DIETARY QUALITY AND NUTRITIONAL STATUS OF ADOLESCENTS IN RURAL AREAS OF SIGI REGENCY, INDONESIA

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ABSTRACT

Introduction: *Adolescence is a transitional period from childhood to adulthood, marked by various changes in different aspects of life. These changes can put adolescents at risk of experiencing nutritional problems. Central Sulawesi faces adolescent nutrition problems due to unhealthy eating patterns and a lack of dietary diversity. The nutritional status of adolescents in Central Sulawesi is also worse than the national average. Rural adolescents are thinner than urban adolescents because they have lower intake of energy, protein, and fat. Place of residence indirectly affects nutritional status during adolescence.* **Method:** *This research was conducted in the rural area of Sigi Regency using a random sampling method with 154 adolescents participating in the study. The Mean Adequacy Ratio (MAR) is used to assess diet quality, and BMI/U measurement is used to determine the nutritional status of adolescents.* **Results:** *Overall, the diet quality is still low. A MAR score of 56.1% indicates that the nutritional intake of adolescents is not yet optimal, with protein, fat, and carbohydrates at adequate levels, but vitamins A, B1, and C, as well as B9 and B12, are still low, indicating a potential deficiency in the body. The percentage of thin and obese adolescents exceeds the national figures. There is no difference in MAR among nutritional statuses.* **Conclusion:** *Comprehensive nutritional interventions are needed to improve the still low diet quality and the still low nutritional status.*

Keywords: Adolescents, Diet Quality, Mean Adequacy Ratio, Nutritional Status, Sigi Regency

INTRODUCTION

Adolescence is a transition period from childhood to adulthood, which is characterized by various changes in different aspects of life. These changes can put adolescents at risk of nutritional problems, as they often change their diets in unhealthy ways, such as skipping meals, overeating, and not paying attention to nutritional adequacy (Dewi et al., 2022).

Adolescents should have a balanced diet in order to avoid nutritional issues that may impair the quality of human resources in the future. Whether someone is at danger of acquiring nutritional difficulties depends on their current nutritional condition, and some age groups are generally more vulnerable to these issues (Fakhirah et al., 2023)

Based on data from the 2023 Indonesia Health Survey, the nutritional status of adolescents in Central Sulawesi tends to be worse compared to the national average. The percentage of adolescents with severe malnutrition in Central

Sulawesi is 2.7%, higher than the national figure of 1.9%. The percentage of adolescents with moderate malnutrition in Central Sulawesi is 8.4%, also higher than the national figure of 5.7%. Meanwhile, the percentage of adolescents with normal nutritional status in Central Sulawesi is 72.9%, lower than the national level of 76.1%. Additionally, the percentage of adolescents with obesity in Central Sulawesi is 5%, higher than the national figure of 4%. Although the percentage of adolescents with overweight status in Central Sulawesi is 11%, lower than the national 12.1%, the difference is not too large (Kemenkes RI, 2023). This indicates that nutrition issues, both undernutrition and overnutrition, still require better attention and management in Central Sulawesi.

Sigi Regency in Central Sulawesi has a vast agricultural area that falls within rural regions. However, Sigi is classified as a priority area for food insecurity in Central Sulawesi, with the highest dimension of food availability but low accessibility and utilization of food (Wasudewa et al., 2021).

Some factors that cause nutrition problems in adolescents are the consumption of low-quality foods and lack of food diversity. One way to achieve normal nutritional status is to regulate a diverse and healthy consumption pattern, which can be seen from the diversity and quality of the food consumed. According to research conducted by Vidyarini and Ayunin (2022), male adolescents have a more diverse food consumption pattern compared to female adolescents when compared by gender. However, in general, the quality of food consumed by adolescents is still considered poor, indicating that they have not consumed the recommended amount of food. The food groups most commonly consumed by Indonesian adolescents are starchy staple foods, meat and processed products, and eggs. On the other hand, Indonesian adolescents rarely consume green vegetables, offal, and vitamin A-rich fruits.

The majority of developing countries, including Indonesia, have undergone modernization and globalization. The public's acceptance of traditional foods has been influenced by this wave of modernization and globalization. Most people have shifted from traditional eating patterns to patterns with less fiber, vitamins, and minerals but more energy, fat, sugar, and salt. If there is an imbalance between intake and expended energy, there will be nutritional problems, either excess or deficiency. Adolescent nutritional health is of great importance as it has a significant impact on their growth and development in adulthood (Kasiaradja et al., 2022).

Some studies found that urban and rural adolescents exhibit different nutritional status and nutrient consumption patterns. Urban adolescents are more overweight than rural adolescents but rural adolescents have a higher rate of malnutrition than urban adolescents. Additionally, urban adolescents have higher average intakes of energy, protein, and fat compared to rural adolescents. Conversely, rural adolescents have lower average carbohydrate intakes (Horiuchi et al., 2019; Musfira and Hadju, 2024).

Due to the wider access, distribution, and food choices in cities compared to villages, place of residence indirectly affects nutritional status during adolescence. Adolescents are highly interested in novel things and are largely influenced by their peers and environment. Parental occupation is directly related to family income and plays a crucial role in meeting the food needs of family members. Daily food consumption patterns are influenced by differences in socioeconomic status. Higher incomes typically allow individuals to purchase more than adequate food and tend to shift towards more expensive foods, such as animal-based products (Horiuchi et al., 2019; Musfira and Hadju, 2024).

One way to assess the quality of the diet and nutritional status of adolescents is by using the MAR (mean adequacy ratio). This method is based on the calculation of the nutrient adequacy ratio (NAR), which is the ratio between nutrient intake and the recommended dietary allowance. The MAR value is obtained by calculating the average NAR for each nutrient measured. A higher MAR value indicates that a person's or household's nutritional status and diet are better, so they can meet their nutritional needs. This research aims to identify the nutritional status and diet quality of adolescents residing in rural areas of Sigi Regency, Indonesia.

METHODS

This research used a random sampling method, where adolescents living in rural areas and from four junior high schools in the Sigi Regency were randomly selected. Inclusion criteria include adolescents with a food intake to basal metabolic rate (BMR) ratio of more than 0.8. BMR was calculate by Harris-Benedict equations. Only 154 adolescents from these four schools who had a food intake to BMR ratio of more than 0.8 were selected to participate in this study. These inclusion criteria have been used to evaluate individuals with reasonably reported food intake rather than under- or over-recorded intake.

Food intake data were collected using a 2x24-hour dietary recall, which covered the participants' food and beverage consumption during two non-consecutive days. Measurements of the participant's body weight and height were also conducted, using a scale and a microtoise. This anthropometric data were then processed using the WHO Anthro software to assess the participant's nutritional status. All enumerators were trained

for two days in the data collection process and body anthropometric measurements to ensure the obtained data were reliable.

The researchers used the mean adequacy ratio (MAR) method, which considers 14 different nutrients and generates an average value from the nutrient adequacy ratio (NAR) of each. A higher MAR value indicates that the participant's diet has better quality, which can meet the individual's nutritional needs. Thus, MAR provides a more comprehensive assessment of diet quality than evaluating only a single individual nutrient. The MAR data are presented in the median score because the data were not normally distributed. The Kruskal-Wallis test was employed to examine the differences in MAR between nutritional status.

RESULTS AND DISCUSSIONS

This research involved adolescents aged between 11 and 17 years who were enrolled in four junior high schools in Sigi Regency. The majority of participants were 13 and 14 years old, comprising 28.6% and 33.8% of the sample, respectively, indicating that this research focused on middle-adolescent individuals. Additionally, the gender distribution of participants was nearly balanced, with 48.1% male and 51.9% female. This balanced gender composition facilitates the identification of any differences or similarities between male and female participants in this research. Detailed data are presented in Table 1.

The mean NAR (MAR) score is 56.1%, indicating that the participant's nutrient intake has reached approximately 56.1% of the recommended needs or below the golden standard of 70% (Monge-Rojas et al., 2022).

Table 1. The characteristics of participants

Characteristics	n	(%)
Age (years)		
11	1	0.6
12	20	13.0
13	44	28.6
14	52	33.8
15	26	16.9
16	9	5.8
17	2	1.3
Gender		
Male	74	48.1
Female	80	51.9

In the macronutrient components, the intake of protein (82.0%), fat (100.0%), and carbohydrates (100.0%) are at relatively adequate levels, with fat and carbohydrates approaching optimal levels. Additionally, the intake of fluids (83.0%) is also considered sufficient. However, in the micronutrient components, there are some areas that require further attention. Vitamin B1 (59.1%) show relatively low levels of adequacy. Meanwhile, vitamin B9 (7.1%), vitamin C (17.0%) and vitamin B12 (23.1%) are at very low levels, indicating a potential for deficiency. Similarly, several minerals such as calcium (37.5%), phosphorus (55.6%), sodium (20.2%), and zinc (55.3%) are also not yet optimal. These results indicate the need for a more comprehensive nutritional intervention, especially to increase the intake of vitamins and minerals that are still low, to ensure a more balanced nutritional status for the participant group. The detailed data can be seen in the following Table 2.

The nutritional status of the participants was also examined (Table 3). Most participants, 75.3%, are classified as having a normal nutritional status. This indicates that most of the group is within the recommended range for their body mass index for age (BMI/A). However, other segments of the population require attention. Approximately 10.4% of the participants are classified as thin, and 1.3% are classified as severely thin. This figure shows that the percentage of thin and severely thin adolescents is higher than the national figure for adolescents aged 13-15 years, which is 8.7%,

Table 2. The characteristics of participants

NAR	Median Score
Protein	82.0
Fat	100.0
Carbohydrates	100.0
Water	83.0
Vitamin A	72.3
Vitamin B1	59.1
Vitamin B9	7.1
Vitamin B12	23.1
Vitamin C	17.0
Calcium (Ca)	37.5
Iron (Fe)	70.7
Phosphor (P)	55.6
Sodium (Na)	20.2
Zinc (Zn)	55.3
MAR	56.1

as well as the percentage of obese adolescents, which exceeds the national prevalence of 4.8%. A significant portion of the group may be vulnerable to malnutrition or inadequate nutrient intake impact.

The prevalence of health and nutrition problems among adolescents can have negative impacts in adulthood. These impacts include an increased risk of non-communicable diseases, metabolic syndrome, cardiovascular diseases, and certain types of cancer. Additionally, nutritional issues such as anemia among adolescent girls can have fatal consequences on reproductive organs and future pregnancies (Labatjo, 2024). At the other end of the spectrum, 6.5% of the participants are classified as overweight, and an additional 6.5% are considered obese.

Overweight and obesity in children and adolescents can lead to disruptions in glucose metabolism, heart disease, and type 2 diabetes. The contributing factors include unhealthy eating patterns, consumption of fast food, educational level, gender, genetic factors, lack of physical activity, and socioeconomic factors. Furthermore, the impacts are also felt socially and psychologically by adolescents who are still attending school (Kamaruddin, Kustiyah, Riyadi and Junus, 2023) . Dietary habits in adolescents, such as the type of food, frequency, quantity, family distribution, and food choices, have an impact on health in adulthood and old age. Imbalances between energy intake and expenditure can lead to weight gain.

Common eating habits in adolescents include snacking, skipping breakfast, irregular eating patterns, frequent consumption of fast food, inadequate intake of vegetables, fruits, and dairy products, as well as improper weight control among adolescent girls. These habits can contribute to issues of excessive nutrition or obesity (Maslakhah and Prameswari, 2022). These

Table 3. Nutritional Status

Status	n	(%)
Severely Thinness	2	1.3
Thinness	16	10.4
Normal	116	75.3
Overweight	10	6.5
Obese	10	6.5

findings highlight the need for a comprehensive approach to addressing the nutritional needs of the participants. While the majority are within the normal range, the presence of both undernutrition and overnutrition suggests the need for targeted interventions to ensure optimal nutritional status for all individuals within the group.

The Kruskal-Wallis results showed no significant differences in the median scores of NAR and MAR between nutritional statuses. The NAR of macronutrients for all nutritional statuses showed optimal scores except for protein in overweight adolescents. Conversely, the NAR of water was optimal across all nutritional statuses except for severely thin nutritional status (Table 4). In addition to nutritional intake, a person›s nutritional status is influenced by many factors, such as physical activity, body metabolism, chronic diseases, or genetics (Phillips, 2013; Ferozi et al., 2024) particularly central adiposity, is the primary causal factor in the development of insulin resistance, the hallmark of the metabolic syndrome (MetS. The same quality of nutrition can result in different nutritional statuses depending on the body's ability to utilize the nutrients that enter the body (Fundo and Silva 2018). Assessment of food intake also has the potential to be underreported or overreported. Individuals with poor nutritional status tend to overreport, while overweight and obese individuals report less to avoid embarrassment or self-consciousness (Carbine et al., 2017; Howes et al., 2024).

In this study, micronutrient intake in all nutritional statuses still lacked values, except for NAR iron in overweight and obese adolescents. Micronutrients with very low values are vitamins B9, B12, and sodium. Previous research conducted on adolescents in rural areas shows the same trend that the diet quality of adolescents in rural areas is still lacking, especially in micronutrients, including vitamins B9, B12, and C (Sari et al., 2022; Wiafe et al., 2023). Other studies indicate that insufficient micronutrient intake also occurs in adolescents in urban areas, with higher sodium intake than in rural areas. (Prynn et al., 2018; Monge-Rojas et al., 2022; Shah et al., 2022). The sale of packaged snacks has spread to rural areas in massive quantities. The sodium intake of adolescents in this study is classified as low.

Table 4. Median Score of NAR based on Nutritional Status

NAR	Nutritional Status					p-value
	Severely Thinness	Thinness	Normal	Overweight	Obese	
Protein	100	94.4	79.6	64.6	84.4	0.19
Fat	100	100	100	100	100	0.87
Carbohydrates	100	100	100	100	100	0.81
Water	58.9	78.5	83.8	80.4	80.3	0.43
Vitamin A	56.7	72.3	74.6	73.5	43.5	0.97
Vitamin B1	45.8	58.3	59.1	60.8	52.0	0.81
Vitamin B9	15.0	7.7	7.0	7.5	7.1	0.71
Vitamin B12	28.1	26.3	22.5	18.1	21.9	0.92
Vitamin C	7.9	17.3	16.0	26.2	17.7	0.56
Calcium (Ca)	38.4	25.9	39.3	42.1	48.9	0.47
Iron (Fe)	43.4	72.5	69.3	79.1	84.8	0.60
Phosphor (P)	47.7	48.9	57.5	51.7	69.0	0.41
Sodium (Na)	9.9	18.7	19.4	24.9	21.5	0.83
Zinc (Zn)	33.2	48.9	55.6	54.5	59.4	0.24
MAR	48.9	58.9	56.3	52.3	55.3	0.81

Nevertheless, it needs attention because the proliferation of packaged snack sales is related to the decline in diet quality (Popkin anf Ng, 2022; Sisay et al., 2024).

Insufficient consumption of vitamins B9, B12, and C can lead to various health problems, including anemia. Anemia is a condition in which the number of red blood cells or the oxygen-carrying capacity is insufficient to meet physiological needs, which disrupts the formation of red blood cells. Vitamin C deficiency can interfere with red blood cell formation because vitamin C is essential for iron absorption, which is a crucial component in the production of red blood cells (Sari, Azizah, Gumilang, Judistiani and Mandiri, 2020). Vitamin B9 and B12 are beneficial in red blood cell division and energy metabolism in the formation of red blood cells.

Another nutrient, Iron deficiency in adolescent girls, is a common issue that can lead to anemia. To prevent iron deficiency, adolescent girls must pay attention to their dietary intake of iron-rich foods (Kristianti and Metere, 2021). However, in this study, iron intake for adolescents in all nutritional status categories showed optimal or nearly optimal values. Anemia that occurs in adolescents can be caused by a deficiency of vitamins B9, B12, and vitamin C, so the intervention for its treatment also needs to consider these nutrient deficiencies (Shekar et al., 2017).

This study delves into the dietary quality of adolescents in rural areas, aiming to contribute to the ongoing research on dietary quality in diverse settings. It also identifies diet quality based on MAR, which takes into account not only the types of nutrients but also the amounts of certain nutrients consumed. Further research is needed regarding the state of adolescent diet quality in rural areas, considering various factors with a better design, such as cohort studies.

CONCLUSION AND SUGGESTION

Based on the research findings, it can be concluded that overall the diet quality of adolescents is still low. Protein, fat, carbohydrate, and water nutrients are classified as good based on the NAR (nutrient adequacy ratio), while other nutrients are classified as inadequate. Most adolescents also fall into the normal nutritional status category, but the percentage of thin and overweight adolescents is still high indicating the need for more comprehensive nutritional interventions, especially to increase the intake of vitamins and minerals that are still low.

There are no significant differences in NAR among various nutritional status groups which can contribute to different health risks in each group. There is a need for further research to expand the research to other regions. This will help to gain a

more comprehensive understanding of nutritional status and diet quality in the population, especially in rural areas. Expanding the scope of the research can provide valuable insights and inform targeted interventions to address the identified nutritional deficiencies or imbalances to improve overall nutritional well-being.

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