



FAST FOOD, FIBER INTAKE, SLEEP DURATION, AND PHYSICAL ACTIVITY AS PREDICTORS OF EXCESS WEIGHT IN SURAKARTA ADOLESCENTS

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ABSTRACT

Overweight among adolescents results from an energy imbalance between caloric intake and energy expenditure. The World Health Organization (WHO) has declared obesity a global epidemic, with approximately 28.5% of Indonesian adolescents reported to have excess body mass index (BMI). This study aimed to analyze the association between fast food consumption frequency, dietary fiber intake, sleep duration, and physical activity with the severity of excess weight status (overweight vs. obesity) among adolescents aged 16–18 years in Surakarta, Indonesia. This cross-sectional study involved 100 respondents with excess weight. Data were collected using a Food Frequency Questionnaire (FFQ), Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ), Sleep Duration Questionnaire (STQ), and International Physical Activity Questionnaire (IPAQ), with nutritional status determined through anthropometric measurements. The FFQ and SQ-FFQ had been previously validated with a Pearson correlation coefficient $r > 0.6$ and reliability coefficient (Cronbach's alpha) > 0.7 . The STQ was validated with $r > 0.6$ and Cronbach's alpha > 0.8 , while the IPAQ has been internationally validated and widely used across studies. Nutritional status was determined through anthropometric measurements. Data analysis included chi-square tests and binary logistic regression. Of 100 respondents, 56% were classified as overweight and 44% as obese. Chi-square analysis revealed significant associations between fast food consumption frequency ($p = 0.020$), dietary fiber intake ($p < 0.001$), and sleep duration ($p = 0.013$) with the severity of excess weight status, while physical activity showed no significant association ($p = 0.912$). Binary logistic regression identified low dietary fiber intake as the most dominant risk factor (OR = 29.034; 95% CI = 6.216–135.605; $p < 0.001$), followed by low fast food consumption frequency (OR = 7.941; 95% CI = 1.447–43.579; $p = 0.017$). Low dietary fiber intake is the most dominant risk factor for the severity of excess weight status among adolescents.

Keywords: adolescents; dietary fiber; fast food; overweight and obesity; physical activity; sleep duration

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INTRODUCTION

Overweight occurs when energy intake from food exceeds energy expenditure, leading to excess energy stored as body fat (Pradigdo et al., 2023). The World Health Organization (WHO) reports that obesity has become a global epidemic, affecting 16% of adolescents aged 13-15 years and 13.5% aged 16-18 years (Wahyuni et al., 2024). In Indonesia, 28.5% of adolescents are recorded as having excess body mass index (Wahyuni et al., 2024). Fast food consumption is a major contributing factor, as these foods are high in calories but low in nutritional value (Pratama et al., 2021). Adolescents tend to favor fast food for its convenience and accessibility, making it a significant risk factor for overweight (Harianto et al., 2022). Low dietary fiber intake also plays an important role in overweight. Dietary fiber slows gastric emptying, increases satiety, and helps regulate energy intake (Meutiarani, 2017). A large-scale study using NHANES 1999-2018 data found that individuals with the highest fiber intake had a 26% lower risk of obesity compared to those with the lowest intake (Zeng et al., 2025). This confirms that inadequate fiber consumption is

a significant risk factor for overweight, particularly among adolescents with high-energy dietary patterns (Sary et al., 2021).

Sleep is a fundamental biological need whose requirements vary across different stages of life. Sleep patterns encompass duration, schedule, rhythm, frequency, and sleep satisfaction over a relatively fixed period of time (Widiyanto, 2016). According to the Indonesian Ministry of Health, adolescents require approximately 8-9 hours of sleep per night to support ongoing physical growth and rapid hormonal development (Kementerian Kesehatan Republik Indonesia, 2021). Sleep deprivation disrupts the balance of ghrelin and leptin, increasing appetite and promoting overconsumption of high-calorie foods (Josiane et al., 2016). This hormonal imbalance leads to increased hunger throughout the day, difficulty feeling full after eating, and a tendency to snack on high-calorie foods, particularly at night (Nur, 2022). In addition, insufficient physical activity further contributes to energy surplus, which is stored as body fat and leads to overweight over time (Wibisono et al., 2024). Based on this background, this study aims to analyze the association between fast food consumption frequency, fiber intake, sleep duration, and physical activity with overweight among adolescents aged 16-18 years in Surakarta, Indonesia.

METHOD

This study employed a cross-sectional design conducted among adolescents aged 16-18 years in Surakarta, Indonesia. A total of 100 respondents were recruited using purposive sampling, consisting of 56 overweight and 44 obese adolescents based on BMI-for-age criteria. Data collection began with verification of respondent identity completeness and questionnaire filling, including the Fast Food Frequency Questionnaire (FFQ), Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ), Sleep Duration Questionnaire (STQ), and International Physical Activity Questionnaire (IPAQ). Fast food consumption frequency was measured using the FFQ, while fiber intake was assessed using the SQ-FFQ. The FFQ and SQ-FFQ had been previously validated with a Pearson correlation coefficient $r > 0.6$ and reliability coefficient (Cronbach's alpha) > 0.7 . The STQ was validated with $r > 0.6$ and Cronbach's alpha > 0.8 , while the IPAQ has been internationally validated and widely used across studies. Nutritional status was determined through anthropometric measurements. Anthropometric measurements including body weight and height were obtained using a body scale and stadiometer to determine nutritional status based on Body Mass Index (BMI). Data analysis was conducted in stages, comprising univariate analysis, bivariate analysis using the chi-square test, and multivariate analysis using binary logistic regression. This study received ethical approval from Dr. Moewardi Regional General Hospital, Surakarta, (No. 301/II/HREC/2026).

RESULT

A total of 100 respondents with excess weight participated in this study, comprising 56 respondents (56%) classified as overweight and 44 respondents (44%) classified as obese. Table 1, presents the bivariate analysis results, and Table 1.2 presents the multivariate analysis results. Fast food consumption frequency showed a significant association with the severity of excess weight status in bivariate analysis ($p = 0.020$), and the low-frequency category remained significant in multivariate analysis ($OR = 7.941$; $p = 0.017$). Dietary fiber intake was the most dominant and significant variable in both bivariate and multivariate analyses ($OR = 29.034$; $p < 0.001$). Sleep duration was significant only in bivariate analysis ($p = 0.013$) but did not retain significance in multivariate analysis ($p = 0.075$), suggesting the presence of confounding variables. Physical activity showed no significant association at either level of analysis ($p = 0.912$). The binary logistic regression model demonstrated a good fit, as indicated by a non-significant Hosmer-Lemeshow test ($\chi^2 = 3.377$; $p = 0.760$), a Nagelkerke R^2 of 0.508 indicating the model explained 50.8% of the variation in weight status severity, and an overall classification accuracy of 80.0%. The model was also globally significant based on the omnibus test ($\chi^2 = 47.717$; $df = 7$; $p < 0.001$).

Table 1.
Bivariate Analysis of Fast Food Consumption Frequency, Fiber Intake, Sleep Duration, and Physical Activity with Excess Weight Status

Variable	Overweight		Obesity		P-value	Note
	f (56)	%	f (44)	%		
Fast Food Consumption Frequency						
Low	6	10.7	14	31.8	0.020	s
Moderate	15	26.8	6	13.6		
High	35	62.5	24	54.5		
Fiber Intake						
Low	17	30.4	39	88.6	<0.001	s
Adequate	11	19.6	2	4.5		
High	28	50.0	3	6.8		
Sleep Duration						
Insufficient	27	48.2	32	72.7	.013	s
Sufficient	29	51.8	12	27.3		
Physical Activity						
Low	2	3.6	1	2.3	0.912	ns
Moderate	24	42.9	20	45.5		
High	30	53.6	23	52.3		

Note: Chi-Square test with significance p-value < 0.05; s: Significant; ns: Not Significant

Table 2.
Binary Logistic Regression Analysis of Factors Associated with Excess Weight Status

	β	Sig.	OR/Exp (β)	95% CI (β)		Nagelkerke R Square
				Lower	Upper	
Fast Food Consumption Frequency (Low)	2.072	.017	7.941	1.447	43.579	0.508
Fiber Intake (Low)	3.368	<.001	29.034	6.216	135.605	
Sleep Duration (Insufficient)	-1.023	0.075	.359	.117	1.107	
Physical Activity (High)	1.755	.247	5.784	.296	113.110	

Note: Significant association at p-value < 0.05

DISCUSSION

The Relationship between Fast Food Consumption Frequency and Excess Weight Status

The bivariate analysis results showed a significant relationship between fast food consumption frequency and the incidence of overweight ($p = 0.020$). In the multivariate analysis, fast food consumption frequency remained a proven independent risk factor ($OR = 7.941$; $95\% CI = 1.447-43.579$; $p = 0.017$), which means that adolescents in the low fast food consumption frequency category had a 7.9 times higher risk of obesity compared to the high-frequency group after controlling for other variables. This finding is in line with Jakobsen et al. (2023), who reported that high fast food consumption increases the risk of overweight by 1.17 times, and Nanda et al. (2023), who found a similar relationship in the adolescent group ($p = 0.004$).

Fast food is a category of food that is practical in its packaging, preparation, and serving, such as nuggets, sausages, instant noodles, fried chicken, hamburgers, and pizza. Adolescents' decisions to consume fast food are shaped by physical, psychological, social, and cultural factors. Fast food is highly favored because of its quick and flexible serving without being bound by time or place, its seemingly hygienic and modern packaging, and its perception as part of a contemporary lifestyle among adolescents (Harianto et al., 2022). Nevertheless, its high-calorie yet low essential nutrient content has the potential to disrupt body health, especially for adolescents who are not fully aware of its negative impacts (Pratama et al., 2021).

The high consumption of fast food among adolescents is influenced by internal and external factors. Internally, preferences for strong tastes and low nutritional knowledge make adolescents less selective in choosing food (Pratama et al., 2021). Externally, peer pressure and massive food industry marketing strategies through social media platforms also encourage adolescents to consume fast food more frequently (Mateen, 2025). Despite these known drivers of consumption, the higher OR value in the low-frequency category presents an interesting paradox, which is likely attributable to reverse causation. In a cross-sectional design, the temporal relationship between exposure and outcome cannot be established. It is plausible that adolescents who are already obese or aware of their excess weight have actively reduced their fast food consumption as a corrective dietary measure, whereas those in the overweight group may not feel the same urgency to restrict their intake. Therefore, the low fast food consumption observed in the obesity group might be a consequence rather than a cause of their weight status. This relationship must be interpreted with caution and investigated further through longitudinal studies.

The Relationship between Fiber Intake and Excess Weight Status

Fiber intake was proven to be the most dominant risk factor in this study (OR = 29.034; 95% CI = 6.216-135.605; $p < 0.001$), meaning that adolescents with low fiber intake have a 29 times higher risk of obesity compared to the group with high fiber intake. The lower the fiber intake, the higher the risk of overweight, because fiber plays an important role in increasing satiety and controlling energy intake, thereby preventing the accumulation of body fat (Ayu et al., 2023). This finding is consistent with Bagus et al. (2025), who found that the majority of obese adolescents consumed vegetables and fruits below the daily recommendations, accompanied by high fast food consumption, thus directly contributing to an increased risk of overweight. This condition is also in line with the Riskesdas (2018) data, which showed that more than 95.5% of the Indonesian population aged ≥ 5 years have an inadequate consumption pattern of vegetables and fruits, making low fiber intake one of the main factors in the overweight trend in Indonesia (Shofwah et al., 2020). Dietary fiber controls body weight through two main mechanisms that work synergistically. First, soluble fiber absorbs water in the digestive tract and forms a gel that delays gastric emptying, so satiety lasts longer and the urge to eat again can be postponed. Second, fiber slows down carbohydrate absorption, thereby preventing blood sugar spikes after meals and maintaining energy stability throughout the day. Both mechanisms collectively help control appetite and overall calorie intake, which serves as an important foundation in the prevention of overweight (Sofia et al., 2023). This is confirmed by an NHANES 1999-2018 data-based study which found that individuals with the highest fiber intake had a 26% lower risk of obesity compared to the lowest intake group (Zeng et al., 2025).

Long-term inadequate fiber intake also brings broad health impacts. According to Fathoni et al. (2024), low fiber consumption is generally accompanied by deficiencies in vitamins, minerals, and antioxidants which disrupt organ function and increase the risk of chronic diseases such as heart disease, diabetes, hypertension, and cancer. In addition, lack of fiber causes hardening of feces, triggering constipation which, if left untreated, can develop into hemorrhoids and even intestinal wall infections. In the long term, fiber deficiency increases the risk of degenerative diseases such as atherosclerosis and colon cancer, exacerbates blood sugar fluctuations leading to insulin resistance and type 2 diabetes, and increases LDL levels which directly magnify the risk of heart disease and stroke. The large OR value in this study emphasizes that increasing fiber intake through the consumption of vegetables and fruits must be the top priority in overweight prevention programs for adolescents.

The Relationship between Sleep Duration and Excess Weight Status

The chi-square test results showed a significant association between sleep duration and the severity of excess weight status ($\chi^2 = 6.121$; $p = 0.013$), which was confirmed by Fisher's Exact Test ($p = 0.015$). The proportion of respondents with insufficient sleep duration was higher in the obesity

group (72.7%) compared to the overweight group (48.2%). Nevertheless, in the multivariate analysis, sleep duration did not show a significant effect after controlling for other variables (OR = 0.359; $p = 0.075$), which is likely due to the influence of the dietary fiber intake and fast food consumption frequency variables that were more dominant in the model. These findings are in line with Deng et al. (2021), who reported a statistically significant association between short sleep duration (adjusted RR = 1.57; 95% CI: 1.36–1.81; $p < 0.001$) and long sleep duration (RR = 0.83; 95% CI: 0.75–0.93; $p = 0.001$) with obesity. Short sleep duration was also associated with significant changes in body mass index z-scores (mean difference = 0.06; 95% CI: 0.04–0.09; $p < 0.001$). Conversely, long sleep duration was identified as a protective factor against obesity in children.

Sleep duration is one of the factors related to weight regulation, especially in adolescents who have higher sleep needs compared to other age groups. Adolescents are recommended to sleep for 8-10 hours per night; however, in practice, many adolescents fail to meet this duration due to school activities, gadget use, and circadian rhythm changes that occur during puberty. Insufficient sleep duration is known to affect energy metabolism and dietary patterns, thereby contributing to an increased risk of overweight.

Biologically, sleep deprivation disrupts the balance of appetite-regulating hormones, primarily ghrelin and leptin. Ghrelin, as the hunger-triggering hormone, has been proven to increase significantly during sleep deprivation, causing hunger to appear more frequently and making it difficult to subside even after eating, including encouraging the habit of consuming high-calorie snacks at night (Josiane et al., 2016). Conversely, leptin levels as the satiety hormone do not experience a significant increase, so the satiety signals to the brain remain weak and encourage overeating behavior with a tendency to choose high-calorie and carbohydrate foods. This condition cumulatively causes fat accumulation and increases the risk of overweight and obesity (Josiane et al., 2016). Short sleep duration is also associated with an increased preference for snacks and high-energy foods (Leenaars et al., 2016), which further exacerbates energy imbalance as the underlying factor of overweight in adolescents.

The Relationship between Physical Activity and Excess Weight Status

Physical activity did not show a significant relationship with the incidence of overweight in either the bivariate ($\chi^2 = 0.184$; $p = 0.912$) or multivariate analysis ($p = 0.459$). This is likely due to the relatively homogeneous distribution of physical activity levels among respondents, where more than 50% of respondents in both groups fell into the high physical activity category, so the differences between groups were not substantial enough to produce a meaningful difference in the body's energy balance (Wicaksono, 2020). This finding is in line with Junaedi et al. (2024), who reported a p-value of 0.547 between physical activity levels and overweight. Similarly, Myftiu et al. (2025) demonstrated that physical activity was not a significant predictor of overweight among adolescents aged 15–18 years ($B = -0.10$; $p = 0.634$; OR = 0.91; 95% CI [0.64–1.29]). Although the overall regression model was statistically significant ($\chi^2(5) = 29.76$; $p < 0.001$), the only significant variables were gender and grade level, not physical activity. These results support the assumption that body weight during adolescence may be more influenced by biological and developmental factors than by physical activity alone. This does not mean that physical activity is unimportant; rather, its positive impact may be more evident in other health aspects, such as cardiovascular fitness, metabolic parameters, and psychological well-being, without being directly reflected in body mass index (BMI) changes.

Physical activity is defined as any bodily movement produced by skeletal muscles that results in energy expenditure above resting conditions (Wicaksono, 2020). A person's physical activity level is influenced by various factors. From the individual aspect, age and gender determine a person's capacity and pattern in physical activity, where physical activity generally decreases with age and

tends to be higher in males than females after entering puberty (Besti, 2019). From the external aspect, social environmental support such as family, peers, and the availability of sports facilities plays a major role in shaping a person's active habits, while an unsupportive environment tends to encourage a sedentary lifestyle (Putra, 2017).

Although not proven significant in this study, a less active lifestyle remains a long-term risk factor that cannot be ignored. According to the American Heart Association (2022), lack of physical activity contributes to overweight, which in the long term increases the risk of various serious diseases, ranging from hypertension, coronary heart disease, and stroke, to type 2 diabetes mellitus due to insulin resistance, as well as several types of cancer such as colorectal and breast cancer (Fund, 2021). The limitations of the cross-sectional design and the relatively small sample size likely affected this study's ability to detect the relationship; thus, a longitudinal study with a larger sample is recommended to confirm the role of physical activity on overweight in adolescents more accurately.

CONCLUSION

Based on the findings of this study, low dietary fiber intake is the most dominant risk factor for the severity of excess weight status among adolescents aged 16-18 years in Surakarta, increasing the risk of obesity by 29 times. Low fast food consumption frequency also showed a paradoxical association, likely due to reverse causation, while sleep duration was not an independent risk factor after controlling for other variables. Physical activity showed no significant association in this study. These findings underscore the urgent need for school-based nutritional education programs that specifically prioritize increasing dietary fiber intake through fruit and vegetable consumption to prevent and manage excess weight among adolescents.

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