

The Relationship Between Protein, Iron, Folic Acid, Vitamin C Intake and Breakfast Habits with The Incidence of Anemia in Female Students of SMPN 152 Jakarta

Hubungan Asupan Protein, Zat Besi, Asam Folat, Vitamin C, dan Kebiasaan Sarapan dengan Kejadian Anemia pada Siswi SMPN 152 Jakarta

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Abstract: In Indonesia, the prevalence of anemia among adolescent girls remains quite high at 32%. Inadequate nutrient intake can disrupt red blood cell formation, particularly important nutrients such as protein, iron, vitamin C, and folic acid. This study aims to investigate the relationship between the intake of protein, iron, folic acid, vitamin C, and breakfast habits with the incidence of anemia among female adolescents in junior high school. This is a quantitative study with a cross-sectional design, analyzed using Spearman correlation tests, conducted at SMPN 152 Jakarta with a sample size of 50 individuals. Data on protein, iron, folic acid, and vitamin C intake were obtained through 24-hour food recall interviews, breakfast habits were assessed by a questionnaire, and anemia data were collected through blood samples using a digital Hb checker. The analysis results indicate a relationship between protein intake ($p = 0.000$), iron intake ($p = 0.000$), folic acid intake ($p = 0.030$), vitamin C intake ($p = 0.010$) and the incidence of anemia, while no relationship was found between breakfast habits ($p = 0.161$) and anemia incidence. It is concluded that there is a correlation between protein intake, iron intake, folic acid intake, and vitamin C intake with anemia incidence at SMPN 152 Jakarta. The variable most strongly correlated with anemia incidence is iron intake with a value of ($r = 0.640$).

Key word: folic acid, iron, protein intake, vitamin c, hemoglobin status

1. INTRODUCTION

Anemia is a condition where the number of red blood cells decreases, disrupting the body's metabolic activities related to hemoglobin (Hb) levels (1). According to the World Health Organization (WHO), the global prevalence of anemia among women of reproductive age (15-49 years) reaches 29.9% (2). In Southeast Asia, the prevalence of anemia among adolescent girls ranges from 25-40% (3). In Indonesia, the Ministry of Health (2018) reported that the prevalence of anemia among adolescent girls is 32%, meaning that 3-4 out of 10 adolescents suffer from anemia. Meanwhile, in DKI Jakarta, the prevalence of anemia among adolescent girls is recorded at 23% (4). Although this figure is lower than the national average, a prevalence above 20% is still categorized as a moderate public health problem (2).

Adolescent girls are at higher risk of anemia due to monthly menstrual cycles, which result in significant iron loss. Additionally, nutritional needs increase during adolescence as part of the growth phase. Prolonged anemia in adolescence can raise the risk of complications during pregnancy and childbirth, including low birth weight

(LBW), caused by insufficient nutrient intake for both mother and baby (5). During adolescence, busy activities often lead to neglect in choosing healthy food. Nutritional deficiencies, especially in protein, iron, vitamin C, and folic acid, can impair the formation of red blood cells (5).

Nutritional intake, particularly protein and iron, plays a crucial role in the process of erythropoiesis (1). Protein is essential for the absorption and transport of iron in the body, and a lack of protein can hinder iron transport, resulting in iron deficiency (6). Adolescents with adequate protein intake are less likely to develop iron deficiency anemia (7). Iron deficiency itself reduces red blood cell production (8). One primary cause is dietary patterns. Iron in food is available as heme (animal-based) and non-heme (plant-based) (9). Adolescent girls with insufficient iron intake are 7.1 times more likely to develop anemia (10).

Anemia is not only caused by a lack of iron intake but also by low iron absorption levels in the body. Vitamin C is one nutrient that aids in iron absorption in the intestines and its transfer into the bloodstream (10, 11). Studies show that about 61.1% of adolescent girls have inadequate vitamin C intake (6). Furthermore, folic acid deficiency can also hinder red blood cell formation. Folic acid is necessary for producing red and white blood cells in the bone marrow and is sourced from leafy green vegetables and liver. However, the body does not store large amounts of folic acid, so daily intake is essential to meet its needs (12).

Data shows that 41-58% of children and adolescents skip breakfast. Skipping breakfast can reduce nutrient intake by 22-28% (13). This directly affects nutrient adequacy and hinders hemoglobin production. Considering that anemia remains prevalent and preventable by reducing risk factors to support future growth and development, and given the lack of similar studies conducted at SMPN 152 Jakarta, the researcher is interested in examining the relationship between protein, iron, folic acid, and vitamin C intake, along with breakfast habits, on Hb levels among female students at SMPN 152 Jakarta.

2. METHODS

This research is a quantitative study with a cross-sectional design, involving a sample of 50 respondents selected using purposive sampling among female students at SMPN 152 Jakarta. The study has passed ethical review by the Health Research Ethics Committee of Universitas Muhammadiyah Prof. DR. Hamka (KEPKK-UHAMKA) No. 03/24.02/03117.

Data on breakfast habits were collected using a validated and reliable questionnaire, represented by scores. Breakfast habits were categorized as "appropriate" or "inappropriate" based on scores meeting several components, including frequency of breakfast, proper timing, and adherence to recommended balanced nutrition guidelines. Data on protein, iron, folic acid, and vitamin C intake were collected through two non-consecutive 24-hour recall interviews using a 24-hour recall questionnaire. The average intake over the two days was analyzed using Nutrisurvey software.

Hemoglobin (Hb) levels were measured by obtaining peripheral blood samples from the fingertips using a digital Hb meter, with blood collection performed by a nurse. Anemia status was categorized as Hb levels below 12 g/dL. Univariate analysis was conducted descriptively, using data normality tests to determine the distribution and

frequency of data and to select the appropriate tests for subsequent bivariate analysis. Spearman rank correlation was used for bivariate analysis to examine the relationships between breakfast habits, protein intake, iron intake, folic acid intake, and vitamin C intake.

3. RESULTS

The study revealed that 40% of female students at SMP Negeri 152 Jakarta experience anemia. While 52% of them have sufficient protein intake, 88% still suffer from inadequate iron intake. Furthermore, nearly all students have folate intake that does not meet their nutritional needs, and more than 80% lack adequate vitamin C intake. The majority of students (90%) also exhibit inappropriate breakfast habits, such as rarely eating breakfast during the week, eating breakfast at an improper time, or consuming meals that do not align with recommended guidelines. Alarming, 30% of them never eat breakfast before going to school. Below is a summary of the data described in the study.

Table 1. Data Distribution and Frequency of Research Variables

Variabel	n (%)	Median (Min – Max)
Status anemia (g/dl)		
Anemia	20 (40)	12,3 (9,5 – 17,1)
Non Anemia	30 (60)	
Intake of Protein (g)		
Sufficient	26 (52)	58,5 (42,1 – 83,3)
Less	24 (48)	
Intake of Zat Besi (mg)		
Sufficient	6 (12)	8,5 (5,5 – 13)
Less	44 (88)	
Intake of Asam Folat (µg)		
Less	50 (100)	139,9 (81,9 – 286,4)
Intake of Vitamin C (mg)		
Sufficient	9 (18)	26,7 (2,5 – 74,5)
Less	41 (82)	
Breakfast Habit (score)		
Appropriate	5 (10)	5 (0 – 9)
Not Appropriate	45 (90)	

The results of the bivariate test in Table 2 show that there is a statistically significant positive correlation between protein, iron, folic acid, and vitamin C intake with hemoglobin (Hb) levels ($p < 0.05$). However, breakfast habits did not show a significant relationship ($p > 0.05$). Among these factors, iron intake had the strongest relationship with Hb levels ($r = 0.640$), followed by protein intake with a fairly strong relationship ($r = 0.485$). Meanwhile, folic acid intake ($r = 0.307$) and vitamin C ($r = 0.362$) showed a weaker relationship. This means that every increase in intake of protein, iron, folic acid, or vitamin C is always followed by an increase in Hb levels.

Table 2. Correlation Test Results of Protein, Iron, Folic Acid, Vitamin C Intake and Breakfast Habits with Hemoglobin (Hb) Levels

Variabel	p-value	r
Intake of Protein	0,000	0,485
Intake of Zat Besi	0,000	0,640
Intake of Asam Folat	0,030	0,307
Intake of Vitamin C	0,010	0,362
Breakfast Habit	0,161	0,201

4. DISCUSSION

Anemia is a condition where the number of red blood cells decreases, or hemoglobin levels fall below normal. Findings from this study reveal that 40% of adolescents suffer from anemia, a figure higher than the national prevalence. Adolescence is a transitional phase from childhood to adulthood, where individuals are prone to various health and nutritional issues. For adolescent girls, this phase is marked by rapid growth in preparation for entering their productive years (11). They often adopt less healthy eating habits, such as skipping breakfast or frequently consuming fast food, which can lead to insufficient dietary diversity needed by the body (14). Previous studies have also shown that less diverse diets are associated with hemoglobin levels (15) and nutritional status (16).

Protein is one of the essential nutrients for the body, functioning as a building and regulatory substance. It also plays a crucial role in iron transport (7). The Spearman correlation test in this study revealed a positive relationship, indicating that lower protein intake correlates with lower hemoglobin levels. Adolescent girls with inadequate protein intake are at greater risk of anemia (17). Wandansari (5) reported that higher protein intake increases hemoglobin levels, reducing anemia prevalence. This study aligns with findings by Anwar & Anggita (2024), who found a moderate correlation ($r = 0.443$, $p < 0.001$) between protein intake and anemia status among female students.

Iron deficiency is another significant factor contributing to anemia. Iron is a key element in hemoglobin formation. This study found a strong correlation ($r = 0.640$) between iron intake and anemia, consistent with Hardiansyah et al. (8), who also examined the relationship between iron intake and anemia in adolescent girls. Insufficient iron intake can impair oxygen transport, leading to reduced energy production and, consequently, decreased productivity among adolescent girls (19).

Folic acid is essential for red blood cell formation and amino acid metabolism. This nutrient is crucial for producing red and white blood cells in the bone marrow, though it is not stored in large amounts by the body (20). The study found a moderate correlation ($r = 0.307$) between folic acid intake and anemia, indicating that higher folic acid intake corresponds with higher hemoglobin levels. Observations revealed that adolescent girls rarely consume folate-rich foods such as chicken or beef liver and leafy green vegetables. This study aligns with research by Sunarto & Yuliana (21) and Rizal et al. (22), who found a strong correlation between folic acid intake and hemoglobin levels in adolescent girls. Folic acid, the synthetic form of folate, is converted into tetrahydrofolate (THF), which participates in methylation reactions critical for synthesizing nitrogen bases in DNA and RNA and for red blood cell maturation (23).

Vitamin C acts as a facilitator, enhancing the absorption of non-heme iron up to fourfold. It also reduces ferric iron (Fe^{3+}) to ferrous iron (Fe^{2+}), making non-heme iron more readily absorbed by the body (11). The study revealed a moderate correlation between vitamin C intake and anemia, consistent with findings by Sholicha & Muniroh (17), who observed a moderate relationship between vitamin C intake and hemoglobin levels. Low vitamin C intake among respondents may result from infrequent consumption of vitamin C-rich foods such as vegetables and fruits. Anwar & Anggita (11) similarly found a significant relationship between vitamin C intake and anemia prevalence.

Breakfast is a critical meal, defined as eating and drinking activities from waking until 9:00 a.m., providing 15-30% of the Recommended Daily Intake (RDI) to support a healthy, active, and productive life (13). The Spearman correlation test in this study found no significant relationship between breakfast habits and anemia. Field observations revealed that many students ate breakfast after 9:00 a.m. or skipped breakfast due to fears of being late for school, replacing it with snacks or canteen meals that did not meet their nutritional needs. This finding aligns with Wandansari (5), who also reported no significant relationship between breakfast habits and anemia. However, overall dietary intake did not meet daily needs, and breakfast, as part of overall meal times, could not fulfill the necessary requirements. While not directly correlated, breakfast habits are associated with overall nutrient adequacy, including protein, iron, folic acid, and vitamin C, which are essential for hemoglobin production.

5. CONCLUSION

This study reveals a concerning prevalence of anemia among adolescent girls at SMP Negeri 152 Jakarta, with 40% of respondents affected, exceeding the national average. The findings underscore significant dietary deficiencies, with 88% of respondents lacking adequate iron intake and most also deficient in folic acid and vitamin C. These nutrients play critical roles in hemoglobin production and red blood cell formation, as supported by the study's positive correlations between nutrient intake and hemoglobin levels. Among these, iron showed the strongest correlation, highlighting its essential role in preventing anemia. Although breakfast habits did not show a direct correlation with anemia, irregular practices, such as skipping breakfast or consuming inadequate meals, indirectly contributed to overall nutrient deficiencies. To address anemia among adolescents, a multi-faceted strategy is needed. This includes promoting dietary diversity, encouraging the consumption of nutrient-rich foods, and fostering consistent healthy eating habits, particularly regular and balanced breakfasts. Nutrition education programs targeting adolescents, parents, and schools could help bridge knowledge gaps and encourage behavioral changes. Additionally, integrating school-based nutrition interventions with policy support can further address the underlying causes of anemia, ensuring improved growth, development, and productivity in this vulnerable population.

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