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The Incidence of Anemia and Its Relationship With Nutritional Status (A Study on Female Students at SMA Negeri 3 Gorontalo)

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ABSTRACT

Introduction: The calibre of its human resources dramatically impacts the development of a nation. However, specific health concerns, such as malnutrition, specifically anemia, continue to impede the progress of women of reproductive age, particularly teenage girls, due to the increasing requirement for iron during puberty and menstruation. This study aims to explore the correlation between nutritional status and the prevalence of anemia in female students, specifically focusing on high school students.

Method: This cross-sectional study examined the correlation between the nutritional status of female students in grade XI at SMA Negeri 3 Gorontalo from September to November 2023. Microtoise and digital scales will be employed to obtain the student's body mass index (BMI) values to evaluate their nutritional status. Anemia will be detected using a digital strip-test Hb measuring instrument, and purposive sampling will be used as the sampling technique. The Spearman rank analysis test will be used to determine the significance of the associative hypothesis.

Results: The study primarily consisted of young women, with the majority being 15 years old (41.2%), possessing normal nutritional status (76.5%), and not experiencing anemia (66.7%). An intriguing correlation was discovered between nutritional status and anemia incidence among female students at SMA Negeri 3 Gorontalo (r=-0.364, p= 0.009).

Conclusion: The prevalence of anemia among female students at SMA Negeri 3 Gorontalo is related to their nutritional status. It is recommended that healthcare professionals provide counselling and education on anemia, particularly for teenage girls.

Keywords: Anemia, teenage girl, nutritional status.

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Introduction

A country's progress in development is influenced by the quality of available Human Resources (HR). However, several obstacles hinder the achievement of this hope, especially those related to health, such as nutritional problems such as anemia. Anemia affects various age groups and genders. However, the most vulnerable group is women of childbearing age, especially adolescent girls. This is related to the increased need for iron during puberty and menstruation. Blood loss during menstruation can cause a decrease in iron levels in the body, which can cause anemia if not balanced with sufficient iron intake through food or supplements. This health issue remains a significant concern in society. Adolescence for girls is considered a crucial period because it is an essential stage in preparation for becoming a mother-to-be. Special attention is required to meet nutritional needs.[1]

According to the United Nations (UN), around 800 million people worldwide are malnourished, especially in developing countries.[2] The prevalence of overnutrition is around 16%, with an overweight rate of around 11.2% and obesity of around 4.8%.[3] According to the World Health Organization, since 2008, around 2.8 million people have died each year due to overnutrition and obesity. The prevalence of malnutrition in the world reaches 14.9%, and Southeast Asia has the highest rate at 27.3%.[4] In 2018, in Indonesia, the prevalence of malnutrition in adolescents aged 13-15 years was around 8.7%, consisting of a very thin level of 1.9% and a thin level of 6.8%.3 According to data from the Gorontalo Provincial Health Office in 2022, in junior high school/MTs adolescents, 78.6% had normal nutritional status, 2.4% were very thin, 9.8% were thin, 69.9% were obese, 1.6% were obese, and 6.5% were stunted. The risk of anemia was recorded in male students as much as 2.4% and female students as much as 5.6%. In high school/MA adolescents, 73.12% had normal nutritional status, 3.6% were very thin, 11.6% were thin, 14.9% were obese, 3.5% were obese, and 0.35% were stunted. The risk of anemia was recorded in male students at 1.07% and female students at 5.9%.

Anemia refers to a condition in which the amount of hemoglobin in the blood is below normal limits.[5] The dangers of anemia in adolescent girls include delayed physical growth and behavioral and emotional disorders. This condition can affect the development of brain cells, affecting the immune system, impaired concentration, fatigue, decreased academic achievement, and low work productivity.[6]

The prevalence of anemia in adolescents in various countries ranges from 40% to 88%. According to the World Health Organization, in 2018, the incidence of anemia in adolescent girls in developing countries reached around 53.7% of the total adolescent girls.[4] Based on

the 2018 Basic Health Research (RISKESDAS), the prevalence of anemia in Indonesia by gender was 20.35% in males and 27.2% in females. In the age range of 5-14 years, the prevalence rate of anemia reached 26.8%, while in the age range of 15-24 years it reached 32.0%.[6] From data from the Gorontalo Provincial Health Office in 2023, the number of adolescent girls suffering from anemia was 0.3% in 2022, and only 0.7% consumed iron supplement tablets. Therefore, this study aimed to prove whether it was confirmed that only 0.3% of adolescent girls in Gorontalo suffered from anemia and the other 99.07% did not.

Thin condition is a nutritional problem that is often found in adolescent girls. They often view thinness as something beautiful, so dieting without expert guidance and direction causes the need for essential nutrients to be unmet.[7] If this condition is not corrected, it can cause nutritional problems such as excess nutrition, malnutrition, inadequate nutrition, Iron Deficiency Anemia, vitamin A deficiency, and Iodine Deficiency Disorders.[8] The impact of anemia in adolescence, if not treated, can be carried over to marriage, pregnancy, and childbirth. The long-term impact can increase the risk of Iron Deficiency Anemia (AKI) and Iron Deficiency Anemia (IDA).[9]

Therefore, researchers are interested in investigating the relationship between nutritional status and the incidence of Anemia in adolescent girls, particularly high school students. Researchers chose SMA Negeri 3 Gorontalo as a research location because, in the initial survey, it was found that of 18 female students aged 16-17 years, there were 16.7% of female students who had a height of <150 cm, 11.1% of female students weighed 30-39 kg, 5.6% weighed >59 kg. In addition, in the last month, 50% of female students felt paler than before, 55.6% who sometimes had headaches, 22.2% who felt they often had headaches, and 11.1% felt they always had headaches. In the last month, 38.9% of female students had difficulty sleeping, and 33.3% of female students often had difficulty sleeping. From some symptoms, there is an impact, namely difficulty concentrating for female students where the results obtained are 55.6% of female students who sometimes find it difficult to concentrate, 16.7% of female students who often find it difficult to concentrate, and 22.2% of female students who always find it difficult to concentrate. Therefore, researchers hope this study can identify the incidence of Anemia in Female Students at SMA Negeri 3 Gorontalo and how Nutritional Status can affect the incidence of Anemia. By knowing this, prevention and screening efforts for Anemia can be carried out and treated early.

Methods

Sampling Techniques

The study employed a purposive sampling method to select participants, ensuring that

only those who met specific inclusion criteria were chosen. The criteria included students from SMA Negeri 3 Gorontalo, specifically those in class XI, who were available and willing to participate in the research. This approach was selected to focus on a specific subset of the population most relevant to the study objectives—students at a critical developmental stage where nutritional status and anemia risk are particularly significant. By using purposive sampling, the study ensured a more targeted and efficient data collection process, allowing for in-depth analysis of the relationship between nutritional status and anemia within this specific group.

Data Measurement

Anemia was assessed using a digital hemoglobin (Hb) strip-test, a reliable and non-invasive tool for measuring hemoglobin levels. Prior to the study, the digital Hb strip-test was calibrated according to the manufacturer's guidelines to ensure accuracy. Validation of the instrument was performed by comparing test results with standard laboratory methods in a preliminary trial. The process involved collecting a small blood sample from each participant, which was then applied to the Hb strip. The device provided an immediate readout of hemoglobin concentration. For the purposes of this study, anemia was defined as an Hb level of ≤ 12 g/dL, while levels ≥ 12 g/dL were considered normal. This method was chosen for its ease of use in field settings, rapid results, and minimal discomfort to participants, ensuring the reliability and validity of the anemia assessments. This research was conducted at SMA Negeri 3 Gorontalo between September and November 2023, utilizing a cross-sectional design with an analytical observational approach. The population comprised 246 students from class XI, determined using the Slovin formula. Nutritional status was assessed using Body Mass Index (BMI), calculated from measurements obtained with a microtome and digital scales. BMI results were classified as follows: normal (z-score $\geq$ -2 SD to 1 SD), thin (z-score $\geq$ -3 SD to < -2 SD), very thin (z-score < -3 SD), obese (z-score >1 SD to 2 SD), and very obese (z-score >2 SD). Anemia was assessed using the digital Hb strip-test, with results categorized as 'yes' if Hb levels were ≤ 12 g/dL, and 'no' if Hb levels were ≥ 12 g/dL.

Data Analysis

Data collected from each respondent were coded and entered into SPSS for analysis. The software was used to conduct frequency analyses of both dependent and independent variables. The results were presented in frequency distribution tables, enabling a clear understanding of the data. To determine the relationship between anemia (the dependent variable) and nutritional status (the independent variable), the Spearman rank correlation test was applied. This statistical method was chosen due to its suitability for analyzing ordinal

data and identifying potential correlations between the studied variables.

Result

In Table 1, it is observed that the majority of respondents at SMAN 3 Gorontalo were 15-year-old female students. A significant portion of these students had normal nutritional status and were not affected by anemia. This trend suggests a possible link between adequate nutrition and the absence of anemia in this age group.

Table 1. Frequency distribution of respondent characteristics based on age, nutritional status, and anemia status

Category	Frequency	Percentage (%)	Means	Standar Deviations
Age				
14	6	11.80		
15	21	41.20		
16	18	35.30		
17	5	9.80		
18	1	2.00		
Nutritional Status				
Overweight	1	2.00		
Normal	39	76.50		
Underweight	11	21.60		
Anemia Status				
Anemia	17	33.30		
No Anemia	34	66.70		
Anemi Levels				
Anemia	17	33.30	10.182	1.1669
No Anemia	34	66.70	13.897	1.4809

Table 2 shows results between nutritional status and anemia incidence using the Spearman Rank correlation test, which produces p value = 0.009. This shows a significant relationship between nutritional status and anemia incidence (p-value <0.05).

The negative correlation value of -0.364 suggests that as nutritional status improves, the incidence of anemia decreases, albeit with a weak strength of association. This finding may point to a broader pattern where better nutritional practices among the students could

potentially lower the risk of anemia. However, the weak correlation implies that other factors may also play a role in anemia incidence, which could be explored further in future studies

Table 2. The relationship between nutritional status and the incidence of anemia

Nutritional Status	Anemia Incidence				Total		p-value	Correlation Coefficient
	Present		Absent					
	n	%	n	%	n	%		
Overweight	1	2.00	0	0	1	2.00		
Normal	8	15.70	31	60.80	39	76.50	0.009	-0.364
Underweight	8	15.70	3	5.90	11	21.50		
Total	**17**	**33.30**	**34**	**66.70**	**51**	**100**		

Discussion

The study results showed that most respondents at SMAN 3 Gorontalo were students with normal nutritional status, namely 39 students (76.5%). This was followed by students who had underweight nutritional status, as many as 11 (21.6%). The remaining one student (2%) was a student who had an overweight nutritional status.

Nutritional status reflects a certain balance in the form of variables or a representation of nutrition in specific variables.10 In children and adolescents, the measurement of Body Mass Index (BMI) is closely related to age due to changes in body proportions and body density that occur with age.[4] Therefore, in children and adolescents, the BMI used is BMI/U, which adjusts for age. Assessment of nutritional status is grouped according to the WHO Child Growth Standards classification for the age range of 0-5 years and the WHO Reference 2007 for the age range of 5-18 years.[3]

According to the study conducted by Ferdian (2024), most female students have normal nutritional status because their family's economic situation and parents' knowledge are able to meet the nutritional needs of their children.[10] Female students with underweight nutritional status can be affected by the economy and the knowledge of parents, who are still lacking.[11] The environment also dramatically influences teenage girls, who highly desire a slim and smooth appearance. Many teenagers eat irregular diets by skipping meals and preferring snacks.[7]

From the research results, it was found that there was one student with overweight nutritional status; in this case, the researcher assumed that overweight nutritional status

could be caused by excessive fat consumption but not paying attention to the nutrients in food. Research conducted by Nafiah supports on the Relationship between Education Level and Family Economy to the Nutritional Status of Toddlers in Mirigambar Village, Sumbergempol District, Tulungagung Regency, where according to the Spearman rank test, there is a significant correlation between the family's economic status and the nutritional condition of toddlers.[20] The study conducted by Ali (2024) also found a significant correlation between family economic status and the nutritional condition of adults.[21] This is also followed by the journal by Ilmirh (2015), who states that external factors that cause nutritional status are income, knowledge, work, and culture.[11] Another supporting factor is, according to Sunita (2010), that thin conditions are a nutritional problem often found in adolescent girls. They often view thinness as something beautiful, so dieting without expert guidance and direction causes the need for essential nutrients to be unmet.[7]

This is also in line with the argument that improvements in the economy and technology have led to improvements in nutritional status compared to previous decades.[12] Adolescent diets significantly affect adolescent health, one of which is important for nutritional status to be in adequate condition to ensure adolescent growth and development in the future. Lack of physical activity in adolescents can be one of the causes of being overweight. A sedentary lifestyle, such as smoking, lack of sleep, and fast food consumption, can worsen this condition. Preventive efforts to maintain body health involve physical activity. However, most adolescents prefer to walk around the mall rather than do physical activities such as walking or light exercise, even though both activities can be a fun way to be physically active.[13]

The research data shows that most of the respondents at SMAN 3 Gorontalo are female students who do not have anemia, totaling 34 students (66.7%), while the remaining 17 students (33.3%) do have anemia. The research data shows that most female students do not have anemia because their body's nutritional needs have been met. This is proven by the fact that out of 34 female students who do not have anemia, 31 female students have normal nutritional status. On the other hand, female students who experience anemia may be caused by an imbalance in the nutrients absorbed, as shown by the research results. Out of 17 female students who experience anemia, eight have an underweight nutritional status, and one female student has an overweight nutritional status.

The findings of this study may be related to the perception of body image and supplement consumption with the incidence of anemia.[14] They emphasized that adolescent body image significantly impacts various behavioral changes, especially those related to

nutritional status. These changes include changes in portion, time, and type of food consumed. Negative body image, which is often influenced by comments and responses from the surrounding environment, can affect adolescent eating behavior, which can ultimately play a role in the incidence of anemia.

Findings from the study indicate that the quality of nutritional status is closely related to the types of food consumed daily.[15] Nutritional status tends to improve When dietary patterns meet the criteria for good nutrition. On the other hand, if food intake is of poor nutritional quality, this can cause nutritional deficiencies and lead to anemia.

The study results showed that the correlation analysis between nutritional status and the incidence of anemia in female students of SMA Negeri 3 Gorontalo using the Spearman Rank correlation test produced a p-value = 0.009. This value indicates a significant relationship between nutritional status and the incidence of anemia in female students of SMA Negeri 3 Gorontalo because the p-value <0.05. Nutritional status refers to the balance between nutrient intake or consumption, absorption, and utilization of these nutrients. Micronutrients and vitamins are elements that produce red blood cells or Hb. If one of the micronutrients is lacking, Hb formation will not be good, and vice versa. Lack of iron in the human body can cause a decrease in Hb formation.[16]

Iron, which is difficult for the body to absorb, can cause anemia. If the body does not get enough iron, the body will not work optimally. The formation of hemoglobin requires many nutrients so that the formation can be optimal, not only the formation but also as a body metabolism. If there are no iron reserves in the body and iron absorption from food is low, the body will produce fewer red blood cells with little hemoglobin. This is what causes anemia.[17]

From the study results with 51 respondents, it was recorded that one student had an overweight nutritional status and anemia. Of the 39 students with normal nutritional status, eight (around 15.7%) had anemia, while 31 (around 60.8%) did not. Of the 11 students who had an underweight nutritional status, eight students (around 15.7%) had anemia, while the other three students (around 5.9%) did not have anemia.

Participants in this study showed various characteristics. Some had normal nutritional status but experienced anemia, while others had abnormal nutritional status but did not experience anemia. Here, it should be noted that factors that influence the incidence of anemia are nutritional status, age, family income, mother's knowledge, diet, menstrual cycle, and knowledge of the adolescents themselves. Although the nutritional status is good, the knowledge about anemia of the mother and adolescents themselves could be better.

Insufficient family income, a poor diet, and disturbed menstruation can cause anemia.[18]

These results support the findings of research by Shara and colleagues (2017), who found a significant relationship between nutritional status and the incidence of anemia in adolescent girls at SMAN 2 Sawahlunto in 2014, and research by A. Muhayati & D. Ratnawati (2019) showed a relationship between nutritional status and diet with the incidence of anemia in adolescent girls has been studied. These findings confirm that nutritional status is closely related to daily diet.[11,15] If the food intake is varied and nutritious, the nutritional status tends to be good. However, if the food eaten has a low nutritional content, this can result in malnutrition and anemia.

The negative correlation between nutritional status and anemia illustrates a complex relationship influenced by various factors, including dietary intake, BMI, and socioeconomic conditions.[22] While poor nutritional status often leads to higher rates of anemia due to deficiencies in essential nutrients like iron and vitamin B12, the relationship is not always straightforward. Anemia can occur across different BMI categories, with underweight individuals typically having higher rates and overweight individuals potentially affected by factors such as inflammation.[23] Additionally, socioeconomic status does not always correlate with better nutritional outcomes, indicating that knowledge and access do not necessarily lead to improved nutritional status. Thus, addressing anemia requires a holistic approach that considers these diverse factors.

This study has a few limitations. Firstly, it only gathered data on nutritional status and Hb levels, which means that other potential causes of abnormal nutritional status, apart from anemia, were not explored. Additionally, there were issues with the statistical data processing; specifically, the chi-square test resulted in a minimum percentage exceeding 20%, which did not meet the test's requirements. Consequently, the Spearman rank statistical test was used instead. Despite these limitations not obstructing the completion of data management, it is advised that future studies include additional factors such as socio-economic status, dietary habits, and access to healthcare to achieve a more thorough understanding of the variables affecting nutritional status and Hb levels.

Conclusion

There is a relationship between nutritional status and the incidence of anemia among female students at SMA Negeri 3 Gorontalo. Based on these findings, it is recommended that health workers implement educational programs and counseling on anemia, specifically targeting female adolescents. Additionally, future research should explore the effectiveness of these educational interventions and examine other contributing factors to anemia, such as

socio-economic status and dietary habits, to inform more comprehensive health policies and strategies..

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