



THE RELATIONSHIP BETWEEN NUTRIENT INTAKE ASSESSED BY 24-HOUR FOOD RECALL AND NUTRITIONAL STATUS BASED ON BODY MASS INDEX AMONG ADOLESCENTS

**Rosdiana^{1*}, Meilin Rahmawati², Marsinah³, Siska Sofiana⁴, Tri Suci
Elida⁵, Sasa Nabila⁶**

1,2,3,4,5,6 Department of Nutrition Faculty of Health, Universitas
Muhammadiyah Bima, Bima City 84113, Indonesia

Email All of Author : rsdyna028@gmail.com^{1*},
meilinrahmawati10@gmail.com², marsinah240406@gmail.com³,
siskasofiana10@gmail.com⁴, trisuci2410@gmail.com⁵
sasanabila@gmail.com⁶,

ARTICLE INFO	ABSTRACT
Received: 8th June 2026 Accepted : 9th June 2026 Published : 13th June 2026 DOI: https://doi.org/10.64479/ijohe rd.v1i1.80	This study aimed to analyze the relationship between nutritional intake based on the 24-hour food recall method and nutritional status as measured by Body Mass Index (BMI) among adolescents. Adolescence is a critical period of growth and development characterized by increased energy and nutrient requirements to support physical growth, reproductive development, and daily activities. Imbalances in nutritional intake, whether inadequate or excessive, may affect adolescents' nutritional status and increase the risk of various health problems. This study employed an observational analytic design with a cross-sectional approach. Nutritional intake data were collected using the 24-hour food recall method, including energy, protein, fat, and carbohydrate consumption, while nutritional status was assessed through Body Mass Index (BMI) measurements. Data analysis was conducted to determine the relationship between nutrient intake levels and the nutritional status of respondents. The results showed a significant relationship between energy, protein, fat, and carbohydrate intake and BMI among adolescents. Adolescents with inadequate nutrient intake tended to have underweight nutritional status, whereas excessive intake was associated with an increased risk of overweight and obesity. These findings highlight the

	importance of maintaining a balanced diet and meeting age-appropriate nutritional requirements. Therefore, continuous nutrition education is needed to improve adolescents' knowledge and healthy eating habits in order to achieve optimal nutritional status and support better health outcomes in the future.
 This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International.	Keywords: anthropometry, nutrient, dietary pattern

1. INTRODUCTION

Adolescents are a population group that is particularly vulnerable to nutritional problems due to the rapid physical, physiological, and psychological changes that occur during this stage of life. Adolescence is characterized by increased requirements for energy, protein, fat, vitamins, and minerals to support growth, reproductive development, and daily activities (World Health Organization, 2022) (World Health Organization, 2024). Failure to meet these nutritional requirements may lead to growth impairment, decreased immunity, reduced academic performance, and various health problems later in life (Khoerunisa & Istianah, 2021).

Nutritional problems among adolescents remain a major public health concern worldwide, including in Indonesia. Changes in dietary habits, increased consumption of fast food, low intake of fruits and vegetables, and meal-skipping behaviors have contributed to the growing prevalence of nutritional disorders among adolescents (Oddo et al., 2022). Furthermore, technological advancements and social media exposure have influenced eating behaviors, often encouraging the consumption of energy-dense but nutrient-poor foods. These conditions have contributed to the double burden of malnutrition, where undernutrition and overnutrition coexist within the same population (World Health Organization, 2024).

Nutritional status reflects the balance between nutrient intake and the body's nutritional requirements. Adequate nutritional status indicates that nutrient intake meets physiological needs, whereas poor nutritional status reflects an imbalance that may adversely affect health outcomes. One of the most commonly used indicators for assessing nutritional status among adolescents is Body Mass Index (BMI), which is calculated based on weight and height measurements. BMI is considered a practical and reliable tool for classifying individuals into underweight, normal weight, overweight, and obese categories (Cahyani et al, 2024).

Dietary intake is one of the primary determinants of nutritional status. Inadequate intake of energy and nutrients may result in undernutrition and impaired growth, whereas excessive intake may lead to overweight and obesity. Previous studies have demonstrated that

imbalances in energy, protein, fat, and carbohydrate consumption are associated with variations in nutritional status among adolescents (Yulyani & Safitri, 2024). Therefore, assessing dietary intake is essential for understanding factors that contribute to nutritional outcomes.

Several methods are available for assessing dietary intake, with the 24-hour food recall being one of the most frequently used approaches. This method collects detailed information regarding all foods and beverages consumed during the previous 24 hours. The 24-hour food recall is widely used in nutritional research because it is relatively simple, cost-effective, and capable of providing comprehensive information about individual food consumption patterns (Khoerunisa & Istianah, 2021). The collected data can subsequently be used to estimate energy and macronutrient intake, including protein, fat, and carbohydrates.

Previous studies have reported significant associations between dietary intake and nutritional status among adolescents. Insufficient energy and protein intake have been linked to underweight status, while excessive energy consumption has been associated with overweight and obesity (Murni et al., 2022). However, findings remain inconsistent due to differences in study populations, dietary assessment methods, socioeconomic conditions, physical activity levels, and environmental factors. These inconsistencies suggest that further investigation is needed to better understand the relationship between nutrient intake and nutritional status among adolescents.

Moreover, many previous studies have focused on individual nutrients or have merely described nutritional status without comprehensively examining the relationship between energy, protein, fat, and carbohydrate intake and BMI-based nutritional status. Studies integrating all major macronutrients assessed through the 24-hour food recall method among adolescents remain limited, particularly in local settings (Islamiyah et al., 2026). This limitation indicates the existence of a research gap that warrants further investigation.

This study is important because adolescents represent the future workforce and human capital of a nation. Good nutritional status during adolescence contributes to improved learning capacity, productivity, physical fitness, and reproductive health. Conversely, nutritional problems that persist during adolescence may increase the risk of non-communicable diseases in adulthood, including diabetes mellitus, hypertension, and cardiovascular diseases (World Health Organization, 2024). Therefore, evidence-based interventions are needed to promote healthy eating behaviors and improve nutritional outcomes among adolescents.

Based on the aforementioned background, this study aimed to analyze the relationship between nutrient intake assessed using the 24-

hour food recall method and nutritional status measured by Body Mass Index (BMI) among adolescents. The study hypothesized that energy, protein, fat, and carbohydrate intake are significantly associated with adolescent nutritional status. The novelty of this study lies in its comprehensive assessment of macronutrient intake and its relationship with BMI-based nutritional status among adolescents within a local context. The findings are expected to provide valuable evidence for the development of nutrition education programs and health promotion strategies aimed at improving adolescent nutritional status and overall well-being.

2. LITERATURE STUDY

Research on adolescent nutrition has grown substantially over the last decade due to the increasing prevalence of both undernutrition and overnutrition among adolescents worldwide. Adolescence is recognized as a critical stage of growth and development that requires adequate nutritional intake to support physical growth, cognitive development, and reproductive maturation (Heslin & McNulty, 2023). Several studies have demonstrated that dietary intake plays a crucial role in determining nutritional status among adolescents. Inadequate energy and nutrient intake have been associated with underweight status and impaired growth, whereas excessive consumption of energy-dense foods has been linked to overweight and obesity (Yulyani & Safitri, 2024). Furthermore, recent studies have highlighted the influence of dietary patterns, food diversity, lifestyle behaviors, and socioeconomic factors on adolescent nutritional outcomes (Demmler et al., 2024). These findings indicate that nutritional status among adolescents is a multifactorial condition influenced by both dietary and environmental determinants.

Various approaches have been employed to assess dietary intake and nutritional status among adolescents. Common dietary assessment methods include the 24-hour food recall, food frequency questionnaire (FFQ), dietary records, and food diaries. Among these approaches, the 24-hour food recall is one of the most widely used methods because it provides detailed information regarding foods and beverages consumed during the previous day while remaining relatively simple and cost-effective (Drapeau et al., 2024). In contrast, FFQs are useful for assessing habitual dietary intake over longer periods but may be affected by recall bias and inaccurate estimation of portion sizes. Dietary records generally provide more precise intake estimates; however, they require high participant compliance and (Budiarti et al., 2023) may alter normal eating behavior.

Similarly, nutritional status assessment methods vary across studies. Body Mass Index (BMI) remains the most frequently used indicator

because it is practical, inexpensive, and suitable for large-scale population studies. Several studies have combined dietary assessment methods with anthropometric measurements to investigate the association between nutrient intake and nutritional status. While some studies reported strong associations between energy intake and BMI, others found weaker relationships due to the influence of confounding factors such as physical activity, socioeconomic status, and lifestyle behaviors (Vilhar & others, 2023). These methodological differences contribute to variations in research findings across different populations.

Although numerous studies have examined the relationship between dietary intake and nutritional status among adolescents, several limitations remain. First, many studies focus on specific nutrients or dietary patterns rather than evaluating the combined effects of energy, protein, fat, and carbohydrate intake on nutritional status (Vilakazi, Nokuthula and Mathunjwa, Sithabile Nombulelo and Legodi, Heather Modiehi and Pisa, 2023). Second, some studies rely heavily on FFQs, which may not accurately capture recent dietary intake or daily consumption variations. Third, inconsistencies in findings across different populations suggest that contextual factors such as cultural dietary habits, socioeconomic conditions, and environmental influences may modify the relationship between dietary intake and nutritional status (Yulyani & Safitri, 2024).

Furthermore, research examining the relationship between nutrient intake assessed through the 24-hour food recall method and BMI-based nutritional status among adolescents remains limited, particularly in local and regional contexts. Most previous studies have focused on national surveys or urban populations, resulting in limited evidence regarding specific adolescent populations and local dietary behaviors (Islamiyah et al., 2026). Consequently, additional research is needed to provide a more comprehensive understanding of the relationship between macronutrient intake and nutritional status among adolescents.

The present study addresses the identified research gaps by comprehensively examining the relationship between nutrient intake assessed through the 24-hour food recall method and nutritional status measured using Body Mass Index (BMI). Unlike previous studies that focused on individual nutrients or specific dietary behaviors, this study simultaneously evaluates energy, protein, fat, and carbohydrate intake as major determinants of adolescent nutritional status (Islamiyah et al., 2026). The use of the 24-hour food recall method allows detailed assessment of recent dietary intake, while BMI provides a standardized and widely accepted measure of nutritional status (Drapeau et al., 2024).

The novelty of this study lies in its integrated analysis of multiple macronutrients and their association with BMI-based nutritional status

within a local adolescent population. The findings are expected to contribute to the existing body of knowledge by providing empirical evidence regarding dietary factors associated with adolescent nutritional status. Additionally, the results may serve as a scientific basis for developing nutrition education programs, health promotion strategies, and evidence-based interventions aimed at improving adolescent health outcomes.

3. MATERIAL AND METHOD

3.1. Research Design

This study employed a quantitative analytical observational design with a cross-sectional approach to determine the relationship between nutrient intake and nutritional status among adolescents. The study was conducted at MTs Muhammadiyah Kota Bima, Indonesia, on April 9, 2026. A cross-sectional design was selected because it allows the assessment of exposure variables (nutrient intake) and outcome variables (nutritional status) simultaneously within a specific period. This approach is appropriate for identifying associations between dietary intake and nutritional status among adolescents while requiring relatively less time and resources compared to longitudinal studies.

3.2. Study Population and Sample

The target population consisted of adolescents aged 14–16 years enrolled at MTs Muhammadiyah Kota Bima. A total of 20 respondents were selected using a purposive sampling technique based on predetermined inclusion and exclusion criteria. The inclusion criteria were: (1) students aged 14–16 years, (2) willing to participate in the study, and (3) able to complete the 24-hour food recall questionnaire. The exclusion criteria included: (1) students suffering from chronic illnesses that could affect nutritional status, and (2) students who were absent during data collection. The sample size was considered adequate for preliminary assessment of the relationship between nutrient intake and nutritional status among the study participants.

3.3. Data Collection Procedures

Data collection was carried out in two stages: preparation and implementation. During the preparation stage, anthropometric equipment including a digital weighing scale and a microtoise for height measurement were prepared and calibrated to ensure measurement accuracy. In addition, a 24-hour food recall questionnaire was prepared, and coordination with the school administration was conducted to facilitate data collection activities.

During the implementation stage, all selected participants were gathered in a designated classroom. Prior to data collection, the researchers explained the objectives and procedures of the study and obtained participants' consent. Anthropometric measurements were then conducted by measuring body weight using a digital scale and height using a microtoise. Body Mass Index (BMI) was subsequently calculated using the standard formula:

$$BMI = Weight(kg)/Height(m)^2 \quad (1)$$

The BMI values were classified according to standard nutritional status categories. Dietary intake data were collected using the 24-hour food recall method, in which participants were asked to report all foods and beverages consumed during the previous 24 hours (Pardamean et al., 2024). Information regarding food types, portion sizes, and meal frequency was recorded. All collected data were documented in the student fieldwork record sheets for further analysis.

3.4. Data Analysis

The collected data were checked, coded, entered, and processed using statistical software. Descriptive (univariate) analysis was performed to summarize participant characteristics, nutrient intake, and nutritional status using frequencies, percentages, means, and standard deviations (Darmin, Walliyudin, Gufran, Alkhair, M. Noris, Muammar Iksan, Dea Zara Avila, Nur Husnul Khatimah, 2023; Mahyuddin et al., 2024; Simorangkir et al., 2022). The mean value was calculated using the following formula:

$$\bar{x} = (\sum xi)/n \quad (2)$$

where $\bar{x}$ represents the mean value, xi represents each observation, and n represents the total number of observations. Bivariate analysis was conducted to examine the relationship between nutrient intake variables (energy, protein, fat, and carbohydrate intake) and nutritional status based on BMI. Depending on the distribution and characteristics of the data, either the Chi-Square test or Pearson correlation test was applied. Statistical significance was determined at a confidence level of 95% with a p -value < 0.05 . The results were interpreted to determine whether nutrient intake was significantly associated with the nutritional status of adolescents.

4. RESULT AND DISCUSSION

4.1 Results

Table 1 presents the demographic characteristics of the respondents. Most respondents were female (87.5%), while only 12.5% were male. The majority of participants were aged 14 years (87.5%). Based on BMI classification, most respondents had normal nutritional status (75.0%), while 25.0% were categorized as underweight. No respondents were classified as overweight or obese.

Table 1. Demographic Characteristics of Respondents

Variable	Category	Frequency (n)	Percentage (%)
Gender	Female	14	87.05.00
	Male	2	12.05
	Total	16	100
Age	13 years	1	06.25
	14 years	14	87.05.00
	15 years	1	06.25
	Total	16	100
Nutritional Status (BMI)	Underweight	4	25.00.00
	Normal	12	75.00.00
	Overweight	0	0
	Obese	0	0
Total		16	100

Source: Primary Data Analysis (2026)

Table 1 presents the demographic characteristics of the respondents. Most respondents were female (87.5%), while only 12.5% were male. The majority of participants were aged 14 years (87.5%). Based on BMI classification, most respondents had normal nutritional status (75.0%), while 25.0% were categorized as underweight. No respondents were classified as overweight or obese.

To assess the dietary adequacy of the respondents, the average daily intake of key nutrients was analyzed and compared with the Recommended Dietary Allowance (RDA) for adolescents. The nutrients evaluated included energy, carbohydrates, protein, fat, and iron, which are essential for supporting growth, development, and overall health during adolescence. The results of the nutrient intake assessment are presented in Table 2.

Table 2. Average Nutrient Intake of Respondents

Nutrient	Mean Intake	Recommended Dietary Allowance (RDA)	Category
Energy	1,178 kcal	2,100 kcal	Inadequate
Carbohydrate	167 g	300 g	Inadequate

Protein	35.2 g	65 g	Inadequate
Fat	31.7 g	70 g	Inadequate
Iron	5.2 mg	15 mg	Inadequate

Source: Primary Data Analysis (2026)

Table 2 shows that the average intake of all nutrients was below the recommended dietary allowance for adolescents. Energy intake reached only 56.1% of the recommended level, while carbohydrate, protein, fat, and iron intakes were also below the recommended standards.

Table 3. Distribution of Nutrient Adequacy Levels

Nutrient	Inadequate n (%)	Adequate n (%)	Excessive n (%)	Total
Energy	17 (85.0)	3 (15.0)	0 (0.0)	20 (100)
Carbohydrate	18 (90.0)	2 (10.0)	0 (0.0)	20 (100)
Protein	16 (80.0)	4 (20.0)	0 (0.0)	20 (100)
Fat	20 (100.0)	0 (0.0)	0 (0.0)	20 (100)
Iron	20 (100.0)	0 (0.0)	0 (0.0)	20 (100)

Source: Primary Data Analysis (2026)

Table 3 demonstrates that the majority of respondents had inadequate nutrient intake. Fat and iron intake were insufficient among all respondents (100%), while inadequate carbohydrate intake was found in 90.0% of respondents.

Table 4. Dietary Consumption Patterns of Respondents

Indicator	Findings
Meal Frequency	Most respondents ate 2–3 times per day
Breakfast	Some respondents skipped breakfast
Staple Food	Rice consumed by all respondents
Animal Protein	Consumed occasionally (fish, chicken, eggs)
Plant Protein	Tofu and tempe frequently consumed
Vegetable Consumption	Present but insufficient
Fruit Consumption	Low and irregular
Snack Consumption	High (instant noodles, biscuits, chips, wafers)
Beverage Consumption	Mostly water; some consumed sugary drinks
Eating Pattern	Several respondents had irregular meal patterns

Source: Primary Data Analysis (2026)

The findings indicate that dietary intake among respondents was dominated by carbohydrate-rich foods, while consumption of animal protein, fruits, and vegetables remained relatively low.

Table 5. Nutritional Status Based on BMI

BMI Category	Frequency (n)	Percentage (%)
Underweight	4	25.0
Normal	12	75.0
Overweight	0	0
Obese	0	0
Total	16	100

Source: Primary Data Analysis (2026)

Table 5 shows that most respondents had normal nutritional status (75.0%), while one-quarter were categorized as underweight.

Table 6. Relationship Between Dietary Pattern and Nutritional Status

Dietary Pattern	Underweight (n)	Normal (n)	Overweight (n)	Total
Irregular	4	5	0	9
Regular	0	7	0	7
Total	4	12	0	16

Source: Primary Data Analysis (2026)

Table 6 shows that respondents with irregular eating patterns were more likely to have underweight nutritional status compared to those with regular eating patterns. All respondents with underweight status were found in the irregular eating pattern group.

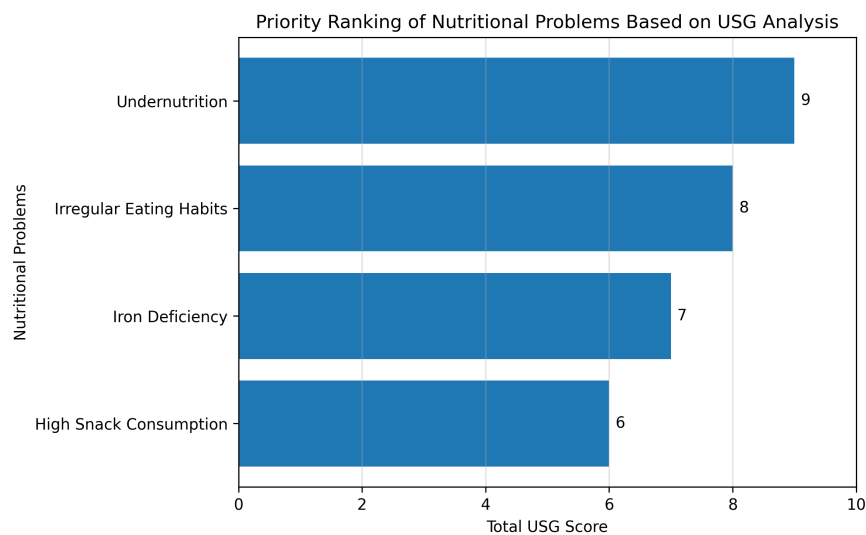


Figure 2. Priority Ranking of Nutritional Problems Based on USG Analysis Among Adolescents

Based on the results of the Urgency, Seriousness, and Growth (USG) analysis, undernutrition (underweight) obtained the highest score of 9 (U=3, S=3, G=3) and was therefore identified as the primary priority problem. This finding is consistent with the nutritional status assessment, which showed that 25% of respondents were classified as underweight (Heny Purbaningsih, 2023; Supadmi et al., 2024). Undernutrition among adolescents may result from inadequate energy and nutrient intake, which can negatively affect physical growth, immune function, cognitive performance, and overall health. Furthermore, the study revealed that all respondents had inadequate fat and iron intake compared with the recommended dietary allowances, indicating the need for immediate nutritional intervention.

The second priority issue was irregular eating patterns, which obtained a total score of 8 (U=3, S=2, G=3). The findings from the 24-hour food recall indicated that several respondents frequently skipped meals, particularly breakfast, and consumed fewer than three main meals per day. Irregular eating habits may lead to insufficient energy and nutrient intake over time, thereby increasing the risk of poor nutritional status among adolescents (Bayu Prabowo, 2024; Supadmi et al., 2024). Therefore, promoting regular meal patterns should be considered an important strategy for improving adolescent nutrition.

Iron deficiency ranked third with a total score of 7 (U=2, S=3, G=2). The average iron intake among respondents was only 5.2 mg/day, which was substantially lower than the recommended requirement of 15 mg/day for adolescents. Inadequate iron intake may increase the risk of iron deficiency anemia, resulting in fatigue, reduced concentration, impaired academic performance, and delayed growth and development. Given the significant health consequences associated with iron deficiency, efforts to improve iron-rich food consumption are necessary.

The issue of high snack consumption received a score of 6 (U=2, S=2, G=2) and was categorized as a moderate priority. The dietary recall data showed that many respondents frequently consumed processed snacks such as wafers, chips, biscuits, bread, and instant noodles. Although these foods contribute to energy intake, they generally contain limited amounts of essential nutrients, vitamins, and minerals. Excessive consumption of such foods may reduce overall diet quality and contribute to nutritional imbalances.

In contrast, normal nutritional status received the lowest score of 3 (U=1, S=1, G=1) and was not considered a priority problem. The majority of respondents (75%) had a normal Body Mass Index (BMI), indicating an appropriate balance between energy intake and nutritional requirements. Nevertheless, maintaining this condition requires continuous nutrition education and the promotion of healthy dietary habits among adolescents.

Overall, the USG analysis demonstrated that undernutrition, irregular eating patterns, and iron deficiency are the most critical nutritional issues among adolescents in this study. These findings highlight the importance of implementing nutrition education programs, encouraging regular meal consumption, increasing the intake of nutrient-dense foods such as animal-source protein, fruits, and vegetables, and conducting routine nutritional monitoring to prevent further nutritional problems and support optimal adolescent growth and development.

4.2 Discussion

The present study aimed to analyze the relationship between nutrient intake and nutritional status among adolescents. The findings revealed that most respondents had inadequate intake of energy, carbohydrates, protein, fat, and iron. Despite these deficiencies, the majority of respondents maintained normal BMI status, although 25.0% were categorized as underweight.

The low average nutrient intake observed in this study indicates that adolescent dietary habits remain below recommended nutritional standards. Energy intake was considerably lower than the recommended dietary allowance, which may negatively affect growth, physical activity, and overall health. Similar findings have been reported by Heslin and McNulty (2023), who highlighted that inadequate nutrient intake remains a common problem among adolescents worldwide.

The study also found that carbohydrate consumption was primarily derived from rice, while animal protein intake was relatively low. In addition, fruit and vegetable consumption was insufficient among most respondents. These findings suggest that dietary quality remains suboptimal despite the regular consumption of staple foods. Previous studies have demonstrated that low dietary diversity is associated with inadequate micronutrient intake and poor nutritional outcomes among adolescents (Demmler et al., 2024).

Another important finding was the relationship between dietary patterns and nutritional status. Respondents with irregular meal patterns were more likely to experience underweight status compared to those with regular eating habits. Skipping meals, particularly breakfast, may contribute to reduced daily energy intake and impaired nutritional status. Similar results have been reported by Yulyani and Safitri (2024), who found that irregular eating behaviors were associated with lower nutritional adequacy among adolescents.

The high consumption of snacks such as instant noodles, wafers, biscuits, and chips observed in this study may also contribute to poor dietary quality. Although these foods provide calories, they often contain limited amounts of essential nutrients required for growth and development. Therefore, improving dietary diversity and encouraging regular meal consumption are important strategies for promoting healthy nutritional status among adolescents.

This study contributes to the understanding of adolescent nutritional problems by providing evidence regarding nutrient intake adequacy and dietary patterns among junior high school students. However, several limitations should be acknowledged. First, the sample size was relatively small, limiting the generalizability of the findings. Second, dietary intake

was assessed using a single 24-hour food recall, which may not fully represent habitual food consumption. Future studies should include larger sample sizes and repeated dietary assessments to obtain more comprehensive results.

4.3 Conclusion

This study found that the majority of adolescents had inadequate intake of energy, carbohydrates, protein, fat, and iron based on the 24-hour food recall assessment. Most respondents had normal nutritional status; however, 25.0% were categorized as underweight. Irregular eating patterns were more common among underweight respondents, indicating a relationship between dietary habits and nutritional status. These findings emphasize the importance of balanced nutrition, regular meal consumption, and nutrition education programs to improve adolescent health and nutritional outcomes.

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CONFLICT OF INTEREST

The authors declare no conflict of interest regarding the publication of this study.

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