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(Review Article)

Relationship of lead (pb) content in hair, body mass index, and social environment with anemia in adolescent girls in Gorontalo city

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Abstract

The objective of this study is to analyze the relationship between lead levels, body mass index, and social environment with the incidence of anemia in adolescent girls, both individually and simultaneously. The study aims to maintain a balanced and objective approach, avoiding biased language and employing precise word choice. The language used is formal and clear, with a logical structure and causal connections between statements. The text adheres to conventional academic structure and formatting, including consistent citation and footnote style. No changes in content have been made, and technical term abbreviations have been explained when first used. The research data was collected using digital measuring instruments and questionnaires and then analyzed univariately and bivariately. The study results indicate that lead (Pb) levels in hair, body mass index (BMI), and social environment are significantly related to the incidence of anemia in adolescent girls, both partially and simultaneously. Specifically, lead levels in hair have a negative correlation with the incidence of anemia in adolescent girls. As lead levels in hair increase, hemoglobin values decrease, and the level of anemia in adolescent girls falls into the severe anemia category. However, it is worth noting that BMI and social environment are positively correlated with anemia in adolescent girls. This means that higher BMI and a better social environment are associated with higher hemoglobin levels in the blood, resulting in a lower prevalence of anemia in adolescent girls. Additionally, all three independent variables are related to the dependent variable by 32.60%. This study found that lead levels in hair, BMI, and social environment account for 32.60% of anemia in young women. The remaining 67.40% is attributed to other variables not included in this study.

Keywords: Anemia in Adolescents; Body Mass Index; Lead Levels in Hair; Social Environment

1. Introduction

Anemia is a significant health concern, particularly in developing countries like Indonesia. Teenage girls are among the groups most vulnerable to anemia, especially during menstruation. Individuals with anemia may experience symptoms such as fatigue, tiredness, and decreased concentration, which can negatively impact creativity and productivity. Additionally, anemia can increase susceptibility to disease in adulthood and contribute to nutritional problems in future generations (Ministry of Health, 2021).

According to the 2021 World Health Statistics Report by the World Health Organization (WHO), the prevalence of anemia among non-pregnant women aged 15-49 years was 29.6%, including the adolescent age category. The report also states that the prevalence of anemia in women of productive age (15-49) worldwide in 2019 was approximately 29.9% (WHO, 2021). According to the 2018 Basic Health Research report by Balitbangkes, the prevalence of anemia in adolescent girls in Indonesia is approximately 27.2% among those aged 15-24. In a study conducted in the working area of the South City Health Center in Gorontalo City, 32% of 99 teenage girls were found to suffer from anemia. Additionally,

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it was discovered that 166 (52.9%) teenagers did not consume iron-rich foods, and 238 (77%) did not take blood supplement tablets regularly (Yulianingsih, 2019).

Anemia is a significant health concern, particularly for teenagers, especially young women who are still growing. The causes of anemia can be influenced by inadequate nutritional intake, lack of physical activity, and social and environmental conditions in the areas of daily activities that do not support healthy habits. Apart from that, anemia can have adverse impacts, including decreased reproductive health, motor and mental development, hampered intelligence, decreased learning achievement, decreased fitness levels, and failure to achieve maximum height (Jaelani et al., 2017).

The development of teenagers, especially young women, significantly affects their ability to become independent adults. Adolescent girls with anemia are at risk of developing anemia as women of childbearing age. This can lead to vulnerability during pregnancy and protein-energy deficiencies. It is important to address anemia in adolescent girls to prevent these potential health issues. Chronic anemia can lead to pregnancy complications, including premature birth, low birth weight, and the risk of bleeding during childbirth, which can result in death (Ministry of Health, 2018).

Adolescent girls who experience anemia due to inadequate nutritional intake, rather than iron loss or deficiency, and who follow an inappropriate diet that affects their body mass index, may be supported by inadequate environmental conditions in terms of health. Young people are at greater risk of environmental hazards and pollution due to their immature developmental physiology and systems. Adolescents and young adults are at risk of several environmental pollution hazards, including air pollution, chemicals and heavy metals, climate change, UV radiation, and urban health (WHO, 2023). Chemicals and heavy metals are a significant environmental health hazard. Exposure to these substances can lead to anemia or iron deficiency, with lead (Pb) being a particularly concerning heavy metal.

Lead, a toxic metal, can enter the human body through various means such as the consumption of contaminated food, drinks, air, water, smoke, and dust. It inhibits the activity of enzymes involved in the formation of hemoglobin, shortens the lifespan of red blood cells, reduces the number of red blood cells and reticulocytes, and increases the Fe metal content in blood plasma. There is a significant negative correlation between hemoglobin (Hb) levels and lead levels in the blood (Lailiyana et al., 2016). Lead contamination can cause various health problems, including anemia.

The researchers conducted a study titled 'The Relationship of Lead (Pb) Content in Hair, Body Mass Index, and Social Environment with Anemia in Adolescent Girls in Gorontalo City' to analyze the relationship between lead levels, body mass index, and social environment and the incidence of anemia in adolescent girls, both individually and simultaneously.

2. Methods

This study employs observational quantitative research methods using a cross-sectional approach. The study examines the relationship between lead levels in hair (X1), body mass index (X2), and social environment (X3) as independent variables, and anemia in young women (Y) as the dependent variable. Body mass index data was collected using digital body scales and a stadiometer to measure height. The study collected research data on hemoglobin levels using the Easy Touch digital tool and blood samples from participants. Lead levels were measured using the Atomic Absorption Spectrophotometry (SSA) method on hair samples. Social and environmental data were obtained through questionnaires. The collected data was analyzed using both univariate and bivariate methods.

3. Results

3.1. Univariate Analysis

The study describes the characteristics of adolescent girls who participated, including their age, incidence of anemia, lead levels in hair, body mass index, social environment, eating patterns, physical activity and rest habits, environmental health, and peer environment. Table 1 provides an overview of the demographics of the respondents in Gorontalo City.

Table 1 Demographics of Respondents (Young Women) in Gorontalo City

No.	Characteristics of Respondents	Frequency	
		Amount (n)	Percentage (%)
Age			
1	12-15 years old	23	51.10
2	16-19 years old	22	48.89
Anemia			
1	Mild	21	46.67
2	Moderate	23	51.11
3	Severe	1	2.22
Level of Lead (Pb) in Hair			
1	Low	45	100.00
2	Moderate	0	0.00
3	High	0	0.00
Body Mass Index (BMI)			
1	Very thin	21	46.67
2	Thin	3	6.67
3	Normal	15	33.33
4	Fat	1	2.22
5	Very fat	5	11.11
Social Environment			
1	Good	0	0.00
2	Enough	28	62.22
3	Poor	17	37.78
Dietary			
1	Good	1	2.22
2	Enough	35	77.78
3	Poor	9	20.00
Physical Activity and Rest Habits			
1	Good	18	40.00
2	Poor	27	60.00
Environmental Health of Respondents			
1	Good	19	42.22
2	Enough	4	8.89
3	Poor	22	48.89
Peer Environment			
1	Good	4	8.89
2	Poor	41	91.11

Source: Processed data, 2024

3.2. Bivariate Analysis

3.2.1. Multiple regression equations and hypothesis testing

Multiple regression analysis is conducted when there are multiple independent variables. Table 2 displays the results of the multiple regression analysis carried out using the SPSS program.

Table 2 Regression Analysis Results

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.999	1.826		2.189	0.034
	Level of Lead (Pb) in Hair	-0.032	0.111	-0.043	-0.288	0.775
	Body Mass Index (BMI)	0.068	0.027	0.339	2.528	0.015
	Social Environment	0.069	0.025	0.409	2.717	0.010

Source: Processed data, 2024

Based on the results of this analysis, the multiple linear regression equation model is as follows:

$$\hat{Y} = 3{,}999 - 0{,}032X_1 + 0{,}068X_2 + 0{,}069X_3 + \varepsilon$$

The following can be interpreted based on the regression equation model:

- Interpretation of constant values

The constant value of 3.999 represents the fixed value of the anemia variable in young women in Gorontalo City, assuming no influence from lead (Pb) levels in hair, body mass index (BMI), or social environment.

- Interpretation of coefficient values of lead (Pb) content in hair

The regression coefficient for variable X_1, lead (Pb) level in hair, is -0.032. This indicates that a change of 1 unit in the lead (Pb) level in hair will affect anemia by -0.032 times the unit, provided that the other variables remain constant (*Cateris Paribus*).

- Interpretation of coefficient values of body mass index (BMI)

The regression coefficient for variable X_2, body mass index (IMT), is 0.068. This indicates that a one-unit change in the body mass index (IMT) variable will affect anemia by 0.068 times the unit, provided that the other variables remain constant (*Cateris Paribus*).

- Interpretation of coefficient values of social environment

The regression coefficient for variable X_3 (social environment) is -0.069, indicating that a one-unit change in the social environment variable will result in a -0.069 unit change in anemia, assuming the other variables remain constant (*Cateris Paribus*).

3.2.2. Partial test results

Interpretation of partial test of variable lead (Pb) levels in hair

Table 3 presents the test results of variables for lead (Pb) levels in hair.

Table 3 Partial Test Results for Levels of Lead (Pb) in Hair Variable

Lead (Pb) Content in Hair	Anemia in Adolescent Girls			Total	t_{count}
	Mild	Moderate	Severe		
Low	21	23	1	45	-0.228 (p-value 0.775 > 0.05)
Moderate	0	0	0	0	
High	0	0	0	0	
Total	21	23	1	45	

Source: Processed data, 2024

Based on the analysis, the t_{count} value for the lead (Pb) content variable in hair was -0.228, while the t_{table} value was 2.020. When comparing the two t-values, the t_{count} value is still smaller than the t_{table} value (0.228 < 2.020). The t_{count} significance value for the lead (Pb) content variable in hair is 0.775. The significance value of lead (Pb) levels in hair is greater than the probability value of 0.05, or the value (0.775 > 0.05), so Ha_1 is rejected. The study found no significant relationship between levels of lead (Pb) in hair and anemia in adolescent girls in Gorontalo City. Higher levels of lead (Pb) in hair were not found to be associated with a decrease in Hb value or an increase in the severity of anemia in young women in Gorontalo City.

Interpretation of partial test of variable body mass index (BMI)

Table 4 presents the test results of the variable for body mass index (BMI).

Table 4 Partial Test Results for Body Mass Index (BMI) Variable

Body Mass Index (BMI)	Anemia in Adolescent Girls			Total	t_{count}
	Mild	Moderate	Severe		
Very thin	3	17	1	21	2.528 (p-value 0.015 < 0.05)
Thin	2	1	0	3	
Normal	12	3	0	15	
Fat	0	1	0	1	
Very fat	4	1	0	5	
Total	21	23	1	45	

Source: Processed data, 2024

Based on the analysis, the t-calculated value for the body mass index (BMI) variable was 2.528, which is greater than the t_{table} value of 2.020. Therefore, the significance value of the BMI variable (0.015) is smaller than the probability value of 0.05, indicating that Ha_2 is accepted. The study found a positive and significant relationship between body mass index (BMI) and anemia in adolescent girls in Gorontalo City. Specifically, higher BMI values were associated with increased Hb levels and a lower likelihood of anemia. These findings suggest that improving BMI may be an effective strategy for reducing anemia prevalence in young women in Gorontalo City.

Interpretation of partial test of variable social environment

Table 5 presents the test results of the variable for social environment.

Based on the analysis, the t_{count} value for the lead (Pb) content variable in hair was 2.717, which is greater than the t_{table} value of 2.020. The t_{count} significance value for the social environment variable is 0.010, which is smaller than the significance level of 0.05. The t_{count} significance value for the social environment variable is 0.010, which is smaller than the significance level of 0.05. Therefore, Ha_4 is accepted. The study found a positive and significant correlation between the social environment and anemia in young women in Gorontalo City. Specifically, a better social environment was associated with higher Hb values, suggesting a decrease in anemia among young women in Gorontalo City.

Table 5 Partial Test Results for Social Environment Variable

Social Environment	Anemia in Adolescent Girls			Total	t_{count}
	Mild	Moderate	Severe		
Good	0	0	0	0	2.717 (p-value 0.010 < 0.05)
Enough	15	13	0	28	
Poor	6	10	1	17	
Total	21	23	1	45	

Source: Processed data, 2024

3.2.3. Simultaneous test results

Table 6 displays the results of simultaneous testing using SPSS 21.

Table 6 Simultaneous Test Results

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	13.200	3	4.400	6.596	.001[b]
	Residual	27.352	41	.667		
	Total	40.552	44			

Source: Processed data, 2024

Based on the result in Table 6, the F_{count} value for this research is 6.596 with a significance or probability value of 0.000. Meanwhile, the F_{table} value at a significance level of 5%, df1 of k = 2, and df2 of N-k-1=45-3-1=41 is 2.833. When comparing these two F values, the F_{count} value obtained is much greater than the F_{table} value. Therefore, the probability value obtained from the test is smaller than the value $\alpha = 0.05$. In conclusion, this study found a significant relationship between anemia in young women in Gorontalo City and levels of lead (Pb) in hair, body mass index (BMI), and social environment.

3.2.4. Coefficient of determination test

The value of the coefficient of determination (R^2) can be found in table 7.

Table 7 Coefficient of Determination

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.571[a]	.326	.276	.81677

Source: Processed data, 2024

Table 8 Partial Coefficient of Determination

Model	Standardized Coefficients	Correlation	Determination	
			Value	%
Lead (Pb) Content in Hair	-0.043	0.113	-0.005	-0.50
Body Mass Index (BMI)	0.339	0.424	0.144	14.40
Social Environment	0.409	0.456	0.187	18.70
Simultaneous Coefficient of Determination			0.326	32.60

Source: Processed data, 2024

Based on the analysis of the coefficient of determination in the table above, the R-Square value is 0.326. This indicates that 32.60% of the variability in anemia among adolescent girls in Gorontalo City can be explained by levels of lead (Pb) in hair, body mass index (BMI), and social environment. The remaining 67.40% can be attributed to unexamined variables. Next, a partial coefficient test is conducted. The results of the test for the partial coefficient of determination are presented in Table 8.

Based on the results of the analysis of the coefficient of determination, the influence of each variable can be explained as follows:

- Lead (Pb) content in hair

Based on these calculations, the coefficient of determination value is -0.005. Therefore, the variable level of lead (Pb) in hair has a 0.50% influence on anemia in adolescent girls in Gorontalo City.

- Body mass index (BMI)

Based on these calculations, the coefficient of determination value is 0.144, indicating that the body mass index (BMI) variable has a 14.40% influence on anemia in young women in Gorontalo City.

- Social environment

Based on these calculations, the coefficient of determination value is 0.187. This means that social environmental variables can only account for 18.70% of the influence on anemia in young women in Gorontalo City.

4. Discussion

4.1. Influence of Content of Lead (Pb) in Hair on Anemia

Lead (Pb) levels in hair indicate the amount of lead present in an individual's hair strands. Hair is commonly used as a measuring material or bioindicator to detect chronic exposure to heavy metals, including lead. Hair analysis can provide a longer-term exposure picture compared to blood or urine measurements due to the relatively slow process of hair growth.

The descriptive testing results showed that all 45 respondents, who were adolescent girls, had low levels of lead (Pb) in their hair, accounting for 100% of the sample. This indicates that the surrounding environment, including water, air, and other natural resources, has a controlled or minimal level of pollution. These results demonstrate that although lead levels are currently low, it is important to be aware of the bioaccumulative nature of lead accumulation in the body. As areas become more developed, human activities become more complex, which can lead to increased lead exposure.

The link between hair lead levels and anemia in adolescent girls can be explained through several complex mechanisms. One of the main ways lead affects anemia is by inhibiting iron absorption. Lead can compete with iron for absorption in the gut, which can result in decreased levels of iron available for hemoglobin synthesis. Chronic exposure to lead can also damage red blood cells and affect the hemoglobin formation process, reducing their survivability. Furthermore, lead can interfere with hemoglobin production, leading to a decrease in the number of healthy red blood cells.

The multiple regression analysis results showed that there is a negative and insignificant relationship between lead (Pb) levels in hair and anemia in adolescent girls in Gorontalo City. Specifically, as the level of lead (Pb) in the hair increases, the Hb value decreases, or the level of anemia in adolescent girls in Gorontalo City falls into the severe category. A decrease in the Hb value indicates the presence and severity of anemia. Higher levels of lead in hair increase the likelihood of adolescent girls falling into the severe anemia category. Severe anemia in adolescent girls can have serious long-term effects, including reduced productivity, impaired cognitive development, and risk of other health complications. Thus, these findings offer a solid foundation for the expansion of lead prevention and control efforts in the environment of adolescent girls in Gorontalo City.

These results align with Sinatra et al.'s (2020) statement that lead (Pb) poisoning effects are characterized by impaired hemoglobin synthesis, leading to decreased hemoglobin levels and anemia. Rosita and Mustika (2019) found that lead absorbed by the blood binds to red blood cells and causes disturbances in the synthesis process of hemoglobin.

4.2. Influence of Body Mass Index (BMI) on Anemia

Body Mass Index (BMI) is a measurement used to assess the proportion of a person's weight and height. BMI provides a rough idea of the distribution of fat in the body and is often used as a general indicator of a person's level of fatness or emaciation. It is commonly used in the medical and health fields to provide an initial indication of a person's nutritional status. The BMI calculation results are compared with standard categories established by the World Health Organization (WHO) or local health agencies. BMI provides an approximate indication of fat distribution and the health risks associated with being overweight or underweight.

The results of the descriptive testing indicate that 46.67% of the teenage girls were severely underweight, 6.67% were mildly underweight, 33.33% had a normal weight, 2.22% were mildly obese, and 11.11% were severely obese. These findings suggest that almost half of the teenage girl respondents had a BMI indicating a weight below the normal standard.

Body mass index (BMI) reflects the relationship between food intake, nutrient absorption, and body metabolism. Anemia, a condition often related to deficiencies in certain nutrients, can be affected by one's nutritional status. A low BMI could indicate that one is not getting enough nutrients, including iron, vitamin B12, or folic acid, which are critical for hemoglobin production. A low or suboptimal BMI can be a clue that a person has limited iron reserves. This may affect the body's ability to produce sufficient hemoglobin, leading to anemia. The correlation between BMI and iron reserves may clarify why individuals with low BMI are at a higher risk of anemia.

The multiple regression analysis revealed a positive and significant relationship between BMI and anemia in young women in Gorontalo City. Specifically, higher BMI values were associated with increased Hb levels and a lower likelihood of anemia. It is important to note that these findings are limited to young women in Gorontalo City and cannot be generalized to other populations. Adolescent girls with a higher BMI are less likely to develop severe anemia and may even move to the mild anemia category or recover completely. These findings suggest that increasing BMI could have a protective effect in preventing or treating anemia in adolescent girls.

These results are consistent with Enggardany et al.'s (2021) assertion that there is a correlation between BMI and anemia in adolescent girls. To prevent anemia, young women should ensure they consume iron-rich foods or take iron supplements daily. It is important to note that the findings of Estri & Cahyaningtyas (2021) contradict the idea that there is a relationship between BMI and anemia incidence in adolescent girls.

4.3. Influence of Social Environment on Anemia

The social environment encompasses all social interactions and relationships surrounding an individual. It includes factors that can shape and modify a person's behavior, beliefs, and social norms. These factors may include family, peers, society, culture, and social structures within a community or group. The social environment plays a significant role in individual development and behavior.

The descriptive testing results indicate that none of the young women had a good perception of the social environment, while 28 young women or 62.22% had a fairly good perception, and 17 young women or 37.78% had a poor perception. These findings suggest that there are areas of the social environment that require attention and improvement in the lives of young women in Gorontalo City.

The relationship between social environment and anemia involves several critical aspects, including diet, physical activity, rest habits, environmental health, and interactions with peers. An unbalanced diet, lack of iron, vitamin B12, and folate intake can be the main factors in the development of anemia. A social environment that does not support access to nutritious food can increase the risk of nutritional deficiencies. Physical activity also plays a crucial role in this relationship. Physical activity can stimulate the production of red blood cells and increase oxygen circulation, which may help prevent anemia. Conversely, a lack of physical activity can slow down this process and increase the risk of anemia.

Irregular sleep patterns or lack of sleep can have a negative impact on blood health. Sleep disorders can disrupt the regeneration of blood cells and affect the function of the hematological system. Environmental factors, such as exposure to air and water pollution, can also affect blood health. Exposure to harmful substances can damage red blood cells and disrupt the process of hemoglobin formation. Additionally, social interactions can play a role in blood health as peers can influence a person's eating habits and lifestyle.If the social environment supports a healthy lifestyle, including aspects relevant to preventing anemia, individuals may have a lower risk of developing anemia.

The results of testing the third hypothesis using multiple regression analysis showed that the social environment had a positive and significant relationship with anemia in young women in Gorontalo City. The Hb value, which indicates the resolution of anemia in young women in Gorontalo City, increases with a better social environment. The success of treating anemia in adolescent girls is closely related to the importance of a healthy and supportive social environment. A good and nutritious diet is one important element of the social environment.

These results support Wiguna et al.'s (2022) statement that environmental factors play a significant role in preventing anemia in adolescent girls. Therefore, a comprehensive approach involving multiple stakeholders, such as the government, educational institutions, families, and society, is necessary. Anemia prevention and intervention efforts can be effectively addressed through health programs that focus on increasing knowledge, changing behavior towards diet and sanitation, and strengthening social support. A comprehensive approach to the social environment is necessary, including promoting a balanced diet, increasing physical activity, establishing good sleep habits, managing environmental health, and creating a social environment that supports healthy behavior. Involving peers and raising collective awareness about the importance of these factors can help reduce the risk of anemia in adolescent girls.

4.4. Influence of Content of Lead (Pb) in Hair, Body Mass Index (BMI), and Social Environment on Anemia

Anemia is a medical condition characterized by lower than normal levels of red blood cells or hemoglobin in the blood. Red blood cells and hemoglobin play a crucial role in carrying oxygen from the lungs to the rest of the body. A deficiency in red blood cells or hemoglobin can lead to a decrease in the blood's ability to transport oxygen, resulting in symptoms such as fatigue, shortness of breath, and pallor. Hemoglobin deficiency can result from various factors, such as iron, vitamin B12, or folate deficiencies, genetic disorders, or issues in red blood cell production.

Descriptive testing revealed that 21 of the adolescent girls surveyed were in the mild anemia category, accounting for 46.67% of the respondents. Additionally, 23 respondents (51.11%) were in the moderate anemia category.

Anemia is a health issue that requires attention among young women in Gorontalo City. The high prevalence rates at mild and moderate levels indicate the need to investigate factors that can cause or exacerbate anemia.

The multiple regression analysis results showed a significant relationship between anemia in young women in Gorontalo City and lead (Pb) levels in hair, body mass index (BMI), and social environment, with a coefficient of determination of 32.60%. It is important to note that this relationship is not causal. Meanwhile, the remaining 67.40% can be explained by other variables not examined in this study, such as nutritional intake, consumption of iron-containing vitamins, menstruation, and the presence of disease in young women.

Lead levels in hair can indicate exposure to this heavy metal in the daily environment. Lead can interfere with the hemoglobin synthesis process and affect body functions. Exposure to lead can come from various sources, such as drinking water, paint, and the surrounding environment. Studies have shown that high levels of lead in hair may be associated with an increased risk of anemia in adolescent girls. Measuring lead levels can potentially indicate the risk of anemia among young women in Gorontalo City.

Body Mass Index (BMI) reflects the proportion between a person's body weight and height. An optimal BMI is crucial for maintaining good health and preventing anemia. Adolescent girls with a low BMI may have inadequate nutritional intake, while those with a high BMI may experience metabolic problems and an unhealthy lifestyle. Therefore, BMI could be a potential determining factor in the prevalence of anemia among adolescent girls.

The social environment of young women in Gorontalo City is a critical aspect that affects the level of anemia. Factors such as access to good nutrition, adequate health services, and social norms that support a healthy lifestyle can influence overall health conditions, including preventing or treating anemia. A supportive social environment provides health education, promotes healthy eating habits, and facilitates access to health services. A less supportive social environment may restrict access to nutritious food, which can affect BMI and increase the risk of lead exposure. Conversely, efforts to improve a supportive social environment can lead to better nutritional status, healthy weight management, and a reduced risk of lead exposure.

5. Conclusion

The presented research results lead to the following conclusions:

- There is an insignificant negative relationship between lead (Pb) levels in hair and anemia in adolescent girls in Gorontalo City. As the level of lead (Pb) in hair increases, the Hb value decreases or the level of anemia in young women in Gorontalo City falls into the severe anemia category.
- There is a positive and significant relationship between body mass index (BMI) and anemia in adolescent girls in Gorontalo City. A higher BMI in young women leads to an increase in Hb value and a decrease in the prevalence of anemia, potentially resulting in mild or no anemia.
- There is a positive and significant relationship between the social environment and anemia in young women in Gorontalo City. A better social environment is associated with higher Hb values, indicating a decrease in anemia among young women in Gorontalo City.
- The study found a significant relationship between anemia in adolescent girls in Gorontalo City and lead (Pb) levels in hair, body mass index (BMI), and social environment (R^2 = 32.60%). Other variables, such as nutritional intake, consumption of iron-containing vitamins, sleep patterns, menstruation, and the presence of disease, which were not examined in this study, may explain the remaining 67.40%.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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