ISSN 2349-7823

International Journal of Recent Research in Life Sciences (IJRRLS)
Vol. 9, Issue 3, pp: (9-13), Month: July - September 2022, Available at: www.paperpublications.org

The Relationship of Micronutrient Intake with the Incidence of Anemia in Adolescents

Rahayu Yekti,[1*] Pratiwi D.Kusumo, [2]Yuna Prilia RJ. Silitonga[3]

[1,2,3] Medical Faculty Universitas Kristen Indonesia

DOI: https://doi.org/10.5281/zenodo.6979674

Published Date: 10-August-2022

Abstract: **Anemia is a condition in which the concentration of hemoglobin in the blood is less than normal. Low iron intake is the biggest factor in the occurrence of iron deficiency anemia. In addition to iron, other nutrients that can cause anemia are: Zinc, Vitamin B6, Vitamin C, Vitamin B12, and Folic Acid. This study aimed to determine the relationship between micronutrient intake and the incidence of anemia in adolescents. The method used is a descriptive-analytic method with a cross-sectional approach. Data on micronutrient intake was obtained through a 2x24 hour recall method and then analyzed with nutrisurvey software and compared with the RDA. Examination of hemoglobin levels using the hematology analysis method. The results showed that the prevalence of anemia was 15 people (25%). The results of the analysis showed that there was a relationship between intake of iron (p = 0.000), vitamin B12 (p = 0.000), folic acid (p = 0.001), and zinc (p = 0.000) with the incidence of anemia. On the other hand, there is no relationship between vitamin C intake and the incidence of anemia (p=1.0). It is recommended that students increase their consumption of foods rich in iron, vitamin B12, folic acid, zinc, and vitamin C**

Keywords: **Anemia, Micronutrient Intake, Adolescents.**

1. INTRODUCTION

Anemia is common throughout the world, especially in developing countries. Anemia is a condition in which the concentration of hemoglobin in the blood is less than normal [1]. About 30% or 2.20 billion of the world's population is anemic. Globally, the prevalence of anemia in Southeast Asia is 41.5% [2],[3]. Based on the 2013 Riskesdas data, the incidence of anemia in Indonesia is 21.7%, of which 26.4% are in the 5-14 year age group and 18.4% in the 15-24 year age group [4]. Anemia has a hemoglobin concentration below the normal value due to a deficiency in the production of erythrocytes and Hb cells, increased erythrocyte breakdown, or excessive blood loss [5]. Several factors can affect anemia, including lack of nutritional intake, bleeding due to accidents, and suffering from worms or infectious diseases [1]. Adolescence is a group that is prone to anemia. This happens because adolescence is a period of transition from child to adult and is a period of development in all aspects towards adulthood. Physical changes due to growth will affect nutritional status and health. This is influenced by an imbalance between the intake of needs that will cause nutritional problems, either in the form of undernutrition or overnutrition. [6].

Consumption of food in teenagers who are instant-paced causes teenagers to get unbalanced nutritious food. In addition, a lack of micronutrients such as low iron intake is the biggest factor in the occurrence of iron deficiency anemia. Besides iron, other micronutrients that can cause anemia are zinc, vitamin C, vitamin B12, and folic acid. Vitamin C can increase the absorption of non-heme iron, and it has been shown that vitamin C supplementation can increase hemoglobin concentration [7].

Effects of anemia in adolescents include increased morbidity, reduced physical performance abilities, and decreased cognitive function, then causes the inhibition of learning abilities and school achievement in adolescents with anemia [8]. The effect of anemia on cognitive abilities, namely the capacity to solve problems, the ability to concentrate, remember an

event that has passed, and understand the physical and social environment [9]. Based on the above background and associated the incidence of anemia in adolescents is quite high. The choice of instant food consumption and micronutrient deficiencies play a role in the production of erythrocyte cells that can cause anemia so researchers are interested in knowing the relationship between micronutrient intake and the incidence of anemia in adolescents.

2. MATERIAL AND METHOD

This research is a descriptive-analytic study using a cross-sectional approach. The population of this research is the students in class 19 of the Faculty of Medicine, Indonesian Christian University, aged 17-19 years, totaling 60 people. A sampling of this research used a purposive sampling technique. Laboratory examinations at UKI General Hospital were used to determine hemoglobin status using the hematology analysis method. Data were collected by interviewing respondents using a questionnaire. Micronutrient intake was measured using a food recall instrument for 2x24 hours, then analyzed with nutrisurvey software and compared with the RDA. Data analysis carried out was univariate and bivariate with chi-square test

3. RESULT

All research respondents, obtained male respondents as much as 23.3% and the highest distribution of female respondents as much as 76.7%. Most of the respondents were 18 years old (56.7%), and the rest were 19 years (30%) and 17 years (13.3%). For Hemoglobin status, there are 25% of respondents have anemia, and 75% have normal Hemoglobin (Table 1)

Table 1: Distribution of Respondents by Anemia Status

Anemia Status	Total Subjects	Percentage
Anemia	15	25%
Non-anemia	45	75%
TOTAL	60	100%

Table 2: Distribution of Respondents by Micronutrient intake

Micronutrient intake	Total	Percentage
Iron intake		
- Less	13	21.7%
- Sufficient	47	78.3%
Vitamin B12 intake		
- Less	10	16.7%
- Sufficient	50	83.3%
Folic acid intake		
- Less	12	20%
- Sufficient	48	80%
Zinc intake		
- Less	21	35%
	39	65%
Vitamin C intake		
- Less (<80% RDA)	33	55%
- Sufficient (≥80% RDA)	27	45%

Intake of multi micronutrients (Fe, vitamin B12, folic acid, zinc, and vitamin C), the intake of Fe (iron) 21.7% of respondents were in the less category and 78.3% of the intake was sufficient, the intake of vitamin 12 was 16.7 % less and 83.3% sufficient, folic acid intake as much as 20% less and 80% sufficient, zinc intake 35% less and 65% sufficient and vitamin C intake as much as 55% less and 45% sufficient (Table 2).

ISSN 2349-7823

International Journal of Recent Research in Life Sciences (IJRRLS)
Vol. 9, Issue 3, pp: (9-13), Month: July - September 2022, Available at: www.paperpublications.org

Table 3: Correlation between nutrition intake and anemia status

	Anemia		Non-Anemia		p-value
	n	%	n	%	
Iron intake					
Less	10	76,9	3	23,1	0,000
Sufficient	5	10,6	42	89,4	
Vitamin B12 intake					
Less	8	80	2	20	0,000
Sufficient	7	14	43	86	
Folic acid intake					
Less	8	66,7	4	33,3	0,001
Sufficient	7	14,6	41	85,4	
Zinc intake					
Less	12	57,1	9	42,9	0,000
Sufficient	3	7,7	36	92,3	
Vitamin C intake					
Less	8	24,2	25	75,8	1,000
Sufficient	7	25,9	20	74,1	
Total	15		45		

Intake of iron (Fe), the respondents with anemia status who had a sufficient intake of iron were 5 people (10.6%). Respondents with non-anemic status (normal) had more iron intake in the sufficient category, 42 people (89.4%). Vitamin B12 intake in the anemia status respondents with sufficient category was 7 people (14%). Adolescents with non-anemic (normal) status had more intakes of Vitamin B12 in the sufficient category, 43 people (86%). The intake of folic acid in the anemia status respondents with sufficient category was 7 people (14,6%). Respondents with non-anemic status (normal) had more folic acid intake in the sufficient category, 41 people (85.4%). Zinc intake in the anemia status respondents with sufficient category as many as 3 people (7.7%). Respondents with non-anemic (normal) status had more zinc intake in the sufficient category, 36 people (92.3%). Vitamin C intake in the anemia status respondents with sufficient category was 7 people (25.9%). Respondents with non-anemic (normal) status had more intake of Vitamin C in the sufficient category of 20 people (74.1%).

4. DISCUSSION

This study found the number of respondents who experienced anemia as many as 15 people (25%) and as many as 45 people (75%) who did not experience anemia. The average age of the respondents was 18 years. Respondents who experience anemia due to lack of iron intake and intake of other nutrients that can affect heme synthesis. Other nutritional deficiencies that can cause anemia are folic acid, vitamin B12, zinc, and vitamin C1. The results of this study there are 13 respondents who have less iron intake (<80% RDA), of which 10 respondents (76.7%) have anemia, while as many as 3 respondents (23.1%) do not have anemia, in Table 3. Based on the results from the 2x24 hour food recall, respondents who are anemic consume less red meat (beef, goat) as a source of iron, while respondents who are not anemic with sufficient iron intake consume beef and white meat (chicken and fish) on average. On average, anemic respondents consume tofu, tempeh, and green vegetables (spinach and cassava leaves) as sources of iron. The results of the Chi-square statistical test obtained a value of p = 0.000 (p <0.05), so there is a relationship between iron intake and the incidence of anemia in students of the Faculty of Medicine UKI class 2019. The results of this study are in accordance with research conducted by Arenda, stating that there is a relationship between iron intake and the incidence of anemia, the more iron intake of the respondent, the higher the hemoglobin level [10].

Sufficient iron stores will meet the needs for the formation of red blood cells in the bone marrow. Iron has a role in the formation of hemoglobin. Iron deficiency can reduce Hb and plasma ferritin levels causing iron anemia. Iron in food can be in the form of Fe-heme and Fe-nonheme. Food sources of Fe-heme are liver, red meat, red meat (beef, goat, and lamb), and white meat (chicken and fish) can be absorbed as much as 20-30%, the higher the iron intake, the higher the hemoglobin level of adolescents [11],[12]. Food sources of non-heme Fe are beans and green vegetables [13], DCN S can be absorbed by only 1-6% [12]. In table 3, the results showed that 10 respondents had less vitamin B12 intake (<80% RDA), of which 8 respondents (80%) had anemia, while 2 respondents (20%) did not. Adolescents with non-anemic (normal) status had

more vitamin B12 intake in the sufficient category, 43 people (86%). The results of the 2x24 hour food recall show that the anemic respondents consume less red meat (beef, goat), milk, and eggs as a source of vitamin B12. Foodstuffs containing vitamin B12 are meat, fish, shellfish, poultry, and milk [14]. The results of the Chi-square statistical test between vitamin B12 intake and anemia obtained a p-value = 0.000 ($p<0.05$). So there is a relationship between vitamin B12 intake and the incidence of anemia in students of the Faculty of Medicine UKI class 2019. The results of this study are in accordance with research conducted by Moris which stated that vitamin B12 significantly affects the incidence of anemia. Vitamin B12 and iron play a role together in the formation of erythrocytes. [15].

In a normal stomach, the parietal cells of the gastric glands secrete a glycoprotein called intrinsic factor, which combines with vitamin B12 from food, so that vitamin B12 can be absorbed by the intestines. If the body lacks intrinsic factors, this will cause a lack of vitamin B12 availability due to abnormalities in the absorption of vitamin [14],[16]. Vitamin B-12 is a cofactor for the enzyme methionine synthase requiring vitamin B-12 in the form of methylcobalamin which catalyzes the conversion of homocysteine to methionine through the transfer of a methyl group from methyltetrahydrofolate. This enzyme links the methylation pathway through the synthesis of the methyl donor S-adenosyl methionine and the pathway by which purines and pyrimidines are synthesized via tetrahydrofolate. Vitamin B-12 deficiency impairs red blood cell synthesis (megaloblastic anemia due to abnormal DNA synthesis) [15],[17]. Vitamin B12 has a function closely related to folate. Vitamin B12 is needed to convert folate into its active form [16],[18].

Folic acid intake in anemic status with sufficient category was 7 people (14.6%) while non-anemic status (normal) who had sufficient folic acid intake was 41 people (85.4%) in table 3. The 24-hour recall results showed that the intake of folic acid on the respondent's consumption of food sources of folic acid such as liver, cereals, mushrooms, and spinach which is the respondent's diet. Most of the serum folate is in the inactive form of 5-methyltetrahydrofolate (5-methyl THFA). Entering cells, 5-methyl THFA is demethylated to tetrahydrofolate (THFA) as the active form. Cobalamin (B-12) serves as a cofactor for this demethylation. Tetrahydrofolate is involved in the formation of many coenzymes in the metabolic system, especially for the synthesis of purines and pyrimidines (formation of DNA), nucleoprotein synthesis, and maintenance in erythropoiesis [17],[19].

There were 3 people (7.7%) with enough zinc intake in anemia status, with more non-anemic (normal) status, and 36 people (92.3%). From the results of a 2x24 hour food recall, it shows that the majority of respondents consume fish, tofu, tempeh, and rice as sources of zinc intake. Zinc acts as a catalyst in iron metabolism as a cofactor for the enzyme alpha-aminolevulinic acid (ALA) - dehydratase which plays a role in the synthesis of heme. [18],[19],[20],[21]. Vitamin C intake of anemia status with sufficient category was 7 people (25.9%), while the non-anemic status (normal) was more who had sufficient vitamin C intake category of 20 people (74.1%). The results of a 2x24 hour food recall it shows that respondents who suffer from anemia consume less fruit and vegetables as a source of vitamin C intake. Vitamin C is also known as ascorbic acid. Vitamin C is hydrophilic and works best in aquatic environments. Vitamin C and vitamin E function as antioxidants [20],[22]. Vitamin C plays a role in the absorption and metabolism of iron, vitamin C reduces iron to ferric and becomes ferrous in the small intestine making it easy to absorb [21],[23]. There are two types of iron in foodstuffs, namely heme iron as a ferrous compound found in animal foodstuffs and non-heme iron as a ferric compound found in many plant foods. The form of ferrous compounds can be directly absorbed by the intestines, while the ferric compounds before being absorbed by the intestines must be converted into ferrous forms by vitamin C as an enhancer [22], [24]. Foodstuffs that contain vitamin C are papaya, oranges, cantaloupe, broccoli, cabbage, peppers, grapes, and strawberries.

5. CONCLUSION

Based on dietary analysis data, there is a correlation between the incidence of anemia and diet, micronutrient intake and the incidence of anemia in adolescents. It is recommended that students increase their consumption of foods rich in iron, vitamin B12, folic acid, zinc, and vitamin C.

REFERENCES

[1] Nutritional Anaemias/ (2018) Tools For Effective Prevention [Internet]. World Health Organization; Available. Https://Www.Who.Int/Nutrition/Publications/Micronutrients/Anaemias-Tools-Prevention-Control/En/

[2] Priyanto Ld. (2018) Hubungan Umur, Tingkat Pendidikan, Dan Aktivitas Fisik Santriwati Husada Dengan Anemia. J Berk Epidemiol. 6:139–46.

[3] Kaimudin Ni, Lestari H, Afa, Rusli J. Skrining Dan Determinan Kejadian Anemia Pada Remaja Putri Sma Negeri 3 Kendari Tahun 2017. J Ilm Mhs Kesehat Masy. 2(6):1–10.

[4] Sholicha Ca, Muniroh L. (2019) Hubungan Asupan Zat Besi, Protein, Vitamin C Dan Pola Menstruasi Dengan Kadar Hemoglobin Pada Remaja Putri Di Sman 1 Manyar Gresik. Media Gizi Indones. 14(2):147–53.

[5] Citrakesumasari. 2012. Anemia Gizi Masalah dan Pencegahannya.Yogyakarta: Kalika; 2012

[6] Masthalina H.(2015). Pola Konsumsi (Faktor Inhibitor Dan Enhancer Fe) Terhadap Status Anemia Remaja Putri. Jurnal Kesehatan Masyarakat 11(1):80- 6. doi:10.15294/kemas.v11i1.3516.

[7] Sahana ON, Sumarmi S. [2015). Hubungan Asupan Mikronutrien Dengan Kadar Hemoglobin Pada Wanita Usia Subur (WUS). Media Gizi Indones. 10:184–91.

[8] Latifah L, Setyani A, Nurcahyani YD. (2015). Anemia, prestasi, dan kecerdasan pada remaja awal laki-laki dan perempuan. MGMI Vol. 7, No. 1, Desember. 45-56.

[9] Sallindri Y. (2019). Hubungan Antara Siklus Menstruasi, Lama Menstruasi, Kebiasaan Sarapan Pagi Dan Pola Aktivitas Sehari-hari Dengan Kejadian Anemia Pada Remaja Putri 1. J Kesehat "Akbid Wira Buana." 5(3):1–10.

[10] Saptyasih Arn, Widajanti L, Nugraheni S. (2016) Hubungan Asupan Zat Besi, Asam Folat, Vitamin B12 Dan Vitamin C Dengan Kadar Hemoglobin Siswa Di Smp Negeri 2 Tawangharjo Kabupaten Grobogan. J Kesehat Masy. 4.

[11] Dian PK. Hubungan Asupan Zat Gizi dan Pola Menstruasi dengan Kejadian Anemia pada Remaja Putri di SMA N 2 Semarang. Universitas Diponegoro Semarang.

[12] Adriani M, Wirjatmadi B. (2013). Pengantar Gizi Masyarakat. Kencana Prenada : Jakarta

[13] Susetyowati DCN. (2016). Gizi Remaja. In: Hardinsyah M, Supariasa IDN, editors. Ilmu Gizi:Teori&Aplikasi. Jakarta: Penerbit Buku Kedokteran EGC; p. 164

[14] Ahmad A. (2016) Vitamin. In: MS H, Supariasa IDN, editors. Ilmu Gizi: Teori&Aplikasi. Jakarta: Penerbit Buku Kedokteran EGC

[15] Moris M.S. (2007) Folate and Vitamin-B12 Status in Relation to Anemia, Macrocytosis, and Cognitive Impairment in Older Americans in Age of Folic Acid Fortification. American J Clin Nutrition. (85):193-200.

[16] Ary W. (2004) Hubungan antara asupan energi dan protein dengan status gizi, status kesehatan dan latihan fisik dengan kesegaran jasmani [Skripsi]. Semarang: Program Studi Ilmu Gizi Fakultas Kedokteran Universitas Diponegoro;

[17] Ankar A, Kumar A. (2022) Vitamin B12 Deficiency. (Updated 2021 Jun 7). In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing

[18] Sunita Almatsier. (2003). Prinsip dasar ilmu gizi. Jakarta: Gramedia Pustaka Utama; 184-5,194-7,248-9

[19] Khan KM, Jialal I. (2022) Folic Acid Deficiency. [Updated 2021 Sep 28]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing.

[20] Soliman JSA, Amer AY, Soliman JSA. (2019). Association of Zinc Deficiency with Iron Deficiency Anemia and its Symptoms : Results from a Case-control Study. 11(1):1–7.

[21] R.Yekti, Bukhari A , Jafar N4 , Thaha AR. (2018) Correlation between Micronutrient intake and Hemoglobin Preconception Women. Indian Journal of Public Health Research & Development, December Vol. 9, No. 12

[22] Bhuvaneswari S, Joshi M, Souza DA. (2015) Quantitative Analysis of Iron and Ascorbic acid contents in locally consumed Fruits and Vegetables. 4(7):42–7.

[23] Gropper SS, Smith JL, Groff JL. (2017) The Water-Soluble Vitamins. In: Advanced Nutrition and Human Metabolism (7th Edition). 7th ed. Australia: Cengage Learning; 7th edition; p. 314