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Relationship between Food and Iron Intake and Hemoglobin Levels among Medical Students: A Cross-sectional Study at Indonesian Christian University, Class of 2021

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: Lack of protein intake will result in hampered iron transport and reduce the formation of hemoglobin (Hb). Hemoglobin is a protein compound found in red blood cells and is useful for transporting oxygen (O2) and carbon dioxide CO2 in the body. The level of protein consumption is closely related to hemoglobin, where the protein binds to iron in the body. If iron intake is lacking, it

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can cause red blood cell production to be disrupted and cause anemia. The world's population with anemia is around 30% or 2.20 billion people and the global prevalence of anemia is around 51%. This study was conducted to determine the relationship between iron intake and hemoglobin (Hb) levels.

Aims: This research was conducted to determine the relationship between food or iron intake and hemoglobin (Hb) levels.

Methodology: This research uses a descriptive-analytical research design with a cross-sectional approach and uses primary data as a research instrument, which was obtained from the results of blood sampling from students from the Faculty of Medicine, Indonesian Christian University Class of 2021 for laboratory examination using the Hematology Analyzer method and a 2x24 hour Food Recall form. The purposive sampling method was used to obtain 72 samples in this study.

Results: The study showed 59 students (81.9%) were not anemic, and 13 (18.1%) were anemic. A total of 12 students (16.7%) had a low iron adequacy score, and 60 students (83.3%) had a sufficient iron adequacy score. There is a relationship between food/iron intake and hemoglobin levels ($p < 0.05$).

Conclusion: there is a significant relationship between iron intake and hemoglobin levels.

Keywords: Hemoglobin; iron; anemia; nutritional status; iron intake; blood consists; blood cells; carboxy hemoglobin.

1. INTRODUCTION

1.1 Hemoglobin and Its Importance

Blood consists of two components, namely a liquid component called plasma and a solid component, namely blood cells. Blood cells consist of three types, namely erythrocytes, leukocytes and platelets. Erythrocytes have a very important function for the human body. The most important function of erythrocytes is to transport oxygen and carbon dioxide between the lungs and tissues. An erythrocyte protein, namely hemoglobin, plays an important role in both transport processes. Hemoglobin is a molecule consisting of heme (iron) and globin polypeptide chains (alpha, beta, gamma and delta). Heme is a prosthetic group consisting of iron atoms, while globin is a protein that is broken down into amino acids. Hemoglobin is found in red blood cells and is the pigment that gives the red color and also carries oxygen from the lungs to all body cells. Hb combines with carbon dioxide to form carboxy hemoglobin and is dark red in color. Arterial blood contains oxygen while venous blood contains carbon dioxide. Each person should have about 15 grams of hemoglobin per 100 ml of blood and a blood count of about five million red blood cells per millimeter of blood. Hemoglobin is a dye compound protein found in red blood cells that helps transport oxygen (O2) and carbon dioxide CO2 in the body. Hemoglobin can be measured using various methods, including the Sahli method, oxyhemoglobin method, and cyanmethemoglobin method, and the amount of Hb/100 ml of blood can be used as an index of the oxygen-carrying capacity of red blood [1-3]. Hemoglobin can be used widely as a parameter to determine anemia status.

1.2 Anemia and Its Implications

Anemia is when the number of red blood cells or the concentration of oxygen carriers in the blood (Hb) is insufficient for the body's physiological needs. Anemia is a reduction below the normal value of erythrocytes, hemoglobin quantity, and packed red blood cell volume (hematocrit) per 100 ml of blood. The main causes of anemia are low hemoglobin levels in the blood or problems with the body's ability to produce red blood cells. The number of red erythrocytes maintained in the blood will always be sufficient because the bone marrow replaces old blood cells with new ones as quickly as the number of red blood cells is destroyed, which requires a lot of resources. The production of new red blood cells will be hampered if nutrients are not present in the right amounts. A deficiency of essential nutrients such as iron, folic acid, pantothenic acid, vitamin B12, cobalt protein, and tannin, one of which causes iron deficiency anemia, can cause anemia caused by problems forming red blood cells [3]. Anemia is when the number of red blood cells or the concentration of oxygen carriers in the blood (Hb) is insufficient for the body's physiological needs. Adolescent girls have a higher risk than teenage boys. For young women, this will have a severe impact in the future because they will become mothers-to-be and will become pregnant

and give birth to premature babies, low birth weight babies, and can also increase the risk of maternal death. Anemia can cause a decrease in concentration, learning achievement, immunity, fitness, and productivity in teenagers.[4]. Some factors, including low protein and iron consumption, blood loss, and malabsorption, can cause iron deficiency anemia. Young women are at higher risk of experiencing nutritional anemia because they care too much about body image, so many limit food consumption and follow strict diets. Anemia is a reduction below the normal value of erythrocytes, hemoglobin quantity, and packed red blood cell volume (hematocrit) per 100 ml of blood. Anemia occurs more often in adolescent girls compared to teenage boys. Young women lose iron (Fe) during menstruation and need more iron (Fe) intake. In young women, this will have a severe impact in the future because they will become mothers-to-be, will become pregnant and give birth to premature babies and low birth weight babies, and can also increase the risk of maternal death. Anemia can cause a decrease in concentration, learning achievement, immunity, fitness, and productivity in teenagers.[4].

1.3 Nutritional Factors Contributing to Anemia

According to the Indonesian Ministry of Health, it has been revealed that several health problems are being experienced, which could threaten the future of Indonesian teenagers. One of the problems faced by Indonesian teenagers is nutritional problems. This can be seen from one indicator, namely the high percentage of students experiencing anemia, namely around 12% of adolescent boys and 23% of adolescent girls, most of which is due to iron deficiency. Anemia is still a nutritional problem with the highest incidence rate compared to other malnutrition problems [5]. Nutrition has a vital role in the blood formation process in the body. If these nutritional requirements are not met immediately, it can cause the health problem of anemia, which will get worse. Protein is essential in transporting iron in the body (transferrin). Therefore, a lack of protein intake will result in the transportation of iron being hampered, which can cause iron deficiency. The level of protein consumption has a close relationship with hemoglobin. In addition, foods that are high in protein, especially animal protein, contain a lot of iron [6,7]. Iron in the body will bind to the protein. In the research results of Husnul Khatimah (2017), there was a relationship between protein intake and the incidence of anemia in young women at MAN 1 Surakarta. Protein is vital in transporting iron in the body to form red blood cells in the bone marrow. If protein intake is lacking, it will result in obstacles in the transfer of iron to the bone marrow and can disrupt red blood cell production [7-9].

Other factors that can influence hemoglobin levels in teenagers include external factors, knowledge of the teenager, age of the teenager, and characteristics of the teenager's parents, namely the education and occupation of the teenager's parents themselves, as well as age. Age can also affect hemoglobin levels because as each teenager gets older and grows, it is influenced by the teenager's ability to choose what they want to eat. So this can affect nutrition in teenagers [10]. Meanwhile, the education of a teenager's parents can influence the job of the teenager's parents. In contrast, the mother's economic needs and intelligence can influence the food the mother must prepare for the family. This also affects the teenager's nutrition [11]. Efforts to create quality Indonesian humans must be carried out by paying attention to human conditions from an early age. Teenagers are a source of potential and the nation's successors. Based on the description that has been explained, researchers are interested in knowing the relationship between iron (Fe) intake and hemoglobin (Hb) levels in adolescents aged 15-24 years [11-12].

2. MATERIALS AND METHODS

2.1 Research Design

This study uses a descriptive-analytical research design with a cross-sectional approach, which aims to determine the relationship between iron intake and hemoglobin levels in adolescents studying at FK UKI Class of 2021. The research data collection location will be at the FK UKI Laboratory in July-August 2022. This research uses primary data as a research instrument. Primary data was obtained from blood sampling from students from the Faculty of Medicine, Indonesian Christian University Class of 2021.

2.2 Population and Sample

The research population used was some students from the Faculty of Medicine, Indonesian Christian University Class of 2021, and the sampling technique was purposive sampling. Only samples met the inclusion and

exclusion criteria, and 72 were used in this research.

2.3 Inclusion Criteria

1. Students from the Faculty of Medicine, Indonesian Christian University Class of 2021.
2. Students willing to have blood taken as a research sample.

2.4 Exclusion Criteria

Students who do not come for blood collection.
Students who do not complete the questionnaire.
Students who have a history of certain diseases

2.5 Data Collection and Processing

Data collection was carried out using primary data, data taken using blood samples and questionnaires taken from FK UKI students Class of 2021 in 2022: 1) Laboratory examination, used to determine anemia status using the Hematology Analyzer method; 2) 2x24 hour Food Recall Form, used to determine the type and amount of energy consumed during 24 hours. The amount of food consumed was asked carefully using URT tools (spoon, glass, plate, etc.) to obtain quantitative data. The data obtained from the food recall form is processed and entered into the Nutrisurvey for analysis and then compared with the nutritional adequacy figures; 3) Questionnaire, used to collect and determine student identity, age, gender, and previous medical history.

Processing the collected data will use the SPSS ver.22 for Windows (Statistical Package for the Social Science) program with the following management steps:1) Editing stage (Check the completeness of the data so that the data obtained is correct information); 2) Coding (This is done to change the data obtained by providing codes in the form of numbers to facilitate the data processing process); 3) Entry (At this stage, the data will be processed by computer for analysis); 4) Cleaning (Data that has been processed and rechecked to ensure there are no errors and is ready for analysis). This research uses univariate and bivariate analysis. Univariate analysis will identify data sets in the form of frequencies, highest values, minimum values , and maximum values of the research variables. Bivariate analysis analyzes the relationship between dependent and independent variables and determines whether significant differences exist between two or more group variables.

3. RESULTS AND DISCUSSION

Sampling was carried out using the purposive sampling technique, where the sample selection was based on inclusion criteria determined by the researcher, and the number of respondents was 72 students. The sample in this study were students from the Faculty of Medicine, Indonesian Christian University, Class of 2021. An overview of the distribution of subjects based on characteristics can be seen in Tables 1 and 2.

The data in Table 1 shows the characteristics of all research respondents. Based on gender, from a total of 72 respondents, there were 24 male respondents (33.3%), and the largest number of respondents were 48 female respondents (66.7%).

Table 1. Characteristics of 2021 Class of Indonesian Christian University Faculty of Medicine Students Based on Gender

Gender	Frequency (n)	Percentage (%)
Male	24	33.3
Female	48	66.7
Total	**72**	**100**

Table 2. Characteristics of 2021 Class of Indonesian Christian University Faculty of Medicine Students Based on Age

Age	Frequency (n)	Percentage (%)
18 year	21	29.2
19 year	37	51.4
20 year	14	19.4
Total	**72**	**100**

Table 3. Overview of Hemoglobin Levels

Hemoglobin Levels	Frequency (n)	Percentage (%)
Low	13	18.1
Normal	59	81.9
Total	**72**	**100**

Table 4. The Description of food/Iron Intake

Food/Iron Intake	Frequency (n)	Percentage (%)
not enough	12	16.7
enough	60	83.3
Total	**72**	**100**

Table 5. Relationship between Food/Iron Intake and Hemoglobin Levels in Class of 2021 UKI Medical Faculty Students

Hemoglobin levels	Iron Intake				Total	p-value
	Not enough		Normal			
	f	%	f	%		
Low	9	12,5	4	5,5	13	0,000
Normal	3	4.1	56	77,8	59	
Total	12	16,7	60	83,3	72	

Data in Table 2 shows that the majority of research respondents were 19 years old (51.4%), and the rest were 18 years old (29.2%) and 20 years old (19.4%).

3.1 Univariate Analysis

Based on the results of univariate analysis, hemoglobin levels were described in Table 3 above.

Based on the Table 3 above, it was found that 18.1% of the 72 research samples had low hemoglobin levels, namely 13 people. Meanwhile, 81.9% of the 72 research samples had normal hemoglobin levels, namely 59 people.

Iron intake was obtained using the 2x24-hour food recall method. Iron consumption is calculated using NutriSurvey software, and then the iron adequacy figure is examined [12].

Data from univariate analysis of the description of food/iron intake is shown in Table 4.

Based on the Table 4 above, it was found that 16.7% of the 72 research samples had insufficient food intake and corelation with iron adequacy rates (<80% RDA), namely 12 people, while 83.3% of the 72 research samples had sufficient iron adequacy rates (280% RDA), namely 60 people. The 2x24 hour food recall results show that many respondents consume food sources of iron as a source of iron intake.

3.2 Bivariate Analysis

Bivariate analysis was carried out to determine the relationship between food/iron intake and hemoglobin levels in UKI Medical Faculty students in the class of 2021, with the results as presented in Table 5 above.

Statistical tests revealed a statistically significant relationship between food/iron intake and hemoglobin levels in students at the UKI Faculty of Medicine Class of 2021, with a value of $p = 0.000$ ($p<0.05$). Therefore, it can be said that there is a significant relationship between iron intake and hemoglobin levels in students at the UKI Faculty of Medicine Class of 2021.

The sample in this study were individuals registered in the 2021 class of the Indonesian Christian University Faculty of Medicine who were active students. This research sample showed an age distribution where 51.4% of the participants were 19. According to WHO, teenagers are residents in the age range of 10-19 years. According to the Republic of Indonesia Minister of Health Regulation Number 25 of 2014, teenagers are residents in the age range of 10-18 years, and according to the Population and Family Planning Agency (BKKBN), the age range for teenagers is 10-18 years. 24 years old and not married. According to the 2010 Population Census, the number of people aged 10-19 years in Indonesia is 43.5 million, or around 18% of the world's population. The youth

group is estimated to be 1.2 billion or around 18% of the world's population. Adolescence is a developmental stage marked by the emergence of secondary sexual characteristics and attaining sexual maturity as determined by biological markers. Adolescence is an important developmental stage marked by significant changes, challenges, and transitions, during which individuals attempt to establish their self-identity. Physiological changes that occur during adolescence have an impact on the well-being and nutrition of adolescents. Balanced nutrition that meets adolescents' special needs can facilitate optimal growth and development. [13-14]

The results of this study showed that 60 respondents had sufficient food/iron intake (<80% RDA), including 56 respondents (93%) with normal hemoglobin levels and four respondents (7%) with low hemoglobin levels. Based on the 2x24 hour food recall results, many respondents had insufficient food/iron intake. Consumption of foods containing iron is found in animal products such as meat, fish, and poultry as a source of heme iron, while non-heme iron sources are found in nuts, fruit, vegetables, grains, tofu dairy products, cheese, and eggs. Sources of iron that come from heme iron sources from animal products can be absorbed better than non-heme iron. Therefore, if iron intake is insufficient and the frequency of absorption inhibitors (inhibitors) consumption is more frequent than the consumption of iron sources, it can cause low iron levels in the body and trigger iron deficiency anemia. Consuming foods containing iron shows that adequate iron intake is good. Iron plays a vital role in the formation of hemoglobin. Iron deficiency can interfere with the formation of hemoglobin, which can cause anemia [15-16].

Based on morphological features, anemia is classified into three types of anemia:

1) Normochromic normocytic anemia

This type of anemia is characterized by a decrease in hemoglobin (Hb) values below normal limits but mean cell volume (MCV) and mean cell hemoglobin (MCH) values within normal limits. Normochromic normocytic anemia is caused by acute bleeding, hemolysis, and metastatic infiltrative diseases of the bone marrow. There was a decrease in the number of erythrocytes not accompanied by changes in hemoglobin concentration

2) Macrocytic anemia

Macrocytic anemia, where macrocytic means the size of the red blood cells is larger than normal. It is normochromic because the hemoglobin concentration is normal (MCV is increased, MCHC is normal). Usually found in megaloblastic anemia (vitamin B12 deficiency, folic acid) and non-megaloblastic macrocytic anemia. Hypochromic microcytic anemia

Hypochromic microcytic anemia, where microcytic means small and hypochromic means it contains less than average amounts of hemoglobin (less MCV, less MCHC). Causes of hypochromic microcytic anemia:

a. Decreased iron: Iron Deficiency Anemia.
b. Reduced globin synthesis: Thalassemia and Hemoglobinopathy.
c. Reduced heme synthesis: Sideroblastic Anemia. [17-28]

The results of the Chi-Square statistical test showed a significant value of p = 0.000 (p<0.05). So, a significant relationship was found between iron intake and hemoglobin levels in UKI Faculty of Medicine students in the Class of 2021. The relationship between iron intake and hemoglobin levels in this study was caused by the lower the iron intake consumed, the lower the Hb levels of teenagers, and vice versa if Increasing iron intake will increase Hb levels in the body. This research is in line with research by Sevtiana Winda Wati, Ria Purnawian Sulistiani, and Rr. Annisa Ayuningtyas in 2022, namely that a significant relationship was found between iron intake and hemoglobin levels in Bachelor of Nutrition students at the Muhammadiyah University of Semarang with a value of (p=0.000) [16]. The results of this research were also obtained in line with research conducted by Cynthia Almaratus Sholicha and Lailatul Muniroh in 2019, which showed a strong relationship between iron intake and hemoglobin levels [17]. The higher the iron intake, the higher the hemoglobin level. This shows that the level of iron adequacy in female students has a significant relationship with hemoglobin levels. [29-30]

4. CONCLUSION

Based on the description of the research results and discussion regarding the significant relationship between iron intake and hemoglobin levels in students at the Faculty of Medicine, Indonesian Christian University Class of 2021,

It is believed that this research can provide awareness to UKI Faculty of Medicine Class of 2021 students and the public to maintain their dietary intake, especially iron intake, to increase hemoglobin levels in the blood and prevent the risk of anemia, especially iron deficiency anemia. With this research, the author fully supports developing government programs in the health sector, especially educational programs regarding iron intake in adolescents. It is hoped that this research can become a guide to support future research

CONSENT

Students who fill out and agree to the informed consent form

ETHICAL APPROVAL

The research protocol has been provided by the Health Research Ethics Commission, Faculty of Medicine, Indonesian Christian University with an ethical clearance letter number, namely No. 20/Research Ethics/FK UKI/2020

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Harahap AP, Pamungkas CE, Amini A, Nopitasari N. The relationship between body mass index and the incidence of anemia in adolescent girls at SMP Negeri 14 Mataram. JRIS Indonesian Midwifery. 2019;3(1):33-6.
2. Abdoerrachman M, Affandi M, Agusman S, Alatas H, Dahlan A, Bakry F. IImu lecture book on child health. volume II. Jakarta: Part IImu Child Health, Faculty of Medicine, University of Indonesia; 1985.
3. Alifah HN. The relationship between nutritional status and hemoglobin levels in female students at the AL munawwir krapyak islamic boarding school, Bantul, Yogyakarta; 2017.
4. Ministry of Health RL. Get to know the nutritional problems that threaten Indonesian teenagers. Communication and Community Services Bureau. 2018;8-9. Available:https://jpp.go.id/humaniora/kesehatan/321081-kenali-problem-gizi-yang-ancam-jual-indonesia
5. Brazier Y. What is nutritional-deficiency anemia? Medical NewsToday. 2017;1-9. Available:https://www.medicalnewstoday.com/articles/188770
6. Djihu MI, Momongan N, Kapantow NH. The relationship between intake and hemoglobin levels in children aged 1-3 years in the working area of the Ranamuut city health center; 000.
7. Khatimah H. The relationship between protein intake, iron and knowledge on hemoglobin levels in adolescent girls at MAN 1 Surakarta. Thesis of Muhammadiyah University of Surakarta. 2017;7.
8. Firani NK. Recognizing blood cells and blood disorders. Brawijaya University Press; 2018.
9. Aini EN. Examination of hemoglobin levels and efforts to handle anemia in adolescents at the BPPT darus sholah jember flagship high school, Idaman Journal. 2020;4(2):77–83.
10. Hasana F. Correlation between hemoglobin levels and cardiovascular endurance in athletic athletes at FIK Makasar State University. Journal of Sport and Health. 2018;1–16.
11. Mahmood NH, Mansor MA. Red blood estimation using hough transform technique. Signal and image processing: An International Journal (SIPIJ). 2018; 3(2):53-64.
12. WHO regularly exercise futsal at the faculty of sports education and Arts IKIP and students who rarely exercise at the science teaching faculty IKIP period january 2018 October 2018. Thesis. Ikip Mataram University; 2018.
13. Adaayatty SJ, Katz A, Wang Y, Eck P, Kwon O, Lee JH, Chen S, Corpe C, Dutta A, Dutta SK, Levine M. Vitamin C as an antioxidant: Evaluation of its role in disease prevention. Journal of American College Nutrition. 2003;22(1):18-35.
WHO. Iron deficiency anemia assessment, Prevention, and Control; 2001.
14. Tarwato Aryani R, Nuraeni A, Miradwijaya B, NS T. Adolescent health problems and solutions. jakarta: Salemba Medika; 2010.

15. Ariani AP. Nutrition Science. Yogyakarta: Nuha Medika; 2017.
16. A'tourrohman, Muhammad. Technique for calculating hemoglobin levels using the Sahli method. Faculty of Science and Technology Walisongo State Islamic University. 2020;1-7.
Hernaningsih Yetti. How to choose hematology analyzer based on clinical usage. 2017;127-132.
17. Priyanto LD. The relationship of age, educational background, and physical activity on female students with anemia. Periodical Journal of Epidemiology. 2018; 6(2):139-46.
18. Sudargo T, Kusmayanti NA, Hidayati NL. Iodine, Iron, and intelligence deficiency. UGM PRESS; 2018 May 31.
19. Ani LS. Iron Deficiency Anemia Handbook. Jakarta: EGC; 2016.
20. Fitriany J, Saputri AI. Iron deficiency anemia. Public Health. 2018;4(2).
21. Harahap NR. Factors associated with the incidence of anemia in adolescent girls. Nursing Arts Journal. 2018;12(2).
22. Skikne, Barry. Anemia: Diagnosis and treatment options for women. OBG Management. 2007;19(12):S1+. Gale OneFile: Nursing and Allied Health
23. Ulaecha J. Efforts to prevent anemia in adolescent girls. Journal of Health Services (JAK). 2020;2(2).
24. Yunita, Freshy Astrika et al. Relationship between young women's knowledge about iron consumption and the incidence of anemia in SMP 18 Surakarta. PLACENTUM: Scientific Journal of Health and Applications. 2020; 8(1):36.
25. Indonesian Ministry of Health. Minister of health regulation No. 28 of 2019 concerning recommended nutritional adequacy rates for indonesian people. Minister of health of the republic of Indonesia regulation of the minister of health of the republic of Indonesia. 2019; 28:13.
26. Sirajuddin, Surmita, Astuti T. Nutrition Teaching Materials: Consumption Survey Book.
27. S D. Adolescent Nutrition. Nutrition Science: Hardinsyah M, Supariasa I, editors. EGC Medical Book Publishers; 2016.
28. Wati SW, Sulistiani RP, Ayuningtyas RA. Correlation of iron, protein, vitamin C intake and nutritional status with hemoglobin levels in female students at muhammadiyah university semarang. In Proceedings of the 2022 Unimus National Seminar. 2022;5.
29. Sholicha CA, Muniroh L. Relationship between intake of iron, protein, vitamin C and menstrual patterns with hemoglobin levels in adolescent girls at SMAN 1 Manyar Gresik. Indonesian Nutrition Media. 2019;14(2):147-53.
30. Almatsier S. Basic principles of nutrition science. Jakarta: PT Gramedia Pustaka Utama; 2004.

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