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Dietary Patterns As A Determinant Of Anemia Among Adolescent Girls In An Islamic Boarding School

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ABSTRACT

Introduction: Adolescent girls in Islamic boarding schools had a higher risk of anemia due to dietary restrictions and lack of variation in nutrient intake. Meanwhile, research regarding the relationship between dietary patterns and the incidence of anemia in this group were still limited. Therefore, this study aimed to determine the relationship between dietary patterns and the incidence of anemia among adolescent girls in an Islamic boarding school as an effort for prevention and nutritional improvement.
Methods: This study used a quantitative research design with a cross-sectional approach. The study population consisted of 40 adolescent girls, used total sampling was applied (n = 40). The inclusion criteria included adolescent girls who lived in the Islamic boarding school and had not consumed blood-supplement tablets in the last month. The research instruments included a questionnaire (Google Form) and hemoglobin (Hb) level examination. Statistical analysis used the Spearman rank correlation test.
Results: The results of the Spearman Rank test showed a significance value of p= 0.001 (p < 0.05) with a correlation coefficient of r= 0.503. This indicated that there was a moderately strong positive relationship between dietary patterns and the incidence of anemia among adolescent girls in the Islamic boarding school.
Conclusions: The better the quality of dietary patterns, the lower the risk of anemia. Adequate nutrient intake played an important role in the process of hemoglobin formation. Environmental conditions in the boarding school, such as limited food variety and structured but less diverse meal schedules, also influenced the adequacy of nutrient intake.

Introduction

Anemia remains a global public health challenge and is commonly observed among adolescent girls. Adolescence is a transitional period characterized by physical, emotional, and psychological changes. It occurs between the ages of 10 and 19 years and represents the maturation of reproductive organs, known as puberty (Lilyanti et al., 2023). During this period, adolescent girls begin to experience menarche, which leads to the loss of iron from the body (Qotima et al., 2022).

The World Health Organization (WHO) reports that anemia affects various vulnerable populations. Approximately 30% of women of reproductive age (15–49 years) experience anemia, which negatively impacts their health and daily productivity (World Health Organization (WHO), 2023). In Indonesia, the Ministry of Health reported in 2022 that the prevalence of anemia among adolescents aged 15–24 years was 15.5% (Kemenkes, 2022). Meanwhile, the East Java Provincial Health Office reported in 2020 that the prevalence of anemia among adolescent girls in East Java reached 42%, indicating that more than 4 out of 10 adolescent girls in the region are at risk of anemia (Dinas Kesehatan Provinsi Jawa timur, 2024).

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Anemia reduces cognitive function and concentration, thereby affecting academic performance and daily productivity (Maigoda, 2025). Reduced oxygen supply to body cells leads to decreased physical fitness and impaired thinking ability in adolescents (Inti Mudjiati et al., 2023). Dietary patterns play a crucial role in meeting nutritional needs and preventing anemia (Izzara et al., 2023). However, many adolescent girls exhibit poor dietary habits, including irregular eating patterns, low consumption of iron-rich foods, and high intake of fast food (Hafiza et al., 2020). Limited nutritional knowledge further exacerbates this condition (Kusnadi, 2021).

Adolescents living in Islamic boarding schools face additional challenges in meeting their nutritional needs. Busy daily schedules, limited food variety, and irregular eating habits contribute to the occurrence of anemia (Yulita, 2021). The habit of skipping meals further worsens nutritional status due to time constraints, lack of motivation, low interest in available food, and occasional food shortages (Musyafra et al., 2024).

Although several studies have examined the relationship between dietary patterns and anemia among adolescents, most were conducted in formal school settings and focused on specific nutrient intake, such as iron, without considering overall dietary patterns. Moreover, studies specifically investigating adolescent girls in Islamic boarding schools using a cross-sectional approach remain limited. This indicates a research gap, particularly regarding the relationship between dietary patterns and anemia incidence in this population.

Adolescent girls at Pondok Pesantren Hidayatus Sholihin Gurah Kediri are at risk of anemia due to irregular and uncontrolled eating habits, as well as suboptimal nutritional management. This study is expected to provide an overview of the nutritional status of adolescent girls in Islamic boarding schools and serve as a basis for developing nutrition improvement programs, health education, and anemia prevention strategies. Therefore, this study aims to examine the relationship between dietary patterns and the incidence of anemia among adolescent girls living in Islamic boarding schools.

Methods

Study Design

This research employed a quantitative method and, based on the time approach, used a cross-sectional design with a correlational framework.

Setting

This study was conducted at Pondok Pesantren Hidayatus Sholihin, Gurah District, Kediri Regency, on April 27, 2026.

Research Subject

The population consisted of all adolescent girls residing in Pondok Pesantren Hidayatus Sholihin. Due to the limited population size, sample size calculation was not performed. Instead, a total sampling technique was applied, resulting in a sample of 40 respondents (n = 40). The use of the entire population aimed to minimize selection bias and ensure maximum data representativeness in evaluating the relationship between dietary patterns and the incidence of anemia in the boarding school environment. The inclusion criteria were adolescent girls who had experienced menstruation (menarche), lived and consumed meals at the boarding school, had not taken iron supplementation tablets in the past month, and were not menstruating at the time of data collection. The exclusion criteria included adolescent girls with chronic diseases that could affect hemoglobin levels, such as thalassemia, chronic kidney disease, and chronic infections. Participants were selected after providing informed consent.

Instruments

The research instruments consisted of two components: a dietary pattern questionnaire and hemoglobin (Hb) measurement. The dietary questionnaire was a modified version of the Food

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Frequency Questionnaire (FFQ) (Syauqy et al., 2021). It was adapted to reflect commonly consumed foods in the boarding school environment and used language that was easily understood by adolescent respondents. Validity testing was conducted using the Pearson correlation test by comparing r-calculated values with r-table values at a significance level of 0.05 (N = 10, r-table = 0.632). The results showed that all questionnaire items had r-calculated values ranging from 0.707 to 0.84, indicating that all items were valid. Reliability testing using Cronbach's Alpha yielded a value of α = 0.925 (>0.70), indicating high reliability. Anemia status was assessed using a portable digital hemoglobin measurement device with an electrochemical biosensor method. The measurement scale was categorized as nominal for data interpretation: anemia (<12 g/dL) and non-anemia (≥12 g/dL), based on WHO standards for adolescent girls.

Data Analysis

Data analysis included univariate analysis to describe frequency distributions of each variable. Bivariate analysis was performed using the Spearman Rank correlation test to determine the relationship between dietary patterns and the incidence of anemia. Data were presented in tables and analyzed based on the interpretation of correlation coefficient values.

Ethical Consideration

This research was conducted with attention to the ethical principles of confidentiality and beneficence, obtained informed consent from respondents, and meets ethical eligibility requirements, Number 0126040772/KEPK/STIKES-PEMKAB/JBG/IV/2026, at KEPK STIKES Pemkab Jombang.

Results

This study involved 40 adolescent girls aged 12–18 years who had experienced menstruation and were registered at Pondok Pesantren Hidayatus Sholihin, Gurah District, Kediri Regency. All participants were actively following the boarding school meal program, had not consumed iron supplementation tablets within the past month, and were not menstruating at the time of the study. The adolescent girls demonstrated varying dietary habits, including differences in meal frequency, consumption of vegetables and iron-rich side dishes, as well as habits of consuming fast food and beverages that inhibit iron absorption, such as tea and coffee.

Table 1. Distribution of respondents based on eating patterns in female adolescents at the Hidayatus Sholihin Islamic Boarding School, Gurah District, Kediri Regency.

No	Dietary Habit	criteria	N	%
1	0-16	low	6	15%
2	17-32	Sufficient	30	75%
3	33-48	good	4	10%

Based on the distribution of respondents according to the dietary pattern questionnaire among adolescent girls at Pondok Pesantren Hidayatus Sholihin, Gurah District, Kediri Regency, it was found that the majority of respondents had a moderately adequate dietary pattern, accounting for 75% (30 respondents). This proportion was higher compared to those with good or poor dietary patterns. Poor dietary habits are a contributing factor to anemia. The quality and consistency of a healthy diet significantly influence overall body health. Hemoglobin, a component of erythrocytes, requires sufficient energy for its formation. Therefore, inadequate energy intake can lead to decreased erythrocyte production and consequently lower hemoglobin levels (Satyagraha et al., 2020). Based on these findings, it can be assumed that the predominance

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of moderately adequate dietary patterns among respondents indicates that optimal nutritional intake has not yet been fully achieved. This condition may increase the risk of anemia. Therefore, improvements in dietary patterns toward a better category are necessary to ensure adequate intake of essential nutrients, particularly energy and iron.

Table 2. Distribution of respondents based on the incidence of anemia in female adolescents at the Hidayatus Sholihin Islamic Boarding School, Gurah District, Kediri Regency.

No	Incidence of Anemia	N	%
1	≤ 12 g/dL	20	50%
2	≥ 12 g/dL	20	50%

Based on Table 2, it can be observed that the proportion of respondents with anemia and those without anemia is equal, each accounting for 50%. This indicates that the incidence of anemia among respondents is relatively high and comparable to those who are not anemic. Anemia is a condition in which the number of red blood cells or the hemoglobin concentration within them is lower than normal. Hemoglobin is essential for transporting oxygen, and when red blood cells are too few or abnormal, the blood's capacity to carry oxygen to body tissues decreases (Dianita et al., 2024). Anemia is one of the most common health problems among adolescents. Theoretically, anemia can be caused by multiple factors, including iron deficiency, bleeding, chronic diseases, monthly menstruation, menstrual disorders, and insufficient intake of folic acid and other nutrients. Both the quantity and quality of food intake play an important role in erythrocyte formation. Inadequate nutritional intake may lead to decreased erythrocyte production and consequently lower hemoglobin levels (Satyagraha et al., 2020). Based on these findings and theoretical considerations, it can be assumed that the high incidence of anemia among respondents may be influenced by suboptimal dietary patterns and low intake of essential nutrients. Therefore, greater attention to adolescents' dietary habits is needed, particularly in ensuring adequate intake of iron and other nutrients to prevent anemia.

Table 2. Distribution of respondents based on the incidence of anemia in female adolescents at the Hidayatus Sholihin Islamic Boarding School, Gurah District, Kediri Regency.

Dietary habit	Incidence of Anemia				Total		*P value*
	Anemia		Not Anemia				
	n	%	n	%	N	%	
Low	6	15.0%	0	0.0%	6	15.0%	
Sufficient	14	35.0%	16	40.0%	30	75.0%	0,001
Good	0	0.0%	4	10.0%	4	10.0%	
Total	20%	50.0%	20	50.0%	40	100.0%	

Based on Table 3, it can be observed that respondents with moderate and good dietary patterns are more likely to not experience anemia compared to those who are anemic. Meanwhile, respondents with poor dietary patterns tend to experience anemia more frequently than those who are not anemic.

Discussion

Based on the results of the statistical analysis using the Spearman Rank test, the Sig. (2-tailed) value was 0.001 ($p < 0.05$) with a correlation coefficient of $r = 0.503$. This indicates a statistically significant relationship between dietary patterns and the incidence of anemia among adolescent girls at Pondok Pesantren Hidayatus Sholihin, Gurah District, Kediri Regency. The strength of the correlation is moderate, with a positive direction. A positive value indicates that the relationship between the two variables is directly proportional.

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This study suggests that the quality of dietary patterns plays an important role in determining anemia status. A literature review by (Arifianti & Sudiarti, 2023) states that the incidence of anemia in adolescent girls is influenced by multiple interrelated and complex factors, Peer influence may encourage risk behaviors related to anemia, while inadequate protein and energy intake can further increase the risk. Anemia is also associated with iron deficiency in the body, which can be caused by menstruation, bleeding, hemoglobinuria, chronic diseases, and inadequate dietary intake (Fitriany et al., 2021). Monthly menstruation increases blood loss, thereby raising iron requirements compared to adolescent boys (Wijayanti et al., 2025).

Iron is found in two forms: heme and non-heme iron. Heme iron is found in red meat, fish, and poultry and is easily absorbed regardless of other dietary components. In contrast, non-heme iron is found in both plant and animal sources, but its absorption is lower and is often influenced by other dietary components (Azkiyah & Rahimah, 2022). Iron intake plays a crucial role in hemoglobin formation, which is essential for oxygen transport in the blood (Pasa et al., 2024). Insufficient iron intake below the recommended dietary allowance does not immediately affect hemoglobin levels because the body still has iron reserves stored in the liver. However, once these reserves are depleted, hemoglobin levels begin to decline, starting with a decrease in ferritin levels (Thamrin & Masnilawati, 2021).

An unbalanced diet, such as low consumption of heme iron sources (animal-based foods) and non-heme iron sources (green vegetables), along with insufficient vitamin C intake, can reduce iron availability in the body. Vitamin C enhances the absorption of non-heme iron up to fourfold by converting ferric iron (Fe^{3+}) into the more absorbable ferrous form (Fe^{2+}) in the intestine (Ayupir, 2021). Conversely, the consumption of iron absorption inhibitors such as tannins (found in tea and coffee) can decrease iron bioavailability. Tannins are polyphenolic compounds that inhibit iron absorption, particularly non-heme iron, which has an absorption rate of only about 2–10% (Andriyani & Susilowati, 2022). This emphasizes that not only the quantity of iron intake is important, but also the quality of diet and eating habits that affect overall iron absorption.

Adolescent girls often have poor dietary quality and eating habits, resulting in inadequate nutrient intake. Physiological conditions such as menstruation further increase iron requirements due to regular blood loss. If these needs are not met with adequate nutritional intake, the risk of anemia increases. The boarding school environment, with scheduled but less varied meals, may also limit the intake of essential nutrients. The findings of this study are consistent with research by (Manila & Amir, 2021)), which found a relationship between dietary patterns and anemia incidence among tenth-grade female students at SMA Murni Padang. The researchers believe that dietary patterns are an important factor associated with anemia among adolescent girls, although not the only factor, and therefore improvements in dietary habits should be accompanied by attention to other nutritional factors.

Similar studies also show a relationship between dietary patterns and anemia incidence among adolescent girls. Adolescents often pay close attention to body image, which may lead them to restrict food intake. Unhealthy eating habits can affect hemoglobin levels and increase the risk of anemia (Nisa, 2021), the researcher assumes that the better the dietary pattern, the lower the risk of anemia among adolescent girls. Therefore, improving dietary patterns by increasing the consumption of iron-rich foods and vitamin C, as well as reducing the intake of substances that inhibit iron absorption, is an important step in preventing anemia among adolescent girls, particularly in the boarding school environment.

Conclusion

Based on the results and discussion regarding the relationship between dietary patterns and the incidence of anemia among adolescent girls in Islamic boarding schools, it can be concluded

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that there is a significant, positive, and moderately strong relationship, with a significance value of p = 0.001 (p < 0.05) and a correlation coefficient of r = 0.503. This indicates that the better the quality of dietary patterns among adolescent girls, the lower the risk of anemia. Adequate nutrient intake, particularly iron, protein, and supporting vitamins such as vitamin C, plays an important role in the process of hemoglobin formation. Conversely, an unbalanced diet that is low in iron can inhibit hemoglobin production and increase the risk of anemia. Environmental conditions in the boarding school, such as limited food variety and structured but less diverse meal schedules, may also affect the adequacy of nutrient intake, thereby strengthening the relationship between dietary patterns and the incidence of anemia.

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