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Article

Determinants of Anemia and Its Impact on the Academic Performance of Female Students at Senior High School 1 Rote Barat Daya

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Abstract:
Background: Anemia is a condition where the hemoglobin (Hb) level in the blood is lower than normal. Anemia can cause fatigue, decreased concentration, which can affect learning achievement. **Objectives:** This study aims to determine the factors that influence anemia status and its effect on learning achievement of female students of SMA Negeri 1 Rote Barat Daya. **Methods:** The type of research used is descriptive analytic research with a cross sectional approach. The population in this study were female students in grades 11 and 12 of SMA Negeri 1 Rote Barat Daya as many as 402 people. Data analysis used in this study was simple logistic regression and multiple logistic regression. **Results:** statistical tests with simple logistic regression showed that there was a relationship between nutritional intake and diet to anemia status with a value of (ρ-value=0,000). However, there was no relationship between history of illness and anemia status (ρ-value=0,936) and no relationship between anemia status and learning achievement (ρ-value=0,247). The results of the analysis using multiple logistic regression showed that there was an influence between diet and anemia status (95%CI value = 1,656-158,389); there was an influence between nutritional intake and anemia status (95%CI value = 2,075-69,601). **Conclusions:** that schools should often hold socialization about the causes and symptoms of anemia, as well as its impact on health, especially for female students. Female students should avoid the habit of consuming foods or drinks containing caffeine or tea in large quantities, because it can inhibit iron absorption.

Keywords: anemia status, learning achievement, female students, nutritional intake, dietary pattern

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1. Introduction

Anemia is a hematological disorder that is very often found both in the clinic and in the community. Anemia is a condition where the mass of erythrocytes and/or circulating hemoglobin (Hb) mass cannot fulfill its function to provide oxygen to body tissues. Laboratorically, it is described as a decrease below normal levels of hemoglobin, erythrocyte count and hematocrystals. Signs of anemia are the 5Ls, namely weakness, fatigue, lethargy, tiredness, and inattentiveness. In addition, there are often complaints such as dizziness, pale mucous membranes of the eyelids, lips, tongue, skin, and palms [1].

All age groups ranging from toddlers to the elderly can experience anemia health problems. Adolescent girls are prone to anemia due to the monthly menstrual cycle. Anemia can lead to decreased endurance and productivity. Anemia that occurs in adolescent girls can also be a risk during pregnancy and will have a negative impact on the growth and development of the fetus in the womb and has the potential to cause complications of pregnancy and childbirth, even causing maternal and child death [2].

The World Health Organization (WHO) in 2007 stated that one type of anemia that is often experienced by adolescents is iron deficiency anemia, this is due to the high need for iron for adolescent growth inversely proportional to the amount of iron intake. The normal Hb value in men is 13.8-17.2 grams/dl while in women it is 12.1-15.2 grams/dl [3]. Adolescent girls are a period of growth and development characterized by rapid changes both physically, psychologically, and cognitively, the age range of adolescents is 10-24 years and not married. Adolescent girls are one of the groups prone to anemia along with menstruation which will release iron needed aged 5-14 years, adolescent girls aged 10-18 years by 57.1% and aged 19-45 years by 39.5% women have the highest risk of anemia, especially in adolescent girls [4]. According to the WHO, the prevalence of anemia among productive-age women aged 15-49 years globally is 29.9%.

Data from Riskesdas 2018, recorded that in Indonesia the prevalence of anemia was 48.9%, an increase compared to the results of Riskesdas in 2013 which was 37.1%. The largest proportion of anemia is in the age group of 15-24 years, which is 84.6% with less energy intake, less protein intake, less iron intake and less vitamin C intake, thin nutritional status, short menstrual cycle, long duration, high activity and low parental income. In Sleman Regency, according to a survey on anemia in junior high school and high school adolescent students in 2017, the prevalence of anemia in adolescent girls was 12.60% which increased to 22.86%[5]. The incidence of anemia in adolescent girls is caused by several factors including lower than recommended food intake, especially foods containing iron, inadequate knowledge of nutrition, acute and chronic infectious diseases and the menstrual cycle. According to WHO, anemia will have an impact on decreased concentration, learning achievement, fitness, youth, productivity and decreased immunity which can affect the health status of adolescents[6].

Based on a manual screening conducted by the Rote Ndao Regency Health Office in 2023 on 2770 adolescent girls, the prevalence of anemia was 29.38%. This phenomenon raises serious concerns regarding public health, especially in the context of adolescent girls who are a vulnerable group to anemia. Anemia can cause fatigue, decreased concentration, and decreased physical endurance, which can affect learning achievement. The high prevalence of anemia in 2023 makes the author feel the need to conduct research on the Determinants of Anemia Status and its Effect on Learning Achievement of Female Students of SMA Negeri 1 Southwest Rote.

2. Materials and Methods

2.1 Study Design and Setting

A cross-sectional design was used in this descriptive research design. From November to December 2023, this research was conducted at SMA Negeri 1 Southwest Rote..

2.2 Population and Sampling

There were 402 female students in grades 11 and 12 of SMA Negeri 1 Southwest Rote. The research sample was 80 people obtained by simple random sampling method.

2.3 Variables and Operational Definitions

Anemia and learning achievement were the dependent variables of the study, while nutritional intake, diet, and history of illness were the independent variables. Data were collected using a questionnaire to assess the determinants of anemia status and its effect on learning achievement.

3. Results

The results show the distribution of respondents based on Anemia Status, Learning Achievement, Nutritional Intake, Diet, and History of Illness at SMA Negeri 1 Southwest Rote in 2024, as presented in Table 1.

Table 1. Distribution of Research Variables

Research Variables	n	%
Anemia		
Yes	34	42,5
No	46	57,5
Academic Achievement		
Poor	5	6,3
Average	49	61,3
Good	26	32,5
Nutritional Intake		
Poor	44	55
Adequate	36	45
Eating Pattern		
Poor	48	60
Adequate	32	40
History of Illness		
Yes	31	38,8
No	49	61,3
Total	80	100,0

Table 1 shows that the majority of respondents do not suffer from anemia (57.5%), have average learning achievement (61.3%), poor nutritional intake (55%), poor eating habits (60%), and no history of illness (61.3%).

Table 2. The Relationship Between Anemia Status and Learning Achievement at SMA Negeri 1 Southwest Rote

Anemia	Learning Achievement						Total		*ρ-Value*
	Poor		Average		Good				
	n	%	n	%	n	%	n	%	
Yes	4	11,8	20	58,8	10	29,4	34	100	
No	1	2,2	29	63	16	34,8	46	100	*0,247
Total	5	6,3	49	61,3	26	32,5	80	100	

Table 2 shows the results of the statistical test using simple logistic regression, with a p-value of 0.247. Thus, it can be concluded that there is no relationship between learning achievement and anemia status in the working area of SMA Negeri 1 Southwest Rote. This is presumed to be due to many other factors that can influence learning achievement besides health factors, including attention, motivation, interest, talent, readiness, teaching methods, curriculum, teacher-student relationships, student-student relationships, school discipline, teaching tools, and school hours.

Table 3. The Relationship Between Anemia Status and Nutritional Intake at SMA Negeri 1 Southwest Rote

Nutritional Intake	Anemia				Total		ρ-Value
	Yes		No				
	n	%	n	%	n	%	
Poor	32	72,7	12	27,3	44	100	
Adequate	2	5,6	34	94,4	36	100	*0,000
Total	34	42,5	46	57,5	80	100	

Table 3 shows the results of a statistical test using simple logistic regression, yielding a p-value of 0.000. Therefore, it can be concluded that there is a relationship between nutritional intake and anemia status at SMA Negeri 1 Southwest Rote. Meanwhile, based on multivariate analysis in Table 6, it is known that nutritional intake is the most influential factor in anemia, with a p-value of 0.006. The Prevalence Odds Ratio (POR) value of 12.01 indicates that respondents with poor nutritional intake are 12.01 times more likely to experience anemia compared to those with good nutritional intake

Table 4. The Relationship Between Eating Patterns and Anemia Status at SMA Negeri 1 Southwest Rote

Eating Patterns	Anemia				Total		*ρ-Value*
	Yes		No				
	n	%	n	%	n	%	
Poor	33	68,8	15	31,3	48	100	
Adequate	1	3,1	31	96,9	32	100	*0,000
Total	34	42,5	46	57,5	80	100	

Table 4 shows the results of a statistical test using simple logistic regression, yielding a p-value of 0.000. Therefore, it can be concluded that there is a relationship between eating patterns and anemia status at SMA Negeri 1 Southwest Rote. Meanwhile, from the multivariate analysis in Table 6, it is known that eating patterns influence anemia, with a p-value of 0.017, indicating a relationship between eating patterns and anemia. The Prevalence Odds Ratio (POR) of 16.09 shows that respondents with poor eating patterns are 16.09 times more likely to experience anemia compared to those with good eating patterns.

Table 5. Results of Multivariate Analysis of Determinant Factors of Anemia Status and Their Impact on Learning Achievement at SMA Negeri 1 Southwest Rote.

No	Variabel	B Value	aPOR	95%CI	*P- Value*
1	Eating Patterns	2,778	16,09	1,656-158,389	0,017
2	Nutritional Intake	2,486	12,01	2,075-69,601	0,006
	Constant	-6,462			

Table 5 shows the results of multivariate analysis using multiple logistic regression with the Backward LR (Likelihood Ratio) method, revealing that the factors influencing anemia status are as follows, respondents with eating patterns <80% are 16.09 times more likely to experience anemia compared to respondents with eating patterns >80%, with a p-value of 0.017 (< α = 0.05), indicating that there is a significant influence between eating patterns and anemia status (95% CI: 1.656–158.389). Respondents with nutritional intake below the recommended levels (energy <2100 kcal, vitamin C <75 mg, protein <65 mg, iron <15 mg) are 12.01 times more likely to experience anemia compared to those with nutritional intake above the recommended levels (energy ≥2100 kcal, vitamin C ≥75 mg, protein ≥65 mg, iron ≥15 mg). This is supported by a p-value of 0.006 (< α = 0.05), indicating a significant relationship between nutritional intake and anemia status (95% CI: 2.075–69.601).

4. Discussion

4.1 Relationship between Learning Achievement and Anemia

Learning achievement is a reflection of learning effort; the better the learning effort made, the better the achievement obtained. Learning achievement is also known as academic achievement, which represents success in completing learning tasks or the level of academic mastery [7].

Students' physical health plays a vital role in determining their academic performance at school. One of the common health issues faced by students is iron deficiency anemia. This condition can have a negative impact on students' performance and productivity. When anemia occurs, students may experience reduced concentration levels, which in turn can adversely affect their academic achievement [8].

There are many factors that influence the learning process and its outcomes (learning achievement). These factors include both internal and external aspects of the individual. External factors include environmental and instrumental factors, while internal factors consist of physiological and psychological aspects. Furthermore, a calm and comfortable (school) environment allows students to grasp learning materials more effectively and achieve optimal mastery [9].

The results of the statistical test using simple logistic regression, with a p-value of 0.247. Thus, it can be concluded that there is no relationship between learning achievement and anemia status in the working area of SMA Negeri 1 Southwest Rote. This is presumed to be due to many other factors that can influence learning achievement besides health factors, including attention, motivation, interest, talent, readiness, teaching methods, curriculum, teacher-student relationships, student-student relationships, school discipline, teaching tools, and school hours.

In line with recent research by [10], one of the contributing factors to declining academic performance is a lack of learning motivation. Generally, motivation plays a crucial role in influencing an individual's academic achievement. Students with high learning motivation tend to achieve better academic outcomes, whereas those with low motivation are more likely to perform poorly in their studies. Therefore, learning motivation can be considered a key indicator in assessing a student's potential for academic success

4.2 Relationship between Nutritional Intake and Anemia

Nutritional status refers to the condition of the body as a result of the intake, absorption, and utilization of nutrients, or the physiological state resulting from the availability of nutrients in the body. Eating habits greatly influence the attainment of an ideal body. Many adolescents, particularly girls, feel dissatisfied with their appearance, especially due to body image perceptions that favor a tall and slim figure as the ideal. However, there are still adolescent girls who do not concern themselves with such perceptions. These differing attitudes can lead to unhealthy eating patterns, increasing the risk of both undernutrition and overnutrition. Adolescents often pay close attention to body image, which may lead them to restrict food intake and adopt various dietary restrictions. Inadequate food consumption reduces the body's iron reserves, accelerating the onset of anemia [11].

The main factor contributing to anemia is insufficient intake, particularly the lack of animal-based food sources in the dietary patterns of the Indonesian population, which leads to inadequate iron consumption. Iron deficiency can have significant consequences for infants and children later in life, such as impaired immune system development, increased susceptibility to illness, delayed mental development, poor academic performance, and disrupted growth functions. It also has a direct impact on students' academic achievement [12].

Adolescence is a period of rapid growth, which leads to an increased need for nutrients. One of the nutrients with increased demand during this period is iron. Iron is required by all body cells and plays a fundamental role in physiological processes, such

as the formation of hemoglobin (red blood cells) and enzyme function. Girls require a higher intake of nutrients compared to boys. The Recommended Dietary Allowance (RDA) table indicates that the iron requirement for adolescent girls aged 13–29 years is 26 mg, which is significantly higher than that of boys of the same age. For girls, iron intake is not only used to support growth but also to replace the iron lost through blood during monthly menstruation. Because of this high iron requirement, girls are at greater risk of iron deficiency, which can eventually develop into anemia [13].

The results of a statistical test using simple logistic regression, yielding a p-value of 0.000. Therefore, it can be concluded that there is a relationship between nutritional intake and anemia status at SMA Negeri 1 Southwest Rote. Meanwhile, based on multivariate analysis in Table 5, it is known that nutritional intake is the most influential factor in anemia, with a p-value of 0.006. The Prevalence Odds Ratio (POR) value of 12.01 indicates that respondents with poor nutritional intake are 12.01 times more likely to experience anemia compared to those with good nutritional intake

This study is consistent with the research conducted by [14], which found that 51.4% of participants were affected. In general, dietary intake can influence iron deficiency, which in turn leads to anemia. Iron deficiency is influenced by several other factors, including non-nutritional conditions such as genetic disorders, infectious diseases, and parasitic infections (e.g., helminthiasis), as well as nutritional factors. Certain foods can inhibit iron absorption, including those containing tannins, phytates, polyphenols, oxalates, and dietary fiber, which are commonly found in tea.

This study also consistent with the research conducted by [15], Showed that among female students with inadequate nutritional intake, 12.4% were anemic and 39.0% were non-anemic. In contrast, among those with adequate nutritional intake, only 3.3% were anemic while 45.2% were non-anemic. These findings suggest a significant relationship between iron intake and the incidence of anemia among female students at SMP N 8 Manado.

4.3 The Relationship Between Eating Patterns and Anemia

A good eating pattern needs to be established as an effort to meet nutritional needs. An improper eating pattern can lead to either excessive or insufficient nutrient intake. Excessive intake can result in overweight and other diseases caused by excess nutrients. Conversely, insufficient food intake will cause the body to become thin and more susceptible to diseases [16]. A healthy eating pattern consists of a balanced diet with a variety of nutrients in adequate and not excessive amounts. A healthy diet can be observed from three aspects: type, amount, and frequency. A poor eating pattern is the habit of consuming unhealthy foods daily. Poor eating habits can pose risks to the body's health [17].

The results of a statistical test using simple logistic regression, yielding a p-value of 0.000. Therefore, it can be concluded that there is a relationship between eating patterns and anemia status at SMA Negeri 1 Southwest Rote. Meanwhile, from the multivariate analysis in Table 6, it is known that eating patterns influence anemia, with a p-value of 0.017, indicating a relationship between eating patterns and anemia. The Prevalence Odds Ratio (POR) of 16.09 shows that respondents with poor eating patterns are 16.09 times more likely to experience anemia compared to those with good eating patterns.

This study is consistent with the research conducted by [18], which found an association between dietary patterns and the incidence of anemia among female adolescents at SMAN 1 Kelumpang Tengah, Kotabaru Regency. Improper dietary habits, as well as peer influence related to the desire to be slim, strict dieting, and irregular eating patterns, can contribute to the development of anemia.

4.4 The Relationship Between History of Illness and Anemia

Infectious and parasitic diseases are among the causes of iron-deficiency anemia in adolescents. This condition tends to be more prevalent in tropical and humid regions with poor sanitation. Chronic illnesses such as acute respiratory infections (ARI) and malaria

can exacerbate anemia. Infections may contribute to nutritional deficiencies through several mechanisms, including vomiting, diarrhea, and loss of appetite. Both diarrhea and ARI can reduce appetite, which in turn leads to decreased nutrient intake. Infections can also result in reduced hemoglobin (Hb) levels. Consequently, these conditions may lower food consumption and increase the risk of anemia [19].

The history of illness among female adolescents at SMAN 1 Rote Barat Daya mostly shows that they do not have a history of illness. This is evident from the research results indicating that the physical activity of female adolescents is categorized as good, which means that their bodily systems function well, resulting in no disruptions in their body metabolism. The presence of illness is generally caused by a disturbance in one of the body's functions. The fact that most female adolescents at SMAN 1 Rote Barat Daya do not have a history of illness suggests that their physical activity is good, supporting the proper functioning of their bodily systems and preventing any metabolic disruptions.

The results of a statistical test using simple logistic regression, yielding a p-value of 0.936. Therefore, it can be concluded that there is no relationship between the history of illness and anemia status in the working area of SMA Negeri 1 Southwest Rote.

This study is consistent with the research conducted by [20], which found no significant relationship between medical history and hemoglobin levels. However, it contrasts with the findings of a study by [21], in which the chi-square test showed a significant association between a history of infectious disease and the incidence of anemia. Adolescents with a history of infectious disease were found to be 17.9 times more likely to develop anemia compared to those without such a history.

The history of illness does not affect the occurrence of anemia because most respondents do not have a history of diseases such as fever accompanied by chills, like malaria and tuberculosis (TB). Infectious diseases that attack the body, such as malaria, have components that damage and destroy the human body. Red blood cells infected by malaria parasites will rupture when the parasites mature and are released in large numbers. However, in chronic infections, anemia still occurs, although not proportionally significant [19].

5. Conclusions

Based on the results of the study on the determinant factors of anemia status and its impact on the learning achievement of female students at SMA Negeri 1 Rote Barat Daya in the working area of Busalangga Health Center, Rote Ndao Regency, it can be concluded that there is a significant relationship between nutritional intake and eating patterns with anemia status, while no relationship was found between history of illness and anemia status. Additionally, anemia status was not found to be associated with the learning achievement of the students.

6. Acknowledgments

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7. Conflicts of Interest

The authors declare no conflict of interest. This study was conducted purely for academic purposes and does not involve any conflict of interest with any partiesThe authors declare no conflict of interest.

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