Analysis of the Relationship between Anemia and Learning Performance among Adolescent Girls at Madrasah Aliyah Negeri (MAN) 1 Gorontalo

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ABSTRACT

Anemia in adolescence is one of the most common health problems worldwide, with an increasing prevalence. Anemia can cause psychomotor and cognitive disorders, affecting learning performance. This study aimed to analyze the relationship between anemia and learning performance among adolescent girls at Madrasah Aliyah Negeri (MAN) 1 in Gorontalo. This quantitative study employs a cross-sectional design. The subjects of this study were 120 adolescent girls, selected using the purposive sampling technique. Respondent characteristics included age; parental education, occupation, and income; as well as the respondent's pocket money. Data were obtained through interviews using a questionnaire, and anemia status was assessed through Hb tests using a digital hemoglobin test. Learning performance was assessed using the learning outcome report. Data analysis was conducted using a chi-square test and multivariate analysis with logistic regression. The results showed that the prevalence of anemia among adolescent girls was 8%. The analysis results indicated a significant relationship between anemia and learning performance (p-value = 0.013), with an odds ratio (OR) of 3.111, meaning that adolescent girls with anemia were at three times higher risk of having poorer learning performance compared to those without anemia. It can be concluded that anemia is associated with the learning performance of adolescent girls; thus, more care needs to be given to the health of adolescent girls in educational institutions.

Keywords: Adolescent girls, anemia, learning performance

INTRODUCTION

Anemia in adolescence is one of the most common health problems worldwide, with an increasing prevalence yearly. The World Health Organization (WHO) reported in 2019 that the prevalence of anemia in adolescent girls reached 30%. In Southeast Asia, the prevalence of anemia in adolescent girls was 42%, with approximately 27% occurring in developing countries, including Indonesia, and 6% in developed countries (1, 2). The Indonesian Ministry of Health's Basic Health Research reported in 2013 that the prevalence of anemia in adolescents aged 15 years and over was 37.1%, increasing to 48.9% in 2018. The prevalence of anemia is higher in women than in men, which is even more concerning. An alarming 84.6% of anemia cases occur in pregnant women aged 15 years and over. Monitoring of adolescent health growth and development at the Gorontalo Provincial Health Office in 2022 showed that the number of anemia cases in adolescent girls increased from 36 cases (4.3%) to 191 cases (5.7%) in 2023. Additionally, there were 139 cases of maternal death in Gorontalo, with 12.7% attributed to anemia (3).

Adolescent girls are highly susceptible to anemia because they experience menstrual cycles every month, leading to significant blood loss and a need for increased iron intake to form hemoglobin. The desire to achieve an ideal body weight often causes adolescent girls to adopt poor eating habits, resulting in nutritional anemia and growth disorders. Anemia is a condition characterized by a deficiency of red blood cells due to insufficient iron intake, which is essential for forming hemoglobin (Hb). Adolescent girls are considered anemic if their Hb level is <12 g/dL. Hemoglobin functions to bind and transport oxygen from the lungs to the

rest of the body, including the brain and muscles. A reduced oxygen supply to the brain can impair cognitive and psychomotor abilities, thereby affecting learning performance (4).

Learning performance is a measure of the success in meeting educational objectives; therefore, low learning performance reflects a low quality of education. Quality education is a key indicator for achieving sustainable development goals (SDGs). The 2019 international student performance survey reported that the performance of Indonesian students aged 15 years and over ranked in the bottom 10th position out of 79 countries. In 2022, Indonesia was ranked 68th out of 81 countries (5). Based on the learning performance assessment by the Higher Education Entrance Test Institute (LTMPT) in 2022, which evaluated the 1,000 schools with the best UTBK scores in Indonesia, Madrasah Aliyah Negeri (MAN) 1 Gorontalo was not included in the nominations for the top 1,000 schools (6).

MAN 1 Gorontalo is one of the leading educational institutions in Gorontalo, known for its active participation in various academic and non-academic achievement activities. This school employs complex learning methods that integrate the Islamic religious education curriculum with the general education curriculum, following guidelines issued by the Directorate General of Islamic Education, Ministry of Religion, as well as guidelines for implementing the independent curriculum and assessment issued by the Ministry of Education, Culture, Research and Technology of the Republic of Indonesia in 2022. These rigorous educational demands require students to have high learning intensity and maintain good physical health. The student at this school is predominantly female. A preliminary survey conducted in September 2023 revealed that five students were absent due to illness, with one hospitalized due to anemia. This study aims to analyze the relationship between anemia and learning performance among adolescent girls at Madrasah Aliyah Negeri (MAN) 1 in Gorontalo.

METHOD

This quantitative analytical observational study employs a cross-sectional design. The research population consisted of all adolescent girls at MAN 1 Gorontalo. The purposive sampling technique was used, with a sample size of 120 respondents. This study was conducted at Madrasah Aliyah Negeri (MAN) 1 in Gorontalo from September to December 2023. The research sample was selected from the population that met the inclusion criteria: adolescent girls targeted by the blood supplement tablet administration program, aged 14-18 years, willing to participate, present at school during data collection, willing to complete all research stages, and possessing odd semester report cards for the 2023/2024 academic year. The exclusion criteria included unwillingness to be interviewed, absent from school during data collection, and incomplete report cards. Data collected included respondent characteristics: age, categorized into early adolescents (≤14 years), middle adolescents (>14-16 years), and late adolescents (>16-18 years); parental education levels, categorized into Elementary School, Junior High School, Senior High School, and College/University); and parental occupations (civil servants/TNI/Polri, private employees, entrepreneurs, farmers, laborers, retirees, and unemployed). Income was categorized as low if below the UMP (minimum wage) and high if above the UMP. Pocket money was categorized as insufficient if <Rp. 20,000 and sufficient if >Rp. 20,000 (7). Anemia status was assessed based on Hb levels using a digital hemoglobin test, with anemic defined as Hb <12 g/dL and non-anemic as Hb >12 g/dL. Learning performance was assessed using the odd semester learning outcome report for the 2023/2024 academic year, with poor performance defined as an average score ≤90 and good performance as an average score >90-100.

Additionally, the study analyzed factors associated with anemia incidence in adolescent girls: knowledge (good if >80% and poor if <80%), history of blood supplement tablet consumption (good if compliance >80% and poor if compliance <80%), and menstrual history (normal if the cycle is 21-28 days and period is 3-8 days, abnormal if the cycle is <21 days or

period is <3 days or >8 days with heavier bleeding)(8). Disease history was categorized as ill if infected with diseases such as malaria, tuberculosis, worms, or HIV/AIDS in the last three months, or had fever and diarrhea in the last month, and not ill if no such conditions were present. Eating habits were categorized as good if eating three times a day or more, consuming sufficient iron-rich foods and enhancers, and avoiding inhibitors like tea and coffee with meals. Whereas, poor eating habits were defined by eating less than three times a day, consuming insufficient iron-rich food intake, and frequently enjoying inhibitors like tea, coffee, chocolate and others containing phytates and tannins that can decrease Fe (iron) absorption. Nutritional status was categorized as poor if BMI/A was less than -2SD and good if BMI/A was more than -2SD. Data collection was conducted using a validated questionnaire. The chi-square test with SPSS version 29.0 analyzed the relationship between anemia and learning performance, with a significance level of $p < 0.05$, and multiple logistic regression analyzed the level of the relationship, with a significance level of $p < 0.05$. The risk of disease exposure was assessed using the Odds Ratio (OR). This study underwent ethical feasibility review by the Research Ethics Commission of Poltekkes Kemenkes Gorontalo, approval number DP.01.01/KEPK/230/2023.

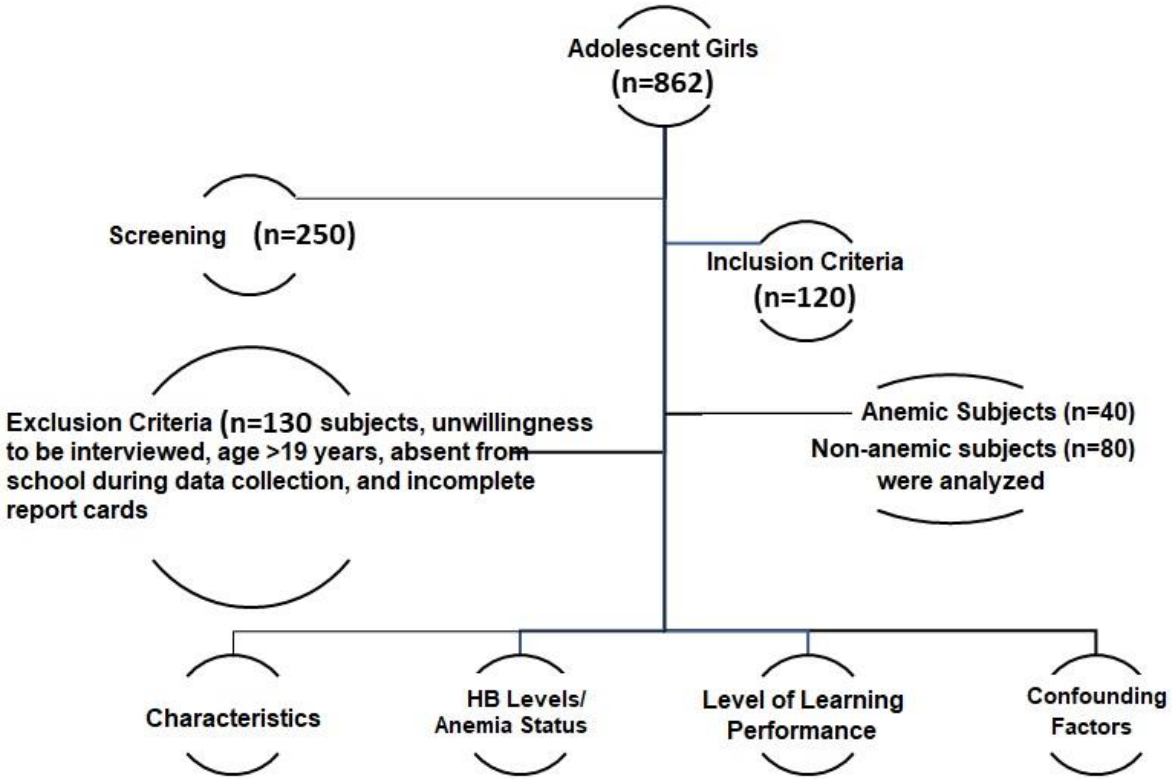

Figure 1. Research Flow Chart

RESULTS AND DISCUSSION

Table 1 shows that most respondents were in the age range of >14-16 years. Among the anemic respondents, 37.5% of their fathers were civil servants/TNI/Polri or entrepreneurs, and 42.5% of their mothers were civil servants/TNI/Polri. Among the non-anemic respondents, 38.75% of their fathers were civil servants/TNI/Polri, and 26.25% were entrepreneurs, while 43.75% of their mothers were civil servants/TNI/Polri. In terms of education, the majority of fathers of anemic respondents had a senior high school education (47.5%), and 55% of their mothers also had a senior high school education. For non-anemic respondents, the majority

of fathers (53.75%) and mothers (65%) had a college/university education. Additionally, 55% of the parents of anemic respondents had low incomes, while 70% of the parents of non-anemic respondents had high incomes. Most anemic respondents (65%) had pocket money of less than Rp. 20,000, whereas most non-anemic respondents (51.25%) had pocket money of more than Rp. 20,000.

A previous study in Cempaka Sub-district, Banjarbaru, found similar trends. The majority of anemic respondents' parents had a senior high school education (48.3%), while the majority of non-anemic respondents' parents had college/university education (80%). In terms of family income, 46.2% of anemic respondents came from high-income families, whereas 76% of non-anemic respondents came from low-income families (9). In terms of occupation, the study indicated that 41.2% of anemic respondents' fathers were security guards, drivers, repair shop workers, parking attendants, masseuses, and other similar jobs, while 74.5% of their mothers were housewives or unemployed. Furthermore, another previous study indicated that the majority of anemic respondents' fathers had a junior high school education (52.9%) and 84.3% of their mothers had a junior high school education (10). Also, another previous study indicated that the majority of respondents' parents had high incomes (33.8%), and most respondents has higher pocket money (66.2%) (11).

Table 1. Distribution of Respondent Characteristics

Respondent Characteristics		Anemic		Non-anemic	
		n	%	n	%
Age	10-14 Years	1	2.5	0	0.0
	> 14-16 Years	22	55.0	43	53.75
	> 16-18 Years	17	42.5	37	46.25
	Total	40	100	80	100
Father's occupation	Civil servant/TNI/POLRI	15	37.5	31	38.75
	Private employee	3	7.5	11	13.75
	Entrepreneur	15	37.5	21	26.25
	Farmer	1	2.5	7	8.75
	Laborer	5	12.5	1	1.25
	Retiree	0	0.0	2	2.5
	Unemployed	1	2.5	7	8.75
	Total	40	100	80	100
Mother's occupation	Civil servant/TNI/POLRI	17	42.5	35	43.75
	Private employee	1	2.5	1	1.25
	Entrepreneur	3	7.5	9	11.25
	Farmer	2	5.0	2	2.5
	Laborer	1	2.5	0	0.0
	Retiree	9	22.5	1	1.25
	Unemployed	7	17.5	32	40.00
	Total	40	100	80	100
Father's education	Not graduated elementary school	1	2.5	2	2.5
	Elementary School	2	5.0	5	6.25
	Junior High School	1	2.5	5	6.25
	Senior High School	19	47.5	25	31.25
	College/University	17	42.5	43	53.75
	Total	40	100	80	100
Mother's education	Not graduated elementary school	1	2.5	3	3.75
	Elementary School	1	2.5	3	3.75
	Junior High School	3	7.5	3	3.75
	Senior High School	22	55.0	19	23.75

	College/University	13	32.5	56	65.0
	Total	40	100	80	100
Family Income	Low	22	55.0	8	10.0
	High	18	45.0	72	90.0
	Total	40	100	80	100
Pocket money	< Rp. 20,000	26	65	39	48.75
	≥ Rp. 20,000	14	35.0	41	51.25
	Total	40	100	80	100

Source: Primary Data, 2023

Table 2 shows that the prevalence of anemia among adolescent girls at MAN 1 Gorontalo in 2023 was 8.0%. This indicates that one in twelve adolescent girls has the potential to experience anemia, reflecting a relatively high prevalence even though it falls within the mild category (12). A previous study at SMK Islam Jepara in 2021 indicated a much higher prevalence of anemia among adolescent girls at 70% (13). Other studies in West Java indicated that the prevalence of anemia in adolescent girls reached 42.4% (14)(15). Despite the lower prevalence of anemia in adolescent girls at MAN 1 Gorontalo compared to these previous studies, efforts to address this problem are still necessary to prevent any increase in prevalence. The high prevalence of anemia in adolescent girls is linked to several factors: low compliance with consuming blood supplement tablets due to side effects, lack of knowledge about the benefits of these tablets, a history of abnormal menstruation, poor nutritional status, and insufficient iron-rich food intake. Additionally, incorrect consumption of iron supplements together with foods containing phytates and tannins, such as coffee and tea, can decrease Fe (iron) absorption. This hampers the body's hemoglobin formation process, leading to low Hb levels and anemia (15).

Preventing and addressing the problem of anemia in adolescent girls through nutritional interventions is essential, as the health of adolescent girls significantly affects the quality of future human resources. Efforts to prevent and overcome anemia in adolescent girls include nutritional education activities, supplementation with blood supplement tablets, and the adoption of a balanced nutritional diet rich in protein and iron. These measures are expected to reduce the prevalence of anemia among adolescent girls (16).

Table 2. Frequency distribution of anemia status for adolescent girls at MAN 1 Gorontalo

Grade	Total Targets	Anemia Status			
		Anemic	%	Non-anemic	%
X	309	45	5.22	264	30.63
XI	281	7	0.81	274	31.79
XII	272	17	1.97	255	29.58
Total	862	69	8.00	793	92.00

Source: Primary Data, 2023

Anemia can occur from insufficient iron levels in the body, leading to a deficiency of red blood cells needed for forming hemoglobin (Hb). Factors contributing to this deficiency include insufficient iron intake, particularly from animal sources, increased iron demands due to physiological conditions like pregnancy, menstruation, and growth, as well as infections such as worms, malaria, or tuberculosis, which can deplete iron stores. Symptoms of anemia are often characterized by: weakness, fatigue, lethargy, listlessness and limpness; pallor on the palms of hands, face, and gums; dizziness; and shortness of breath even during light activity due to decreased oxygen levels in the body (17). Failure to address this condition with a balanced nutritional diet rich in protein and iron, along with recommended blood supplement tablet consumption, can exacerbate anemia (18). Prevention and management of anemia in adolescent girls are crucial to mitigate both short-term and long-term effects, including impaired brain development and cognitive abilities, leading to decreased learning performance and hindered growth (12).

Table 3 shows the factors significantly associated with the incidence of anemia in adolescent girls, including the history of blood supplement tablet consumption, menstrual history, and nutritional status, with a p-value of less than 0.05. Conversely, knowledge, disease history, and eating habits, with a p-value of more than 0.05, are not significantly associated with the incidence of anemia among adolescent girls at MAN 1 Gorontalo.

Table 3. Analysis of factors associated with anemia in adolescent girls

Variable		Anemia Status		n	p-value	Odds ratio
		Anemic	Non-anemic			
Knowledge	Good	22 (55%)	54 (67.5%)	76 (63.3%)	0.180	1.699
	Poor	18 (45%)	26 (32.5%	44 (36.7%)		
History of blood supplement tablet consumption	Good	16 (40%)	54 (67.5%)	70 (58.3%)	0.004*	0.321
	Poor	24 (60%)	26 (32.5%)	50 (41.7%)		
Menstrual history	Normal	1 (2.5%)	12 (15%)	13 (10.8%)	0.038*	6.882
	Abnormal	39 (97.5%)	68 (85%)	107 (89.2%)		
Disease history	Ill	3 (7.5%)	4 (5.0%)	7 (5.8%)	0.582	1.541
	Not ill	37 (92.5%)	76 (95%)	113 (94.2%)		
Nutritional status	Good	24 (60.0%)	65 (81.25%)	89 (74.2%)	0.012*	2.889
	Poor	16 (40.0%)	15 (18.75%)	31 (25.8%)		
Eating habit	Good	16 (40.0%)	36 (45.0%)	52 (43.3%)	0.602	1.227
	Poor	24 (60.0%)	44 (55.0%)	68 (56.7%)		

*Source: Primary Data, 2023, *significant (p<0.05) based on chi-square test*

Consuming blood supplement tablets is recommended by the WHO as one of the key strategies to prevent and control iron deficiency anemia in adolescent girls. Regular blood supplement tablet administration, typically one tablet per week and one tablet per day during menstruation, is believed to elevate hemoglobin levels in the body. This study established a significant relationship between the history of blood supplement tablet consumption and the incidence of anemia, with a p-value of 0.004. This indicates that blood supplement tablet consumption significantly affects the incidence of anemia, with an odds ratio of 0.321, suggesting that respondents who comply with good blood supplement tablet consumption practices have a lower risk of experiencing anemia compared to those who consume do not. However, several obstacles were identified in efforts to prevent and control anemia through supplementation with blood supplement tablets among adolescent girls at MAN 1 Gorontalo. These obstacles include some adolescent girls not receiving blood supplement tablets, very low compliance with consuming blood supplement tablets due to side effects like nausea and dizziness, lack of knowledge about the benefits of these tablets, and limited budget leading to irregular hemoglobin level monitoring before and after intervention. These results align with a previous study conducted in Bogor, which reported low compliance with consuming blood supplement tablets among adolescent girls (33.0%) (19). Similarly, another previous study in Bengkulu found that compliance with blood supplement tablet consumption among anemic adolescent girls was only 17.6%. The analysis results indicate that adolescent girls who are non-compliant with consuming blood supplement tablets has a 61.55 times higher likelihood of anemia compared to those who are compliant (20). Additionally, a study in the working area of Puskesmas Pasar Rebo, East Jakarta, revealed ineffectiveness of the program of supplementation with blood supplement tablets due to low coverage of blood supplement

tablets, targets not receiving the tablets, and insufficient socialization about the benefits of blood supplement tablets (21).

Nutritional status, reflecting the body's condition resulting from food consumption, plays a critical role in an individual's susceptibility to anemia. Analysis of the relationship between nutritional status and anemia status yielded a significant p-value of 0.012, indicating that respondents with poor nutritional status were associated with a higher incidence of anemia among adolescent girls at MAN 1 Gorontalo. These results align with a previous study indicating a significant relationship (p=0.000) between nutritional status and the incidence of anemia in adolescent girls (22). Moreover, the odds ratio of 2.889 suggests that respondents with poor nutritional status are nearly three times more likely to experience anemia. Similar results indicated that poor nutritional status increases the likelihood of anemia by a factor of 5.301 (23). Another influential factor in the incidence of anemia is menstruation, characterized by periodic bleeding from the uterus due to hormonal fluctuations and the shedding of the uterine lining (24). Menstruation imposes a significant risk of anemia, particularly for those with abnormal or irregular menstrual patterns. Menstrual disorders, such as cycles shorter than 28 days, periods lasting more than 7 days, and excessive blood loss exceeding 80 ml per day, contribute to this susceptibility. A previous study has also highlighted how special physiological states like menstruation, pregnancy, and growth and development can elevate the body's iron requirements, potentially leading to anemia (25). Analysis of the relationship between menstruation and anemia revealed a significant p-value of 0.038, indicating that menstruation is significantly associated with the incidence of anemia among adolescent girls. The odds ratio of 6.882 suggests that respondents with abnormal menstruation are nearly seven times more likely to experience anemia compared to those with normal menstruation patterns.

Efforts to prevent and control anemia in adolescent girls can also involve adopting a balanced nutritional diet comprising a variety of foods, particularly animal protein sources rich in iron such as liver, fish, meat, and poultry, accompanied by the consumption of fruits and vegetables abundant in vitamin C. Vitamin C enhances iron absorption in the body(26). Analysis of the eating habits of adolescent girls at MAN 1 Gorontalo revealed that 60.0% of anemic respondents and 55.0% of non-anemic respondents exhibited poor eating habits such as eating less than three times a day, imposing dietary restrictions, following incorrect diets, infrequently consuming vitamin C-rich sources like fruits and vegetables, consuming insufficient animal protein, preference for fatty foods, and skipping breakfast. Furthermore, most anemic respondents consumed insufficient iron sources; for example, beef was consumed only once a year, and some respondents never consumed chicken liver, fish, shellfish, anchovies, or nuts. Conversely, most non-anemic respondents consumed a diet rich in iron sources.

Consuming enhancers like sufficient sources of vitamin C and folic acid can enhance iron absorption in the body. However, the majority of respondents in this study did not consume sufficient fruits and vegetables. They mainly consumed oranges and papaya, with other types of fruits and vegetables being rarely consumed. On the other hand, food inhibitors such as coffee, tea, milk, chocolate, and ice cream contain phytates and tannins that bind iron into complex compounds, hindering its absorption. Daily consumption of these foods alongside iron-rich foods can decrease iron absorption in the body. Analysis of the relationship between eating habits and the incidence of anemia yielded a p-value of 0.602, indicating no significant relationship between eating habits and the incidence of anemia of anemia in adolescent girls. The odds ratio of 1.227 suggests that poor eating habits have a 1.227 times higher likelihood of causing anemia. However, a previous study has found a significant association between eating habits and the incidence of anemia in adolescent girls, with an odds ratio of 8.50 indicating that poor eating habits pose an 8.50 times higher risk of causing anemia in adolescent girls (27).

Table 4 shows data from the analysis of the average (mean) hemoglobin level, with a value of 13.237 mg/dl. The range of hemoglobin levels varies between 12.5 mg/dl, with the lowest level recorded at 7.4 mg/dl and the highest at 19.9 mg/dl. The median hemoglobin level is 13.100 mg/dl, and the standard deviation is 2.6270. These statistics indicate that, on average, the respondents have normal hemoglobin levels (>12 mg/dl), although there is

significant variability among the respondents' hemoglobin levels. In terms of learning performance scores, the average (mean) score is 88.2524, with the score ranging from 81.53 to 92.08. The median score is 89.09. These statistics indicate that the majority of respondents have poor average learning performance scores (scores <90). The standard deviation of 2.55247 indicates relatively low variation in learning performance scores among respondents, regardless of their anemic or non-anemic status as adolescent girls.

Table 4. Analysis of HB levels and learning performance scores of adolescent girls at MAN 1 Gorontalo

Variable	n	Mean	Median	Range	Min	Max	SD
HB levels	120	13.237	13.100	12.5	7.4	19.9	2.6270
Learning performance scores	120	88.2524	89.09	10.55	81.53	92.08	2.55247

Source: Primary Data, 2023,

Table 5 shows the analysis of the relationship between anemia status and the level of learning performance among adolescent girls at MAN 1 Gorontalo. The obtained p-value is 0.013, indicating a significant relationship between anemia and learning performance. The odds ratio is 3.111, indicating that adolescent girls who are anemic are three times more likely to exhibit poor academic performance compared to those who are not anemic. These results imply that anemia significantly affects the academic performance of adolescent girls.

Table 5. Analysis of the relationship between anemia status and the level of learning performance among adolescent girls at MAN 1 Gorontalo

Anemia Status	Learning Performance		n	p - value	Odds Ratio	95% CI for Exp (B)	
	Poor	Good				Lower	Upper
Anemic	32	8	40				
Non-anemic	45	35	80	0.013	3.111	1.275	7.590
Total	77	43	120				

*Source: Primary Data, 2023, *significant (p<0.05) based on chi-square test, OR 955 CI for Exp (B) based on multiple logistic regression test*

The analysis results indicate a significant relationship between anemia status and decreased learning performance among adolescent girls. These results align with a previous study indicating that high hemoglobin levels are associated with higher intellectual scores. Additionally, the incidence of anemia in female students significantly affects their learning performance, with a p-value of 0.026 (28). Moreover, another study reported that respondents with low hemoglobin levels (<12 g/dl) have a 9.643 times higher risk of experiencing decreased learning performance compared to respondents with normal hemoglobin levels (>12 g/dl)(29). Learning performance encompasses the changes achieved by students through learning activities, expressed in symbols, numbers, letters, and sentences, reflecting their level of success based on predetermined standards. It represents the culmination of students' intellectual and practical development, indicating their proficiency in both thought and action(30). Low learning performance can be affected by various factors, including health issues, which are particularly pertinent among adolescent girls, such as iron deficiency anemia. Maintaining a healthy physical condition is crucial for supporting the learning process among adolescent girls. Good health fosters enthusiasm and concentration during learning

activities, thereby facilitating improvements in learning performance. Conversely, disruptions to physical well-being can impede concentration and hinder academic success (4).

Anemia occurs from the body's insufficient hemoglobin levels, often due to iron deficiency. Hemoglobin, a component of red blood cells, plays a crucial role in transporting oxygen from the lungs to the rest of the body, including the brain. Iron deficiency can adversely affect brain function, particularly the neurotransmitter system, which serves as a conduit for nerve signals. This deficiency can lead to decreased sensitivity of nerve receptors, particularly dopamine receptors, thereby impairing concentration, memory, and learning abilities. Consequently, such disruptions ultimately contribute to decreased learning performance (31). In cases of anemia, the body requires iron to replenish the hemoglobin needed for the formation of red blood cells lost through bleeding. Iron serves various crucial roles in the body, including brain development, immune system function, myelogenesis, and maintenance of myelin, which acts as a conductor for stimuli along nerve cells. Iron deficiency can lead to reduced activity of monoamine oxidase, which is involved in synthesizing dopamine and serotonin. Dopamine and tyrosine are essential for motor coordination, while serotonin aids in neurotransmission and concentration. Low iron levels can detrimentally affect cognitive performance, impacting learning concentration and consequently, learning performance. Anemia among adolescent girls may result in mental and intellectual impairment, decreased concentration, and decreased enthusiasm for learning, all of which can negatively affect learning outcomes.

Reflecting on the methodology, this study faces several limitations. The small research sample size could hinder the generalizability of the results. Additionally, the accuracy of the research data relies on the measurement methods and instruments utilized. Therefore, caution should be exercised when attempting to generalize the results of this study.

CONCLUSION

The relationship between anemia and learning performance among adolescent girls at Madrasah Aliyah Negeri (MAN) 1 Gorontalo is significant. Factors contributing to the incidence of anemia include a history of blood supplement tablet consumption, menstrual history, and nutritional status. Conversely, knowledge, disease history, and eating habits are not significantly associated with the incidence of anemia. Anemic adolescent girls are three times more likely to exhibit poor academic performance compared to their non-anemic counterparts. Thus, heightened attention to adolescent health, particularly within educational institutions, is crucial for enhancing the learning performance and overall health of adolescent girls.

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