ISSN : 1907-8153 (Print)
e-ISSN : 2549-0567 (Online)

Association of Physical Activity and Fruit-Vegetable Consumption with Nutritional Status among Adolescent Girls

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Article Information: received in September 2025; approved in November 2025; published in December 2025

ABSTRACT

Nutritional status represents an individual's overall physical condition, which is influenced by dietary intake and the body's ability to utilize nutrients efficiently. Among the various determinants, physical activity and fruit–vegetable consumption play essential roles. According to the 2018 Basic Health Research data in Makassar City, the prevalence of nutritional status among adolescents aged 13–15 years was 2.69% severely thin, 7.01% thin, 63.21% normal, 17.67% overweight, and 9.42% obese. This study aimed to analyze the association between physical activity, fruit–vegetable consumption, and nutritional status among 65 female adolescents at SMPN 40 Makassar. Data were collected from November 2024 to February 2025 using a validated Food Frequency Questionnaire (FFQ) for dietary assessment and the International Physical Activity Questionnaire (IPAQ) for activity measurement. Nutritional status was classified based on the Body Mass Index-for-Age (BMI/A) criteria from the World Health Organization (WHO, 2007). Statistical analysis employed the Chi-Square test. The results showed no significant association between physical activity and nutritional status ($p = 0.210$) nor between fruit–vegetable consumption and nutritional status ($p = 0.243$). These null findings suggest that other dietary or lifestyle factors, such as total energy intake, meal frequency, or sedentary behavior, may play a more dominant role in determining adolescent nutritional status in urban settings. Future studies are recommended to expand the scope by including multiple determinants of adolescent health and nutrition behaviors.
Keywords: Physical activity; vegetable and fruit consumption; nutritional status

INTRODUCTION

Nutrition plays a crucial role in maintaining health and human productivity, influencing physical growth, cognitive development, and overall well-being. Both undernutrition and overnutrition disrupt optimal growth and increase susceptibility to disease [1]. The World Health Organization adolescence (ages 10-19) as a critical period for establishing lifelong eating and activity patterns that significantly influence adult health outcomes [2]. Optimal nutrition during this stage is essential to support the rapid physical and hormonal changes of puberty [3].

Nutritional status among adolescents is commonly assessed using Body Mass Index-for-Age (BMI/A), which reflects the balance between energy intake and expenditure. According to the energy balance model, sustained energy intake exceeding energy expenditure leads to weight gain and potential obesity [4]. Conversely, a deficit results in weight loss or undernutrition. This interaction between dietary habits, particularly fruit and vegetable consumption, and physical activity is a primary determinant of adolescent nutritional status, as confirmed by global meta-analyses [5,6]

Indonesia continues to face a significant double burden of malnutrition, characterized by the coexistence of undernutrition and overnutrition [7]. Among adolescents, undernutrition is often linked to limited food access and low dietary diversity, while overnutrition is driven by modern lifestyle factors such as sedentary behavior, low physical activity, and increased consumption of processed foods [8–10]. This shift is particularly evident in urban centers. In South Sulawesi, particularly in Makassar City, the 2018 Basic Health Research (Riskesdas) reported that 27.09% of adolescents aged 13–15 years experienced abnormal nutritional status, highlighting the severity of the issue at the local level.

Physical activity plays an essential role in regulating this energy balance. W1hen energy intake exceeds expenditure due to low levels of physical activity, excessive weight gain may occur [11]. Regular physical activity is associated with improved body composition by increasing muscle mass and decreasing adipose tissue [12]. However, rapid technological adoption and changing social environments, especisally in urban settings, have led to decrease physical activity and increased screen time among global adolescent population [13,14].

Concurrently, global research consistently links inadequate fruit and vegetable intake to poorer BMI outcomes [15,16], demonstrating that this dietary deficiency compromises overall nutritional quality [17]. Furtheremore, studies focusing on urban youth highlight strong associations between frequent fast-food consumption, insufficient physical activity, and negative health outcomes [18,19]. The transition through adolescence, specifically the physical and metabolic demands during puberty, underscores the critical need for adequate nutrient intake and the protective effects of regular exercise against metabolic dysfunction [3,20]. Trends show that physical activity levels are generally insufficient across global adolescent populations, emphasizing the importance of local interventions [21,22].

ISSN : 1907-8153 (Print)
e-ISSN : 2549-0567 (Online)

Data from the 2018 Riskesdas indicated that 96.4% of adolescents aged 10–14 years in South Sulawesi had inadequate weekly fruit and vegetable consumption, far below the recommended daily intake [23]. While general nutritional status studies exist [24], and local reports highlight prevalence in surrounding areas [25], the comprehensive understanding of the interplay of these three factors remains limited in Eastern Indonesia.

Research Gap and Novelty: Previous studies in Indonesia have primarily focused on rural populations or examined single factors affecting adolescent nutrition, such as physical activity or fruit-vegetable intake in isolation [26]. However, few studies, especially in Eastern Indonesia, have simultaneously examined the interrelationship between physical activity, fruit and vegetable consumption, and nutritional status within an urban adolescent population. This gap is critical, as the urban environment intoduces unique behavioral determinants, such as high access to fast food and specific social influences, which may differentially affect the energy balance equation [27]. Public Junior High School 40 Makassar, located strategically in a dense urban area, serves as an ideal setting to investigate these interacting factors.

Based on the urgent public health need to address the double burden of malnutrition and the identified research gap, this study was conducted to analyze the association between physical activity, fruit and vegetable consumption, and nutritional status among female adolescents in SMPN 40 Makassar. The study adopts an energy balance framework to explain how interacting lifestyle behaviors influence nutritional outcomes, providing empirical evidence relevant for targeted adolescent health promotion strategies in urban Indonesia.

MATERIALS AND METHODS

This analytical observational study employed a cross-sectional design and was conducted at State Junior High School 40 Makassar from November 2023 to February 2024. The study population consisted of all female students enrolled in the school. The minimum required sample size of 65 respondents was determined using a precision-based sampling approach with a 5% margin of error and a 95% confidence level, considering an estimated prevalence of 27% for abnormal nutritional status among adolescents based on the 2018 Basic Health Research (Riskesdas). A simple random sampling technique was applied to ensure equal representation of participants. The independent variables were physical activity and fruit–vegetable consumption, while the dependent variable was nutritional status. Physical activity data were obtained through interviews using an adolescent physical activity questionnaire adapted from the International Physical Activity Questionnaire (IPAQ), which calculates total Metabolic Equivalent of Task (METs) per week. Physical activity levels were categorized as light (<600 MET-minutes/week), moderate (600–3000 MET-minutes/week), and vigorous (≥3000 MET-minutes/week), following WHO (2020) recommendations. Fruit and vegetable consumption data were collected using a validated Food Frequency Questionnaire (FFQ) comprising 35 items. Adequacy was assessed according to the Ministry of Health of the Republic of Indonesia (Permenkes No. 41 of 2014) and WHO (2020) standards, defining adequate intake as ≥400 grams per day (equivalent to five servings) and inadequate intake as <400 grams per day. Nutritional status was determined through anthropometric measurements. Body weight was measured using a GEA Medical digital scale with an accuracy of 0.01 kg, and height was measured with a microtoise accurate to 0.1 cm. Body Mass Index-for-Age (BMI/A) was calculated and classified according to WHO Growth Reference (2007) into severely thin, thin, normal, overweight, and obese categories. Data were analyzed descriptively to summarize participant characteristics and inferentially using the Chi-Square test with SPSS, to examine associations between physical activity, fruit–vegetable consumption, and nutritional status among adolescent girls.

RESULTS

Table 1. Distribution of Subjects by Class and Age of the Study Sample

Characteristics	Category	n	%
Class	VIII.1	11	16,90
	VIII.2	12	18,50
	VIII.3	9	13,80
	VIII.4	12	18,50
	VIII.5	11	16,90
	VIII.6	10	15,40
Age (years)	13	40	61,50
	14	20	38,50
Total		65	100.00

A total of 65 adolescent girls participated in this study. Table 1 presents the distribution of respondents by class and age. Most students were in classes VIII.2 and VIII.4 (each 18.50%), while the smallest proportion came

Vol. XX No. 2 Desember 2025
https://doi.org/10.32382/medkes.v20i2

ISSN : 1907-8153 (Print)
e-ISSN : 2549-0567 (Online)

from class VIII.3 (13.80%). In terms of age distribution, the majority were 13 years old (61.50%), indicating that the study sample predominantly represented early adolescents.

Table 2. Distribution of Nutritional Status among Adolescent Girls

Nutritional Status	n	%
Undernutrition	7	11.00
Normal	46	71.00
Overnutrition	12	18.00
Total		100.00

Table 2 describes the nutritional status of the respondents. The majority had normal nutritional status (71.00%), followed by 18.00% who were categorized as overweight, and 11.00% who were undernourished. This pattern shows that although most students were within the normal range, issues of both undernutrition and overnutrition were still present among the population.

Tabel 3. Distribution of Physical Activity among Adolescent Girls

Physical Activity	n	%
Light	4	6.00
Moderate	44	68.00
Vigorous	27	26.00
Total		100.00

Table 3 summarizes the physical activity levels of respondents. Most students engaged in moderate-intensity physical activity (68.00%), consistent with daily school routines and extracurricular activities. A smaller proportion had vigorous activity (26.00%), while only 6.00% engaged in light physical activity.

Tabel 4. Vegetable and Fruit Consumption among Adolescent Girls

Vegetable and Fruit Consumption	n	%
Adequate	21	32.30
Inadequate	44	67.70
Total		100.00

Table 4 displays the fruit and vegetable consumption patterns. More than two-thirds (67.70%) were classified as having inadequate intake, indicating that limited fruit and vegetable consumption is a common behavior among the adolescents studied.

Tabel 5. Association between Physical Activity and Nutritional Status

Physical Activity	Status gizi						Total		*p*
	Undernutrition		Normal		Overnutrition				
	n	%	n	%	n	%	n	%	
Light	0	0.00	4	6.00	0	0.00	4	6.00	
Moderate	7	10.80	30	46.20	7	10.80	44	68.00	0.210
Vigorous	0	0.00	12	18.50	5	7.70	17	26.00	
Total	7	10.80	46	70.70	12	18.50	65	100.00	

Table 5 presents the relationship between physical activity and nutritional status. Statistical analysis showed no significant association (p = 0.210). Most students across all physical activity categories exhibited normal nutritional status, suggesting that factors other than physical activity—such as total energy intake or dietary patterns—may have contributed to their nutritional outcomes.

Vol. XX No. 2 Desember 2025
https://doi.org/10.32382/medkes.v20i2

ISSN : 1907-8153 (Print)
e-ISSN : 2549-0567 (Online)

Tabel 6. Association between Vegetable and Fruit Consumption and Nutritional Status

Vegetable and Fruit Consumption	Nutritional Status						Total		*p*
	Undernutrition		Normal		Overnutrition				
	n	%	n	%	n	%	n	%	
Adequate	1	1.50	14	21.50	6	9.20	21	32.30	0.243
Inadequate	6	9.20	32	49.20	6	9.20	44	67.70	
Total	7	10.80	46	70.80	12	18.40	65	100.00	

Table 6 shows the association between fruit and vegetable consumption and nutritional status. Similar to physical activity, no significant relationship was observed (p = 0.243). Interestingly, even among adolescents with inadequate fruit and vegetable intake, a large proportion still presented with normal nutritional status, indicating that they likely fulfilled their daily energy needs through other food sources prevalent in their environment.

DISCUSSION

The majority of adolescent girls at SMPN 40 Makassar were categorized as having normal nutritional status. This finding suggests that, overall, the respondents' energy intake and growth trajectory remain within acceptable physiological ranges. Nutritional status during adolescence is shaped by a complex interaction of dietary intake, nutrient absorption, metabolic needs, hormonal changes, and lifestyle behaviors. According to [28], adequate gizi intake coupled with efficient nutrient utilization plays a central role in maintaining normal nutritional status. The results of this study are consistent with [25], who also reported predominance of normal nutritional status among junior high school students, indicating that adolescents often have resilient physiological mechanisms that allow temporary fluctuations in diet or physical activity without immediately disrupting body composition.

Regarding physical activity, most respondents were classified within the moderate category. This pattern may reflect typical urban school routines, where structured schedules—such as walking between classrooms, participating in school-based extracurricular activities, and adhering to regulated daily timetables—contribute to moderate-intensity activity. Previous research similarly found that adolescent girls engage more frequently in moderate rather than vigorous physical activity, potentially due to social norms, perceived safety, school-related responsibilities, and gendered expectations that discourage high-intensity sports participation [24]. Biologically, moderate activity is sufficient to maintain basic metabolic balance but may not be intense enough to produce significant changes in body composition, which helps explain the absence of a strong relationship between activity level and nutritional status.

The findings also show that fruit and vegetable intake among participants was generally low. Similar patterns have been documented by Herman *et al.* (2020), who noted that adolescents often consume fruits and vegetables below recommended levels. From a behavioral standpoint, this age group tends to prefer foods with high palatability—often energy-dense, fried, or sweetened products—over micronutrient-rich options like fruits and vegetables. Urban environments, particularly around schools, also increase access to inexpensive fast foods and snacks, reducing adolescents' motivation to choose healthier options. Biologically, insufficient intake of fruits and vegetables may limit micronutrient and fiber consumption, but adolescents may still maintain normal nutritional status in the short term due to adequate or even excessive consumption of carbohydrate- and fat-rich foods that meet their energy requirements.

The absence of a significant association between physical activity and nutritional status aligns with findings from [12], suggesting that physical activity alone may not be a dominant determinant of nutritional status in adolescents. Factors such as basal metabolic rate, hormonal changes during puberty, sleep duration, stress levels, and habitual dietary intake may play a more substantial role. However, this finding differs from [29], who reported a significant relationship. The discrepancy may be attributed to differences in sample characteristics, measurement protocols, or environmental contexts. For instance, adolescents in regions with limited access to high-energy foods may show a more direct effect of physical activity on body weight, whereas in urban settings like Makassar, energy-dense foods are readily accessible, potentially masking the influence of physical activity on nutritional outcomes.

Similarly, no significant association was observed between fruit and vegetable consumption and nutritional status. This result is consistent with the findings of [30], who also reported non-significant associations. One plausible explanation is that fruit and vegetable intake, while essential for micronutrient adequacy, contributes minimally to total daily energy intake. Adolescents who consume insufficient fruits and vegetables may still achieve energy sufficiency through other dietary components, particularly refined carbohydrates and fats. In contrast, studies such as Putri Aulia Arza's work in Pesisir Selatan demonstrated a significant association, possibly due to differences in food availability, household food security, cultural dietary patterns, and regional

Vol. XX No. 2 Desember 2025
https://doi.org/10.32382/medkes.v20i2

ISSN : 1907-8153 (Print)
e-ISSN : 2549-0567 (Online)

socioeconomic conditions. These variations suggest that the influence of fruit and vegetable consumption on nutritional status is context-specific and may be more pronounced in settings where food diversity is limited.

This study has several limitations. First, the cross-sectional design restricts the ability to infer causal relationships between lifestyle behaviors and nutritional status. Second, dietary data were obtained through self-reported questionnaires, which may be subject to recall bias or social desirability bias. Third, the study did not assess other potentially influential variables such as total daily energy intake, sleep duration, psychosocial stress, screen time, household food environment, or parental feeding practices. These factors may have contributed to the observed lack of association.

CONCLUSION AND RECOMMENDATIONS

This study revealed that most adolescent girls at SMPN 40 Makassar demonstrated moderate levels of physical activity and predominantly normal nutritional status, although fruit and vegetable consumption remained below the recommended level. These findings indicate that while energy balance is generally maintained, diet quality and healthy lifestyle behaviors are still suboptimal.

The results further highlight that nutritional status among adolescents is influenced by a combination of biological, behavioral, and environmental factors rather than by physical activity or fruit–vegetable intake alone. This underscores the need for multidimensional strategies to address adolescent nutrition in urban settings, particularly those integrating school-based health promotion, parental engagement, and supportive community environments.

Methodologically, this research serves as a preliminary exploration that provides valuable insights into adolescent nutrition behavior in urban Indonesia. Future studies should consider a longitudinal design or mixed-method approaches to capture behavioral determinants more comprehensively. Expanding the sample to include rural–urban comparisons, incorporating dietary quality indices, and assessing psychosocial factors such as stress or sleep duration would provide a broader understanding of adolescent health patterns.

In practical terms, schools and policymakers are encouraged to implement structured nutrition education, promote accessible healthy food options within school canteens, and strengthen national adolescent health programs through data-driven interventions. With methodological refinement and broader contextual integration, this study has the potential to contribute significantly to Indonesia's adolescent nutrition and health strategy framework.

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