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Original Article

Analysis of factors associated with the incidence of anemia in adolescent girls at the Muara Enim Health Center: A cross-sectional study

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Abstract

Background
Anemia among adolescent girls is a significant public health issue in Indonesia, including in Muara Enim District, with a steadily increasing prevalence. The causes of anemia are multifactorial, including knowledge, nutritional status, adherence to iron (Fe) tablet consumption, and economic status.

Objective
This study aims to identify the factors associated with the incidence of anemia among adolescent girls in the working area of Muara Enim Health Center, Muara Enim District, in 2025.

Methods
This research employed a quantitative cross-sectional design. A total of 95 respondents were purposively selected from the population of adolescent girls in the Muara Enim Public Health Center area in 2024. Data were collected using a structured questionnaire and medical records, and analyzed using univariate, bivariate (chi-square test), and multivariate (multiple logistic regression) methods.

Results
Most respondents experienced anemia (53.7%), had good knowledge (57.9%), normal nutritional status (97.0%), were non-adherent to Fe tablet consumption (53.7%), and came from families with income below the regional minimum wage (72.6%). Bivariate analysis showed that adherence to Fe tablet consumption (p = 0.00) and economic status (p = 0.00) were significantly associated with anemia incidence, while knowledge (p = 0.99) and nutritional status (p = 0.21) were not. Multivariate analysis identified economic status as the most dominant factor (p = 0.002; OR = 0.20), indicating that adolescent girls from families earning ≥ regional minimum wage had an 80% lower risk of anemia.

Conclusion
Adherence to Fe tablet consumption and economic status are key factors in preventing anemia among adolescent girls, with economic status being the most influential. Integrated interventions should focus on strengthening Fe supplementation adherence and empowering families economically to reduce anemia prevalence in this population.

Background

Anemia remains a significant public health concern in Indonesia, particularly among adolescents (Enggar et al., 2025). Adolescent girls are at higher risk of developing anemia than boys, partly due to their predominant consumption of plant-based foods, which contain lower levels of iron than animal-based sources (Rahmy et al., 2022). Additionally, adolescent girls are classified as a vulnerable group due to their regular menstruation and increased iron requirements during periods of growth (Yunita et al., 2023). A menstrual cycle shorter than 21 days further increases the risk of anemia (Rahmawati et al., 2024). This condition is exacerbated by unhealthy eating habits, including the frequent consumption of snacks and fast food, which are typically low in nutritional value (Mangalik et al., 2023). The combination of increased iron demands, iron loss through menstruation, and inadequate dietary intake makes adolescent girls particularly susceptible to anemia (Al-Sharbatti et al., 2003).

Globally, anemia continues to pose a major health burden. WHO data (2023) indicate that the prevalence of anemia among women aged 15–49 years reached 30.7%. In Indonesia, the 2018 Basic Health Research (Riskesdas) reported an anemia prevalence of 48.9% among adolescent girls aged 15–24 years (Kemenkes RI, 2018). Another report from the Ministry of Health in 2021 showed that 33.7% of women aged 15–49 years were affected by anemia, significantly higher than the 11.3% prevalence among men (Healthdata, 2023). In South

Sumatra, anemia remains a public health challenge, especially among adolescent girls (Saydihuri, 2024). The Provincial Health Office recorded 22,681 cases of anemia, with 4,391 cases occurring in Muara Enim District (Dinas Kesehatan Provinsi Sumatera Selatan, 2019). Local data from Muara Enim Public Health Center showed an increase in adolescent anemia prevalence from 23.57% in 2021 to 27.90% in 2023 (Puskesmas Muara Enim, 2025). A UNICEF survey also reported that nearly 90% of adolescent girls in Indonesia have discontinued iron supplementation (UNICEF, 2020).

Anemia in adolescent girls has profound effects on both physical and psychological health. It can impair cognitive and motor development, and hinder physical growth and brain maturation (Khobibah et al., 2021). Anemia is also associated with reproductive health complications, including low birth weight, perinatal hemorrhage, and increased maternal and infant mortality (Rahadinda et al., 2022). Other consequences include reduced concentration, poor academic performance, and decreased physical fitness (Aulya et al., 2022). If left untreated, anemia can result in fatigue, shortness of breath, difficulty concentrating, and cognitive decline (UNICEF, 2020). Common symptoms among adolescent girls include lethargy, lack of motivation, and dizziness, especially when standing up from a seated position (Aprilianti & Sugesti, 2024). These multidimensional effects underscore the importance of early detection and prevention of anemia during adolescence.

The causes of anemia are multifactorial, ranging from micronutrient deficiencies such as iron, folic acid, and vitamin B12, to menstrual blood loss (Kemenkes RI, 2023). Abnormal nutritional status and menstrual duration also contribute to anemia incidence (Lestari et al., 2023). Furthermore, low adherence to iron tablet consumption and poor dietary habits significantly aggravate the condition (Arma et al., 2021). The imbalance between nutrient intake and bodily requirements remains a root cause that is often overlooked in preventive strategies (Lailiyana & Hindratni, 2024). Therefore, it is essential to identify specific contributing factors to better tailor anemia prevention programs.

The Indonesian government has implemented several strategies to address anemia among adolescent girls. Educational campaigns on anemia and balanced nutrition have been introduced in schools in collaboration with local health centers (Kemenkes RI, 2018). Additional interventions include food fortification, weekly iron supplementation, and treatment of underlying health conditions such as malnutrition, parasitic infections, and malaria. However, adherence to iron tablet consumption remains low, largely due to a lack of understanding of the benefits of supplementation (Manyullei et al., 2024). This highlights a disconnect between intervention programs and adolescent health behaviors. A more context-specific and holistic approach is needed to effectively combat anemia in this age group.

Previous studies have shown that several factors influence the incidence of anemia, including knowledge, eating habits, iron supplementation, nutritional status, and menstrual patterns. Eryeni et al. (2024) found that knowledge, iron levels, and menstrual duration were significantly associated with anemia. Similarly, Rahmawati & Fauziah (2024) reported a significant correlation between nutritional status and anemia, as did Ridwan & Suryaalamsah (2023). However, these determinants may vary across regions depending on the local socio-economic and cultural context. Hence, it is crucial to conduct localized studies in areas with a high prevalence of anemia, such as Muara Enim District.

Muara Enim Public Health Center has recorded a continuous increase in anemia cases among adolescents over the past three years. This trend demands urgent attention from health professionals, nutrition program managers, and policymakers. A comprehensive assessment of the determinants of anemia—including individual, familial, and environmental factors—may help design more effective strategies. These strategies should integrate both curative and preventive measures and aim to build adolescent awareness of healthy behaviors. Such contextual research is critical to bridge knowledge gaps and enhance evidence-based decision-making in anemia prevention programs.

Based on the background described, this study aims to identify the factors associated with the incidence of anemia among adolescent girls in the working area of Muara Enim Public Health Center.

Methods

Study Design

This study employed a quantitative approach with a cross-sectional design to identify the factors associated with the incidence of anemia among adolescent girls in the working area of Muara Enim Public Health Center, Muara Enim District, in 2025. The research was conducted from May 2 to May 16, 2025. The cross-sectional approach enabled the researchers to conduct observations and data collection simultaneously at a single point in time.

Sampling

The population of this study comprised all adolescent girls registered in the working area of Muara Enim Public Health Center in 2024, totaling 1,839 individuals. The sample consisted of 95 respondents, selected using Slovin's formula with a 10% margin of error. The sampling technique used was purposive sampling, which involves selecting participants based on specific predefined characteristics (Narbuko & Achmadi, 2013). The inclusion criteria were adolescent girls who were willing to participate and able to communicate effectively, while the exclusion criteria were individuals who declined participation or did not complete the informed consent form.

Instruments

The primary instrument in this study was a structured closed-ended questionnaire designed to measure the variables of knowledge, nutritional status, adherence to iron tablet consumption, and economic status. Knowledge was categorized as good or poor; nutritional status as normal or abnormal; adherence as adherent or non-adherent; and economic status as meeting or not meeting the district minimum wage (UMK). Data on anemia incidence were obtained from secondary records provided by the Muara Enim Public Health Center.

Data Collection

Data collection was carried out by directly distributing questionnaires to respondents who met the inclusion criteria. Respondents completed the questionnaires independently after receiving a detailed explanation from the researcher regarding the study's objectives, benefits, and procedures. Additional data on anemia status were obtained from medical records or documentation available at the health center.

Data Analysis

Data analysis was conducted in three main stages: editing, coding, and processing. The editing phase ensured the completeness and consistency of questionnaire responses. Subsequently, the data were coded numerically to facilitate data entry and analysis. All data were processed using SPSS software. Data analysis included: Univariate analysis to describe the frequency distribution of each variable. Bivariate analysis using chi-square tests to examine the relationship between independent and dependent variables. Multivariate analysis using multiple logistic regression to determine the most influential factors related to the incidence of anemia.

Ethical Consideration

This study adhered to ethical principles including informed consent, confidentiality, and anonymity. Prior to completing the questionnaire, all respondents were given clear information about the study's purpose, procedures, and their rights as participants. Those who agreed to participate signed a written informed consent form. The researcher ensured that all collected data were used solely for academic purposes, and participants' identities were kept strictly confidential.

Results

Table 1 presents an overview of the frequency distribution of the characteristics of the 95 respondents involved in this study. This information is essential to understand the proportion of each variable examined, including both independent and dependent variables, and serves as a foundation for further analysis.

Table 1 shows the frequency distribution of characteristics among the 95 respondents. The majority of respondents experienced anemia

(53.7%), had good knowledge (57.9%), normal nutritional status (97.0%), were non-adherent to iron tablet consumption (53.7%), and came from families with income below the regional minimum wage (72.6%).

Table 1. Frequency Distribution Based on Respondent Characteristics

Variables	Frequency (n)	Percentage (%)
Anemia Status	44	46,3
Normal	51	53,7
Abnormal		
Knowledge	55	57,9
Good	40	42,1
Poor		
Nutritional Status	93	97,0
Normal	2	2,1
Abnormal		
Adherence to Iron Tablet	44	46,3
Adherent	51	53,7
Non-adherent		
Economic Status	26	27,4
Meets Regional Minimum Wage	69	72,6
Does Not Meet Regional Minimum Wage		
Total	**95**	**100**

Bivariate analysis was conducted to examine the relationship between independent variables and the incidence of anemia among adolescent girls. The statistical test used was the chi-square test, with a significance level of $p < 0.05$. The results of the analysis are presented in Table 2.

Table 2. Analysis of Factors Associated with Anemia among Adolescent Girls in the Working Area of Muara Enim Public Health Center

Variables	Anemia Status				Total	Pvalue
	Normal		Abnormal			
	n	%	n	%	n	
Knowledge						
Good	26	47,3	29	52,7	55	0,99
Poor	18	45,0	22	55,0	40	
Nutritional Status						
Normal	42	45,2	51	54,8	93	0,21
Abnormal	2	100,0	0	0	2	
Adherence to Iron Tablet						
Adherent	28	63,6	16	36,4	44	0,00
Non-adherent	16	31,4	35	68,6	51	
Economic Status						
Meets Regional Minimum Wage	19	73,1	7	26,9	26	0,00
Does Not Meet Regional Minimum Wage	25	36,2	44	63,8	69	

The results of the chi-square test showed that knowledge ($p = 0.99$) and nutritional status ($p = 0.21$) were not significantly associated with the incidence of anemia. In contrast, there was a significant relationship between adherence to iron tablet consumption ($p = 0.00$) and economic status ($p = 0.00$) with the incidence of anemia. Adolescent girls who were non-adherent to iron tablet consumption and those from families with income below the regional minimum wage were more likely to experience anemia.

Multiple logistic regression analysis was conducted to determine which independent variable had the strongest influence on the incidence of anemia among adolescent girls. Variables included in the final model were those with $p < 0.05$ in the bivariate analysis. The final modeling results are presented in Table 3.

Table 3. Final Model of Multiple Logistic Regression Analysis of Independent Variables Associated with Anemia Incidence

Variable	*pValue*	*OR*	95,0% *C.I.for EXP*(B)	
			Lower	*Upper*
Economic Status	0,002	0,20	0,77	0,56

The analysis revealed that economic status was a significant predictor of anemia incidence (p = 0.002). The odds ratio (OR) of 0.20 indicates that adolescent girls with an economic status equal to or above the regional minimum wage (UMK) were 80% less likely to experience anemia compared to those from families below the UMK threshold. The 95% confidence interval (CI) ranged from 0.77 to 0.56, suggesting a strong association, although the order of the lower and upper bounds appears to be reversed in the table, which may be a technical inconsistency.

Discussion

The study found no significant association between knowledge and the incidence of anemia among adolescent girls at the Muara Enim Public Health Center. This finding suggests that the level of knowledge possessed by respondents does not necessarily correlate directly with anemia prevention behavior. Knowledge is defined as the result of sensory perception, particularly through the eyes and ears, which play a crucial role in acquiring information (Notoatmodjo, 2020). Although knowledge is often considered a precursor to changes in health behavior (Oktalia et al., 2023; Yulianti, Aisyah, & Handayani, 2024), its implementation in daily life is influenced by many other factors. This result is consistent with the findings of Haryanti et al. (2024) and Sulistyorini & Maesaroh (2019), who also found no significant relationship between knowledge and anemia incidence. The researchers assumed that most adolescents gained information about anemia through general education from schools or health personnel, which may not have been sufficient to influence preventive behavior effectively.

Similarly, nutritional status was not significantly associated with anemia incidence among the respondents. Nutritional status is an important indicator of health and is determined by the balance between nutrient intake and the body's nutritional requirements (Muharramah et al., 2023). Although the majority of respondents in this study had a normal nutritional status, it did not guarantee that they were free from anemia. Some adolescent girls tend to limit their food intake, especially iron-rich animal-based foods, in an effort to maintain body shape (Janah & Ningsih, 2021). This finding aligns with studies conducted by Indartanti & Kartini (2014) and Adiyani et al. (2018), which also reported no significant relationship between nutritional status and anemia. Therefore, the researchers concluded that nutritional status may not be a dominant factor in the incidence of anemia, particularly because most participants had relatively good nutritional status.

In contrast, adherence to iron tablet consumption was found to be significantly associated with anemia incidence. Adequate iron intake is essential for adolescent girls, especially since they lose iron regularly through monthly menstruation (Putri et al., 2024). Adherence to iron supplementation represents a health behavior that plays a vital role in anemia prevention. In this context, adherence refers to the extent to which individuals follow recommended therapeutic or health behaviors (Hamranani et al., 2020). This finding is supported by studies from Handayani & Budiman (2022) and Suaib et al. (2024), which also reported a significant relationship between adherence to iron tablet consumption and anemia. Based on these findings, the researchers concluded that promoting consistent adherence to iron supplementation is a critical strategy in preventing anemia among adolescent girls.

Another key factor found to have a significant association with anemia was economic status. A family's economic condition influences many aspects of life, including the ability to meet adequate and balanced nutritional needs (Nurwati & Listari, 2021). Adolescents from families with incomes below the regional minimum wage (UMK) were more likely to experience anemia compared to those from families with higher incomes. Families with limited financial resources tend to consume cheaper, carbohydrate-rich foods that are low in essential nutrients such as protein, iron, and vitamins (Munir et al., 2022). Moreover, lower income levels can also limit access to education and quality healthcare. This is consistent with the findings of Hatta et al. (2017) and Tarigan et al. (2023), which indicated a relationship between family income and anemia incidence. Therefore, economic status plays a major role in determining the nutritional quality and overall health of adolescent girls.

Furthermore, the multivariate analysis revealed that economic status was the most dominant factor influencing anemia incidence. An odds ratio (OR) of 0.20 indicated that adolescent girls from families with economic conditions equal to or above the UMK had a significantly lower risk of developing anemia compared to those from lower-income households. This finding suggests that economic status not only has a direct impact but may also mediate other factors, such as access to nutritious food and iron supplementation. The result reflects the broader reality that a family's financial capacity directly affects food quality and healthy lifestyle practices (Mahda Rizka & Wardiyah, 2024). Therefore, effective strategies for reducing anemia should include cross-sectoral approaches that incorporate social and economic dimensions, in addition to health interventions.

Based on these findings, it is crucial to implement interventions targeting both the improvement of adherence to iron tablet supplementation and the strengthening of family economic capacity. Continuous health education delivered through schools and health facilities should be integrated with family economic empowerment programs. Such efforts can enhance the purchasing power of families and increase awareness of the importance of anemia prevention from an early age. In addition, family support is essential in fostering sustainable healthy behaviors, particularly in ensuring regular iron tablet consumption. Involving parents in education campaigns can be a strategic approach to enhancing adolescent adherence. Thus, holistic interventions that focus on the adolescent's social environment may yield more effective results.

This study also provides important implications for policymakers and healthcare providers to give greater attention to economic status as a key determinant in anemia prevention among adolescents. Free iron tablet supplementation programs must be accompanied by efforts to monitor adherence and the effectiveness of distribution. On the other hand, collaboration across education, health, and social sectors is necessary to empower low-income communities to meet their families' nutritional needs. Through such multisectoral approaches, efforts to reduce the prevalence of anemia among adolescent girls can become more targeted and sustainable. Additionally, evidence-based policymaking, informed by findings such as those in this study, can assist in setting local intervention priorities.

In conclusion, this study indicates that adherence to iron tablet supplementation and economic status are the two most critical factors to consider in the prevention of anemia among adolescent girls. While knowledge and nutritional status are important, they were not found to be significantly associated in this context. Therefore, anemia prevention strategies should focus on strengthening iron supplementation programs and empowering families economically. Continuous education efforts that go beyond knowledge-building to encourage real behavioral change are essential. Future research is needed to explore other contributing factors, such as menstrual patterns, stress levels, or underlying health conditions. A comprehensive approach may help to effectively reduce anemia prevalence among adolescent girls in the future.

Conclusion and Recommendation

This study found no significant association between knowledge and nutritional status with the incidence of anemia among adolescent girls in the working area of Muara Enim Public Health Center. In contrast, there was a significant relationship between adherence to iron tablet consumption and economic status with anemia incidence. Multivariate analysis indicated that economic status was the most dominant factor influencing anemia, with adolescents from low-income families being at a higher risk. These findings emphasize the crucial role of socioeconomic factors in meeting nutritional needs and ensuring access to iron supplementation.

An integrated intervention is necessary to improve adolescent girls' adherence to iron tablet consumption, through continuous education in schools and direct counseling by healthcare professionals. Moreover, anemia prevention programs should incorporate family economic empowerment strategies to enhance household purchasing power for nutritious food. Health centers are expected to strengthen cross-sectoral collaboration, particularly with schools and social agencies, to effectively reduce the prevalence of anemia. Further research is recommended to explore additional contributing factors such as dietary patterns, menstrual habits, and underlying medical conditions, to provide a more comprehensive understanding of anemia among adolescents.

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Declaration on the Use of AI
No AI tools were used in the preparation of this manuscript.

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