THE EFFECT OF IRON INTAKE ON HEMOGLOBIN LEVELS ON FEMALE ADOLESCENTS IN JATIROGO DISTRICT, TUBAN REGENCY, EAST JAVA

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ABSTRACT

Hemoglobin (Hb) levels will be an indicator in determining cases of anemia. Normal Hb levels in women are 12-16 g/dl. Female adolescents are susceptible to anemia due to physiological or normal menstruation every month and inappropriate eating patterns. Based on the 2018 Riskesdas results, 96.8% of adolescents aged 10-14 years and 96.4% of adolescents aged 15-19 in Indonesia do not consume vegetables and fruit which is rich in micronutrients, one of them is iron. Analytic research method with cross sectional approach. The population of this study amounted to 763 respondents with 263 adolescents as respondent which were determined by cluster random sampling tehnic. Iron intake as an independent variables, and hemoglobin level as a dependent variable. The research analysis used Spearmans correlation statistical test. The test results showed a significant relationship between iron intake and hemoglobin levels in the blood obtained p-value = 0.010 < 0.05. It was concluded that there was an effect of iron intake and Hemoglobin levels. The lower the intake of protein and iron, the lower the hemoglobin level.

Keywords: Anemia; Hemoglobin levels, Iron; Tenager.

1. INTRODUCTION

Hemoglobin is the main component ini red blood cells which is useful to transport O2 and CO2, and also to maintain the normal pH in intracellular process (Abeysiri et al., 2020). Hemoglobin is a protein rich in iron, has an affinity for oxygen and with oxygen it forms oxyhemoglobin in red blood cells. Through this function oxygen is carried from the lungs to the tissues throughout the body, if the Hb level is <12 gr%, it is classified as an anemia (Newhall et al., 2020).

Anemia is a global problem that occurs in almost all countries in the world, both in developing and developed countries (Safiri et al., 2021). Prevalence of anemia on female adolescents was 23,02% and it was moderately high (Habtegiorgis et al., 2022). In Indonesia, based on the 2013 Riskesdas results, the incidence of anemia in women of childbearing age (WUS) aged 15-49 years was 22.7%. Riskesdas 2018 results showed that the incidence of anemia in Indonesia reached 32% among those aged 15-24 years and 3-4 people out of 10 teenagers in East Java experienced anemia (*Laporan Riskesdas 2018 Nasional.Pdf*, n.d.) (Dinkes Prov. Jawa Timur, 2022). Based on the Dinas Kesehatan Kabupaten Tuban in Programme for Youth Report, Recap for Quarters I-IV 2022, the prevalence of anemia in adolescent girls is 0.15%

Anemia that occurs in young women will have short-term and long-term impacts, such as getting tired easily, having difficulty concentrating when studying, which in the end can affect learning achievement and low productivity. Apart from that, anemia can also cause a decrease in the immune system and put you at risk of developing infectious diseases (Benson et al., 2021; Nairz & Weiss, 2020). Untreated anemia in adolescents can continue into adulthood and during pregnancy, this can cause an increased risk of Infant Mortality Rate (IMR) and Maternal Mortality Rate (MMR) (Asrat et al., 2020; Heesemann et al., 2021). Anemia in female adolescents can occur due to several things, such as rapid growth and development of teenagers but not balanced with

adequate nutritional intake, menstruation, incidence of infectious diseases, worm infections, marriage and early pregnancy (Djuardi et al., 2021; Sari et al., 2022; Skolmowska et al., 2022).

Basically, anemia is not a disease, but a sign or symptom of a disease or other abnormal condition (Turner et al., 2025). Most types of anemia are caused by insufficient intake of nutrients obtained from food. The types of anemia are usually classified based on their biological mechanisms (Piskin et al., 2022; Warner & Kamran, 2025a).

Iron is a micronutrient that plays a role in the formation of Hb in the blood. Food sources rich in iron can come from plant and animal foods, such as meat, liver, nuts, cereals and seeds (*Food Sources of Select Nutrients | Dietary Guidelines for Americans*, n.d.). Lack of iron which can be obtained from these foods will reduce Hemoglobin levels in the blood and is defined as iron deficiency anemia (IDA) (Mantadakis et al., 2020).

The threshold value or cut off for Hb levels to determine anemia is generally classified by WHO (World Health Organization) into several groups, including (1) Hb <11.0 g/dl at the age of 6 months–4 years; (2) Hb <11.5 g/dl at age 5–11 years; (3) Hb <12.0 g/dl at age 12-14 years; (4) Hb <13.5 g/dl in men and Hb <12 g/dl in women.

Apart from recommending high protein intake, the government has also made various efforts to reduce the incidence of anemia in female adolescents (in particular), one of them is by implementing iron supplementation (Tablet Tambah Darah/TTD) programe. Provision of TTD for female adolescents is carried out in health facilities and schools.

Based on thus background, this aim of this research is to analyze the relationship between iron intake and hemoglobin levels in female adolescents in Jatirogo District, Tuban Regency.

2. METHOD AND ANALYSIS

This research is a type of "analytic observational" research. This study used a correlational design with a cross-sectional time approach which aimed to determine the relationship between iron intake and blood hemoglobin levels in female adolescents in Jatirogo District. The population in this study were all female adolescents in Jatirogo District. The total population is 763 female adolescents with a sample of 263 people taken using cluster random sampling techniques and with several inclusion and exclusion criteria.

The independent variable in this study was iron intake, while Hb levels in the blood were the dependent variable. Data collection used a questionnaire for iron intake data, and an observation sheet to record the results of examination of Hb levels using the Easy Touch GCHb hemoglobinometer.

Data analysis in this study used computer aids with the SPSS for Windows program consisting of univariate analysis and bivariate analysis. Univariate analysis was carried out by making a frequency distribution of each variable and the characteristics of the respondents. Bivariate analysis was carried out to examine the effect between two variables, namely each independent variable and the dependent variable. The statistical test used is the Spearman test by calculating the OR. The confidence level was determined by p = 0.05 with a 95% CI.

3. RESULT AND DISCUSSION

Table 1 Distribution of Respondents Based on Age of Female Adolescents in Jatirogo District 2024

Age of Female Adolescent	N	%
15 yo	0	0
16 yo	63	24
17 yo	116	44
18 yo	84	32
Total	263	100

Based on table 1, it can be concluded that almost half of the

respondents were 17 years old, they were 116 people or 44%.

Table 2. Distribution of Respondents Based on Degree of Female Adolescents in Jatirogo District 2024

Degree	N	(%)
10	65	24
11	103	39
12	98	37
Total	263	100

Based on table 2 above, it can be seen that almost half of the respondents are in the eleventh grade, they were 103 teenagers or 37%

Table 3 Distribution of Iron Intake on Female Adolescents in Jatirogo District 2024

Category	N	(%)
Severe deficit <70%	150	57,0
Moderate deficit 70-89%	44	16,7
Normal 90-120%	57	21,7
High intake >120%	12	4,6
Total	263	100

Based on table 3, the calculation of the average iron intake of respondents compared to the Nutritional Adequacy Rate (Angka Kecukupan Gizi/AKG) for adolescents aged 15-18 years, the majority are in the severe deficit category, they were 150 people or 57%

Table 4. Distribution of Hemoglobin Levels of Female Adolescents in Jatirogo District 2024

Category	N	(%)
Abnormal	207	78,7
Normal	56	21,3
Total	263	100

Table 4 shows that almost all respondents had abnormal Hb levels, they were 207 people or 78.7%.

Table 5 Cross-Tabulation of Iron Intake and Hemoglobin Levels of Female Adolescents in Jatirogo District 2024

Iron Intake	Haemoglobin Levels		Total
	Normal	Abnormal	
Severe Deficit	36 (24%)	114 (76%)	150 (100%)
Moderat Deficit	10 (22,7%)	34 (77,3%)	44 (100%)
Normal	8 (14%)	49 (86%)	57 (100%)
High Intake	2 (16,7%)	10 (83,3%)	12 (100%)
Total	56 (21,3%)	207 (78,7%)	263 (100%)

Based on table 5, it can be seen that of the 263 respondents, almost all respondents with severe deficit iron intake had abnormal Hb levels, namely 76% of respondents, almost all respondents with moderate deficit iron intake had abnormal Hb levels, namely 77.3%. Likewise, almost all of the respondents with normal iron intake had abnormal Hb too. Even respondents with excessive iron intake almost all had abnormal Hb, they were 83.7%.

Based on the Spearman correlation test using SPSS software, a p value of 0.010 was obtained, which indicates that the variable between iron intake and hemoglobin levels in the blood has a significant relationship. The strength of the relationship between these variables is shown through the correlation coefficient, namely 0.089, which means that H1 is accepted with the strength of the relationship being very weak.

DISCUSSION

Identification of Iron Intake of Female Adolescents in Jatirogo District, Tuban Regency 2024

The results of research conducted by researchers show that the iron intake of young women in Jatirogo District can be seen from the results of table 3. The iron intake of most respondents is included in the severe deficit category, namely 57.0% and a small number of others have iron in the normal category 21.7%, moderate deficit 16.7%, and more 4.6%. The percentage of intake in both severe and moderate deficit categories is due to a lack of iron intake consumed from food or blood supplement tablets that are not consumed.

Based on the results of interviews conducted, in general respondents who had normal or excessive iron intake more often consumed natural foods high in iron such as red meat, spinach and nuts. This data was collected through a 24-hour individual recall form which was carried out by interviewing respondents for 3 days with details of 2 weekdays and 1 weekend. The adequacy of the respondent's intake is determined by comparing real energy intake with the nutritional adequacy rate (RDA).

Consuming food to support iron intake from the variety of food choices, such as eggs, fish, meat, poultry, as well as several colored vegetables and fruit such as spinach, carrots, tomatoes, pineapple, guava, but the iron intake from these foods must be supported by reducing consumption of drinks high in sugar, packaged drinks, and tea which can inhibit iron absorption (Lee, 2023).

Of the various food choices mentioned above, the animal food group is the one that best supports iron intake. Meat is a source of animal food that is high in iron, but meat consumption is still an obstacle, especially in developing countries, including Indonesia. In Indonesia, beef consumption per year is 2.7 kg, which is still quite low compared to other countries in Southeast Asia, especially compared to developed countries.

Animal foods are better sources of iron intake because plant foods contain an anti-nutritional compound called phytate. Phytates are found in many wheat, grains and legumes. Phytate is the main inhibitor in iron absorption (Brouns, 2021; Rahfiludin et al., 2021). However, plant-based foods also contain foods high in Vitamin C which can support iron absorption. Vitamin C can increase iron absorption sixfold in those who experience iron deficiency (Piskin et al., 2022).

Apart from paying attention to Vitamin C which helps the absorption of iron, other groups of micronutrients are also known to help the formation of red blood cells, such as folic acid and Vitamin B12 (Qasrawi et al., 2024), as well as Vitamin E which acts as an erythropoietic agent. able to reduce the fragility of red blood cells (Altamura et al., 2020), and Vitamin A which plays a role in increasing iron storage and growth and differentiation of red blood cell precursors (Brittenham et al., 2023).

Lack of iron intake on female adolscents can also be caused by other their behaviors, such as skipping breakfast and other main meals (Wiafe et al., 2020). The behavior of skipping meals will significantly reduce the intake of iron, folate, calcium, sodium and fiber.

Based on the things mentioned above, it can be concluded that consuming diverse and balanced food ingredients can support each other in fulfilling nutritional needs, one of which is meeting iron needs. Apart from paying attention to intake, it is also necessary to pay attention to adolescents's behaviors and habits that can influence their eating patterns.

Hemoglobin Levels on Female Adolescents in Jatirogo District, Tuban Regency

The results of research conducted by researchers show that almost all respondents have abnormal Hb levels, they were 78% of respondents and the remaining 21% have normal Hb levels. This is because young women have a ten times greater risk of suffering from anemia compared to young men and young women menstruate every month and are growing so they need more iron intake. Determining anemia can also be done by measuring hematocrit (Ht), which on average is equivalent to three times the hemoglobin level. The limit for hemoglobin levels in adolescent girls to diagnose anemia is if the hemoglobin level is less than 12 gr/dl . This is shown in the form of the hemoglobin level observation sheet where hemoglobin levels were checked on respondents using the GCHB Easy

Touch device during one examination on respondents.

A study states that hemoglobin levels can be influenced by several factors that cannot be controlled, such as age, gender and iron metabolism in the body (Warner & Kamran, 2025b). As one gets older, a person will increasingly experience a physiological decline in all body organs, including a decline in the spinal cord which produces red blood cells. In adolescence there is growth from children towards maturity into adults. Physical, biological and psychological changes occur during adolescence. If there is an imbalance between meeting nutritional intake and nutritional needs, including iron, this can be the cause of anemia in adolescents. Unbalanced nutritional intake can result in nutritional problems, both undernutrition and excess nutrition (Calcaterra et al., 2023; Valvano et al., 2023).

If iron stores in the body are sufficient, the formation of red blood cells will be optimal, but if the body lacks iron intake, the body can activate reserve iron to meet the amount of iron needed by the body. A person can become anemic due to insufficient iron intake, there are no iron reserves in the body, so red blood cell production decreases which results in hemoglobin levels in the body (Kristin et al., 2022). Hemoglobin plays a very important role in daily activities. Hemoglobin functions to bind oxygen. When the body lacks hemoglobin, oxygen intake will decrease, and this can affect teenagers' activities in daily life. When young women experience anemia, it can be a risk factor for stunted fetal growth, giving birth to babies with low birth weight and even premature birth (Oktarina et al., 2024).

Anemia factors on female adolescents were lack of paying attention to the amount of food they eat, or poor diet absorption, excessive menstruation, chronic infectious diseases, sudden bleeding such as accidents (Attia et al., n.d.; Valvano et al., 2023).

Based on the facts and theories that have been explained, researchers are of the opinion that the majority of hemoglobin levels in teenage girls fall into the abnormal category, this is due to changes in the biological function of a teenager's body and is not supported by optimal nutritional intake from daily food.

Iron Intake and Haemoglobin Levels on Female Adolescents

The results of the interpretation of data obtained from research results from 263 respondents showed that there was a weak relationship between iron intake and hemoglobin levels in the blood. The data obtained shows that the average iron intake for adolescent girls is 10.48 mg, while the iron intake that is in line with the nutritional adequacy rate (RDA) for adolescent girls aged 16-18 years is 15 mg. This shows that the research results of the average iron intake when compared with the iron intake required by the Nutritional Adequacy Rate (AKG) are not appropriate, shown at a percentage of 69.86%. The results of the Spearman correlation test show that the correlation coefficient value of the relationship between iron intake and Hb levels is 0.089, which means that the two variables have a relationship, but it is very weak.

The same result found in another research. This study had a weak relationship with anemia indicating a weak relationship between iron intake and anemia. Assessment of anemia status in this study also used secondary data on Hb levels. This research suggests increasing iron supplementation and improving sanitation (Swaminathan et al., 2019). Another research also showed that infectious diseases influenced the Hb level (Sumbele et al., 2020). Diarrhea, house hold food insecurity, stunting, dietary diversity, and age were the predictor of Hb level (Azmeraw et al., 2023), which is determine the anemia.

However, there were different results obtained in other studies. There was a relationship between the level of iron, protein, vitamin C consumption and hemoglobin levels (Siahaan et al., 2023). Iron absorption has one of the main functions, namely supporting the formation and proliferation of red blood cells in the body. Insufficient iron intake and frequent consumption of absorption inhibitors can reduce iron levels in the body and can cause iron deficiency anemia (Adriani & Wiratmadi, 2012).

Iron levels that are not met can affect iron levels to anemia as indicated by hemoglobin levels. Tea contains tannin which is a substance that can inhibit iron absorption (Royani et al., 2017). Research conducted by Cornell University and The USDA's Agricultural Research Service (ARS). Ithaca, New York, United States states that the tannin and polyphenol content in tea can inhibit the absorption of iron in the digestive tract, which can trigger anemia or anemia. Phytate is also an anti-nutrient found in nuts and it is the main compound for storing phosphorus. Phosphate binds essential minerals and the body unable to absorb some minerals, including iron. This can cause anemia (Kumar et al., 2022). One of the habits of Indonesian is daily consumption of tea. Tea is usually consumed in the morning or after the main meal. This should be taken into account considering that tea contains anti-nutritional substances called tannins which can interfere with iron absorption (Fan, 2016).

Iron is an important element for cell life in the body. Iron functions in the production of enzymes and proteins through the process of exchanging electrons with several molecules (Soares & Hamza, 2016). Homeostasis zat besi dapat mempengaruhi system imunitas bawaan maupun adaptif (Ni et al., 2022). Iron has various benefits for the body, including transporting oxygen throughout the body to keep it stable, and maintaining the body's immune system (Putri et al., 2022). Iron deficiency in the human body can cause various diseases such as anemia, fatigue in the body, and decreased endurance. Iron deficiency is a common problem for adolescent girls and working women (Organization, 2008; Petraglia & Dolmans, 2022).

Lack of nutrients such as iron can cause anemia due to insufficient nutrients needed to produce and synthesize erythrocytes. One of them is causing iron deficiency anemia which is characterized by clinical symptoms such as pale conjunctiva, shortness of breath, dizziness and lethargy. Iron deficiency anemia is characterized by incomplete hemoglobin synthesis due to significant iron deficiency, resulting in reduced capacity of erythrocytes to deliver oxygen to body cells and tissues. Other research also states that there is an increase in Hb levels in someone with sufficient Vitamin C intake. This is because Vitamin C can increase the body's immunity, reduce infections, and increase iron absorption.

It can be concluded that female adolescents in this study who had a normal iron intake but have abnormal hemoglobin levels are thought to be due to rarely consuming natural foods that can help iron absorption such as green vegetables and light colored fruits that are high in Vitamin C. Adolescent habits who often consume fast food and drinks that are high in sugar, food additives, tannin, caffeine are also inhibiting factors in iron absorption. Apart from that, they also often skip consuming blood supplement tablets, which can cause abnormal Hb levels. Therefore, it is necessary to increase awareness among young women about the importance of adequate iron intake or according to needs, as well as improving diet.

Apart from assessing Hb levels, another method that can also be used to determine the incidence of anemia is by assessing serum ferritin levels in the blood. Ferritin is an iron storage protein that plays an important role in

Hb synthesis and denaturalization (Plays et al., 2021). So, if in this study a weak relationship is found between iron intake and Hb levels, then the suggestion for future researchers is to conduct research on iron intake and serum ferritin levels.

4. CONCLUSION

a. Most of female adolescent in Jatirogo District had a severe protein intake deficit with a percentage of 57.0% or 150 respondents.
b. The majority of female adolescents in Jatirogo District had an abnormal hemoglobin levels with a percentage of 78.7%, totaling 207 respondents.
c. There was a relationship between iron intake and hemoglobin levels in Hb levels of female adolescents in Jatirogo District with a value of (p = <0.010), with a weak correlation coefficient level of 0.089

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