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DIETARY PATTERNS, NUTRITIONAL STATUS, AND ANEMIA IN ADOLESCENT GIRLS: A STUDY AT PUBLIC JUNIOR HIGH SCHOOL 10 GORONTALO

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Abstract

Background: Poor dietary patterns are one of the factors that may contribute to anemia. Good food quality and sufficient food quantity are essential for optimal body health, including anemia. Energy intake also plays a role in the formation of erythrocytes. **Objective:** The study aims to determine the relationship between dietary patterns and the incidence of anemia among adolescent girls at Public Junior High School 10 Gorontalo. **Method:** The study employed a cross-sectional design. The sampling technique used was purposive sampling, involving a total of 62 students. Data were collected through a dietary pattern questionnaire, observation, and analyzed using the Chi-square test. **Results:** A total of 30 respondents (48.4%) had moderate dietary patterns. In terms of nutritional status, 49 respondents (79%) had a normal nutritional status. The total prevalence of anemia in this study was 24.2%. The statistical test showed a p-value = 0.019, indicating a significant association between dietary patterns and anemia ($p < 0.05$). However, analysis of the association between nutritional status and anemia showed a p-value = 0.474, indicating no significant relationship between nutritional status and anemia ($p > 0.05$). **Conclusion:** There was a significant association between dietary patterns and anemia ($p = 0.019$). However, there was no association between nutritional status and the incidence of anemia among adolescent girls ($p = 0.474$). Improve diet quality such as high protein, green leave vegetable, consume iron supplementation was important to prevent anemia among adolescent girls.

Introduction

Adolescence is a golden period with optimal growth and development. During this period, adolescents have essential physical and psychological needs. Moreover, if there is a nutritional deficiency, one of the problems is anemia. Anemia in adolescent girls is still a problem in Indonesia. The impact of anemia is quite significant for adolescent health (1). Women of reproductive age are particularly vulnerable to blood loss due to menstruation

and pregnancy. Anemia is a condition whereby the numbers of red blood cells are lower than normal, preventing the adequate transport of oxygen to tissues and organs. Anemia is defined as a condition where hemoglobin (Hb) concentration is less than the requirement, and has been known to be a global health problem with significant adverse health consequences (2). The clinical definition of anemia by the World Health Organization (WHO) is Hb ≤ 7.45 mmol/L (12 g/dL) in women and Hb ≤ 8.07 mmol/L (13 g/dL) in men (3). Anemia has affected more than 2 billion people globally, which is approximately over a quarter of the world's population (4).

Anemia leads to poorer health, well-being and productivity, ultimately costing societies with socio-economic losses. The lack of hemoglobin resulting from anemia limits blood oxygen transport, resulting in reduced physical and mental capacity, along with other health risks (5). Reducing anemia among women of reproductive age is an important factor in the improvement of women's health, children's health, school performance, women's work productivity, healthier pregnancy outcomes and intergenerational benefits for good health, economic and community development (6). Anemia among adolescent girls is a significant public health concern with far-reaching consequences for physical health, cognitive development, and overall well-being (7).

The determinants of anemia are multifactor that ranging from nutritional deficiencies, chronic diseases, inflammation, infections, gynaecological and obstetric conditions, and inherited red blood cell disorders. Beyond physiological causes, broader pathways such as socioeconomic status, gender inequality, educational and geographic disparities play a fundamental role in the aetiology of anemia (8). Anemia is part of malnutrition problems which the micronutrient deficiencies known to cause or contribute to anemia include vitamins A, B_2, B_6, B_9, B_{12}, C, D and E, and zinc, each acting through different mechanisms (5). The main cause of anemia is low iron intake, especially in adolescent girls who require more iron due to menstruation and growth periods (9).

Globally, the prevalence of anemia among women of reproductive age has increased from 27.6% in 2012 to 30.7% in 2023, the prevalence is higher among pregnant women (25.5%). The prevalence of anemia high in South East Asia Region (46.4%) compared to all other region in the worldwide (8). The prevalence of anemia among pregnant women in Indonesia base on National Health Survey is 27.7% while in age 15-24 year old the incidence of anemia 14.6% (10). In Surabaya the prevalence of anemia among adolescent girls as many as 14.3% (1). The high prevalence of anemia in Indonesia underscores the importance of a comprehensive approach to increasing hemoglobin levels (11). According to WHO, due to the public health problem, anemia in a population is identified according to population prevalence as not a public health problem (≤4.9%), mild (5.0–19.9%), moderate (20.0–39.9%), and severe (≥40.0%) (5).

Nutrition consumed by adolescents determines nutritional status, in this case body

mass index (BMI). Nutritional status, often measured by Body Mass Index (BMI), is theoretically linked to anemia because it reflects the overall adequacy of macronutrient and micronutrient intake, including iron, which is essential for hemoglobin synthesis. A low BMI may indicate chronic undernutrition and micronutrient deficiencies, increasing the risk of anemia, whereas a high BMI (obesity) can be associated with chronic low-grade inflammation that impairs iron absorption and metabolism. Several studies have analyzed the relationship between anemia and BMI also mid-upper arm circumference (MUAC) (12). Nutritional status including weight, height, and MUAC associated with anemia (1). However multivariate logistic regression showed that the most influencing factors for anemia were MUAC and duration of blood per menses (1). Anemia is not only related to anthropometric measurements but also nutritional intake. Ensuring adequate iron intake through a balanced diet and possible supplementation is very important for adolescent girls to prevent the adverse effects of anemia on their health and well-being. Raising awareness about iron-rich foods and improving health education programs is crucial for preventing and managing anemia (13).

A preliminary study in Junior High School 10 Gorontalo revealed a total of 321 students, of which 160 were adolescent girls. Based on the background, the aim of the study was to analyze association between diet and nutritional status with the incidence of anemia among adolescent girls.

Materials and Methods

The study was conducted at Junior High School 10 Gorontalo which was conducted in May-June 2025. The study design was used a quantitative study with a cross-sectional design. The sampling technique used purposive sampling with the number of samples was 62 adolescent respondents in grade VII and grade VIII.

The research variables characteristic of adolescent girls respondents included age, class, dietary pattern, nutritional status, and hemoglobin status. Characteristics of adolescents aged 12-15 years. Dietary patterns is a pattern of food consumption with the order of types and amounts of food consumed at a certain time, the measurement of dietary patterns in the study uses a structured questionnaire consisting of 12 question items about the behavior of adolescent girls in providing answers to things related to diet including eating frequency, type of food, breakfast habits, snack habits, consumption of instant noodles, fluid needs, and consumption of fruits and vegetables were categorized as good (score >10), moderate (score >7), and poor (score >3) (14,15).

Nutritional status using the body mass index by age (BMI/U) indicator is influenced by the intake of macronutrients (carbohydrates, fats, proteins) and micronutrients (vitamins and minerals). Weight measurement using a digital scale with a Tanita Bia digital scale with an accuracy of 0.5 gram, while height measurement using stadiometer with an accuracy of

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0.1 cm. Nutritional status is categorized as poor (z-score -3SD to <-2SD), normal (z-score is -2 SD to +1SD), overweigth (z-score +1SD to +2SD), and obesity (z-score is >+2SD) (16).

Anemia is defined as a reduced concentration of hemoglobin in erythrocytes so that it is insufficient for physiological needs in the body, measured using the NESCO digital haemometer. Based on hemoglobin concentration, anemia is classified as mild, moderate, and severe with cut-off values for hemoglobin concentration of non-pregnant woman are non-anemic (≥12 g/dL), mild (11.0–11.9 g/dL), moderate (8.0–10.9 g/dL) and severe (<8 g/dL) (5). Data was collected through interviews using questionnaires and direct measurement for nutritional status. The data analysis was used the chi square test.

Results

The characteristic of the adolescent girls revealed about age, class, dietary pattern, nutritional status and hemoglobin status. The majority of respondents in the study were 14 years old, namely 29 people (46.8%) and 13 years old as many as 24 people (38.7%). The characteristics of the learning class level showed that the majority of respondents were from class VIII, namely 33 people (53.2%) and only 29 people (46.8%) were students from class VII. The characteristics of eating habits show that 30 people (48.4%) have a moderate dietary pattern, 25 people (40.3%) have a good dietary pattern, and only 7 people (11.3%) have a poor dietary pattern. The analysis of nutritional status showed that the majority of respondents had normal, namely 49 people (79.0%), while as many as 7 people (11.3%) had underweight, and 6 people (9.7%) had obesity.

Table1. Characteristic of Respondent

Variable	n	%
Age		
12 years	1	1.6
13 years	24	38.7
14 years	29	46.8
15 years	8	12.9
Class		
VII	29	46.8
VIII	33	53.2
Dietary pattern		
Poor	7	11.3
Moderate	30	48.4
Good	25	40.3

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Variable	n	%
Nutritional status	7	11.3
Underweight		
Normal	49	79.0
Overweight	0	0.0
Obesity	6	9.7
Hemoglobin status		
Low	15	24.2
Normal	19	30.6
High	28	45.2

The analysis association between dietary patterns, nutritional status with anemia shown in Table 2. The majority of respondents had moderate dietary pattern (48.4%), followed by good (40.3%), and poor dietary pattern (11.3%). The results of the measurement of hemoglobin (Hb) levels showed that 15 people (24.2%) of the respondents had low Hb levels, 19 people (30.6%) had normal Hb levels, and 28 people (45.2%) had high Hb levels. High-level anemia was most commonly found in respondents with poor dietary patterns and moderate dietary patterns. In contrast, a good dietary pattern had a low proportion of anemia (12.0%). The results of the statistical test showed a value of p = 0.019, indicating a significant association between diet and anemia. This indicates that poor diet tends to be associated with more severe levels of anemia.

Analysis nutritional status indicated that most of the adolescent girls had normal (79.0%), followed by underweight (11.3%) and obesity (9.7%). Characteristic of respondent adolescent gilrs in normal nutritional status who had high hemoglobin status as many as 24 respondents (49%). Underweight nutritional status among adolescent who had low hemoglobin status as many as 14.3%, normal nutritional status with low hemoglobin status among 12 respondents (24.5%), and there were also obese adolescents who had anemia (33.3%). The results of the statistical test showed a value of p = 0.474, which means that there was no significant relationship between nutritional status and anemia category (p > 0.05).

Table 2 Association between dietary patterns, nutritional status with anemia

Variable	Hemoglobin status								p value
	Normal		Low		High		Total		
	n	%	n	%	n	%	n	%	
Dietary pattern									
Poor	5	71.4	1	14.3	1	14.3	7	11.3	0.019
Moderate	6	20.0	11	36.7	13	43.3	30	48.4	
Good	8	32.0	3	12.0	14	56.0	25	40.3	

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Variable	Hemoglobin status								p value
	Normal		Low		High		Total		
	n	%	n	%	n	%	n	%	
Nutritional status									
Underweight	4	57.1	1	14.3	2	28.6	7	11.3	
Normal	13	26.5	12	24.5	24	49.0	49	79.0	0.474
Obesity	2	33.3	2	33.3	2	33.3	6	9.7	
Total	19	30.6	15	24.2	28	45.2	62	100	

DISCUSSION

Based on the age characteristics of the adolescent girls, it was shown that many of the respondents were in the early adolescent age range (13-15 years old) which was an important phase in psychosocial and educational development. Class-level characteristic data showed that the distribution of respondents was fairly evenly distributed between the two grade levels, with a slight dominance of grade VIII students. The results of this study are in line with research in Bekasi, which showed early adolescent characteristics in 51.1% of the study respondents (15). Dietary pattern that not match with the recommendations of more than half of the respondents were adolescent girls. Poor dietary patterns have negative impact on health and balance of daily intake. Adolescents who have a good diet, namely eating food regularly and in accordance with balanced nutrition guidelines. These findings indicate the need to increase education on the importance of healthy eating among adolescents. Poor dietary pattern was 40.3% relatively high compared previous study that revealed poor dietary pattern was 62.6% (15).

Analysis of nutritional status showed that most of the adolescent girls of the study were in normal nutritional status, although there were still a small number of respondents who experienced malnutrition problems or obesity. This was important to consider in an effort to maintain and improve the nutritional health of adolescents as a whole. Analysis of Hb levels showed that there were some adolescents with low Hb levels. Low Hb will have an impact on health and daily activities. The prevalence of anemia in this study was 24.2% relatively high compared previous study that indicated anemia among adolescent was 16.3% (15).

The study revealed association between dietary pattern with anemia (p value = 0,019). The study supported by previous study that revealed association between dietary pattern with anemia (p value = 0.023) (15). Dietary pattern was significantly associated with an increased risk of anemia and worse anemia-related biomarkers(15). The characteristics of the anemia–inflammation-related dietary pattern were similar to those of the Western dietary pattern, including high intakes of meat, processed meat, refined grains, fried foods, and sugary foods (17). Positive correlation between the anemia–

inflammation-related dietary pattern and inflammatory biomarkers, such as WBC and CRP. Anemic subjects had a higher WBC count than non-anemic subjects, but CRP levels were not significantly different between anemic and non-anemic subjects (15).

In this study, poor dietary patterns significantly contributed to anemia. Beyond general food consumption, specific dietary patterns play a crucial role. For instance, irregular breakfast habits, lack of animal protein consumption (which is the primary source of heme iron), and insufficient intake of green leafy vegetables (which provide non-heme iron and folate) can directly reduce hemoglobin synthesis. These specific poor dietary patterns limit the bioavailability of iron needed for optimal erythrocyte formation.

Furthermore, the poor dietary patterns observed in this study may stem from a lack of understanding regarding anemia and nutrition. A recent study by Awaru and Asmi (2024) found that a significant majority of adolescent girls (66.7%) have poor knowledge about anemia, which often leads to inadequate dietary choices and poor health practices. Therefore, addressing this knowledge gap through education is essential because when adolescents understand the implications of anemia, they are more motivated to improve their dietary patterns and health behaviors.

Bivariate analysis indicated that obese adolescent girl had anemia as many as 33.3%. the study supported by previous study that revealed overweight and obesity increase risk 20% and 23% of anemia. All abnormal weight statuses, including underweight, overweight, obesity, and central obesity, were linearly associated with an increased risk of anemia (19).

The study revealed there were not association between body mass index with anemia (p value = 0.474). The study differs from a previous study which found that weight, height, and MUAC associated with anemia among adolescent girls (1). The lack of association between nutritional status (BMI-for-age) and anemia in this study (p = 0.474) may be due to other more influential factors that were not measured. According to existing literature, factors such as specific iron intake, menstrual bleeding duration and patterns, or parasitic infections (e.g., helminth infections) play a more direct role in causing anemia in adolescent girls than overall body mass. While BMI reflects generalized energy and macronutrient balance, it does not always capture specific micronutrient deficiencies like iron deficiency.

Study Limitations

This study has several limitations. First, the sample size is relatively small (62 respondents) and was selected using a purposive sampling technique, which may affect the generalizability of the findings. Second, this study utilized BMI-for-age as the sole indicator of nutritional status. Existing literature suggests that Mid-Upper Arm Circumference (MUAC) might be a more sensitive anthropometric indicator for detecting anemia risk in

this specific population. Additionally, other confounding variables such as specific iron intake, menstrual patterns, and external infections (e.g., helminth infections or malaria) were not controlled in this study.

Conclusion

Data analysis indicated association between dietary pattern with anemia among adolescent girls, however there was no association between nutritional status with anemia. Adequate nutrition intake is crucial part to prevent anemia among adolescents. Nutrition education through school or health sectors is very important among adolescent girls that guidance to improve diet quality that can prevent anemia. For practical implications, it is highly recommended that schools implement routine monitoring of students' hemoglobin levels in collaboration with local community health centers (Puskesmas). Furthermore, future studies should consider using a larger sample size, including MUAC as an additional nutritional indicator, and measuring confounding variables such as menstrual duration and specific iron intake to provide a more comprehensive analysis.

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