THE RELATIONSHIP BETWEEN DIETARY PATTERNS AND HEMOGLOBIN LEVELS IN ADOLESCENT FEMALES AT SMKS BINA MANDIRI BONE BOLANGO

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ABSTRACT

Adolescent health efforts are aimed not only at adolescents but also at parents and caregivers to support them in raising healthy adolescents. The purpose of this study is to determine the relationship between dietary patterns and hemoglobin levels in female adolescents at SMK Bina Mandiri Bone Bolango. The approach used in this study is quantitative. This study examines the correlation between dietary patterns and hemoglobin levels in adolescent girls. The results of this study indicate that, based on univariate analysis, the majority of respondents have an ideal nutritional status and adequate intake of energy, protein, and fat. However, many respondents still lack sufficient intake of carbohydrates, vitamin A, and vitamin C, indicating an imbalance in the quality of their daily food intake. The results of the bivariate analysis indicate that only carbohydrate and vitamin C intake are significantly associated with hemoglobin levels. The better the intake of these two nutrients, the higher the respondents' hemoglobin levels tend to be. Meanwhile, other variables such as age, BMI/U, energy, protein, fat, and vitamin A did not show a significant relationship with hemoglobin. This finding suggests that specific macronutrients and vitamin C play a more dominant role in supporting hemoglobin levels in adolescents than other nutritional variables.

Keywords: Eating Pattern, Hemoglobin, Adolescent Girls

INTRODUCTION

Anemia is a significant global health problem, particularly among adolescent girls, with prevalence reaching 24.3% overall in 2021 according to *the Global Burden of Disease Study.* (Gardner et al., 2023)In South Asia, this prevalence reaches 52%, while in West-Central Africa, it reaches 57% in women of childbearing age, caused by iron deficiency due to suboptimal diets (Stevens et al., 2022). This condition not only threatens the physical health, cognitive development, and productivity of adolescent girls, but also risks causing long-term reproductive health problems and intergenerational consequences such as stunting (WHO, 2025). Therefore, anemia is an urgent issue and requires serious attention to achieve the target of reducing prevalence by 50% by 2030 in accordance with *the Sustainable Development Goals.* (WHO, 2025).

In Indonesia, the prevalence of anemia among young women aged 15-24 years was recorded at 15.5% according to the 2023 Indonesian Health Survey (SKI) of the Indonesian Ministry of Health, a decrease from 32% in the 2018 Riskesdas. However, this group is still considered vulnerable with a figure of 18% compared to young men who are only 14.4% (Kemenkes RI., 2025).

National data from 2021 showed a 32% prevalence among adolescent girls, caused by a diet low in iron and low consumption of iron tablets, making it a major challenge in prevention efforts (BKPK, 2023). Addressing this issue is increasingly urgent because anemia can lead

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to stunting and future health problems in pregnant women. (Widhi Astuti & Rosalinna, 2025)Therefore, the Ministry of Health has implemented a weekly Iron Tablet (TTD) supplementation program and provided nutritional education through the Anemia Prevention Guidelines (Kemenkes RI, 2021).

Adolescence is the initial period of intergenerational contribution to quality. Adolescents with nutritional problems such as anemia and chronic energy deficiency (CED) who do not receive adequate nutrition and healthcare are at risk of developing anemia (Oktavia et al., 2024).

At the Gorontalo Province level, the Health Office recorded the prevalence of anemia among adolescent girls at 21.26% in 2023, with 213 cases identified in 2021 and iron supplementation rates below 90% in several districts (Dinkes Gorontalo, 2023). This situation demonstrates the existence of inequalities in access to health services and nutrition education, which further exacerbates local risks, making anemia a top priority (Dinkes Gorontalo, 2023). Bone Bolango Regency, which has a high prevalence rate, requires intensive intervention to reduce the prevalence rate and improve the quality of life of adolescent girls. (Puspita et al., 2024).

Data from the Bone Bolango Health Office in 2018 recorded 67 cases of anemia among high school girls out of a total of 128 cases, this figure is the highest when compared to Boalemo (54 cases) and Pohuwato (7 cases), with Kabila District experiencing the worst impact due to unhealthy eating patterns (Rati Astuti, 2023). This confirms that poor diet is a very important issue, which is supported by the Kabila Health Center survey in West Poowo Village (138 at-risk cases, P=0.00) and West Dutohe Village (undernutrition status) (Salim, 2021; Waluyo & Cahyani Daud, 2022). Other factors such as menstruation and inadequate diet also worsen this situation. (Ibrahim et al., 2023).

Sub-districts like Kabila, Suwawa, and Tapa experienced iron tablet coverage of only 82% in 2023 (below the 90% target), indicating gaps in access and awareness that need to be addressed urgently through comprehensive campaigns (Dinkes Gorontalo, 2023). This gap adds urgency to focused and collaborative interventions at the local level to prevent long-term impacts.

The Bone Bolango Health Office recommends that adolescent Posyandu (Integrated Health Post) regularly administer TTD, conduct hemoglobin screening, and provide local PMT such as mustard greens/kangkung ice cream and moringa pudding for adolescent girls to reduce anemia. Cross-sector collaboration with PKK and UKS cadres through monthly measurements ensures sustainability and addresses nutritional challenges in Bone Bolango. (Dinkes Bone Bolango, 2024).

SMK Bina Mandiri Gorontalo is an educational institution that is predominantly comprised of female students. The total number of students in grades 10-11 is 100 students from three diverse majors: Nursing and Caregiving Support Services (LPKC), Clinical and Community Pharmacy Support Services (LPFKK), and Ecotourism. Considering that most adolescents consume fruits and vegetables with low frequency. Therefore, it is necessary to conduct research on the "Relationship between Fruit and Vegetable Patterns Eating with hemoglobin levels in female adolescents at SMK Bina Mandiri Gorontalo.

METHOD

The approach used in this study was a quantitative approach . To examine the relationship between dietary patterns and hemoglobin levels in female adolescents at SMK Bina Mandiri Gorontalo. The type of research used was an *analytical*

observational study with a cross-sectional research design .

The population in this study was all 10th and 11th grade students at SMK Bina Mandiri Gorontalo, totaling 100 students. The sample used was 50.

The data collection technique used in this study is *Food Recall,* Questionnaire and Laboratory Examination.

The data analysis technique in this study consisted of univariate analysis with descriptive tests to examine the correlation between dietary patterns and hemoglobin levels in female adolescents at SMK Bina Mandiri Gorontalo. *Bivariate analysis* with the Pearson Correlation test (p= <0.05), which was used to measure the strength and direction of the relationship between two variables.

RESULTS AND DISCUSSION

1. Univariate Analysis

a. Age

Table 4.1. Frequency Distribution of Respondents by Age

No	Age	Frequency (*n*)	Percentage (%)
1	15 years	16	32.0
2	16 years	24	48.0
3	17 years	9	18.0
4	18 years	1	2.0
Total		**50**	**100.0**

Source: *Primary Data 2025*

Based on the table above, it can be seen that the respondents are predominantly 16-year-olds (48%), followed by 15-year-olds (32%). Only a small number of respondents are 17-year-olds (18%), and only 2 are 18-year-olds. This indicates that the majority of respondents are in their mid-adolescence.

b. BMI/U

Table 4.2. Frequency Distribution of Respondents Based on BMI/Age

No	BMI/U	Frequency (*n*)	Percentage (%)
1	Thin	19	38.0
2	Normal	25	50.0
3	Fat	6	12.0
Total		**50**	**100.0**

Source: *Primary Data 2025*

The table above shows that the majority of respondents had a Body Mass Index (BMI) within the ideal range, reaching 50%. Meanwhile, 38% of respondents were in the low-weight category, and 12% were obese. This indicates that half of the respondents had good nutritional status, but a significant proportion still suffered from malnutrition.

c. Eating Patterns of Teenage Girls

Table 4.3. Eating Patterns of Adolescent Girls

Dietary habit	Carbohydrate	Protein	Fat	Vitamin A	Vitamin C
	%	%	%	%	%
Good	0	136	156.5	0	0
Enough	73.3	0	0	63.8	0
Not enough	0	0	0	0	32.3

Source: *Primary Data 2025*

Based on the table above, dietary patterns show that protein intake is in the good category with a percentage of 136% (>75%) of the total protein intake of all respondents, namely 50 adolescent girls. Fat intake is also in the good category with a percentage of 156.5% (>75%) of the total fat intake of the same respondents. Meanwhile, carbohydrate intake shows a sufficient category (55–75%) with a percentage of 73.3%, followed by Vitamin A intake which

also has a percentage of 63.8% (55–75%). However, for Vitamin C intake, the adolescent girls' diet shows a category of insufficient (<55%) with a percentage of 32.3%. This indicates that although some nutritional intakes have met the standards for a healthy diet, there are still nutritional aspects that require more attention related to the quality of the daily diet of adolescent girls.

d. Hemoglobin

Table 4.4. Frequency Distribution of Respondents Based on Hemoglobin

HB Status	Frequency (n)	Percentage (%)
Normal (≥12 G/DL)	24	48.0
Anemia (<12 G/DL)	26	52.0
Total	**50**	**100.0**

Source: *Primary Data 2025*

The respondents' hemoglobin levels showed a nearly balanced range between normal and anemic. Fifty-two percent of respondents were in the normal range, while 48% were anemic. This difference of only four percentage points indicates that anemia is a significant problem in this group. This figure indicates that nearly half of the respondents are at risk of health consequences due to low hemoglobin levels.

e. Carbohydrate Intake

Table 4.6. Frequency Distribution of Respondents Based on Carbohydrates

No	Carbohydrate	Frequency (*n*)	Percentage (%)
1	Not enough	2	4.0
2	Enough	25	50 ,0
3	Good	23	46 ,0
Total		**50**	**100.0**

Source: *Primary Data 2025*

Based on the analysis results shown in the table above, it was identified that the majority, namely 25 respondents with a percentage of 50 %, had carbohydrate intake that was classified as sufficient , while there were 23 respondents (46 %) in the good category , and only 2 respondents with a percentage of 4 % were included in the insufficient category. This phenomenon indicates that many respondents have achieved optimal carbohydrate intake.

f. Protein Intake

Table 4.6. Frequency Distribution of Respondents Based on Protein

No	Protein	Frequency (*n*)	Percentage (%)
1	Good	50	100 ,0
2	Enough	0	0.0
3	Not enough	0	0.0
Total		**50**	**100.0**

Source: *Primary Data 2025*

Based on the analysis results shown in the table above, all 50 respondents , with a percentage of 100%, had protein intakes that fell into the Good category . This indicates a good and even protein consumption pattern.

g. Fat Intake

Table 4.7. Frequency Distribution of Respondents Based on Fat

No	Fat	Frequency (*n*)	Percentage (%)
1	Not enough	0	0.0
2	Enough	0	0 ,0
3	Good	50	100 ,0
Total		**50**	**100.0**

Source: *Primary Data 2025*

Based on the analysis results shown in the table above, it also shows 50 respondents with a percentage 100% of the

participants had a fat intake in the Good category . This phenomenon also indicates that fat consumption was consistently sufficient.

h. Vitamin A Intake

Table 4.8. Frequency Distribution of Respondents Based on Vitamin A

No	Vitamin A	Frequency (*n*)	Percentage (%)
1	Not enough	26	52.0
2	Enough	1 2	24 ,0
3	Good	12	24 ,0
Total		**50**	**100.0**

Source: *Primary Data 2025*

Based on the analysis results shown in the table above, the majority of respondents are included in the less category, as many as 26 respondents (52 %). Meanwhile, 24 respondents with a percentage of 48 % were in the good and sufficient categories with equal frequency . This phenomenon indicates a significant problem in meeting vitamin A requirements.

i. Vitamin C Intake

Table 4.9. Frequency Distribution of Respondents Based on Vitamin C

No	Vitamin C	Frequency (*n*)	Percentage (%)
1	Not enough	4 0	8 0.0
2	Enough	5	1 0 ,0
3	Good	5	10 ,0
Total		**50**	**100.0**

Source: *Primary Data 2025*

Based on the analysis results shown in the table above, respondents were also dominated by the less category, with 40 respondents representing 80 %. Meanwhile, there were only 10 respondents representing 20 % were in the good and sufficient categories with equal frequency . Vitamin C deficiency was very apparent in this group.

2. *Nutrisurvey Food Records* Analysis

Table 4.1 0. Nutrisurvey Results of Nutrient Intake in Adolescent Girls

No	Nutrients	Average (grams)	AKG (grams)	Percentage (%)	Category
1	Carbohydrate	218.0	300	72.7	Moderate Deficit
2	Protein	88.4	65	136.0	More
3	Fat	109.5	70	156.5	More
4	Vitamin A	383.0	600	63.8	Heavy Deficit
5	Vitamin C	27.8	65	42.8	Heavy Deficit

Source: *Primary Data 2025 (Nutrisurvey)*

Based on the analysis conducted through the NutriSurvey presented in the table above, it can be seen that of the 50 adolescent girls who responded, their carbohydrate intake only reached 218.0 grams. Compared to the recommended intake of 300 grams, this means that the adolescent girls' carbohydrate intake is in the moderate deficit category, only meeting approximately 72.7% of the recommended intake. This could be a sign that their bodies may be lacking a primary energy source. When we look at vitamin A intake, the recorded figure is 383.0 IU, while the ideal requirement is 600 IU. Therefore, vitamin A intake is in the severe deficit category, reaching only approximately 63.8% of the recommended intake. For vitamin C, the situation is similar; the adolescent girls' vitamin C intake is only 27.8 mg, compared to the recommended 65 mg. This indicates that their fruit and vegetable consumption is still low, categorized as a severe deficit, meeting only 42.8% of the recommended intake. However, the adolescent girls' protein intake is quite good, reaching 88.4 grams. Compared to the recommended daily requirement of 65 grams, this means they've

met 136.0% of the recommended daily intake, exceeding the recommended daily intake. So, while there are some deficiencies in carbohydrate and vitamin intake, they appear to be getting a good amount of protein.

3. Bivariate Analysis

a. The Relationship Between Diet and Hemoglobin

Table 4.11. Relationship between Diet and Hemoglobin

Dietary habit	Hb levels				Total		*P-Value*
	Low		Normal				
	N	%	*N*	%	*n*	%	
Good	1	2.0	26	52.0	27	54.0	0.001
Enough	5	10.0	0	0.0	5	10.0	
Not enough	18	36.0	0	0.0	18	36.0	
Total	**24**	**48.0**	**26**	**52.0**	**50**	**100**	

Source: *Primary Data 2025*

Based on the table above, it can be seen that in a good diet there are 27 respondents (54%) with hemoglobin levels, where 26 respondents (52.0%) have normal hemoglobin levels, while only 1 respondent (2.0%) has low hemoglobin levels. In a sufficient diet, there are 18 respondents (36.0%) who have low hemoglobin levels, and 5 respondents (10.0%) have low hemoglobin levels for a sufficient diet. On the other hand, it can be seen that the p-value of 0.001 is smaller than the calculated r-value of 0.05. This indicates a significant relationship between diet and hemoglobin levels.

Discussion of Research Results

1. Univariate Analysis

a. Age

Based on the analysis results, it shows that the majority of respondents are in the age range of 15 to 16 years, with the highest percentage at the age of 16 years, namely 24 respondents or 48%, followed by respondents aged 15 years as much as 32%. Meanwhile, for the age range of 17 to 18 years, the percentage is higher at the age of 17 years with 18% and followed by one respondent aged 18 years or 2%. This narrow age range indicates that the condition of anemia in this study mainly reflects the situation of middle adolescence. This finding is in line with research conducted by Athala (2025), which shows that high school-aged adolescents are a group at high risk of anemia due to increased physiological needs during growth. (Athala, 2025).

b. BMI/U

The results of the nutritional status analysis showed that 38% of respondents were underweight, 50% were normal weight, and 12% were obese. These findings indicate a double nutritional burden, with adolescents predominantly underweight. However, the relationship between Body Mass Index (BMI) and anemia is often inconsistent across publications. Acharya (2024) found a relationship between low BMI and anemia (Acharya, 2024), while Arsy (2024) reported an insignificant relationship. This suggests that nutritional status is not the only factor influencing hemoglobin levels (Arsy, 2024).

c. Dietary habit

Based on the results of the dietary pattern analysis, 54% of respondents

indicated a good diet, while 10% were in the adequate category. However, 36% of respondents still had an inadequate diet. This inadequate diet reflects low dietary diversity, which can negatively impact essential micronutrient intake. Research by Li et al. (2025) revealed that low dietary diversity significantly increases the risk of anemia in children and adolescents (Li et al., 2025).

d. Hemoglobin

Based on the analysis, hemoglobin status showed that 26 respondents were in the normal category (52%), while 24 respondents, equivalent to 48%, were anemic. This figure is quite significant and requires serious attention. Skolmowska (2022) emphasized that anemia in adolescents is generally caused by a combination of iron deficiency, poor diet, and physiological conditions such as menstruation in adolescent girls.

e. Carbohydrate Intake

Based on the analysis of carbohydrate intake, it was found that nearly half of the respondents, 24 people (48%), had insufficient carbohydrate intake. Furthermore, 19 respondents (38%) were in the adequate category, while only 7 people (14%) were in the good category. This low carbohydrate intake may reflect an imbalance in overall dietary patterns. Widhawati (2024) explains that an unbalanced diet low in complex carbohydrates is often associated with poor diet quality, which can ultimately affect hemoglobin status (Widhawati, 2024).

f. Protein Intake

Based on the results of the protein intake analysis, it was found that all 50 respondents (100%) reported that their protein intake was adequate. However, this does not necessarily indicate the effectiveness of protein on hemoglobin status, as protein quality (animal vs. plant) plays a different role. Sari et al. (2022) and Maemonah (2025) found that the relationship between protein and hemoglobin depends on the quality of intake and the presence of other micronutrient deficiencies (Sari et al. 2022; Maemonah, 2025).

g. Fat Intake

The analysis of fat intake showed that the majority of respondents, 98%, had sufficient fat intake, while only one respondent with a 2% intake was in the moderate category. This phenomenon suggests that fat plays a role in the absorption of fat-soluble vitamins, such as vitamin A, which can affect iron metabolism. Tang (2025) stated that, however, evidence regarding a direct relationship between fat intake and hemoglobin is still limited (Tang, 2025).

h. Vitamin A Intake

Analysis of vitamin A intake showed that 76% of respondents were in the insufficient category, 6% were in the adequate category, and only 18% were in the sufficient category. This phenomenon is crucial because vitamin A plays a role in mobilizing iron from the body's reserves. Rai (2022) and Tang (2025) noted that vitamin A deficiency can worsen anemia even when iron intake is adequate (Rai 2022; Tang 2025).

i. Vitamin C Intake

Based on the analysis of vitamin C intake, it was found that the majority of respondents, 45 people (90%), had insufficient vitamin C intake, while 1 respondent (2%) was in the moderate category, and only 4 respondents (8%) were in the sufficient category. Vitamin C plays a very important role because it can increase the absorption of non-heme iron from plant sources. Research by Skolmowska (2022) shows that vitamin C supplementation can significantly increase iron absorption (Skolmowska, 2022).

2. *Nutrisurvey Food Records* Analysis

The analysis results show that the respondents' consumption patterns are not balanced when compared to the Recommended Nutritional Intake (RDA). Carbohydrate intake was recorded at 218 grams, which only meets 72.7% of the 300 gram RDA, indicating that the main energy needs have not been met and are in the moderate deficit category. This deficiency can cause the body to feel tired more quickly or have difficulty maintaining daily activities. Musfira & Hadju, (2024) showed variations in carbohydrate intake in various regions as well as a tendency to skip breakfast (Musfira & Hadju, 2024). In addition, two important micronutrients, namely vitamin A and vitamin C, are also far below the standard or in the severe deficit category. Vitamin A only reached 383 IU from 600 IU (63.8%), Research by Kumar et al., (2024) showed a prevalence of low vitamin A intake among certain adolescent groups (Kumar et al., 2024). While vitamin C is even lower, namely 27.8 mg from 65 mg (42.8%). This low figure reflects a lack of fruit and vegetable consumption, which in the long term can impact immunity, skin health, and vision function. Research by Firtipancari et al., (2023) found a link between vitamin C intake and the incidence of anemia in adolescent girls (Fitripancari et al., 2023).

In contrast, protein and fat intake far exceeded the recommended intake and were in the higher category. Protein reached 88.4 grams, equivalent to 136% of the 65-gram RDI. Pries et al. (2025) showed that seemingly adequate protein figures sometimes still harbor micronutrient-related problems (Pries et al., 2025). Meanwhile, fat reached 109.5 grams, which is 156.5% of the 70-gram RDI. This phenomenon was reported by Musfira & Hadju (2024), who showed an increase in the consumption of ultra-processed foods (Musfira & Hadju, 2024). This excess is generally related to the dominant consumption of animal foods, fried foods, or processed foods high in fat. If this pattern continues, the body is at risk of excess calories, weight gain, and metabolic problems such as high cholesterol. This imbalance indicates that the respondents' diets are not proportional between food groups that provide energy, building blocks, and regulating food.

3. Bivariate Analysis

The results of the study showed a significant relationship between diet and hemoglobin levels. Most respondents who had a good diet showed normal Hb levels, while the group with a poor diet

tended to have low Hb levels, with a p-value of 0.001 confirming the statistical significance of the relationship. This finding is in line with Tang's (2025) research which stated that dietary variety and adequacy of micronutrients, especially iron, folate, vitamin B12, and vitamin C, are very important for maintaining optimal hemoglobin levels (Tang, 2025) . Research by Li et al. (2025) confirmed that low dietary variety increases the risk of anemia in children and adolescents (Li et al., 2025), while Tareke et al. (2024) found that dietary variety is associated with nutritional status including hemoglobin (Tareke et al., 2024). Further findings from Widhawati (2024) also showed that an unbalanced diet in adolescent female students is correlated with anemia (Widhawati, 2024). These findings support the patterns seen in your data and strengthen the biological basis of the relationship between diet and Hb status.

The results of this study, supported by several previous studies, confirm that dietary quality is a crucial factor influencing hemoglobin status. Research by Fitri et al. (2024) showed that nutritional deficiencies in women of childbearing age directly increase the risk of anemia (Fitri et al., 2024), while research by Nurbaeti et al. (2025) emphasized the relationship between micronutrient intake and Hb levels in women (Nurbaeti et al., 2025). Therefore, an inadequate diet is not only associated with low Hb levels but can also exacerbate long-term health risks.

CONCLUSION

Based on the results of research on the relationship between diet and hemoglobin levels in adolescents, it can be concluded that anemia remains a significant problem among the respondents, as seen in 24 participants with low hemoglobin levels. Univariate analysis showed that most respondents had ideal nutritional status and adequate energy, protein, and fat intake. However, many respondents still experienced deficiencies in carbohydrate, vitamin A, and vitamin C intake, indicating an imbalance in the quality of their daily food intake.

This study shows that dietary patterns have a significant relationship with respondents' hemoglobin levels. The group with a good diet predominantly had normal Hb levels, while the group with a poor diet tended to have low Hb levels. A p-value of 0.001 confirms that this relationship did not occur by chance, indicating that dietary quality was proven to be an influential factor in hemoglobin status. Overall, these results emphasize the importance of improving dietary quality as a measure to prevent anemia. Thus, interventions to improve dietary patterns can be recommended as an effective strategy to improve hemoglobin status in the study population.

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