–144,0 mmHg) for systolic blood pressure, and 78,5 mmHg (50,0–97,0 mmHg) for diastolic blood pressure.

Table 2*Univariate Analysis*

Characteristics of respondents	Median	Minimal	Maximal
Weight (Kg)	45.1	25.0	87.0
Height (cm)	153.0	132.0	174.0
Systolic blood pressure (mmHg)	113.5	84.0	144.0
Diastolic blood pressure (mmHg)	78.5	50.0	97.0

Based on Table 3, among the 69 respondents in the 'Frequent' fast food consumption group, 43 (51.2%) were not obese (underweight or normal), while 26 (31.0%) were classified as obese (overweight or obese). Conversely, in the 'Infrequent' group (n=15 respondents), 11 (13.1%) were not obese, and 4 (4.8%) were obese. The categories were simplified to non-obese and obese to meet the requirements for Fisher's Exact Test, as the data did not satisfy the Chi-square criteria. Fisher's Exact Test yielded a p-value of 0.557, which is greater than 0.05. Therefore, there is no statistically

significant relationship between the frequency of fast food consumption and nutritional status among students at SMP Muhammadiyah 3 Medan.

Table 3

Correlation between Fast Food Consumption Frequency and Nutritional Status

Fast Food Consumption	Nutritional Status				Total		p-value
	Non-Obese		Obese				
	n	%	n	%	n	%	
Frequent	43	51.2	26	31.0	69	82.1	0.557*
Infrequent	11	13.1	4	4.8	15	17.9	
Total	54	64.3	30	35.8	84	100.0	

Based on Table 4, in the 'Frequent' fast-food consumption group (n=69 respondents), 29 (34.5%) had normal blood pressure, while 40 (47.6%) exhibited elevated blood pressure. Conversely, in the 'Infrequent' consumption group (n=15 respondents), 4 (4.8%) had normal blood pressure, and 11 (13.1%) showed elevated blood pressure. Fisher's Exact Test yielded a p-value of 0.384. Since this value exceeds the significance level of 0.05, there was no statistically significant relationship between the frequency of fast food consumption and elevated blood pressure among students at SMP Muhammadiyah 3 Medan.

Table 4

Correlation between Fast Food Consumption Frequency and Blood Pressure

Fast Food Consumption	Nutritional Status				Total		p-value
	Normal		Increased				
	n	%	n	%	n	%	
Frequent	29	34.5	40	47.6	69	82.1	0.384
Infrequent	4	4.8	11	13.1	15	17.9	
Total	33	39.3	51	60.7	84	100.0	

DISCUSSION

This cross-sectional study presents a complex picture of adolescent health behaviors and outcomes at SMP Muhammadiyah 3 Medan. The study revealed an alarmingly high prevalence of unhealthy dietary habits, alongside severe rates of precursors to non-communicable diseases. The prevalence of frequent fast-food consumption was exceptionally high, reported by 82.1% of students. This finding confirms the widespread adoption of Western-style dietary practices and the high exposure to high-calorie, nutrient-poor foods in this school-age population (Kruger et al., 2019). This dietary shift aligns with rapid urbanization and rising disposable income in the Medan area (Rahman & Khan, 2020).

The measured health outcomes underscore the severity of the problem. The combined prevalence of overweight and obesity (35.7%) far exceeds the national average of 29.5% among Indonesian adolescents (Ministry of Health of the Republic of Indonesia, 2018). Furthermore, the rate of elevated blood pressure, including hypertension, at 60.7% is profoundly concerning. High blood pressure in adolescence is strongly associated with an increased risk of cardiovascular disease later

in life (Jones et al., 2021). These high rates suggest that the environmental and behavioral risk factors are pervasive and potent within this community.

Despite high fast food consumption and high obesity and elevated blood pressure rates, the study found no statistically significant relationship between fast food frequency and either obesity ($p = 0.557$) or elevated blood pressure ($p = 0.384$). Although this finding appears counterintuitive, it could reflect the limitations of examining a single dietary variable in a multifactorial condition. Researchers attribute these findings to complex confounding variables, including genetics, pubertal timing, socioeconomic status, sleep duration, physical activity, screen time, dietary fiber intake, stress levels, environmental density, and reverse causation (Bernabe-Ortiz & Carrillo-Larco, 2020; Livingston et al., 2021; Lontaan et al., 2025).

Obesity as a Result of Total Energy Imbalance

The primary etiology of obesity is a sustained positive energy balance, regardless of the source of the calories (Smith & Doe, 2020). While fast-food contributes significantly to energy surplus, focusing only on its frequency may overlook the broader context of total energy intake. It is plausible that students categorized as "infrequent" fast-food consumers (17.9% of the sample) derive their excess calories from other prevalent sources, such as daily consumption of sugary drinks, high-fat street snacks, or large portion sizes of traditional meals (Putri et al., 2024; Samosir et al., 2025).

Several studies have challenged the presumed link between fast-food and weight gain among young people. Longitudinal research across multiple USA cities found no significant correlation between fast-food consumption and changes in BMI among school-aged populations, even after accounting for the density of fast-food outlets along school-to-home routes (Purba et al., 2021). Similar results emerged in Surabaya, Indonesia, where a study of elementary students reported no correlation between fast-food intake and obesity ($P=0.298$), despite the inclusion of sedentary lifestyle factors such as digital device usage (Zunnahri et al., 2025). Furthermore, a large-scale international cross-sectional analysis spanning 17 countries confirmed the absence of a direct association between fast-food and BMI in adolescents (Braithwaite et al., 2014; Bernabe-Ortiz & Carrillo-Larco, 2020).

The significant number of students who reported frequently consuming fast-food yet maintained a normal weight (43 respondents) suggests they may be compensating for the high caloric intake through greater physical activity or a higher basal metabolic rate, which is common among growing adolescents (Jones et al., 2019).

The Dominance of Other Lifestyle Factors

The lack of a significant correlation also highlights the potential dominance of other, unmeasured confounding variables. Physical activity is a critical determinant of both obesity and hypertension (Lee & Kim, 2021). If physical activity levels are uniformly low across the entire sample (both frequent and infrequent fast-food consumers), then the variance in health outcomes would be driven more by this lack of activity than by the fast-food variable itself.

Confounding Sources of Sodium and Fat in Elevating Blood Pressure

Among the 40 participants with elevated blood pressure and frequent fast-food intake, the statistical analysis found no significant correlation. This outcome differs from established dietary theories, which typically suggest that the high concentrations of trans fats and sodium in fast-food directly escalate blood pressure (Rezende-Alves et al., 2020). While the consumption of calorie-dense, salty, and fat-rich fast-food is a recognized driver of hypertension in teenagers, this specific data set suggests other variables may be involved.

One possibility is that fast-food is not the sole or primary source of sodium for these individuals. Highly processed snacks and the heavy use of seasonings in home-cooked meals can contribute an equal or greater amount of sodium to a teenager's diet, thereby triggering hypertensive responses (Rahman & Khan, 2020). Consequently, in regions where "hidden sodium" is prevalent across various food types, the specific frequency of fast-food visits may be a less reliable predictor of blood pressure than the cumulative daily sodium intake from all sources (Lee & Kim, 2021). This underscores the importance of monitoring total salt consumption relative to the Ministry of Health's recommended daily limit of 2,000 mg (Ginting et al., 2024).

Although literature on this specific discrepancy remains limited, findings by Khuzaimah et al. (2025) mirror the results of this research ($P=0.289$). Their findings suggest that non-modifiable factors, such as genetics, often more strongly dictate adolescent blood pressure levels. For instance, children whose parents both suffer from hypertension face a risk 4 to 15 times higher than those with no such family history, while the prevalence stands at roughly 12.8% for those with at least one hypertensive parent (Mardianti et al., 2020).

Methodological Limitations

The primary methodological limitation is the severe imbalance in the sample size between the two fast-food consumption categories (n frequent = 69 vs. infrequent = 15). This uneven distribution significantly reduced the statistical power of Fisher's Exact Test to detect a true difference, especially when the effect size is small or moderate. The results, therefore, should be interpreted cautiously, primarily indicating that frequency as measured here is not an independent factor, rather than dismissing the well-established biological risk of high-calorie, high-sodium foods on cardiovascular health. Furthermore, further research is required to quantify the portion sizes and energy content of each menu item to minimize portion-size bias when defining the frequency of fast-food consumption.

CONCLUSION

Most of the respondents were female, 13 years old, frequently consumed fast-food, were of normal weight, and had normal blood pressure. The frequency of fast-food consumption was not significantly associated with the incidence of obesity ($P = 0.557$) or elevated blood pressure ($P = 0.384$) among adolescents at SMP Muhammadiyah 3 Medan. Future studies should implement and evaluate school-based longitudinal interventions to address the high frequency of fast-food intake by integrating nutritional literacy with digital wellness education and mitigating long-term metabolic risks. Additionally, researchers should explore the influence of confounding variables, such as sleep

hygiene and genetic resilience, to determine how these factors may temporarily mask the physiological impact of poor dietary habits in adolescence.

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Author Contribution Statement

Bertrand Matahari Pustahasakti Siagian: Conceptualization, Data curation, Formal analysis, Investigation, Writing-original draft. **Winra Pratita:** Conceptualization, Methodology, Resources, Supervision. **Bayu Rusfandi Nasution:** Investigation, Validation, Writing-original draft. Afrida Aryani Nasution: Data curation, Investigation, Resources. **Fauzan Azmi Hasti Habibi Samosir:** Methodology, Data curation, Software, Validation, Visualization. **Bernard Bintang Pustahabima Siagian:** Data curation, Investigation, Software, Writing-reviewing. **Saroj Wannapokin:** Software, Validation, Writing-reviewing & editing.

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