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RELATIONSHIP BETWEEN ANIMAL PROTEIN DIETARY PATTERNS AND THE INCIDENCE OF ANEMIA IN ADOLESCENT GIRLS

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ABSTRACT

Background: Adolescent girls have a higher risk of developing anemia than adolescent boys because they menstruate every month and often lack adequate nutritional intake. Irregular and unbalanced eating patterns are among the factors contributing to anemia. Protein intake in the community is still dominated by vegetable protein, which has a lower absorption capacity compared to animal protein. Animal protein is important because it provides heme iron, which has higher absorption than non-heme iron from plant sources. It contains complete essential amino acids needed for hemoglobin synthesis. Protein also plays a role in iron transport and metabolism through proteins such as transferrin and ferritin. Adequate animal protein intake helps maintain hemoglobin levels and prevents anemia, especially in adolescent girls who experience regular iron loss during menstruation. The aim of this study was to determine the relationship between animal protein consumption patterns and the incidence of anemia among adolescent girls at Citeureup 1 Senior High School.
Methods: This study used a case–control design. The population consisted of female adolescents from Citeureup 1 Senior High School who met the inclusion criteria. The total sample was 60 respondents (30 in the case group and 30 in the control group). Data were analyzed using the Chi-Square test.
Results: The results showed a significant relationship between animal protein consumption patterns and the incidence of anemia among adolescent girls at Citeureup 1 Senior High School, with a p-value of 0.001 and an Odds Ratio (OR) of 145.
Conclusion: The study concludes that adolescent girls need to maintain regular and balanced eating patterns to prevent anemia. Lower protein intake is associated with lower hemoglobin levels.
Keywords: anemia, consumption patterns, animal protein, adolescent girl

INTRODUCTION

Public health problems that are still prevalent among adolescents include anemia, which occurs not only in developing countries but also in developed countries. In general, anemia can occur in all age groups, with school-age children, adolescents, women of childbearing age (WCA), and pregnant women being at high risk for anemia (Mantadakis et al., 2020). Anemia is a condition in which the number of red blood cells or hemoglobin (Hb) levels in the blood are lower than normal values for a group of people according to age and gender. Normal Hb levels in men and women differ. Hb levels for men with anemia are less than 13.5 g/dl, while Hb levels in women are less than 12 g/dl. Anemia can cause several clinical symptoms. This ultimately causes health problems because a lack of hemoglobin in the blood will disrupt the supply of oxygen to the body. Anemia can cause

Volume 2 No 2, Hal 45-61, Desember 2025
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several clinical symptoms. This ultimately leads to health problems because the lack of hemoglobin in the blood disrupts the supply of oxygen to the body (Nurbadriyah, 2018).

According to the World Health Organization (WHO) in 2017, the incidence of anemia in adolescent girls worldwide is 40-88%. The majority of cases occur in developing countries, with 124 developing countries experiencing cases of anemia in adolescent girls

reaching 53.7% (WHO, 2019). In Indonesia, according to the Ministry of Health in 2018, the prevalence rate of anemia in adolescents aged 15-24 years was 32%, which means that an estimated 3-4 adolescents out of every 10 adolescents suffer from anemia. However, they are the future generation of the nation who will determine the next generation. Director of Nutrition International Rozy Afrial Jafar stated that the 2018 Nutrition International survey found 41.93% of adolescent girls in West Java province suffered from anemia. Bogor Regency showed a prevalence of anemia among adolescents aged > 15 years of 35.6%. (Riskesdas, 2020) The proportion of anemia among females (27.2%) is higher compared to males (20.3%) (Balitbangkes, 2018). Regardless, adolescent girls are one of the populations most vulnerable to anemia. Based on this data, it is evident that anemia is a common nutritional issue among adolescents.

According to the WHO in 2018, adolescents are people aged between 10 and 19 years old, while according to Indonesian Minister of Health Regulation No. 25 of 2014, adolescents are people aged between 10 and 18 years old (WHO, 2022). These differences in definition show that there is no universal agreement on the age range for adolescents. However, adolescence is associated with the transition from childhood to adulthood. Adolescence is a phase that is vulnerable to health risks because during this phase, the body undergoes rapid development, requiring adequate nutrition. According to the 2023 Health Science Journal, adolescent girls have a higher risk of anemia due to insufficient nutrient intake. Additionally, adolescent girls experience menstruation every month, requiring higher iron intake, while consuming fewer calories than males. Many adolescent girls still have improper eating patterns, resulting in relatively low iron intake

Consumption (Suandana et al., 2023). This aligns with the 2019 study by Muhayati and Ratnawati, which found a correlation between nutritional status and eating patterns with the incidence of anemia in adolescent girls (Muhayati & Ratnawati, 2019).

Another study mentions that there is a relationship between diet and the incidence of anemia. People who experience malabsorption, malnutrition, and an unbalanced diet will develop anemia. Poor food choices and irregular eating habits lead to inadequate food and iron intake, resulting in iron deficiency anemia in adolescents (Syahril & Mansyur, 2022). Anemia can be influenced by several factors, including iron intake, education, age, nutrition, dietary patterns, and economic status. Dietary patterns are the ways in which an individual or group of people choose and consume food in response to physiological, psychological, cultural, and social influences (AR et al., 2024). Irregular and unbalanced dietary patterns are one of the factors contributing to the development of anemia. In adolescent girls, body image perception can be one of the factors that influence eating behavior. Dissatisfaction with one's own body is a cause of disturbed eating behavior in adolescents (Santoso, 2022).

Iron (Fe) is a micronutrient that is essential for the body. Generally, iron from plant-based protein sources (non-heme), such as nuts and vegetables, has low absorption compared to iron from animal-based protein sources (heme) such as meat, eggs, and fish. Animal protein is referred to as complete and high-quality protein because it contains all essential amino acids in a composition that closely matches the body's requirements, as well as high digestibility, resulting in high absorption rates (Anisa Yulianti et al., 2024). In Indonesia, based on the 2014 Individual Food Consumption Survey (SKMI), the average level of protein adequacy in Indonesia has exceeded the recommendation, reaching 105.3

Volume 2 No 2, Hal 45-61, Desember 2025
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percent. However, the protein sufficiency of the Indonesian population is still dominated by plant-based proteins such as legumes and cereals, with an average consumption of 56.7 grams and 257.7 grams per day (Fatmawati et al., 2023). In comparison, animal protein is only 42.8 grams per day, even though animal-based protein has a higher biological value compared to plant-based protein (Faridi et al., 2022). Meanwhile, the recommended nutritional sufficiency for the Indonesian population, especially for protein, is 100 grams per day. grams per day, even though animal-based protein has a higher biological value compared to plant-based protein.(14) Meanwhile, the recommended nutritional adequacy for the Indonesian population, particularly for protein, is 57 grams per capita per day (Supariasa & Hardiansyah, 2016).

Anemia will have short-term and long-term effects. The effects of anemia on adolescent girls and WUS will carry over until she becomes an anemic pregnant woman, which can increase the risk of Fetal Growth Restriction (FGR), preterm birth, low birth weight (LBW), and developmental disorders in children, including stunting and neurocognitive disorders. Bleeding before and during childbirth can threaten the safety of the mother and her baby. Babies born with low iron (Fe) reserves will continue to suffer from anemia in infancy and early childhood and an increased risk of illness and neonatal and infant mortality (Syahril & Mansyur, 2022). One of the government's interventions to reduce the prevalence of anemia in adolescents is iron and folic acid supplementation through the provision of iron tablets. Sources of IFT include health facilities, schools, and self-initiatives. The target of the IFT program at the school level has been developed to reach adolescent girls in junior high school, high school, and equivalent levels, as well as women outside of school as a strategic effort to break the cycle of nutritional problems. The provision of IFT to adolescent girls is included in the government program, namely the Prevention and Control Program Anemia in Adolescent Girls and Women of Reproductive Age, where one of the specific objectives is to increase compliance with blood transfusion table consumption among adolescent girls, thereby reducing the prevalence of anemia among them (Syahril & Mansyur, 2022).

Prevention and control of anemia are carried out by providing sufficient iron intake to the body to increase hemoglobin formation. Efforts that can be made include increasing iron intake through a balanced diet, which consists of a variety of foods, especially animal-based foods that are rich iron (heme iron) in sufficient quantities, fortifying food ingredients with iron, and providing regular iron supplementation over a certain period to quickly increase hemoglobin levels, which should be continued to increase iron stores in the body (Syahril & Mansyur, 2022). Based on the results of a study by Kumalasari et al. in 2022, it was found that respondents who had a good diet had anemia (10%) while respondents who had a poor diet had anemia (40%) of respondents. Dietary patterns among adolescent girls, particularly poor dietary patterns, can cause anemia because anemia is directly influenced by daily food consumption that is low in iron, such as green vegetables (spinach, pumpkin seeds, legumes) (Wahdah et al., 2019). Nutritional issues among adolescents are a serious problem that needs to be addressed. Government programs to address anemia are currently limited to programs for pregnant women, while the Adolescent Health Care Program remains limited in addressing nutritional issues among adolescents and is not yet effective in all Community Health Centers across Indonesia. This issue requires attention from all healthcare workers.

The results of a preliminary study conducted at Citeureup 1 Senior High School showed that four out of five interviewed female adolescents experienced symptoms of anemia, such as weakness, lethargy, fatigue, and pallor. Conjunctival examination also revealed pale conjunctiva in most respondents, accompanied by irregular eating patterns. Although previous studies have reported that anemia in adolescent girls is associated with

Volume 2 No 2, Hal 45-61, Desember 2025
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dietary patterns and overall nutritional intake, most research has focused on iron intake or general diet quality without specifically examining the role of animal protein consumption. Animal protein plays a crucial role in hemoglobin synthesis and iron absorption due to its heme iron content and high biological value; however, evidence regarding its direct association with anemia among adolescent girls, particularly in the Indonesian school setting, remains limited. Therefore, this study aims to address this knowledge gap by specifically analyzing the relationship between animal protein consumption patterns and the incidence of anemia among adolescent girls at Citeureup 1 Senior High School. This study is expected to provide new evidence on the importance of animal protein intake in anemia prevention and to support targeted nutritional interventions for adolescent girls.

RESEARCH METHOD

This study used a quantitative approach, namely analytical observational research with a case-control design, because it aims to describe the relationship between animal protein dietary patterns and the incidence of anemia based on quantitative data. The study was conducted at Senior High School 1 Citeureup during the period of April to May 2023. The sampling technique used in this study was probability sampling with the simple random sampling method. The study population consisted of all female adolescents at Senior High School 1 Citeureup. The sample included female adolescents who met the inclusion and exclusion criteria. The sample size was determined using the formula for analytical, unpaired categorical studies, resulting in 30 respondents in the case group and 30 respondents in the control group, with a total of 60 respondents. The inclusion criteria in this study were all female adolescents at Senior High School 1 Citeureup who were willing to participate as respondents. The exclusion criteria included respondents who were taking medications that could affect hemoglobin levels, currently menstruating, experiencing diarrhea, adhering to a vegetarian diet, having certain allergies, or having recently donated blood. Data collection was carried out using two instruments: a hemoglobin examination using the Easy Touch Hemoque digital device to determine anemia status, and a Semi Quantitative–Food Frequency Questionnaire (SQ-FFQ) to assess animal protein dietary patterns. The SQ-FFQ used in this study was an existing standardized questionnaire commonly applied in nutritional research; therefore, no additional validity or reliability testing was performed, as the instrument had already been validated in previous studies. This study obtained ethical approval from the Health Research Ethics Committee of Poltekkes Kemenkes Bandung, with approval number No.69/KEPK/EC/III/2024. Data analysis was performed using the SPSS program. The Chi-square test was used to analyze the relationship between animal protein dietary patterns and the incidence of anemia among female adolescents.

RESULTS

The results of this study are described in the following table:

Table 1. Frequency Distribution of Anemia in Adolescent Girls Based on the Age

No.	Incidence of Anemia	Frequency (f)	Percentage (%)
1.	16 years old	4	6,7
2.	17 years old	38	63,3
3.	18 years old	15	25,0
4.	19 years old	3	5,0
	Total	60	100

Table 1 shows that most respondents were 17 years old, totaling 38 people (63.3%).

Volume 2 No 2, Hal 45-61, Desember 2025
E-ISSN: 3090-577X
https://doi.org/10.34035/jmrh.v2i2.1936

Table 2. Frequency Distribution of Anemia in Adolescent Girls

No.	Incidence of Anemia	Frequency (f)	Percentage (%)
1.	Anemia	30	50
2.	Not Anemic	30	50
	Total	60	100

Table 2 shows that 30 people (50%) had anemia and 30 people (50%) did not have anemia. This indicates that the proportion of respondents with anemia and without anemia was equal.

Table 3. Frequency Distribution of Animal Protein Consumption Patterns

No.	Animal Protein Consumption Patterns	Frequency (f)	Percentage (%)
1.	Less	34	56,7
2.	Good	26	43,3
	Total	60	100

Table 3 shows that most respondents had an inadequate animal protein consumption pattern, namely 34 people (56.7%)

Table 4. Relationship between Animal Protein Consumption Patterns and Anemia Incidence in Adolescent Girls

No.	Animal Protein Consumption Patterns	Frecuency Anemia				Total		*p value*	Odss Ratio 95% CL
		Yes		No					
		f	%	f	%	f	%		
1	Less	29	96,7	5	16,7	34	100	0,001	145,000
2	Good	1	3,3	25	83,3	26	100		(15,864-1.325,302)
	Total	30	100	30	100	60	100		

Based on Table 4, it shows that the group of respondents with anemia mostly consumed less animal protein, namely 96.7%. Meanwhile, the group of respondents without anemia mostly had a good animal protein consumption pattern, namely 83.3%. Based on the results of the Chi-square statistical test, the p-value was 0.001, indicating a relationship between animal protein consumption patterns and the incidence of anemia in adolescent girls. Based on the analysis results, an OR value of (95% CI = 145.000 (15.864-1,325.302) was also obtained, meaning that adolescent girls who have an inadequate animal protein consumption pattern are 145,000 times more at risk of anemia than adolescent girls with a good animal protein consumption pattern.

DISCUSSION

The findings related to animal protein consumption patterns indicate their important role in supporting nutrient absorption and preventing anemia. Anemia is a condition in which a person lacks enough healthy red blood cells to carry oxygen to body tissues. Red blood cells transport oxygen through hemoglobin, and low hemoglobin levels cause anemia with symptoms such as paleness, lethargy/fatigue, shortness of breath, loss of appetite, and growth disorders. The onset of anemia can be caused by an improper, irregular, and unbalanced diet lacking essential nutrients (Wahdah et al., 2019). High-intensity school, organizational, and extracurricular activities can lead to irregular eating patterns that affect

Volume 2 No 2, Hal 45-61, Desember 2025
E-ISSN: 3090-577X
https://doi.org/10.34035/jmrh.v2i2.1936

hemoglobin levels (Putri & Hasanah, 2021). The impact of anemia in adolescents can extend to pregnant women, increasing the risk of premature birth (<37 weeks) or low birth weight (<2500 g). Babies with LBW may grow into stunted children, who may become adolescent girls and later pregnant women with nutritional deficiencies, giving rise to the next generation of stunted individuals with lower IQ, psychological disorders, and increased risk of chronic diseases (Nurbadriyah, 2018). A study by Sholica and Muniroh (2019) at Senior High School Negeri 1 Manyar Gresik found the average hemoglobin level was 11.8±11.6 g/dl, with 59.7% experiencing anemia. Nutrient intake is one factor affecting hemoglobin levels, as adequate intake is essential for hemoglobin formation and red blood cell production (Sholicha & Muniroh, 2019). Handini et al. (2023) at Al-Amanah Al-Gontory Islamic Boarding School, South Tangerang, showed a relationship between protein intake (p=0.000) and anemia. The majority of respondents experienced anemia (27.4%). Anemia can be influenced by dietary intake (iron and protein) and frequent consumption of inhibitors (Wahdah et al., 2019).

The findings related to animal protein consumption patterns indicate their important role in supporting nutrient absorption and preventing anemia. The study shows that most respondents have inadequate animal protein consumption (56.7%). Consumption patterns refer to the types and amounts of food consumed at a specific time (Supariasa & Hardiansyah, 2016). Protein is the body's largest component after water and functions to build and maintain cells. It is obtained from meat, dairy products, fruits, and vegetables, and its quality depends on amino acid composition. High-quality protein contains complete essential amino acids needed for growth and essential body bonds (Alristina et al., 2021). Hemoglobin, which carries oxygen and carbon dioxide, is a protein compound. P.rotein also transports nutrients, including iron, from the digestive tract into the blood and further to tissues. Therefore, protein deficiency can disrupt the absorption and transportation of nutrients. Animal-based foods provide iron that is better absorbed than non-heme iron (Setyawati & Hartini, 2018). Kumalasari et al. (2022) found that among respondents with good dietary patterns, 6 (10%) had anemia, while 24 (40%) with poor dietary patterns experienced anemia. Poor dietary patterns in adolescent girls can lead to anemia because daily consumption is often low in iron-rich foods such as green vegetables and legumes (Wahdah et al., 2019). Wahdah et al. (2019) at Al Mas'udiyah Puteri 2 Blester Islamic Boarding School reported that most respondents had mildly deficient dietary patterns (57.3%), followed by normal (28%), severely deficient (12.2%), and excessive (2.4%). This high deficiency is due to monotonous daily intake lacking energy, building, and regulating nutrients. Because protein plays a key role in transporting nutrients including iron, its deficiency disrupts absorption and transport processes (Wahdah et al., 2019). Aparian et al. (2022) in the Anak Dalam indigenous community found that 88.2% of respondents rarely consumed animal or plant protein. Protein is the main component of globin, which supports iron transport and storage. Iron absorption in the small intestine is assisted by heme carrier protein, as well as transport proteins such as transferrin and ferritin (Asparian et al., 2022). Handini et al. (2023) at Al-Amanah Al-Gontory Islamic Boarding School found a relationship between protein intake (p=0.000) and anemia. Most respondents had adequate protein intake (56.6%), with minimum and maximum intake of 45.59 g and 79.70 g. The standard deviation of 5.78, lower than the mean (63.95), indicates low intake variation. Because protein transports iron needed for hemoglobin formation, deficiency disrupts this process, leading to decreased hemoglobin levels and iron-deficiency anemia (Handigolkar et al., 2016).

Based on the results of the study, there is a correlation between animal protein consumption patterns and the incidence of anemia among adolescent girls at Senior High School 01 Citeureup. Respondents with poor animal protein consumption patterns were

Volume 2 No 2, Hal 45-61, Desember 2025
E-ISSN: 3090-577X
https://doi.org/10.34035/jmrh.v2i2.1936

145 times more likely to experience anemia compared to those with good consumption patterns. Protein plays an essential role in iron absorption, and insufficient intake inhibits this process because fewer carrier proteins—such as retinol-binding protein, transferrin, and lipoproteins—can be synthesized, resulting in disrupted absorption and transport of several nutrients (Faridi et al., 2022). Sholica and Muniroh (2019) at Senior High School Negeri 1 Manyar Gresik found a significant relationship between protein intake and hemoglobin levels (p=0.000), with a Spearman correlation of r=0.663, indicating a fairly strong relationship. Lower protein intake corresponds to lower hemoglobin levels. Most female students more frequently consumed plant-based protein than animal-based protein due to limited daily allowance (Rp 10,000/day), making cheaper snacks more accessible (Sholicha & Muniroh, 2019). Kumalasari et al. (2022) reported that dietary patterns affect anemia incidence, with an OR=2.060, meaning respondents with poor dietary patterns were 2.060 times more likely to experience anemia. Poor dietary patterns fail to meet the nutrient diversity required for hemoglobin synthesis, and long-term deficiencies in iron, protein, and minerals disrupt red blood cell formation (Wahdah et al., 2019). Anindia et al. (2024) concludes that there is a significant association between protein intake and the occurrence of anemia among adolescent girls at Darul Arqom Muhammadiyah Islamic Boarding School, Kalirejo, Central Lampung. Adolescents with inadequate protein intake were found to have a higher risk of anemia compared to those with sufficient protein intake, indicating that protein intake is an important contributing factor in the prevention of anemia among adolescent girls (Anindia et al., 2025). Anwar et al. (2021) showed that dietary patterns based on iron and animal protein intake (p=0.039) were associated with anemia among female adolescents at Senior High School 1 Pasawahan. Inadequate protein and iron intake disrupt hemoglobin production and may lead to anemia (Anwar et al., n.d.). Based on SQ-FFQ interviews, the most frequently consumed animal protein sources were chicken eggs and seafood, while the main plant-based protein consumed was tempeh. Chicken meat was only consumed a few times per month, and red meat was rarely consumed.

This study has several limitations. First, the case–control design limits the ability to establish a causal relationship between animal protein consumption patterns and the incidence of anemia. Second, dietary intake data were collected using a Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ), which relies on respondents' recall and may be subject to recall bias. Third, this study was conducted in a single senior high school with a relatively small sample size, which may limit the generalizability of the findings to other adolescent populations. In addition, other factors that may influence anemia, such as micronutrient intake (vitamin C, folate), parasitic infections, and socioeconomic status, were not analyzed in detail.

CONCLUSION

Based on the results of the research and discussion regarding the relationship between animal protein consumption patterns and the incidence of anemia at Senior High School 1 Citeureup, it can be concluded that 50% of adolescent girls are anemic and 50% are not anemic. In addition, 56.7% of these adolescents have inadequate animal protein consumption patterns. The study also found a significant relationship between animal protein consumption patterns and the incidence of anemia, with a p-value of 0.001. Furthermore, female adolescents with inadequate animal protein consumption patterns were found to have a 145-times greater risk of developing anemia compared to those with adequate animal protein consumption patterns.

Volume 2 No 2, Hal 45-61, Desember 2025
E-ISSN: 3090-577X
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RECOMMENDATIONS

Health promotion campaigns emphasizing the importance of consuming protein-rich foods, especially for adolescents, should be encouraged to help adolescents meet their nutritional needs and reduce the incidence of anemia.

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