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Gender Differences in Nutritional Status Among Adolescents in Sangihe Islands, Indonesia: A School-Based Cross-Sectional Study

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Abstract

Adolescence is a critical phase of growth that requires higher nutritional intake, with different needs for males and females. Research on the relationship between gender and nutritional status among adolescents in Indonesia's border island regions remains limited. This study aims to analyze the relationship between gender and nutritional status among adolescents at Manganitu State Junior High School No. 2 (SJHS 2), Sangihe Islands Regency. This cross-sectional study was conducted in October 2024 and included 139 students aged 12–15 years, selected through total sampling. Nutritional status was measured using the Age-Adjusted Body Mass Index (BMI-for-Age) based on the 2006 WHO standards and analyzed using the Chi-Square test ($\alpha = 0.05$). The results showed that the majority of respondents had good nutritional status (79.1%); however, 5.8% were underweight, 5.0% were overweight, and 10.1% were obese. Statistical analysis revealed no significant association between gender and nutritional status: underweight ($p = 1.000$), normal weight ($p = 0.436$), overweight ($p = 0.758$). Gender is not a primary determinant of nutritional status in this population; behavioral and environmental factors such as dietary patterns and physical activity are thought to play a greater role. Routine anthropometric monitoring and nutrition education remain necessary given the continued presence of dual nutrition problems. Further research is recommended to more comprehensively explore the determinants of adolescents' nutritional status in the Sangihe Islands region.

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Introduction

Adolescence marks a critical life stage defined by heightened nutritional requirements and sex-based differences in growth. Differences in nutritional needs and growth and development patterns

during adolescence are fundamentally determined by a biological factor: sex. Adolescent boys are at higher risk of stunting and being underweight due to their high energy requirements, while adolescent girls are at greater risk of nutritional problems such as anemia (Silwanah et al., 2026). Adolescents go through puberty, a phase characterized by rapid physical growth. Consequently, this increases their daily nutritional needs. Nutrients such as energy, protein, iron, calcium, and other key micronutrients are required in high amounts, with most exceeding the recommended intake for adults. Nutritional problems during adolescence will affect adolescents' growth even into adulthood (Parajuli & Pattaneeya, 2025).

Nutritional challenges among Indonesian adolescents are multifaceted, with undernutrition, obesity, and micronutrient deficiencies posing significant concerns. Statistics reveal a high prevalence of both stunting and overweight in this age group. If these issues are not addressed promptly, they will hinder economic potential and national development goals (UNICEF, 2024). Globally, in 2022, 390 million children and adolescents were classified as overweight, with 160 million deemed obese. Additionally, 190 million in this group were severely underweight (WHO, 2024). According to the 2023 Indonesian Health Survey, nutritional status among children aged 13–15—based on BMI-for-age—showed 1.9% severely underweight, 5.7% underweight, 12.1% overweight, and 4.1% obese. In North Sulawesi, 13–15-year-olds had 0.9% severely underweight, 4.9% underweight, 13.2% overweight, and 5.7% obese (Indonesian Ministry of Health, 2024). In the coastal Sangihe Islands Regency, most adolescents were underweight at 51.2% (Gansalangi et al., 2025). These data highlight persistent and serious nutritional problems across Indonesia, particularly in North Sulawesi and Sangihe Islands Regency.

The influence of gender on adolescent nutritional status is well documented through internal biological changes. Gender is a biological variable associated with changes in body composition, nutritional needs, and growth patterns during puberty (Afiatna et al., 2026). The findings of Sari & Ratu (2019) indicate a significant association between gender and adolescents' nutritional status. Additionally, the results of Mekonen & Zeweter (2025) show an association between male gender and nutritional status with a p-value of 0.04. In contrast, the results for female adolescents were not statistically significant. The study by Mangalik et al. (2025) on the nutritional status of 13–15-year-old adolescents in Pati focused solely on the prevalence of poor nutritional status.

This study examines how gender influences adolescents' nutritional status. Additionally, it compares the geographical contexts of the research: the previous study focused on the Java mainland, while this study centers on an archipelagic region. In island settings like Sangihe, diets traditionally rely on marine resources such as fish. However, the rising prevalence of ultra-processed foods now shapes daily patterns, often with unequal effects on adolescents in remote areas (Juliani et al., 2025). Consequently, unique patterns of nutritional status emerge, in which gender influences malnutrition risk through differences in physical activity and body image perception (Mekonen & Zeweter, 2025). At SJHS 2 Manganitu, the interplay between the coastal food environment and growing reliance on ultra-processed foods is thought to drive gender-based differences in nutritional status. Previous research shows inconsistent results, with some studies finding significant associations and others not.

Nutritional status depends on the balance between nutrient intake and the body's needs, making it an individual phenomenon. Achieving optimal nutritional status requires a balance between energy intake and energy requirements, while imbalances can lead to nutritional problems (Dwimawati, 2020). The Sangihe Islands, located on the Indonesia-Philippines border, have a strategic yet vulnerable position that poses unique challenges in accessing food, health services, and nutritional information. Limited inter-island transportation forces reliance on imported foods, often dominated by processed and ultra-processed products with suboptimal nutritional content (Yuliantini et al., 2022). Studies show that island communities experience higher food insecurity than

mainland populations, resulting in distinctive nutritional profiles (Frayon et al., 2021; Hughes & Mark, 2005). Additionally, increased access to information and social media, even in remote areas, strongly influences adolescents' food choices and perceptions of body image (Rodgers et al., 2022). The combined impact of limited access to nutritious food and exposure to new consumerist patterns through digital media drives a unique nutritional transition among adolescents in island border regions (Nilsen et al., 2023; Van Sluijs et al., 2021).

Most research on adolescent nutritional status in Indonesia has focused on urban and mainland areas, leaving border island regions like the Sangihe Islands understudied. Yet, understanding nutritional status in border areas is crucial, as these regions are prioritized in national health initiatives but lack baseline data (Indonesian Ministry of Health, 2024). High undernutrition rates (51.2%) have been reported in the coastal Sangihe Islands Regency, but such data are general and do not specifically reflect junior high school adolescents—a group in a critical growth phase (Gansalangi et al., 2025). Evidence from Montenegro further highlights that nutritional profiles among adolescents differ between rural and urban contexts, emphasizing the need for a contextual approach in nutrition interventions (Vrevic et al., 2024).

The need for improved nutritional status assessments at Manganitu State Junior High School 2 (SJHS 2) highlights gaps in school health services in Sangihe Islands Regency. Despite its distinctive socioeconomic and cultural characteristics, SJHS 2 has never conducted a comprehensive nutritional assessment, according to the principal. The 2021 Health Profile shows a decline in school health service coverage from 2020, with only 34.9% of schools in North Sulawesi Province receiving health services, including nutritional status assessments, compared to 57.5% nationally (Indonesian Ministry of Health, 2021). This shortfall means regional coverage still lags behind the national target. Monitoring adolescents' nutritional status is crucial for early detection of nutritional problems and ensuring balanced food intake and energy needs. These assessments serve as primary indicators for adolescent health and physical growth (Afiatna et al., 2026).

The unique border island location of SJHS 2 Manganitu significantly influences adolescent body image and self-concept. Studies in the Pacific have shown that ethnicity and cultural identity moderate the relationship between body weight status and body satisfaction among adolescents in island regions (Frayon et al., 2021). Research on small-scale fishing communities indicates that adolescents' self-concept is shaped by the distinctive local socioeconomic context, where family economy, physical activity, and gender roles affect perceptions of the body and health (Jose et al., 2025). In Sangihe, fisheries- and agriculture-based economic activities that involve all family members regardless of gender may create expectations regarding physical form and capabilities that transcend gender boundaries (Pauwelussen, 2022). This may ultimately influence consumption patterns, physical activity, and the nutritional status of adolescents differently than in mainland populations.

Understanding why gender differences in nutritional status vary across studies requires examining context-specific influences. Previous research, such as cross-country studies in Sub-Saharan Africa, links these differences to social norms and culturally specific physical activity patterns (Darling et al., 2020). Mekonen & Zeweter (2025) further argue that analyzing adolescent nutrition by gender is inseparable from socioeconomic context and lifestyle. Thus, this study at SJHS 2 Manganitu is crucial for re-examining these dynamics within a border island region—a setting with a fish-based diet, rising exposure to ultra-processed foods, and unique geographic factors that shape physical activity.

Through this locally specific approach, the findings of this study will fill a significant gap in the literature on adolescent nutrition by using a gender-based perspective in border island regions—an ecological context that has been less studied than mainland areas. Outer island regions have unique characteristics, including limited access to maritime logistics and fluctuations in food supply, which

lead to monotonous consumption patterns and the risk of dual nutritional polarization among adolescents. By conducting a gender-disaggregated analysis, this study not only presents prevalence data but also reveals how the biological vulnerabilities and social roles of adolescent boys and girls interact with the constraints in island regions. The findings of this study represent a crucial new contribution to the development of gender-sensitive and region-specific nutrition interventions for remote areas. Furthermore, these findings serve as a foundation for schools and community health centers to design targeted, gender-specific health intervention programs. Consequently, programs to improve adolescent nutrition in border regions can be implemented more adaptively, efficiently, and targeted. The research question is whether demographic characteristics, such as gender, actually shape the nutritional status of the adolescent population on this island. The objective of this study is to analyze the relationship between gender and nutritional status among adolescents at SJHS 2 Manganitu High School. The research findings are expected to fill gaps in previous data while serving as a foundation for schools and community health centers to design targeted, gender-specific health intervention programs. Thus, programs to improve adolescent nutrition in border regions can be implemented more adaptively, efficiently, and targeted.

Materials and Methods

Research Design, Time, and Location

This study employed a quantitative cross-sectional design. This design was chosen because it is suitable for measuring the relationship between independent and dependent variables at a specific point in time, and is cost- and time-efficient for research in an archipelagic region with limited access. The study was conducted at SJHS 2 Manganitu, Sangihe Islands Regency, in October 2024. This location was selected because no comprehensive nutritional status assessment had ever been conducted at the school, and because of its characteristics as an archipelagic region on the Indonesia-Philippines border that experiences food insecurity and limited access to healthcare.

Population and Sample

The target population for this study was all students enrolled at Manganitu State Junior High School No. 2, totaling 185 students. The sampling technique used was total sampling, in which the entire population meeting the inclusion criteria was included as respondents (Golzar et al., 2022). The inclusion criteria for this study were students aged 10–18 years enrolled at Manganitu SJHS 2 and present at the study site at the time of data collection. The exclusion criteria were students aged 10–18 years who were unwilling to have their height and weight measured. Of the 185 students in the population, 20 were absent, and 26 were not present at the study site during data collection, leaving 139 students as the study sample. Although total sampling ideally covers the entire population, the limited student attendance on the day of the study meant that the final sample did not fully represent the population (Mukti, 2025). This constitutes one of the study's limitations.

Research Instruments and Variables

The independent variable in this study was gender, obtained from school registration data. The dependent variable was nutritional status, measured based on the Body Mass Index by Age (BMI/A). Anthropometric measurements were conducted using instruments that comply with the standards established in the Minister of Health Decree No. HK.01.07/MENKES/51/2022 on Standards for Anthropometric Instruments and Early Detection Tools for Child Development (Minister of Health of the Republic of Indonesia, 2022). Height was measured using a microtoise, while weight was measured using a digital step-on scale. Both instruments were calibrated and used in accordance with standard operating procedures to ensure measurement accuracy.

Nutritional status assessment is based on Minister of Health Regulation No. 2 of 2020 on Child Anthropometric Standards (Minister of Health of the Republic of Indonesia, 2020) as well as WHO (2006) standards for school-aged children and adolescents. Body Mass Index (BMI) is calculated using the formula: weight (kg) divided by the square of height (m^2). The BMI value is then plotted on the 2006 WHO growth charts to obtain the BMI-for-age Z-score. Nutritional status categories are defined as follows:

1. Undernutrition: Z-score < -2 SD
2. Adequate nutrition: Z-score from -2 SD to +1 SD
3. Overweight: Z-score from +1 SD to +2 SD
4. Obesity: Z-score > +2 SD

Data Collection Procedures

Data collection was conducted through a series of structured procedures. The researchers first coordinated with the school principal and homeroom teachers to set the measurement schedule and ensure the availability of participants who met the inclusion criteria. On the day of the study, the researchers explained the purpose, objectives, and procedures of the study to all potential participants. This explanation included information on the types of measurements to be taken, the study's benefits, and assurances about data confidentiality. After understanding this explanation, respondents and homeroom teachers were asked to provide written consent (informed consent) as a sign of their willingness to participate. For willing respondents, the researchers measured weight and height alternately. The measurement results were recorded on the provided data collection sheets, which included the respondent's identification number, gender, age, weight, and height.

Data Analysis

The collected data were analyzed using SPSS version 27. Data analysis was conducted in two stages. First, univariate analysis was performed to describe the respondents' characteristics and the distribution of nutritional status, presented in the form of frequency distribution tables and percentages. Second, a bivariate analysis was conducted to test the relationship between gender and nutritional status using the Chi-Square test. The Chi-Square test was chosen because both variables are categorical, and this study aimed to measure an association rather than a cause-and-effect relationship. The statistical significance level was set at $p < 0.05$.

Ethical Considerations

This study received ethical approval from the Health Research Ethics Committee at the Manado Health Polytechnic under number KEPK.01/09/372/2024. All research procedures were conducted in accordance with the principles of research ethics, which include respect for participants (respect for persons), beneficence, and justice (justice). Participation in this study was voluntary, and respondents had the right to withdraw at any time without any consequences. The confidentiality of respondents' identities and data was maintained by not including their names in the data collection forms or in the final research report. Data were used solely for scientific purposes and stored securely.

Results and Discussions

Respondent Characteristics and Nutritional Status Profile

This study involved 139 students at Manganitu SJHS 2, aged 12–15 years. As shown in Table 1, the majority of respondents were female (59.0%), while male respondents accounted for 41.0%. By age group, 13-year-olds constituted the largest group (34.5%), followed by 12-year-olds (32.4%), 14-year-olds (28.8%), and 15-year-olds (4.3%).

Table 1. Frequency Distribution Based on Respondent Characteristics Among Adolescents at Manganitu SJHS2

Respondent Characteristics	Frequency	Percentage (%)
Sex		
Male	57	41.0
Female	82	59.0
Total	139	100
Age		
12 years	45	32.4
13 years	48	34.5
14 years	40	28.8
15 years	6	4.3
Total	139	100

The main findings of this study indicate that the majority of respondents have good nutritional status. As shown in Table 2, 110 respondents (79.1%) fall into the "good nutritional status" category. However, of particular concern is the finding of the *double burden of malnutrition* within the same population. A total of 8 respondents (5.8%) were undernourished, 7 respondents (5.0%) were overweight, and 14 respondents (10.1%) were obese. Thus, the total prevalence of excess nutrition (overweight and obesity) was 15.1%, significantly higher than the prevalence of undernutrition (5.8%).

Table 2. Frequency Distribution Based on Nutritional Status Among Adolescents at Manganitu SJHS2

Nutritional Status	Frequency	(Percentage) %
Underweight	8	5.8
Normal weight	110	79.1
Overweight	7	5.0
Obese	14	10.1
Total	139	100

These findings indicate that although the majority of adolescents at Manganitu SJHS 2 have a nutritional status classified as good, the double burden of malnutrition remains a significant public health challenge in this island region. This "double burden" pattern aligns with the findings of Maehara et al. (2019), which show that Indonesian adolescents simultaneously experience both extremes of malnutrition—undernutrition and overnutrition. That study found that approximately one-quarter of adolescent girls (25%) and boys (21%) were stunted, while 11% of adolescents—both girls and boys—were overweight.

Even more intriguing, previous research findings in the coastal areas of Sangihe Islands Regency actually indicated that the majority of adolescents fell into the underweight category (51.2%) (Gansalangi et al., 2025). This striking discrepancy indicates that adolescents' nutritional status in island regions varies significantly and is influenced by specific local factors, such as access to food, dietary patterns, physical activity, and the socioeconomic conditions of each region. A multisite study across nine low- and middle-income countries also confirmed that the dual nutritional burden among adolescents is shaped by intersecting economic, educational, behavioral, and digital determinants, with varying gender patterns in each context (Zhao et al., 2026).

The predominance of good nutritional status in this population may reflect relative success in meeting basic nutritional needs, but the high prevalence of overnutrition (15.1%) indicates an

ongoing nutritional transition. Research by Prasetya et al. (2023) shows that good nutritional status enables optimal physical growth and brain development, which can only be achieved if the body's nutrient intake is sufficiently met and efficiently managed to support daily activities. Syahfitri et al. (2017) also emphasize that good nutritional status is the foundation for optimal growth and development in adolescents.

Based on brief interviews with adolescents at Manganitu SJHS 2, they reported that physical activities such as walking to and from school are part of their daily routine. This finding aligns with research by Ashar et al. (2025), which states that physical activity plays a crucial role in maintaining adolescents' weight stability, with higher physical activity intensity directly proportional to the energy required and expended by the body. Conversely, excessive calorie intake without adequate physical activity increases the risk of adolescents becoming overweight. Recent systematic reviews also indicate that adherence to physical activity guidelines (physical activity and time spent being sedentary) correlates with healthier dietary outcomes among children and adolescents, including higher consumption of fruits and vegetables and lower consumption of sugary drinks and snacks (Zeng et al., 2024).

Persistent Cases of Undernutrition Among Adolescents

Although good nutritional status predominates, this study still identified adolescents with undernutrition, among both male and female adolescents. This finding aligns with the study by Ahmed et al. (2025), which noted that nutritional vulnerability occurs among adolescent girls—14.9% of whom were undernourished based on BMI—due to suboptimal dietary patterns such as skipping breakfast and low adherence to daily fruit and vegetable consumption.

A study by Hadush et al. (2021) also confirmed that during early adolescence, the risk of undernutrition is 1.96 times higher compared to late adolescence. According to Awel et al. (2016), early adolescence is a period of rapid growth, so nutritional needs are higher. If nutritional needs are not met during this period, it can lead to continued growth disorders, reduced learning capacity, and low productivity in adulthood.

Based on a study by Sy et al. (2024) involving 1,433 adolescents, the prevalence of undernutrition was 21.7%, while the rates of overweight, obesity, and abdominal obesity were 5.9%, 1.8%, and 5%, respectively. The risk of undernutrition is significantly higher among male adolescents, those aged 10–14 years, those experiencing diarrhea, and adolescents who habitually skip lunch and frequently consume snacks. Conversely, female adolescents were more likely to be overweight or have abdominal obesity. These findings underscore that the risk of undernutrition is influenced not only by biological factors but also by behavioral and environmental factors.

This study found that adolescent boys tend to engage in outdoor activities outside of class, such as tag and ball games, while adolescent girls are more active indoors. This pattern aligns with the findings of Darling et al. (2020), who noted that adolescent boys are often more physically active, while girls tend to engage in more indoor activities. These differences in habits, combined with differing cultural norms regarding the ideal body, may result in boys being leaner than girls (Larouche et al., 2019; Van Sluijs et al., 2021). A multisite study across nine LMICs also found that a lack of physical activity increases the risk of both undernutrition and overnutrition among adolescent boys (Zhao et al., 2026).

Ages 13 and 14 fall within early to mid-adolescence, a phase characterized by rapid physical growth. Adolescent girls experience an earlier growth spurt than boys, serving as a biological preparation for entering the reproductive phase. In contrast, adolescent boys typically do not experience this phase until two years later. Each individual's energy requirements are unique, as they depend on age and the intensity of physical activity. Inadequate energy intake directly impacts productivity, as evidenced by reduced work motivation and a slower work pace. As individuals age,

their energy requirements continue to increase to support increasingly complex and demanding physical activities (Syahfitri et al., 2017).

High Prevalence of Overweight and Obesity

One of the most alarming findings in this study is the high prevalence of overweight (5.0%) and obesity (10.1%), which combined reach 15.1%. This figure is significantly higher than the prevalence of undernutrition (5.8%), indicating that excess weight has become a more dominant issue among the adolescent population at this school.

This finding aligns with the study by Nauli et al. (2021), which reported that as many as 30% of adolescents are overweight or obese. Previous studies have shown that the consumption of processed snacks and sugar-sweetened beverages is a major risk factor for obesity among adolescents (Tripicchio et al., 2019). Although this study did not measure these variables quantitatively, the high prevalence of overweight and obesity at Manganitu SJHS 2 indicates the need for further investigation into students' consumption patterns.

Based on brief interviews with adolescents at Manganitu SJHS 2 about their favorite foods and beverages, they preferred instant noodles, sweet drinks such as boba, and packaged snacks. Based on the researcher's observations, some adolescents brought packed lunches consisting of instant noodles and rice. This dietary pattern aligns closely with the findings of Juliani et al. (2025), who noted that the influx of ultra-processed foods is beginning to dominate daily diets in island regions, often disproportionately affecting adolescents in remote areas.

Research by Pratiwi et al. (2021) revealed that the high levels of fat and salt in instant noodles make this product a risk factor for obesity among adolescents. The frequency of instant noodle consumption directly affects an individual's nutritional status, leading to body fat accumulation and drastic weight gain, thereby placing adolescents in the "overweight" category. Global studies also indicate that consumption of ultra-processed foods (UPFs) is associated with the double burden of malnutrition, poor diet quality, and high levels of salt, sugar, and saturated fat, alongside low levels of protein, iron, vitamins, and fiber (Wanjohi et al., 2025).

Results from a previous study indicate a significant association between the consumption of packaged beverages and the prevalence of overnutrition among adolescents ($p=0.011$). Students classified as overnourished tend to overlook the energy content of these beverages due to their sweet taste and the ease of access to purchase them at street stalls, convenience stores, or vending machines. Conversely, students with normal nutritional status tend to limit their consumption due to a lack of interest in these types of beverages (Sakinah & Izna, 2022).

Research by Tripicchio et al. (2019) notes that overweight and obesity among adolescents pose a serious health threat to global health. This not only impacts physical health but also triggers psychological issues such as low self-esteem and depression. Adolescent obesity is not merely a current problem but also a threat to their future health. Furthermore, the risk of chronic diseases such as heart disease and stroke tends to be higher among adults who were obese during adolescence. This aligns with the findings of Abubakar et al. (2024), who noted that the dual burden of malnutrition—including both micronutrient deficiencies and overweight—poses a major challenge in many countries. A multisite study across nine LMICs also found that out-of-school adolescents have a higher risk of experiencing the double burden of malnutrition (DBM) (OR = 1.8; 95% CI: 1.0–3.3) (Zhao et al., 2026).

Unbalanced dietary patterns—such as fast food, sugary foods, and a lack of physical activity—contribute to these health issues. These conditions not only hinder adolescents' growth and development but also increase the risk of noncommunicable diseases later in life. A study in the Thousand Islands also found a similar phenomenon, where 46% of adolescents were underweight,

19% were overweight or obese, and 21% of adolescent girls had anemia—a clear illustration of the dual burden of malnutrition in Indonesia's island regions (Komalasari et al., 2025).

No Significant Association Between Gender and Nutritional Status

The results of the Chi-Square test presented in Table 3 indicate no significant association between gender and nutritional status among adolescents at Manganitu SJHS. All statistical indicators—including probability values (p-values) above 0.05 and confidence intervals encompassing the standard value of 1—consistently show that there is no significant gender-specific effect on variations in the respondents' nutritional status. These data demonstrate that the risk of malnutrition is evenly distributed across genders. This finding suggests that variations in nutritional status in this population are more likely influenced by factors other than gender.

Table 3. Relationship Between Gender and Nutritional Status Among Adolescents at Manganitu SJHS 2

*Nutritional status		OR (CI 95%)	p-value
Underweight	Male Female	1.000 (0.176 – 5.682)	1.000
Normal Weigth	Male Female	0.642 (0.210 – 1.958)	0.436
Overweight	Male Female	0.750 (0.121 – 4.662)	0.758

**Obesity is used as the reference group for nutritional status*

The absence of significant differences between males and females is likely because both groups face risks from different angles: males tend to be more physically active but may consume more calories. In contrast, females tend to be less active but are more likely to follow restrictive diets. Dwinovary & Dheni (2025) note that an imbalance between food intake and energy expenditure is a primary factor causing nutritional problems. Intake that exceeds requirements leads to weight gain, whereas excessive energy expenditure without optimal nutritional support results in undernutrition.

This aligns with the study by Satriani & Khairunnas (2025), which states that the absence of a significant association between gender and students' nutritional status indicates that the variations in nutritional status observed among both male and female students are likely random or influenced by other determinants. This is consistent with the study by Gardašević et al. (2021), which noted that there are no significant differences between gender and nutritional status among adolescents, as both male and female adolescents are equally at risk for obesity. Thus, in this study, gender does not play a crucial role in determining students' nutritional status. A study of school-aged children (8–13 years) in Bogor also found no statistically significant differences in nutritional status between boys and girls, as assessed by BMI-for-age and blood biomarkers. However, girls had a significantly higher percentage of body fat ($p < 0.001$) (Al Khairiyah et al., 2025).

In contrast, a study by Mekonen & Zeweter (2025) confirmed a significant association between adolescents' sex and nutritional status. This phenomenon is driven by the tendency for both adolescent girls and boys to have negative body image and to spend more than 2 hours in front of screens. A multisite study across nine LMICs also found that insufficient digital screen time among adolescent boys was associated with an increased risk of stunting. Still, it reduced the risk of being overweight or obese (Zhao et al., 2026). These varied findings suggest that the relationship between gender and nutritional status is highly dependent on the local social, cultural, and economic context.

In this study, a higher proportion of adolescent girls at Manganitu SJHS 2 had good nutritional status. Based on the researchers' observations, adolescent girls tended to bring packed lunches from home, which allowed them to avoid buying sweet snacks or packaged snacks on school grounds. A

study by Ramdayani et al. (2024) revealed a significant association between the habit of bringing packed lunches and adolescents' nutritional status—as measured by the BMI-for-Age Z-score—with a p-value of 0.002. This finding aligns with studies by Gaylis et al. (2017) and Taufiqa et al. (2025), which noted that adolescent boys tend to have higher BMI percentiles due to more frequent consumption of high-calorie foods, even though their physical activity levels are higher.

This relates to contrasting consumption patterns: adolescent girls more often choose fruits and vegetables, while adolescent boys tend to consume fast food, processed meats, and sugary drinks. A previous study of adolescents in the coastal region of Sangihe Islands Regency showed a significant association between body image and nutritional status. Adolescents with a negative body image are at higher risk for nutritional disorders compared to those with a positive body image. Conversely, a positive body image among adolescent girls encourages healthier food choices, increased self-confidence, and acceptance of one's own physical condition. This prevents adolescents from engaging in extreme dieting practices while still fostering awareness of the need to limit the intake of high-fat foods (Gansalangi et al., 2025).

Study Limitations

Although there are findings that warrant closer attention, this study has several limitations. First, the cross-sectional design used cannot establish a causal relationship between gender and nutritional status. Second, this study did not account for potential confounders such as dietary intake, physical activity, and socioeconomic status, which could influence the relationship between gender and nutritional status. Third, the sample, which was drawn from only one school, limits the generalizability of the findings to the broader adolescent population in Sangihe Islands Regency or other island regions in Indonesia. Fourth, the lack of quantitative data on dietary patterns and physical activity limits the depth of interpretation of the findings, particularly in explaining why there were no significant differences between genders. Future research is recommended to involve a larger and more diverse sample and to measure behavioral variables such as dietary intake, physical activity, and social media exposure more comprehensively.

Conclusion

This study concluded that there was no significant association between gender and adolescents' nutritional status at SMP Negeri 2 Manganitu: underweight ($p = 1.000$), normal weight ($p = 0.436$), overweight ($p = 0.758$), suggesting that biological factors are not the primary determinants of nutritional status in this population. Although the majority of respondents (79.1%) had good nutritional status, dual nutritional problems were observed, with the prevalence of overnutrition (15.1%) nearly three times that of undernutrition (5.8%), signaling an ongoing nutritional transition in this border island region. These findings confirm that behavioral and environmental factors—such as dietary patterns, physical activity, and access to ultra-processed foods—play a greater role in shaping adolescents' nutritional status than gender differences. Therefore, nutrition interventions in island regions cannot rely solely on gender-based approaches but require holistic strategies that include routine anthropometric monitoring, nutrition education, promotion of healthy eating patterns, and increased physical activity, with the active involvement of schools, families, and community health centers. Further research with a larger sample size and comprehensive measurement of behavioral variables is highly recommended to gain a complete understanding of the determinants of adolescents' nutritional status in Indonesia's island regions.

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