

THE RELATIONSHIP BETWEEN NUTRITIONAL INTAKE AND BEHAVIORAL FACTORS ON THE INCIDENCE OF ANEMIA IN FEMALE ADOLESCENTS IN SENIOR HIGH SCHOOLS IN JAMBI CITY

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Abstract

Adolescents are one of the high-risk groups for anemia. Adolescent girls who experience anemia and chronic energy deficiency are at risk of becoming stunted mothers. This study aims to identify the prevalence and determinants of adolescent girls that increase the risk of anemia in Jambi City. This study is an analytical study using a cross-sectional research design. The study was conducted from July to November 2024. The population in this study were all female high school students in Jambi City in 2023, namely 6878 students. The minimum sample in this study was 201 female adolescents, who were divided into 6 public secondary schools that were randomized in clusters, grade XI female students, did not experience chronic/acute diseases related to bleeding. The variable of hemoglobin levels was measured by direct examination, the consumption variable was interviewed using a semi-FFQ questionnaire. Knowledge and attitude variables about anemia were also collected using a validated questionnaire. Univariate and bivariate tests and to measure the magnitude of risk using the SPSS data analysis program application. The results of this study are the prevalence of anemia in adolescent girls, namely 131 adolescents (64.7%) and the prevalence of chronic energy deficiency of 89 adolescents (44.3%). The conclusion is that the factors that influence the incidence of anemia in adolescent girls in Jambi City are carbohydrate intake (p.value = 0.033), protein intake (p-value = 0.000), iron intake (p.value = 0.000), zinc intake (p.value = 0.021), knowledge about anemia (p.value = 0.000), and attitudes towards anemia. (p.value = 0.000).

Keywords: Anemia, Adolescents, Protein intake, knowledge, attitude.

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INTRODUCTION

Adolescence is a time of rapid growth and maturation in human development, and that additional nutrition is needed to support their accelerated growth. In other words, adolescence is an intense anabolic period when the need for all nutrients increases. During adolescence, 20% of final adult height and 50% of adult weight are achieved and bone mass also increases by 45% (1). Among adolescents, girls are a vulnerable group, especially in developing countries where they are traditionally married at an early age and are exposed to greater risks of reproductive morbidity and mortality. The health and nutritional status of adolescent girls is a reflection of the cumulative effects of physical growth, onset of menarche and increases in fat and muscle mass that require additional nutrition(2). Physical growth of adolescent girls is generally related to food intake which is determined by the availability of food in terms of quantity, quality and the ability to digest, absorb and utilize the food. In addition, girls who are undernourished are at risk of becoming stunted mothers who are more likely to suffer from obstetric complications and give birth to babies with low birth weight. In the absence of

effective nutritional interventions, low birth weight girls become the next generation of stunted mothers, thus perpetuating the vicious cycle of malnutrition (2) (3).

Anemia is a less of hemoglobin levels, erythrocyte, and hematocrit counts so that the number of erythrocytes and / or circulating hemoglobin levels cannot fulfill their function of delivered oxygen to body tissues. Anemia is characterized by hemoglobin levels less than 13.5 g/dl in adult men and less than 11.5 g/dl in adult women (4). ~~(5)~~. Based on WHO findings, globally, the prevalence of anemia in non-pregnant women aged 15-49 years reached 30.5%, while the prevalence of anemia in children was 39.8% (6). Based on to Indonesian Ministry of Health 2023, the prevalence of anemia in Indonesia is 48.9% in pregnant women and 84.6% in pregnant women aged 15-24 years, adolescents are the age with the most anemia

Adolescence is a period of rapid growth and maturation in human development, and adequate nutrition is needed to support their accelerated growth. Poor nutritional status both anthropometrically and clinically (anemia) in adolescence is an important determinant of health. Moreover, adolescents have different needs and have various problems. Chronic energy deficiency in adolescents causes short stature and lean body mass and is associated with deficiencies in muscle strength and work capacity (7). Adolescents are one of the high-risk groups for anemia. After menstruation, adolescent girls are more at risk of anemia than adolescent boys. This is due to rapid growth, hormonal changes, malnutrition, and the risk of increased blood loss during the menstrual period experienced every month. In addition, adolescents, especially students, also have high activity levels which have an impact on irregular eating patterns and adolescent girls are also influenced by a lifestyle that wants to look slimmer so they go on a strict diet without paying attention to the right way to diet. Anemia in adolescent girls has a long and prolonged impact not only on the adolescent girls themselves but also on subsequent pregnancies and also on babies or prospective babies if prevention and treatment are not carried out immediately early. The prevalence of anemia in adolescents in developing countries is 27%, while in developed countries the prevalence is 6% (8).

Indonesia is currently facing a triple burden of nutritional problems, in addition to macro-nutrient deficiencies (stunting, underweight, and wasting), the problem of excess macro-nutrients (obesity and overweight), and also the problem of micro-nutrient deficiencies (vitamin A deficiency, iron deficiency anemia and iodine deficiency disorders), including in adolescents. Based on the results of the 2018 Riskesdas, Jambi Province is one of the provinces with the highest stunting (height for age) in Sumatra for the 5-12 year age group, namely 26.4%. Meanwhile, for the prevalence of overweight and obese children and adolescents (BMI for Age), Jambi Province has the highest percentage in Sumatra, namely 12.2% obese, and 11.4% obese. Stunting in the 13-15 year age group is also the second highest in Jambi Province, namely 34.6% (9). Jambi City has a prevalence of overweight in adolescents aged 16-18 years of 13.6% with the obese category of 9.35% and the obese category of 4.25%. From these results it was found that as many as (32.0%) school children/adolescents (aged 15-24 years) suffer from nutritional anemia (4). Therefore, this study aims to identify the prevalence and predisposing factors including nutrition intake and behavior of adolescent girls that increase the risk of anemia in Jambi City. The determinant factors identified in this study are direct causal factors stated in the 1998 UNICEF theoretical framework, namely macro and micro nutrient intake, as well as predisposing factors (adolescent knowledge and attitudes about

anemia) (10). Based on the background of the problem in this study, the aim of this study is to analyze the intake factors of adolescent girls (energy intake, macronutrients and micronutrients) and behavioral factors (attitudes and knowledge) that influence the incidence of anemia in adolescent girls in Jambi City.

METHODS

This research is an analytical study using a cross-sectional research design. This study was conducted on a population of female adolescents in Jambi City with a sampling unit being a high school which is the environment where most of the female adolescent groups are located. Based on the 2024 report of the Jambi Provincial Health Office, the prevalence of female adolescents in grades IV and X in Jambi City who were indicated as having anemia was 19.96%, which was the second highest after Sarolangun Regency. The population in this study were all female high school students in database of public senior high school Jambi City in 2023, namely 6878 female students. The number of samples was 201 people. The inclusion criteria for the sample were female adolescents aged 15-17 years (grade IX), students who attended public schools, and were willing to be samples in this study. The exclusion criteria in this study were adolescent students who had chronic and chronic diseases. The total number of public high schools in Jambi City is 13 schools and is spread across 8 sub-districts. The sampling technique used the Multistage random sampling technique. The data collected in this study were primary data collected through direct measurements and interviews. Adolescent girls are categorized as anemic if their hemoglobin levels are below or lower than 12 gr/dl (hemoglobin level check using an HB meter), and are said to have Chronic Energy Deficiency (CED) if their upper arm circumference is below 23.5 cm. The data obtained were processed using computer assistance (SPSS and MS. Excel programs). Data analysis using univariate to determine the distribution of proportions for categorical scale variables and mean values and variations for numeric scale data. Bivariate analysis is analyzed using the Chi-square test.

RESULTS

Based on table 1, it is known that the characteristics of female teenagers in State High Schools in Jambi City are predominantly Muslim, namely 189 teenagers (94.0%). The type of work of parents, especially fathers, is mostly self-employed/entrepreneurs as many as 63 people (31.3%), who have parents/fathers working as civil servants as many as 47 people (23.4%) and working as daily laborers as many as 38 people (18.9%). The type of work of parents, namely mothers, is dominated by housewives as many as 133 people (66.2%), then mothers of teenage girls who work as civil servants as many as 31 people (15.9%). The education of parents of teenage girls, especially fathers, is mostly junior high school graduates as many as 95 people (47.30%), and those with the latest education are bachelor's/diploma as many as 59 people (29.4%). While the last education of mothers of teenage girls, namely junior high school graduates, is also the most, 85 people (42.3%), then diploma/bachelor's graduates as many as 58 people (28.9%). The average pocket money for teenage girls at Jambi State Senior High School is less than IDR 50,000, - as many as 151 teenagers (75.1%), only 16 teenagers (8.0%) bring lunch from home, even though teenage girls at the state senior high school level in Jambi city are required to attend full-day school, namely school from 8 am to 4 pm.

Table 1. Distribution of Characteristics of Female Adolescents in Public High Schools in Jambi City, 2024.

| Characteristics of Adolescent Girls | Total (N) | Percentage (%) |
|--|-----------|----------------|
| Religion | | |
| Islam | 189 | 94.0 |
| Cristian | 12 | 6.0 |
| Parents' Occupation (Father) | | |
| Civil Servant | 47 | 23.4 |
| Private employees | 38 | 18.9 |
| Entrepreneur | 63 | 31.3 |
| Farmer | 8 | 4.0 |
| Daily laborer | 38 | 18.9 |
| Unemployment | 7 | 3.5 |
| Parents' Occupation (Mother) | | |
| Civil Servant | 31 | 15.9 |
| Private employees | 15 | 7.5 |
| Entrepreneur | 16 | 8.0 |
| Daily laborer | 5 | 2.5 |
| Housewife | 133 | 66.2 |
| Parents' Educational (Father) | | |
| Never attended school | 24 | 11.9 |
| Graduated from elementary school | 11 | 5.5 |
| Graduated from junior high school | 95 | 47.3 |
| Graduated from high school | 12 | 6.0 |
| Diploma/Bachelor/Master's Graduate | 59 | 29.4 |
| Parents' Educational (Mother) | | |
| Never attended school | 24 | 11.9 |
| Graduated from elementary school | 15 | 7.5 |
| Graduated from junior high school | 85 | 42.3 |
| Graduated from high school | 19 | 9.5 |
| Diploma/Bachelor/Master's Graduate | 58 | 28.9 |
| Average daily pocket money | | |
| Provisions/no snacks | 16 | 8.0 |
| Less than IDR 50.000,- | 151 | 75.1 |
| IDR 50.000 – IDR 100.000 | 33 | 16.4 |
| More than IDR 100.000,- | 1 | 0.5 |
| Diagnosis of diseases previously suffered | | |
| Yes, I have been diagnosed | 8 | 3.8 |
| Never | 201 | 96.2 |
| Total | 201 | 100 |

Source: Processed Primary Data, 2024

Table 2 states that the nutritional status of female adolescents in Jambi City State Senior High Schools with indicators of hemoglobin levels in the blood shows that the prevalence of anemia (blood hemoglobin levels below 12 gr/dl) in female adolescents in Jambi City is high, namely 131 adolescents (64.7%), while nutritional status based on upper arm circumference, the incidence of chronic energy deficiency (CED = Upper arm circumference below 23.5 cm) is also quite high, namely 89 adolescents (44.3%).

Table 2. Distribution of Anemia and Chronic Energy Deficiency Incidents in Female Adolescents of State Senior High Schools in Jambi City, 2024.

| Nutritional status variables of adolescent girls | Total (N) | Percentage (%) |
|--|-----------|----------------|
| Nutritional status based on hemoglobin levels | | |
| Anemia | 130 | 64.70 |
| Normal | 71 | 35.30 |
| Nutritional status based on upper arm circumference | | |
| Chronic energy deficiency | 89 | 44.3 |
| Normal | 112 | 55.7 |

As shown in Table 3, the percentage of female adolescents in Jambi City who were found to be anemic and were having insufficient and sufficient intakes of key nutrients and minerals are as follows: 60.00% and 69.30% on energy, 59.0% and 70.3% on carbohydrates, 74.80% and 30.40% on protein, 61.40% and 68.00% on fat, 76.40% and 35.10% on iron, 51.40% and 70.00% on zinc, 66.00 % and 62.40% on Vitamin C. About 72.60% and 74.70% of female adolescents who were found anemic had low knowledge and negative attitude about anemia, respectively.

Table 3. Cross tabulation of independent variables with the incidence of anemia in female adolescents at Jambi City State High Schools, 2024.

| Variabel independent | Status Anemia | | | | Total | |
|----------------------------------|---------------|-------|--------|-------|-------|--------|
| | Anemia | | Normal | | N | % |
| | n | % | n | % | | |
| Energy Intake | | | | | | |
| Insufficient energy intake | 60 | 60.00 | 40 | 40.00 | 100 | 100.00 |
| Sufficient energy intake | 70 | 69.30 | 31 | 30.70 | 101 | 100.00 |
| Carbohydrate Intake | | | | | | |
| Insufficient carbohydrate intake | 59 | 59.00 | 41 | 41.00 | 100 | 100.00 |
| Sufficient carbohydrate intake | 71 | 70.30 | 30 | 29.70 | 101 | 100.00 |
| Protein Intake | | | | | | |
| Insufficient protein intake | 116 | 74.80 | 39 | 25.20 | 155 | 100.00 |
| Sufficient protein intake | 14 | 30.40 | 32 | 69.60 | 46 | 100.00 |
| Fat Intake | | | | | | |
| Insufficient Fat Intake | 62 | 61.40 | 39 | 38.60 | 101 | 100.00 |
| Sufficient Fat Intake | 68 | 68.00 | 32 | 32.00 | 100 | 100.00 |
| Iron Intake | | | | | | |
| Insufficient Iron Intake | 110 | 76.40 | 34 | 23.60 | 144 | 100.00 |
| Sufficient Iron Intake | 20 | 35.10 | 37 | 64.90 | 57 | 100.00 |
| Zinc Intake | | | | | | |
| Insufficient Zinc Intake | 59 | 58.40 | 42 | 41.60 | 101 | 100.00 |
| Sufficient Zinc Intake | 71 | 71.00 | 29 | 29.00 | 100 | 100.00 |
| Vit.C Intake | | | | | | |
| Insufficient Vit.C Intake | 66 | 66.00 | 34 | 34.00 | 100 | 100.00 |
| Sufficient Vit.C Intake | 63 | 62.40 | 38 | 37.60 | 101 | 100.00 |
| Knowledge about Anemia | | | | | | |
| Lack of Knowledge | 106 | 72.60 | 40 | 27.40 | 146 | 100.00 |
| Good Knowledge | 24 | 43.60 | 31 | 56.40 | 55 | 100.00 |
| Attitude towards Anemia | | | | | | |
| Negative Attitude | 121 | 74.70 | 41 | 25.30 | 162 | 100.00 |

| Variabel independent | Status Anemia | | | | Total | |
|----------------------|---------------|-------|--------|-------|-------|--------|
| | Anemia | | Normal | | N | % |
| | n | % | n | % | | |
| Positive Attitude | 9 | 23.10 | 30 | 76.90 | 39 | 100.00 |

Source: Processed Primary Data, 2024

Based on table 4, it is known that the factors that influence the incidence of anemia in adolescent girls in Jambi City are carbohydrate intake (p.value = 0.033, PR = 0.608, 95% CI = 0.339 - 1.090), protein intake (p-value = 0.000, PR = 6.799, 95% CI = 3.292 - 14.041), iron intake (p.value = 0.000, PR = 5.985, 95% CI = 3.074 - 11.652), zinc intake (p.value = 0.021, PR = 0.574, 95% CI = 0.319 - 1.031), knowledge about anemia (p.value = 0.000, PR = 3.423, 95% CI = 1.230 - 6.525), and attitudes against anemia (p.value = 0.000, PR = 4.837, 95% CI = 2.312 - 11.444).

Tabel 4. The relationship between significance and prevalence ratio of factors influencing the incidence of anemia in female adolescents at Jambi City State High Schools

| Intake, knowledge and attitude factors | P-value | PR | Anemia | |
|--|---------|-------|--------|--------|
| | | | 95% CI | |
| | | | Lower | Upper |
| Energy Intake | 0.168 | 0.664 | 0.371 | 1.189 |
| Carbohydrate Intake | 0.033* | 0.608 | 0.339 | 1.090 |
| Protein Intake | 0.000* | 6.799 | 3.292 | 14.041 |
| Fat Intake | 0.202 | 0.748 | 0.419 | 1.337 |
| Iron Intake | 0.000* | 5.985 | 3.074 | 11.652 |
| Zinc Intake | 0.021* | 0.574 | 0.319 | 1.031 |
| Vit.C Intake | 0.384 | 1.140 | 0.639 | 2.035 |
| Knowledge | 0.000* | 3.423 | 1.230 | 6.525 |
| Attitude | 0.000* | 4.837 | 2.312 | 11.444 |

DISCUSSION

The prevalence of anemia in adolescent girls in Jambi City based on the results of this study is much higher than the national average. Previously, according to Riskesdas data in 2018, the prevalence of anemia in adolescents was 32 percent. This means that 3-4 out of 10 adolescents suffer from anemia or lack of red blood cells. According to WHO, the prevalence of anemia in women in Indonesia is 23.9%, which is divided into the prevalence of anemia in women aged 5-14 years of 26.4% and 15-25 years of 18.4%. 2018 based on gender, namely in men 20.35%, while women 27.2%. For the prevalence of anemia in the age of 5-14 years of 26.8% and 15-24 years of 32.0% (11).

Sugar, especially fructose and sorbitol, is one of the nutrients that can increase iron absorption. Fructose and sorbitol function as ligands so that they can prevent the binding of nonheme iron with inhibitor components and increase its availability. Complex carbohydrate intake has been reported to increase iron bioavailability(12). Consumption of iron supplements together with galactooligosaccharides (GOS) can increase the solubility of ferrous fumarate diffusion. Iron absorption in women who were given ferrous fumarate and GOS supplements was higher than those who were only given iron supplements. Consumption of GOS can reduce serum ferritin so that it can increase iron bioavailability (13).

Anemia due to malnutrition is usually experienced by adolescent girls who are influenced by food availability and eating habits. Adolescents tend to want an ideal body shape while nutritional knowledge is lacking. They deliberately reduce food intake to less than what is needed. Anemia due to nutritional deficiency is characterized by impaired hemoglobin synthesis (14). The nutrients in question are protein, pyridoxine (vitamin B6) which acts as a catalyst in the synthesis of heme in hemoglobin molecules, in addition iron (Fe) is also one of the nutritional components in the formation of hemoglobin. Unlike carbohydrate consumption, a high-fat diet is thought to increase the risk of anemia due to damage to red blood cells. Non-HDL cholesterol can cause hemolysis in red blood cells, while increasing HDL can increase the size and number of red blood cells and platelets (15).

One of the nutrients that has an important role is protein. Protein is useful as a building and regulating substance, in addition protein also regulates human health by providing molecular precursors of amino acids and also functions as a component in body cells, protein also has a role in transporting iron to the spinal cord for the formation of red blood cells (16). Protein intake, especially animal protein, helps increase iron absorption, therefore low protein intake can affect Hb levels to be less, which can lead to anemia. Angraini and Sofwan's research stated that there was a significant relationship between chronic energy deficiency and the incidence of anemia in adolescents ($p= 0.020$), respondents in this study met nutritional intake standards, had sufficient and even high energy or macronutrient intake, foods that are consumed contain more carbohydrates and fats, but, 95.6% of responden had a low iron intake (17). This condition perhaps cause of risk of anemia, especially iron-deficiency anemia Adolescent girls tend to consume a high-calorie diet with fat as an energy source, leading to excess weight (normal weight: 56% energy from carbohydrates and 27.5% energy from fat; overweight/obese: 48% energy from carbohydrates and 34.4% energy from fat). Animal studies have shown that high-energy diets or high-fat and high-fructose diets cause changes in iron metabolism and this is partly due to abnormal hepcidin levels. After administration of radiolabeled ferric citrate to rats, Sonnweber et al. reported that hypoferrremia caused by a high-fat diet was due to reduced intestinal iron absorption. However, rats fed a high-fat and high-fructose diet for 16 weeks developed hepatic iron accumulation indicating dysfunctional hepatic iron release. In animal studies, high-fat diets typically contain 60% of their energy from fat, which is unlikely to occur in humans. In humans, overweight/obese individuals tend to replace carbohydrates with fat and protein as an energy source (18).

Knowledge about anemia is related to the definition of anemia, symptoms of anemia, short-term/long-term impacts of anemia, complications of anemia, iron-rich food content, anemia prevention efforts, and anemia control efforts. Research on adolescent girls in Makassar stated that low knowledge about anemia was also at 62%. Similar findings were found in studies in other regions, namely 53.1% of adolescent girls in Talang Padang (2017) and 44.7% of adolescent girls in Bengkulu (2013) also had poor knowledge about anemia (19). This is likely due to the lack of information in the family environment, considering that the respondents' families have a low socio-economic background with parents working as laborers, farmers, small traders and entrepreneurs, and the highest education is junior high school graduates. Socialization related to anemia is also still lacking in the school environment, as

reported by the school that there has never been a special intervention related to nutrition education that has been carried out in schools in the last 3 years (20).

The definition of attitude is a person's relatively consistent evaluation and feelings towards an object or idea, consisting of aspects of belief and attribute evaluation. According to Philip Kotler, attitude is a person's evaluation, feelings, and tendencies that consistently like or dislike an object or idea. The attitude assessed in this study was the attitude of adolescent girls about statements related to anemia (21). The results of this study are supported by research by Izdihar, et al. in 2022 that adolescent girls who have negative attitudes will be at risk of experiencing anemia by 28%, research by Rantika in 2019 and Nugraheni in 2017 which stated that there was a relationship between negative attitudes and the risk of anemia p -value = 0.034 and p -value = 0.036, because the attitude has entered the stage of respect and responsibility which has an impact on good anemia prevention behavior(22). It is hoped that this research can provide knowledge about anemia and anemia prevention, so that young women can be motivated to change their lifestyle and eating habits as well as increase the awareness of young women about health and the future (23).

The limitation of this study lies in the method of hemoglobin (Hb) examination. Consistent with certain other case-control studies, this research relied on Hb checks without integrating a ferritin assessment. The inclusion of ferritin level testing would actually provide a more accurate result in evaluating iron status and anemia, thereby offering a more comprehensive picture of the hemoglobin status of the study subjects. Consequently, the results obtained must be interpreted with consideration of this methodological limitation.

CONCLUSION AND RECOMMENDATION

Nutritional intake factors that are at risk of increasing the incidence of anemia in female adolescents at Jambi City State High Schools are lack of protein and iron consumption, excessive carbohydrate and zinc consumption. Predisposing factors that influence the incidence of anemia are low knowledge about anemia and negative attitudes/disagreement that anemia can have an impact on adolescent health. It is hoped that the next researchers will add several other factors related to the incidence of anemia. Relevant institutions are expected to pay more attention to the intake of students by moving the part in charge of the dormitory to monitor their schedules, and provide a more diverse menu so that the protein obtained is not only more vegetable protein but balanced with animal protein intake. This study recommends the importance of a program to improve healthy eating patterns for adolescent girls and an interpersonal approach to education to understand knowledge and attitudes about anemia.

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