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Determinants of Anemia among Female Adolescents in Maubesi Health Center, North Central Timor District, East Nusa Tenggara

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Abstract
Anemia in Indonesia remains a significant public health concern, especially among adolescents. Several diverse factors contribute to anemia in this age group, including suboptimal nutritional intake habits. This study aimed to determine the factors associated with anemia among female adolescents in Lanaus Village, Maubesi District. This was a cross-sectional study conducted in April 2023. The population consisted of all female adolescents in Lanaus Village, totaling 171 individuals. The sample size was calculated using Slovin's formula, resulting in 63 respondents. Purposive random sampling was used as the sampling technique, and participants were selected based on predefined inclusion and exclusion criteria. The research instrument was a structured questionnaire. Data analysis included univariate analysis, chi-square tests, and logistic regression. The study found a significant association between anemia and the following factors: compliance with iron supplementation (p-value = 0.002), socioeconomic status (p-value = 0.008), and breakfast habits (p-value = 0.000). On the other hand, there was no significant relationship between BMI and anemia (p-value = 0.096). Among the significant factors, compliance with iron supplementation and breakfast habits was most strongly associated with anemia. Breakfast habits were identified as the dominant factor influencing anemia among female adolescents in Lanaus Village, with a p-value of 0.019 and an odds ratio (OR) of 15.427. Adolescents who did not regularly eat breakfast were found to be 15.42 times more likely to experience anemia. It is essential for adolescents to understand the importance of regular breakfast consumption and adherence to iron supplementation as key strategies in the prevention and control of anemia.

Keywords: Adolescents, Anemia, Breakfast, Iron Supplementation.

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1. INTRODUCTION

Adolescence is characterized by significant physical and psychosocial challenges. It is a critical period of growth, reproductive maturation, and developmental transitions that requires increased nutritional intake, making adolescents more vulnerable to nutritional deficiencies. Adolescents are at high risk of threats such as death, illness, and injury. During this phase, they also develop certain behavior patterns related to diet, physical activity, tobacco, and drug use that can either protect or harm their health, both now and in the future (World Health Organization, 2021).

The World Health Organization (WHO) estimates that 30% of females worldwide are anemic (World Health Organization, 2023). Another study stated that the global prevalence of anemia among female adolescents ranges from 40%, especially in developing countries, reaching up to 53.7% (Sari et al., 2020). The prevalence of anemia among adolescents in Indonesia is still quite high. Riskesdas 2018 found that 32% of adolescents were anemic, which means that 3 out of 10 adolescents suffer from anemia (Ministry of Health Republic of Indonesia, 2018).

Anemia is a global public health problem among adolescents. Anemia during adolescence has a negative impact on growth, cognitive abilities, and performance, and it poses serious consequences throughout the reproductive years. Anemia in female adolescents significantly affects their health, including causing irregular menstruation. If left untreated, it can impair reproductive health in their future roles as mothers (Deivita et al., 2021). Female adolescents who suffer from anemia are at risk of becoming anemic women of childbearing age and later anemic pregnant women. Untreated anemia during the preconception period can negatively impact both mother and fetus during pregnancy and at birth (Omotalyo et al., 2021). This increases the chances of giving birth to a low birth weight (LBW) baby, stunting, and complications during childbirth such as hemorrhage, infections, and several other pregnancy-related risks (Youssry et al., 2018).

The factors that affect anemia among adolescents are quite diverse. Female adolescents are more likely to experience anemia compared to males. One study found that females were 1.73 times more likely to have anemia than males. Furthermore, female adolescents aged 15–19 years were twice as likely to be anemic compared to those aged 10–14 years. This may be due to the onset of menstruation and the higher likelihood of early pregnancy in the 15–19 age group. In addition, rapid physical changes and developmental transitions during this stage may contribute to the risk (Zhu et al., 2021). The most common cause of anemia worldwide is iron deficiency, which results from insufficient iron intake, decreased absorption, or blood loss. Female adolescents experience regular blood loss during menstruation, which increases their risk. Dietary differences may also play a role. Female adolescents tend to consume fewer protein- and vitamin-rich foods and eat less frequently compared to males. Dietary diversity has been found to be a significant factor associated with anemia among female adolescents. Adolescents who lack access to a variety of foods are at risk of anemia due to low intake of essential nutrients such as protein, iron, vitamin B12, and folate, all of which are required for red blood cell formation. When the number of red blood cells or the hemoglobin content is below normal, anemia occurs (Habtegiorgis et al., 2022).

Previous studies have shown that breakfast habits are associated with increased hemoglobin (Hb) levels in female adolescents. Skipping breakfast reduces the number of meals consumed per day, which may negatively impact nutritional intake. Adolescents who eat three or more meals per day are more likely to meet their nutritional requirements (Ropitasari et al., 2020). However, another study on female adolescents found no significant relationship between breakfast habits and the incidence of anemia. Nonetheless, further analysis of iron-rich food consumption, iron supplement intake, and BMI status revealed a significant relationship between these factors and anemia among females (Indrawati et al., 2023).

Knowledge level, attitude, and family income have also been identified as factors related to anemia. Socioeconomic status can influence one's access to iron-rich foods such as meat, fish, poultry, and other animal-based products (Rangkuti, 2020). A previous study supported this, stating that anemia was significantly associated with knowledge (p = 0.000) and peer support (p = 0.000), but not with family income (p = 0.166). Good knowledge empowers adolescents to prevent anemia. Both family and peers are external factors that influence adolescents' knowledge levels and adherence to anemia prevention behaviors (Triharini et al., 2023).

The Maubesi Health Center has established four adolescent health posts across different villages: Maubesi, Letmafo, Letmafo Timur, and Lanaus. Maubesi has 112 female adolescents, Letmafo has 92, Letmafo Timur has 75, and Lanaus has the highest number with 171 female adolescents. A preliminary study conducted in Lanaus Village included hemoglobin (Hb) examinations of 20 female adolescents, revealing that 16 of them were anemic. Among those, 12 had mild anemia and 4 had moderate anemia. Based on previous studies, the factors related to anemia include compliance with iron supplementation, socioeconomic status, body mass index (BMI), and breakfast habits. The goal of this study was to analyze the factors associated with anemia among female adolescents in Lanaus Village, under the jurisdiction of Puskesmas Maubesi, Timor Tengah Utara, East Nusa Tenggara, Indonesia.

2. RESEARCH METHOD

This study was a quantitative observational analysis using a cross-sectional design. It was conducted in Lanaus Village, under the jurisdiction of Maubesi Health Center, in April 2023. The population consisted of all female adolescents in Lanaus Village, totaling 171 individuals. The sample size was calculated using Slovin's formula, resulting in 63 respondents. Purposive random sampling was used as the sampling technique. Respondents were selected based on inclusion and exclusion criteria. The inclusion criteria included female adolescents aged 10–19 years who participated in the Youth-Posyandu in Lanaus Village. Exclusion criteria were adolescent girls who had not yet experienced menarche, those currently menstruating, or those within 2–3 days after menstruation. Data were collected using primary data obtained from respondents through a questionnaire as the main instrument. Data analysis included univariate analysis, chi-square tests, and logistic regression. Ethical approval for this study was obtained from the Ethics Committee of Poltekkes Kemenkes Yogyakarta, with approval number DP.04.03/e-KEPK.1/125/2023, issued on February 11, 2023.

3. RESULTS AND DISCUSSION

Univariate analysis in this study aimed to determine the frequency distribution of respondents' characteristics, including the incidence of anemia among female adolescents, compliance with iron supplementation, socioeconomic status, BMI, and breakfast habits.

Table 1. Respondents' characteristics

Variable	Frequency (n=63)	Percentage (%)
Alnemia		
No	26	41.3
Yes	37	58.7
Compliance with iron supplementation		
Yes	30	47.6
No	33	52.7
Socioeconomic		
Sufficient	12	19

Variable	Frequency (n=63)	Percentage (%)
Insufficient	51	81
BMI		
Normal	35	55.6
Abnormal	28	44.4
Breakfast habit		
Good	18	28.6
Poor	45	71.4

Table 1 shows that the incidence of anemia was 58.7%. The normal hemoglobin (Hb) level for females is between 12 to 16 g/dL. When the Hb level falls below this range, it indicates anemia. The majority of adolescents (52.4%) were non-compliant in consuming iron supplements. Based on family socioeconomic status, 81% of respondents were from low-income families. About 55.6% of female adolescents had a normal BMI, while 71.4% were not accustomed to eating breakfast.

Table 2. Descriptive analysis of anemia and BMI

Variable	n	Min	Max	Mean	SD
Anemia	63	10	15.40	11.59	1.135
BMI	63	12	27	17.04	2.876

The descriptive analysis of the anemia and BMI variables is presented in Table 2. The lowest hemoglobin level among adolescents was 10 g/dL, and the highest was 15.40 g/dL, with an average of 11.59 g/dL. For the BMI variable, the minimum BMI value was 12, which falls under the underweight category, and the maximum BMI was 27, indicating obesity, with an average value of 17.04.

Table 3. Factors of anemia among female adolescents

Variables	Anemia				Total		p-value
	No		Yes				
	n=26	%	n=37	%	n=63	%	
Compliance with iron supplementation							
Yes	26	86.7	4	13.3	30	100	0.000
No	0	0	33	100	33	100	
Socioeconomic							
Suficient	9	75	3	25	12	100	0.008
Insufficient	17	33.3	34	66.7	51	100	
BMI							
Normal	13	37.1	22	62.9	35	100	0.457
Abnormal	13	46.4	15	53.6	28	100	
Breakfast habit							
Good	15	83.3	3	16.7	18	100	0.000
Poor	11	24.4	34	34	45	100	

Adolescents who were non-compliant with iron supplementation were all anemic, resulting in a 100% prevalence, as shown in Table 3. In contrast, only 13.3% of those who were compliant with iron supplementation were anemic. There was a significant relationship between adherence to iron supplement consumption and anemia, with a p-value of 0.000 (<0.05).

Table 3 also shows that among adolescents with sufficient socioeconomic status, 75% did not experience anemia. This is higher than the 33.3% of adolescents from insufficient socioeconomic backgrounds who were not anemic. Socioeconomic status was significantly related to anemia among female adolescents in Lanaus Village, with a p-value of 0.008.

Among adolescents with a normal BMI, 62.9% experienced anemia. Meanwhile, 53.6% of adolescents with an abnormal BMI (underweight or obese) also experienced anemia. Based on Table 3, there was no significant relationship between BMI and anemia among female adolescents, as shown by a p-value of 0.457. Out of the total respondents, 34 females (75.6%) who were not accustomed to eating breakfast were anemic. Only 16.7% of females who did eat breakfast were found to be anemic, as seen in Table 3. The chi-square test results yielded a p-value of 0.000, indicating that breakfast habits were a significant factor associated with anemia among female adolescents in Lanaus Village.

Table 4. The final model of the most affecting factors to adolescents' anemia

Variable	p-value	Exp (B)	CI 95%	
			Lower	Upper
Compliance of iron supplementation	0,028	4.745	1.181	19.060
Breakfast habit	0,019	15.427	1.571	51.460
Constant	0,001	0,000	-	-

Variables that were associated with anemia at a p-value <0.25 were considered for the multivariate logistic regression model. The variables tested included adolescents' compliance with iron supplementation, socioeconomic status, and breakfast habits. The final results of the analysis are shown in Table 4. Compliance with iron supplementation was significantly related to anemia. Analysis showed a p-value of 0.028, with an odds ratio (OR) of 4.745 and a 95% confidence interval (CI) of 1.181–19.060. This means that adolescents who were non-compliant with iron supplementation were 4.74 times more likely to suffer from anemia compared to those who complied.

The most influential factor associated with anemia among female adolescents in Lanaus Village was breakfast habits. This variable was the dominant factor, with a p-value of 0.019 and an OR of 15.427 (95% CI 1.571–51.460). Adolescents who did not regularly eat breakfast were 15.42 times more likely to experience anemia compared to those who had a habit of eating breakfast.

Based on the study findings, the main determinants of anemia among female adolescents in Lanaus Village were breakfast habits and compliance with iron supplementation. Breakfast is especially important for adolescents due to their high physical activity levels, requiring sufficient calories and micronutrients. A balanced breakfast provides energy, building blocks, and regulatory nutrients that supply one-third of the daily nutritional requirements. Consuming breakfast helps ensure adequate nutrient intake to support physical and cognitive function.

Malnutrition and micronutrient deficiencies can impair adolescents' physical, mental, and cognitive development. Dietary factors such as macronutrient and micronutrient intake, as well as meal frequency, have been significantly linked to reduced odds of anemia (Mohammed et al., 2019). A 2020 study found that 62% of female adolescents who regularly ate breakfast were not anemic, with hemoglobin levels ≥12 g/dL, suggesting a well-balanced dietary intake (Yuliani et al., 2020).

Breakfast is crucial for maintaining overall body condition. Adolescents who skip breakfast may experience physical issues, especially a lack of energy and motivation, which can negatively affect school performance resulting in reduced concentration, fatigue, drowsiness, and other physical complaints. Adolescents who frequently skip breakfast are also at risk of poor anthropometric status, which can lead to wasting over time. Mid-upper arm circumference (MUAC) is a recognized indicator of poor anthropometry and chronic energy deficiency, which is often associated with anemia. When nutrient intake is insufficient, the micronutrients needed for red blood cell formation—such as iron, folate, and vitamin B12—become limited, increasing the risk of anemia (Handayani et al., 2019; Sari et al., 2022).

Daily food intake should ideally be divided into three main meals: breakfast, lunch, and dinner. However, there is no universal standard for the number of meals; some studies suggest that meal frequency is less important than the quality of food consumed. A reduced meal frequency—such as skipping breakfast and having a large, high-calorie dinner, or only eating once a day—can lead to poor metabolic control (Paoli et al., 2019). This suggests that skipping breakfast significantly increases the risk of physical problems, including anemia.

For optimal red blood cell formation, daily food consumption, especially breakfast, should be balanced and include carbohydrates, protein, fat, and key micronutrients. Hemoglobin, the primary component of red blood cells, is responsible for transporting oxygen to body tissues. Low oxygen levels due to anemia impair metabolic processes delivering oxygen to the tissue. Reduced oxygen in the body distresses the metalbolic process (Ulfal & Wongsalsuluk, 2022).

Dietary habits play a critical role in the incidence of anemia among adolescents. In this study, breakfast habits were the most influential factor, with a p-value of 0.019 and OR 15.427 (95% CI 1.571–51.460) among female adolescents in Lanaus Village. Adolescents who did not have a regular breakfast routine were 15.42 times more likely to experience anemia than those with good breakfast habits. This finding aligns with a study by Dewi et al. (2023), which also showed that adolescents with poor dietary habits, especially irregular meal patterns and frequent breakfast skipping, were at higher risk of anemia (Dewi et al., 2023).

The most common cause of anemia worldwide is iron deficiency, which results in microcytic and hypochromic red blood cells. Iron deficiency may result from low iron intake, decreased absorption, or blood loss due to menstruation. Anemia can also occur when adolescents consume foods that inhibit iron absorption. Iron is an essential component of hemoglobin, and its absorption can be impaired if protein intake is low. Protein functions as both a building and regulatory nutrient and plays a role in transporting iron to the bone marrow for red blood cell formation (Ekasanti et al., 2020; Salsabil & Nadhiroh, 2023).

Vitamin C also enhances iron absorption by converting ferric iron to ferrous iron, which is more readily absorbed by the body. Therefore, adolescents should pay close attention to nutritional components in their food, especially iron, protein, and vitamin C. A 2022 study revealed that when food intake is nutritionally adequate, nutritional status improves; conversely, poor dietary intake can cause nutritional problems. The study found a significant association between nutritional status and anemia in female adolescents (Novelia et al., 2022).

Female adolescents are at higher risk of anemia due to regular blood loss during menstruation. Iron supplementation is recommended to prevent iron deficiency anemia (Deivita et al., 2021). Iron supplements help maintain and increase hemoglobin levels. A systematic review (2019) showed that among menstruating women, iron supplementation increased hemoglobin and ferritin levels, and reduced the prevalence of anemia compared to no supplementation or placebo. Weekly supplementation with 60–120 mg of iron is sufficient to produce a positive hematologic response (McLoughlin, 2020). Another study reported that the World Health Organization (WHO) recommends daily iron supplementation for menstruating girls with 30–60 mg of elemental iron, as the average blood loss during menstruation is around 60 mL. Even girls who are not menstruating are recommended to take weekly iron supplements of 60 mg of elemental iron (Stoffel et al., 2020).

Compliance with iron supplementation was significantly related to anemia among adolescents in Lanaus Village, with a p-value of 0.028, OR 4.745 (95% CI: 1.181–19.060). Adolescents who were non-compliant with iron supplementation had a 4.74 times greater risk of anemia compared to those who were compliant. This finding aligns with a previous study in 2019, which reported that female adolescents with irregular iron consumption patterns were 4.25 times more likely to experience anemia compared to those with regular iron consumption (Manik & Simamora, 2020). Vitamin C is the only dietary component, apart from animal-based sources, that has been proven to enhance iron absorption. A study examining the

effectiveness of iron supplementation with and without vitamin C found significant changes in hemoglobin (Hb) levels before and after the intervention in both groups. There was a strong association between iron supplementation with vitamin C and increased Hb levels, with a p-value of 0.000 (Lauryn et al., 2021).

Non-compliance with iron supplementation may result from low motivation, lack of awareness of the benefits, a perceived low risk of anemia, or feeling healthy. Adolescents' knowledge and attitude toward iron supplementation are key personal factors influencing compliance. Another study supports that adequate knowledge about anemia reduces the risk because it encourages willingness to consume iron tablets consumption (Swamilaksita et al., 2022). Knowledge, attitude, and other personal factors are associated with practices related to anemia prevention. Good knowledge and positive attitudes motivate adolescents to adopt healthy behaviors. Poor practices toward anemia prevention are among the main contributors to its high prevalence (Oumer & Hussein, 2019). Health promotion is an effective intervention to reduce anemia by enhancing individuals' capacity (knowledge, attitudes, and abilities). However, its effectiveness may be limited by inadequate supervision and support from teachers, parents, or other parties (Silitonga et al., 2023). A previous study also found a significant relationship between health education and the knowledge level of female adolescents about nutritional intake. However, the study indicated that education improved knowledge only, but did not lead to improved nutrient intake (Silalahi et al., 2016).

Family support, teachers, peers, and the surrounding environment can influence adolescent anemia. These are external factors that affect adolescents' compliance with iron supplementation. Parents who engage daily with their teenage children can effectively provide information about anemia and support adherence to iron supplementation. The role of parents as information providers and reminders is therefore crucial. Many adolescents respect and trust their parents, making them more likely to follow their advice (Silitonga et al., 2023). A study conducted in 2019 found that 60% of adolescents at 8th Mualro Jambi High School did not eat breakfast. This data highlights that many adolescents skip nutritious meals at home and instead consume only snacks or drinks at school. Parents play a critical role in preparing and facilitating balanced, nutritious breakfasts (Gebreyesus et al., 2019). This is supported by another study which found that reasons for skipping breakfast included lack of appetite, dieting, time constraints, and having working parents who leave early in the morning. As a result, meals—especially breakfast—are often skipped because parents are unable to prepare them (Jain et al., 2020).

The formal sector, particularly schools, also plays a vital role in reducing the incidence of anemia. Teachers and peers must work together to support adolescent health. During adolescence, the influence of peers increases, and they become an important—even preferred—source of health information (Akuiyibo et al., 2021). However, the role of teachers and school counselors cannot be replaced by peers. These adults are responsible for providing accurate health education and monitoring daily iron tablet consumption. Therefore, a combined approach involving both teachers and peers is necessary to achieve optimal results. Teachers can remind students regularly about taking their iron supplements (Meilani & Setiyawati, 2023).

4. CONCLUSION

Determinants of anemia among female adolescents include breakfast habits and compliance with iron supplementation. Socioeconomic status is also related to anemia. Among these, breakfast habits are the dominant factor. Adolescents who are not accustomed to eating breakfast have a lower likelihood of meeting their nutritional needs, which are essential for the formation of red blood cells. Anemia occurs when the number of red blood cells containing hemoglobin is lower than normal. The involvement of family, peers, and the formal sector—

such as schools is critical in reducing the incidence of anemia. Skipping breakfast and non-compliance with iron supplementation can be addressed by increasing adolescents' knowledge and attitudes about anemia, and by fostering synergy among parents, peers, and other parties in facilitating, supervising, and motivating healthy behavior.

The results of this study can serve as a reference for anemia prevention programs among female adolescents. Such programs should actively involve the role of families, teachers, peers, and the adolescent's surrounding environment. This study may support policymakers and stakeholders in designing and improving programs to reduce anemia in female adolescents, an issue that directly affects their quality of life and reproductive health as future mothers.

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