The Relationship between Nutrition Knowledge and Eating Frequency with Anemia: A Nutrition Perspective from Islamic Boarding Schools

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Abstract

Anemia remains a common undernutrition problem among adolescent girls. Adolescent girls are vulnerable to anemia due to their increased nutrient needs for growth and monthly blood loss through menstruation. Poor eating habits, such as low meal frequency and unbalanced nutritional intake, can exacerbate the risk of anemia. Islamic boarding schools (pesantren) are a place for adolescents to learn and live. They are expected to provide nutrition education and adequate food provision for them. This study aims to determine the relationship between nutritional knowledge and eating frequency with the incidence of anemia. The study design used a cross-sectional approach, with a sample size of 75 female students residing at the Islamic boarding school. The sample was selected using purposive sampling. Data were collected through Hb examination to determine anemia and interviews using questionnaires to obtain data on nutritional knowledge and eating frequency. The correlation analysis was performed using the Spearman correlation test. The results showed that 16% of the students had anemia, 58.7% ate twice a day, and 54.7% had insufficient knowledge. The results of the Spearman's Rank correlation test showed a p value of 0.019 ($p < 0.05$), which means there is a relationship between nutritional knowledge and anemia, and a p value of 0.553 ($p > 0.05$), which means there is no relationship between eating frequency and anemia. Nutrition education is needed to improve nutritional knowledge, especially regarding anemia and balanced nutrition in students, and to encourage a balanced diet to prevent anemia in this group.

1. Introduction

Anemia remains a significant global health problem, especially for adolescent girls. According to WHO (2023) anemia in adolescent girls in developing countries is reaching a high prevalence, especially in Asia and Africa. Anemia that often occurs is anemia due to iron deficiency which reduces the body's capacity to carry oxygen,

which has an impact on quality of life and productivity. According to the WHO, adolescent girls are particularly susceptible to anemia due to increased iron requirements during periods of rapid growth, menstruation, and lifestyle changes. In Indonesia, anemia is recorded as a considerable public health problem, with a high prevalence among adolescent girls, which not only affects their health, but also their academic achievement and social life (Rachmi et al., 2021). The impact of anemia is widespread, affecting cognitive and physical development, which can have a long-term impact on school achievement, productivity, and overall quality of life (Novelia et al., 2022).

This anemia problem is more prominent in several regions in Indonesia. For example, data from the Basic Health Survey (Riskesdas, 2018) shows that the prevalence of anemia in adolescent girls is very high, at 32.5%, with some areas, especially in rural areas, reporting higher rates (Djogo & Letor, 2022). Another study conducted by the Indonesian Ministry of Health (2022) also showed that more than 40% of adolescent girls in Indonesia do not meet the nutritional intake needed to prevent anemia. A study by Sari et al. (2022) shows that almost 20% of adolescent girls in Indonesia are malnourished, especially those related to iron and vitamin A deficiencies. In these areas, limited access to quality health services, poor eating habits, and economic challenges contribute greatly to the rising cases of anemia. Adolescent girls in the area are more likely to be malnourished and have limited access to iron-rich foods, which further exacerbates the risk of anemia.

Several studies examining the determinants of anemia in adolescent girls highlight a variety of factors, including poor diet, lack of knowledge about nutrition, and low family income (Novelia et al., 2022). A study conducted in West Java found that poor diet, especially a lack of iron-rich foods, is strongly associated with anemia in adolescent girls (Rachmi et al., 2021). Similarly, another study in Kupang identified a significant link between malnutrition and the incidence of anemia, with the prevalence of anemia among adolescent girls reaching 64.5% (Djogo & Letor, 2022). Decreased intake of iron-rich foods, such as vegetables and fruits, contributes to an increase in the prevalence of anemia, although menstrual status has not been shown to be significantly associated with anemia (Sigit et al., 2024).

Although there has been a great deal of research on anemia, there are still significant gaps in our understanding of its specific causes and effective interventions in a variety of social and cultural contexts. While many studies have addressed the prevalence of anemia globally and nationally, few have focused on specific factors that affect adolescent girls in Islamic boarding schools (Islamic boarding schools) in Indonesia, where unique dietary patterns and cultural practices can affect nutritional status ((Novelia et al., 2022; Sari et al., 2022). This research gap demonstrates the importance of more localized studies to identify the specific challenges faced by adolescent girls in Islamic boarding schools and how these contribute to the risk of anemia.

There are still many instances of anemia in young women living in Islamic boarding schools. At the Al-Mizan Islamic Boarding School Muhammadiyah Lamongan, anemia in female students is 57.5% (Nabilla et al., 2022). At the International Islamic Boarding School of Muhammadiyah Boarding School Miftakhul Ulum Pekajangan Pekalongan**,** out of a total of 66 respondents (36.4%) experienced mild anemia, (15.2%) moderate anemia, (4.5%) severe anemia and the rest (43.9%) did not experience anemia (Syafrina & Sulistyanto, 2022). Meanwhile, the incidence of anemia in adolescent girls is 64.8% at the Al-Amalul Khair Islamic Boarding School, Palembang City (Lestari et al., 2024). The incidence of anemia in Ogan Ilir Regency shows that 46% of adolescent girls experience anemia (Rahmiwati et al., 2025). Based on this data, there are still challenges for Islamic boarding schools in dealing with anemia. Where knowledge about nutrition and unbalanced diets contribute to the high prevalence of anemia. Adolescent girls in these pesantren tend to have limited eating habits and depend on the diet provided by the pesantren, which often does not meet optimal nutritional needs (Rahmawati et al., 2021).

This study aims to examine the relationship between nutritional knowledge, eating frequency, and the prevalence of anemia in adolescent girls in Islamic boarding schools. By focusing on this population, this study will provide valuable insights into how educational interventions and dietary improvements can help prevent and manage anemia in the pesantren setting (Djogo & Letor, 2022).

In addition, this research will also contribute to the development of science about adolescent nutrition in Indonesia. It is hoped that the findings of this study can provide useful information for policies and practical interventions aimed at reducing anemia and improving the health and academic outcomes of adolescent girls, especially those in Islamic boarding schools (Asy Syifa & Hasniyati, 2024).

1.1 Literature Review

Definition, Causative Factors, and Impact of Anemia

Anemia is defined as a condition when hemoglobin (Hb) levels or red blood cell counts (erythrocytes) are below standard than average based on age group and sex (Warner, 2023). According to the WHO (2023), adolescent girls need about 15 mg of iron per day, higher compared to boys who only need about 11 mg per day. In adolescents and women of sub-fertile age-, anemia is still a major burden on public health with an estimated hundreds of millions of people affected (Suprapti et al., 2025). In particular, in the context of adolescent girls, the most common type of anemia is iron deficiency anemia (IDA). Iron deficiency anemia is the most frequent cause of microocytic anemia in the adolescent group (Fairman & Wang, 2016).

The causes of anemia are multifactorial: ranging from insufficient nutritional intake, absorption disorders, blood loss (menstrual bleeding or gastrointestinal tract), to chronic medical conditions or parasitic infections that increase iron loss or use. (Suprapti et al., 2025). Iron deficiency anemia occurs when the body's iron stores are depleted (characterized by low ferritin), then there is a decrease in transferrin saturation, and finally hemoglobin production decreases so that hemoglobin decreases (Animasahun & Itiola, 2021). Iron is an essential component in the formation of hemoglobin, which transports oxygen throughout the body. In adolescent girls, the need for iron increases with increased blood volume, rapid body growth, and menstrual blood loss. Without adequate iron intake, the body cannot produce hemoglobin efficiently, which can lead to iron deficiency anemia (IDA) (Rachmi et al., 2021).

Specific mechanisms associated with adolescent girls include: increased iron needs due to growth, menstruation that causes monthly blood loss, and a diet that may be deficient in heme iron intake or contain absorption inhibitors (e.g., tea / coffee consumption with meals). This makes adolescent girls a high-risk group for iron deficiency anemia. The physical impact of anemia is fatigue, decreased work capacity, impaired immunity, and in severe cases can cause heart and organ disorders. For example, Animasahun & Itiola, (2021) mentioned that in children and adolescents, iron deficiency has an impact on linear growth and immune function (Animasahun & Itiola, 2021).

From a cognitive and mental perspective, iron deficiency anemia has been shown to reduce academic performance, concentration, and neurological function. For example, a review article in Pediatrics in Review suggests that iron deficiency affects DNA synthesis, the neurotransmitter dopamine, and myelination, which has implications for brain function and cognition (Tong & Vichinsky, 2021). Malnutrition can affect brain development, reduce cognitive abilities, and decrease concentration at school (N. Sari et al., 2021). In the long term, nutritional deficiencies in adolescence can lead to ongoing health complications, such as an increased risk of premature birth and babies with low birth weight (Lestari et al., 2024). In addition, in adolescent girls, anemia also has socioeconomic implications: decreased productivity, fatigue that affects school attendance and performance, and potential risks to future pregnancies. This shows that the incidence of anemia is not only a medical problem but also has educational implications and human resource development. It is important to understand these impacts because it will help reinforce the urgency of independent variables (nutritional knowledge and feeding frequency) for interventions. If anemia can be prevented through improving knowledge and eating, then the potential benefits for the physical, mental, and academic health of young women in Islamic boarding schools will be enormous.

Nutrition and Anemia Knowledge

Nutritional knowledge plays a very important role in determining a healthy and balanced diet. A good knowledge of nutrition can motivate individuals to eat foods that are nutritious and include all the essential

nutrients needed by the body, such as iron, vitamins, and other minerals. Conversely, lack of nutritional knowledge often leads to poor diets, which contribute to malnutrition, including iron deficiency anemia.

For example, research by Rachmi et al., (2021) showed that adolescent girls with low levels of nutrition knowledge tend to consume less nutritious foods and more often ignore iron-rich foods. The study shows that adequate knowledge of iron-rich foods, as well as the importance of consuming other healthy foods, is directly related to better nutritional status, which in turn reduces the risk of anemia in adolescent girls.

In the pesantren environment, where the diet often depends on the menu provided by the institution, the nutritional knowledge of the students about the importance of nutritious and balanced food is very important. Students with limited knowledge about nutrition may not be able to make optimal food choices to prevent nutritional deficiencies, thereby increasing the prevalence of anemia among them (Syafrina & Sulistyanto, 2022).

Nutrition education has been shown to be effective in raising awareness about healthy eating and contributing to a decrease in the prevalence of anemia. Research by Novelia et al., (2022) showed that after nutrition education interventions in schools in Indonesia, there was a significant increase in knowledge about nutrition and healthy eating among adolescent girls, which was followed by a decrease in the incidence of anemia. Better knowledge of nutrition not only helps improve the quality of diet, but it also encourages young women to make positive changes in their eating habits.

In Islamic boarding schools, a nutrition education approach based on understanding and practical skills in choosing the right food can reduce the prevalence of anemia among female students, as has been seen in intervention studies in several schools in Indonesia (Syafrina & Sulistyanto, 2022).

Diet and Frequency of Eating as Triggering Factors

An unbalanced diet is the main factor that affects the nutritional status of adolescent girls, especially in the pesantren environment. Adolescent girls are often malnourished due to the limited variety of foods available, which in turn affects their intake of iron and other essential nutrients. A study conducted by Rachmi et al., (2021) showed that adolescent girls with irregular and malnourished eating habits have a higher risk of suffering from anemia.

Low or irregular eating frequency is also a trigger factor for anemia. In adolescent girls who only eat twice a day or less, the intake of iron entering the body is not enough to meet their daily needs, thus increasing the risk of iron deficiency and anemia (P. Sari et al., 2022). In Islamic boarding schools, where food is often served in limited quantities and at irregular times, young women are more prone to not getting enough iron from the available food. The inability to eat regularly or get iron-rich foods at the right time can increase the risk of anemia among students (Syafrina & Sulistyanto, 2022).

Islamic Boarding School

Pesantren, in the Indonesian context, is an Islamic educational institution that has a dormitory system where students live and study. In addition to delving into the teachings of Islam, pesantren also teach life skills that are useful for students in society. Islamic boarding schools usually focus on teaching religious sciences such as the Qur'an, Hadith, Fiqh, and Tawheed, but some Islamic boarding schools also teach general science and other practical skills.

Islamic boarding schools in Indonesia have various models, ranging from traditional Islamic boarding schools that prioritize religious education, to modern Islamic boarding schools that offer religious and general education at the same time. Despite this, most Islamic boarding schools, especially those in rural areas, face challenges in providing nutritious and balanced food for students, which often has an impact on their nutritional status.

A study conducted by Syafrina & Sulistyanto,(2022) shows that the diet in pesantren is often insufficient to meet the daily iron needs needed by adolescent girls, which is at risk of increasing the incidence of anemia. This

is exacerbated by irregular eating habits, as well as the absence of adequate nutrition education assistance for students. Islamic boarding schools that do not have a diversity of nutritious food menus are very susceptible to health problems such as anemia, which can disrupt the nutritional balance and immunity of students.

Diets in pesantren are often limited to the menu provided by the institution, which generally depends on the availability of foodstuffs around the pesantren and limited resources. The food provided usually consists of local ingredients that are cheap and easy to get, such as rice, tempeh, tofu, and vegetables that do not always cover all the nutritional needs of the students. Although some pesantren strive to provide more nutritious food, there are still many challenges faced, such as limited funds, poor nutrition knowledge, and lack of good diet planning. Without adequate education about the importance of nutrition, students tend not to realize the importance of consuming foods rich in iron and other micronutrients. This shows that pesantren as an educational institution needs to have an active role in improving nutritional knowledge and improving students' diets to prevent anemia (Lestari et al., 2024).

2. Research Methods

This research was conducted in November 2025 at the Syafaatut Thulab Islamic Boarding School in Ogan Ilir Regency. This study is a quantitative research with a cross-sectional design. The population of this study is all students in the Islamic Boarding School. After sample calculation, a sample of 75 students who live in Islamic boarding schools was obtained. Samples were selected by purposive sampling. The method of data collection is by Hb examination to obtain data on Hb levels so that it can be determined whether the condition is anemia or not and interviews using questionnaires are carried out to obtain nutritional knowledge and eating frequency data. The data from the research will be entered and processed using a computer statistical program with a Spearman's Rank Correlation test.

3. Result and Discussion

The research was conducted at the Syafaatut Thulab Islamic Boarding School. The students who were the sample of this study amounted to 75 people. The study was conducted in one time between dependent and independent variables. The variables in this study were anemia, nutritional knowledge and frequency of meals. The following data from the research results are presented in the form of a table.

Table 1. Distribution of Anemia Frequency, Nutritional Knowledge and Eating Frequency

Category	n	Percentage (%)
Hb Rate		
Anemia	12	16
No Anemia	63	84
Total	75	100
Nutritional Knowledge		
Less	41	54,7
Good	34	45,3
Total	75	100
Feeding Frequency		
1	9	12
2	44	58,7
3	20	26,7
4	2	2,6
Total	75	100

Based on the table above, it is known that 16% of respondents experience anemia. Around 54.7% of respondents have poor nutritional knowledge and 58.7% eat only 2 meals a day.

Table 2. Distribution of Descriptive Statistical Variables

Variable	Sum	Mean	Median	Min-Max	SD	95% CI Mean
Knowledge	75	5,31	5,00	1 - 9	1,938	4,86 – 5,75
Feeding Frequency	75	2,2	2,00	1 - 4	0,678	2,04 – 2,36

Based on table 2, it is known that the average knowledge of respondents is 5.31 with a standard deviation of 1.938. Meanwhile, the frequency of meals in a day, the average number of respondents ate 2.2 times with a standard deviation of 0.678.

Table 3. Analysis of the Correlation of Nutritional Knowledge and Frequency of Eating with the Incidence of Anemia

Respondent Characteristics	Group				Correlation Coefficient	Value p
	Anemia		No Anemia			
	(n)	%	(n)	%	(r)	
Nutritional Knowledge					- 0,271	0,019
Less	6	14,6	35	85,4		
Good	6	17,6	28	82,4		
Feeding Frequency						
≤ 2 times	9	17	44	83	0,070	0,553
> 2 times	3	13,6	19	86,4		

Based on the table above, it is known that 6 respondents with less knowledge experienced anemia (14.6%). The same is true for 6 well-informed respondents who experienced anemia (17.6%). After the spearman correlation test was carried out between the variables of nutritional knowledge and anemia, the value of r = -0.271 and the value of p = 0.019 were obtained, which means that there is a relationship between nutritional knowledge and the incidence of anemia. The direction of the relationship is negative, which means that the higher the nutritional knowledge, the lower the risk of anemia. The strength of the relationship is relatively weak. Then in the variable frequency of meals, it was seen that 9 respondents with the frequency of eating ≤ 2 times a day were anemic (17%). After the spearman correlation test between the variable of eating frequency and anemia, the value of r = 0.070 and the value of p = 0.553 were obtained, which means that there was no relationship between the frequency of eating and the incidence of anemia.

The results of the study showed that around 16% of the incidence of anemia in the Syafaatut Thulab Islamic boarding school. In terms of nutritional knowledge, 54.7% of respondents have less knowledge while 58.7% have a frequency of eating only 2 times a day. At the International Islamic Boarding School of Muhammadiyah Boarding School Miftakhul Ulum Pekajangan Pekalongan**,** 36.4% had mild anemia, 15.2% had moderate anemia, 4.5% had severe anemia and the remaining 43.9% did not have anemiaLow nutritional knowledge can lead to a deficiency of important micronutrients, such as iron, which plays a major role in the formation of hemoglobin. Iron serves to transport oxygen throughout the body, and its deficiency can lead to iron deficiency anemia (WHO, 2023). The importance of nutritional knowledge in influencing a healthy diet and reducing the risk of anemia, which is in line with the theory *of the Health Belief Model* (Rosenstock, 1974) and *the Theory of Planned Behavior* (Ajzen, 1991), which states that good knowledge and understanding of health threats (such as anemia) can encourage individuals to take preventive measures, such as improving diet. The results of this study also show that although the frequency of eating plays a role, the quality and type of food consumed become more important.

The results of this study are in line with the findings of research conducted by Utami et al., (2022), which show that good nutritional knowledge is related to a decrease in the prevalence of anemia in adolescent girls in Islamic boarding schools. Good knowledge of the importance of consuming nutritious foods, such as iron, is

crucial to prevent anemia. Another study found that the higher the nutritional knowledge, the lower the risk of anemia, which is in line with the theory that nutritional knowledge can affect a healthy diet and meet the nutritional needs the body needs to prevent anemia. This is reinforced by research results showing that nutrition education can help individuals choose nutritious foods, which ultimately prevents anemia (P. Sari et al., 2022).

Research conducted by Novelia et al., (2022) supports this study, which shows that better nutritional knowledge is associated with a decrease in the prevalence of anemia in adolescent girls. Higher knowledge about the importance of consuming foods rich in iron and other nutrients can improve diet and reduce the risk of anemia. Similar findings were also found in a study by Rachmi et al., (2021), which stated that nutrition education is effective in reducing the incidence of anemia in adolescent girls. In a study by Fauni et al., (2025), it was found that the consumption of fast food that is high in salt and low in fiber among adolescent girls also contributes to nutritional problems, including anemia.

However, the association between eating frequency and the incidence of anemia was not significant in this study. One possible reason is that although the frequency of daily meals is low, the quality of the food consumed also affects nutritional status, including anemia. For example, even if the respondents ate twice a day, if the food consumed was rich in iron and other nutrients, then the risk of anemia could still be low. This suggests that not only the frequency of eating plays a role, but also the type and quality of food consumed (Rachmi et al., 2021).

However, these findings contradict research conducted by Sigit et al., (2024), who found that despite the association between nutritional knowledge and nutritional status, low feeding frequency still contributes to the high prevalence of anemia. In their study, eating frequency had more effect on adolescent nutritional status, and nutritional knowledge, while important, did not necessarily reduce the prevalence of anemia if diet remained unbalanced. This is in line with findings by Musfira & Hadju, (2024) who noted that the consumption of healthy foods rich in iron is more important than just the frequency of meals to prevent anemia. This difference may be due to environmental factors such as access to nutritious food that may differ between study sites.

In this study, respondents came from highly structured environments (pesantren), who may have limited access to nutrient-rich foods even though they have knowledge of nutrition. In addition, other external factors, such as eating habits that are limited by time or the diet provided by the pesantren, can affect the results. Therefore, although nutritional knowledge is associated with a reduced risk of anemia, other factors such as food quality and dietary diversity remain important in preventing anemia.

4. Conclusions

This study showed that 16% of respondents experienced anemia with results showing a weak negative relationship between nutritional knowledge and the incidence of anemia. The higher the nutritional knowledge, the lower the risk of anemia in adolescent girls even though the strength of this relationship is relatively weak. Meanwhile, the frequency of eating did not show a significant association with the incidence of anemia. This shows that although less eating frequency has a role in reducing the amount of food consumed in a day, other factors such as the quality and diversity of food consumed have a greater effect on nutritional status and risk of anemia.

Based on the results above, the importance of good nutrition education in increasing nutrition knowledge and awareness of healthy eating can reduce the prevalence of anemia among young women, especially in the pesantren environment. An educational approach that increases nutritional knowledge about the importance of consuming iron-rich foods can help students to choose more nutritious foods, which can ultimately reduce the risk of anemia. Islamic boarding schools can integrate nutrition education into their curriculum and work with nutritionists to develop a more nutritious menu for students. Therefore, more intensive nutrition education and increased access to nutritious food in Islamic boarding schools can improve nutritional status and reduce the prevalence of anemia among female students.

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