ARTÍCULO ORIGINAL

Gac Méd Caracas 2023;131(Supl 4):S581-S590
DOI: 10.47307/GMC.2023.131.s4.13

Effect of Crispy Catfish and Red Beans on Increasing the Hemoglobin Level of Young Women with Anemia

Efecto del Bagre Crujiente y Las Judías Rojas en el Aumento del Nivel de Hemoglobina en Mujeres Jóvenes con Anemia

Widi Hastuti[2a], Gurid Pramintarto Eko Mulyo [2a], Mimin Aminah[3a], Widartika Widartika[4a], Syarif Assalam[5b], Shilka Amelia[6a], Muna Nur Aeni[7a]

SUMMARY

Introduction: *Women have the highest risk of sufering anemia, especially young women. One way to prevent anemia in adolescents is to increase the intake of food sources of protein and iron. One of the food sources of protein is catfish. Red beans as a vegetable source that contains iron and is high in fiber. Crispy catfish and red beans are food products that are processed, served attractively, and have a long shelf. The study aimed to determine the effect of crispy catfish and red beans on increasing hemoglobin (Hb) levels in young women with anemia.*
Methods*: This study used a quasi-experimental pre-test – post-test design. The sample of young women was 26 people per group, totaling 52 samples. In both groups, interventions were carried out every day for 21 days with interventions in the form of snacks. The intervention group was given 60 grams of crispy catfish and red beans, while the control group was given 60 grams of crispy without catfish and red beans.*
Results: *Crispy catfish and red beans per serving size of 60 grams contained 128.45 % of energy, 95.5 % of protein, 83.5 % of fat, 154.87 % of carbohydrates, 28.93 % fiber, and 0.39 % of iron. There was no significant difference in the food intake of respondents before the intervention, between the intervention group and the control group, for energy value p=0.681 (p<0.05), protein value p=0.267 (p>0.05), fat value p=0.428 (p>0.05), carbohydrate value p=0.126 (p>0.05), fiber value p=0.139 (p>0.05), and Fe value p=0.122 (p≤0.05). There is a significant difference in protein intake after the intervention (with catfish crispy) value p=0.0001 (p<0.05), while energy intake, carbohydrates, fat, fiber, and Fe there was no difference. There was a significant increase in Hb levels in young women after the intervention, with a p-value of 0.0001 (p <0.05).*
Conclusion: *This product can be an alternative snack for young women with anemia. The highest protein score is the amino acid Lysine. There is an effect on protein intake and an increase in the Hb level of young women with anemia after the intervention of giving crispy catfish and red beans.*

Keywords*: Anemia, hemoglobin level, young women, local food production, malnutrition.*

DOI: https://doi.org/10.47307/GMC.2023.131.s4.13

ORCID: 0000-0003-1700-5679[1]
ORCID: 0000-0003-4701-9588[2]
ORCID: 0009-0000-9712-0874[3]
ORCID: 0000-0001-9097-5757[4]
ORCID: 0009-0000-0063-2858 [5]
ORCID: 0009-0009-9438-8758 [6]
ORCID: 0009-0002-0170-4221 [7]

[a] Politeknik Kesehatan Kemenkes Bandung, Bandung, Indonesia
[b] Universitas Pasundan Bandung, Bandung, Indonesia

*Corresponding Author: Widi Hastuti
E-mail: widihastuti@staff.poltekkesbandung.ac.id

Recibido: 29 de junio 2023
Aceptado: 26 de julio 2023

RESUMEN

Introducción: *Las mujeres tienen el mayor riesgo de sufrir anemia, especialmente las jóvenes. Una forma de prevenir la anemia en adolescentes es aumentar la*

ingesta de proteínas y hierro de fuentes alimentarias. Una de las fuentes alimentarias de proteínas es el bagre. Las alubias rojas son una fuente vegetal que contiene hierro y es rica en fibra. El bagre crujiente y las alubias rojas son productos alimenticios que se procesan, se sirven de forma atractiva y tienen un largo período de conservación. El objetivo del estudio fue determinar el efecto de la administración de bagre crujiente y alubias rojas sobre los niveles de hemoglobina (Hb) en mujeres jóvenes con anemia. **Métodos:** *Este estudio utilizó un diseño cuasi-experimental pre-test - pos-test. La muestra de mujeres jóvenes fue de 26 personas por grupo, por lo que el total es de 52 muestras. En ambos grupos se realizaron intervenciones diarias durante 21 días con intervenciones en forma de tentempiés. Al grupo de intervención se le dieron 60 gramos de bagre crujiente y alubias rojas, mientras que al grupo de control se le dieron 60 gramos de bagre crujiente sin alubias rojas.* **Resultados:** *El bagre crujiente y las alubias rojas por ración de 60 gramos pueden aportar 128,45 % de energía, 95,5 % de proteínas, 83,5 % de grasas, 154,87 % de hidratos de carbono, 28,93 % de fibra y 0,39 % de hierro. No hubo diferencias significativas en la ingesta de alimentos antes de la intervención entre el grupo de intervención y el grupo de control, para el valor energético p=0,681 (p<0,05), el valor proteico p=0,267 (p>0,05), el valor de grasa p=0,428 (p>0,05), el valor de carbohidratos p=0,126 (p>0,05), el valor de fibra p=0,139 (p>0,05), y el valor de Fe p=0,122 (p≤0,05). Se observó una diferencia significativa en la ingesta de proteínas después de la intervención (con bagre crujiente) p -valor =0.0001 (p<0.05), mientras que en la ingesta de energía, carbohidratos, grasa, fibra y Fe no hubo diferencias. Se obsevó un incremento significativo en los niveles de Hb de las mujeres jóvenes entre el grupo de intervención y el grupo de control, con un valor de p 0,0001 (p <0,05).* **Conclusiones:** *Este producto puede ser un tentempié alternativo para mujeres jóvenes con anemia. La puntuación de proteína más alta es el aminoácido Lisina. Existió un efecto sobre la ingesta de proteínas y un aumento del nivel de Hb de las mujeres jóvenes con anemia tras la administración de bagre crujiente y alubias rojas.*

Palabras clave: *Anemia, nivel de hemoglobina, mujeres jóvenes, producción local de alimentos, malnutrición.*

INTRODUCTION

Anemia is one of the health problems around the world. The global prevalence of anemia in women aged 15-49 years was 29.9 % (1-3). It causes anemia in young women to become a health problem with a prevalence of >15 %. According to Basic Health Research (2013), the prevalence of anemia in Indonesia is 21.7 %, with 26.4 % of anemia patients aged 5-14 years and 18.4 % of patients aged 15-24 years (4,5). Women, especially young women, have the highest risk of anemia (6-8).

Young women are one of the groups at risk of anemia (6,9). Menstruating girls need iron to replace menstrual loss. Iron loss during one menstrual cycle (about 28 days) is approximately 0.56 mg daily. This amount is coupled with a basal loss of 0.8 mg daily, bringing the total iron loss to 1.36 mg daily. According to Lutfiasari, et al. (2023), the limit of hemoglobin (Hb) levels for young women to diagnose anemia is if the Hb level is less than 12 g/dL (10). Anemia causes a reduction of oxygen binding to hemoglobin and transport from the lungs to the rest of the body, which will result in difficulty concentrating and learning. In addition, physical endurance is low, with a decrease in physical activity and with the consequence to get sick easily (12,13).

Iron is required for the synthesis of hemoglobin. Iron deficiency happens because young women experience menstruation every month. Intake of nutrients in the body must be fulfilled, especially in adolescents. Protein intake in the body is beneficial for iron absorption. Besides, vitamin C in the adolescent body must be fulfilled because vitamin C is a reducing agent. Then in the intestine, iron will be maintained in the form of iron so that it is more easily absorbed by consuming food sources of iron (14).

A low intake of protein sources can cause anemia in young women (15). In the population aged 16-18 years, the average adequacy of protein consumption is 64.4 %, and adolescents who consume below the minimum need as much as 35.6 % (16). One of the government programs to overcome anemia in young women is the provision of blood supplement tablets with a national target. Young women get blood tablets with preventive doses, namely once a week and once a day during menstruation. However, the provision of blood supplement tablets only focuses on pregnant women, while for young

women has not been done optimally (17). It causes a high incidence of anemia in young women (18).

Overcoming the problem of anemia that occurs in young women can be done by including supplementary iron in the form of snacks like crispy catfish and red beans. Based on local food, young women's snacks are prioritized in animal and vegetable protein sources. Indonesia has a variety of diverse foods, and local food has great potential to be a functional food source. Good functional food should be a daily consumption pattern, especially locally based, to improve healthy function and health and reduce disease risk.

Catfish is a source of animal protein as one of the local foods that the Indonesian people widely use for food. The benefits of bioactive components in catfish are the content of unsaturated fatty acids that can reduce the risk of disease and improve immune function. Abundant availability of catfish, with total catfish production in Indonesia reaching 116 114 tons in 2022 (19). The price is relatively affordable, making catfish chosen to be a food that is widely used by the Indonesian people to be used as food that somebody can consume daily. Nutrients in 100 g of fresh catfish are energy 135 kcal, protein 17 grams, fat 6.6 grams, carbohydrates 1.1 g, and Iron 1.6 mg (20). The nutritional content of catfish is higher than snakehead fish, as the protein content in snakehead fish is only 16.2 g, and iron content is only 0.1 mg. Catfish is good local food for people with anemia because of its high iron content (20).

Research conducted by Hastuti (2022) resulted in the product crispy catfish (20). This product contains protein but lacks fiber content. If we want a crispy product that contains protein and fiber, then the product needs to add fiber-source food, namely red beans, with a fiber content of 4.0 g/100 g. Red beans have a relatively high iron content compared to other beans. Red beans have an iron content of 10.3 mg/100 g (21). Iron in red beans is high compared to other legumes such as mung beans, which contain as much as 7.5 mg/100 g, soybeans 6.9 mg/100 g, cashew nuts 3.8 mg/100 g, and peanuts 4,1 mg/100 g (21). Total red bean production in Indonesia reached 66.210 tons (22).

Crispy catfish is a processed product liked by people of various ages, such as children, adolescents, and adults. This product is preferred because it has a crunchy texture and is easy to digest. Based on the results of other studies, the group of adolescents studied was given an intervention by giving high iron (Fe) food products such as snack bars, cookies, biscuits, and muffins (10,23-25). Crispy products can innovate in making high-protein and iron food products (21). This processed product is highly nutritional because it contains carbohydrates, protein, fat, iron, and high fiber.

The high protein and iron content in catfish and red beans is expected to increase protein and iron intake for young women with anemia. The study aimed to determine the effect of crispy catfish and red beans on increasing hemoglobin (Hb) levels in young women with anemia.

METHODS

This study used a quasi-experimental pre–test–post–test design. The study design compared the incidence of anemia among young women before and after the intervention. This research received approval for an ethical review from the Health Research Ethics Commission of the Health Polytechnic of the Ministry of Health Bandung No. 09/KEPK/EC/VIII/2021, dated August 10, 2021.

Sampling was carried out using purposive sampling techniques. The criteria for inclusion of the sample were adolescents aged 10-15 years, had menstruation, did not suffer from chronic diseases such as pulmonary tuberculosis and hepatitis, did not eat foods containing iron inhibitors, namely tannins, and students were willing to participate in the study by filling out informed consent. The sample size was determined based on calculations using the formula Lameshow, 1990, and considered the addition of subjects who dropped out by 10 %. From the analysis of the formula, a minimum sample of 26 young women (intervention group) and 26 young women (control group) was obtained so that the total sample was 52 young women.

This study used instruments in the form of interview questioners to determine the

characteristics of samples (age, Hb level) and respondents (age, education level, occupation), SFFQ (Semiquantitative Food Frequency Questioner) forms and 1 x 24-h recall forms for measured food intake. The independent variable was the intervention of giving crispy catfish and red beans. The dependent variable is the hemoglobin level of young women (26).

The interventions were carried out every day for 21 days in the form of snacks. The intervention group was given 60 grams of crispy catfish and red beans, with an energy content of 253.72 kcal and protein of 5.68 g; while the control group was given 60 grams of crispy , with an energy content of 197.50 kcal, protein 6.00 g (Recommended Nutritional Adequacy Rate for Young Women, Ministry of Health, 2019). This intervention was carried out at school and accompanied by their respective teachers. After intervention, Hb levels and food intake was assessed using the 2 x 24-hours recall method on days 5 and 15 (26).

This study used univariate analysis to categorize sample characteristics (age), respondent characteristics (age, education level, occupation), and nutritional status presented in a frequency distribution table and analyzed descriptively. This study used bivariate analysis to determine the relationship between variables. Bivariate analysis was used for the dependent t-statistical Test to determine differences in food intake and Hb values before and after the intervention. The limit of significance used a 95 % confidence level with a p-value <0.05.

Protein score is the arrangement and number of amino acids contained in protein molecules because the efficiency of using protein in the body will depend on the smallest number of essential amino acids (27). The quality of protein is determined by the amount and the arrangement of amino acids in the protein. Protein is said to be of high quality if it has an amino acid arrangement that matches the arrangement of amino acids in human body tissues (28). The quality of the new product's amino acids is determined to be compared with egg amino acids, considered the standard of amino acid perfection. The value of one amino acid, e.g., tryptophan, is compared to the total number of amino acids of the whole product, then a percentage is produced. The formula to get a protein score on a product is by comparing the percentage of one amino acid with the percentage amino acid of the egg so that it can be said to be a protein score, with a unit of "score."

$$\text{Protein score: } \frac{\%\ \textit{amino acid of produc}}{\%\ \textit{standard of amino acid (egg)}}$$

RESULTS

The characteristics of the sample according to the father's education, father's occupation, mother's education, and mother's occupation are presented in Table 1.

Table 1 shows that most of the father's education level was a senior high school in both the intervention and control groups. The father type of work was partly self-employed in both the intervention and control groups. The mother's education level in the intervention and control groups was mostly senior high school. The level of education was a factor that affects the quality and quantity of food because, with a high level of education, it was expected that the knowledge and information about nutrition will be better. The mother's work was significant as a housewife in the intervention and control groups.

The results of testing the nutritional value of crispy catfish and red beans per 100 grams are presented in Table 2.

Table 2 shows that 100 g of crispy catfish and red beans contain an energy of 514.15 Kcal and a protein calorie percent of 46 %. The results of testing the nutritional value of crispy catfish and red beans per serving size of 60 grams are presented in Table 3 below.

Table 3 shows that crispy catfish and red beans per serving size of 60 grams can contribute 128.45 % of energy, 95.5 % of protein, 83.5 % of fat, 154.87 % carbohydrates, 28.93 % fiber, and 0.39 % of iron. The type of protein score crispy catfish and red beans can be seen in Figure 1. It shows that lysin was the highest type of amino acid in crispy catfish and red beans.

Table 1

Sample Characteristics According to Father's Education, Father's Occupation, Mother's Education, and Mother's Occupation

Variable	Intervention Group		Control Group	
	n (26)	%	n (26)	%
Father's education				
Junior High School	0	00.0	0	00.0
Senior High School	20	76.9	15	57.7
Diploma	6	23.1	7	26.9
Bachelor	0	00.0	4	15.4
Father's occupation				
Civil Servants	0	0.0	0	00.0
Private employees	2	7.7	3	11.5
Self-employed	23	88.5	23	88.5
Laborer	1	3.8	0	00.0
Mother's education				
Junior High School	0	00.0	0	00.0
Senior High School	20	76.9	18	69.2
Diploma	4	15.4	3	11.5
Bachelor	2	7.7	5	19.2
Mother's occupation				
Civil Servants	1	3.8	0	0.0
Private employees	2	7.7	2	7.7
Self-employed	9	34.6	2	7.7
Housewives	14	53.8	22	84.6

Table 2

The Nutritional Value of Crispy Catfish and Red Beans per 100 g

Groceries	Net weight (g)	Gross weight (g)	Energy (Kcal)	Protein (g)	Fat (g)	Carbohydrate (g)
Catfish Flour	40	308	406.15	52.31	20.31	3.38
Red Bean Flour	60	63	108.00	6.95	1.39	17.68
	Total		514.15	59.26	21.70	21.07
	BMC requirements		360.00	46 % (≥16 %)		

Table 3

The Nutritional Value of Crispy Catfish and Red Beans per Serving Size of 60 grams compared to the Daily Value (RDA)

Test Type	Lab Test Results	Average DV Snack Age 10 - 15 years	% DV
Energy	253.72 kcal	197.50	128.46
Protein	5.73 g	6.00	95.50
Fat	5.68 g	6.80	83.50
Carbohydrates	44.92 g	29.00	154.87
Fiber	0.81 mg	2.80	28.93
Iron	0.47 mg/kg	1.20	0.39

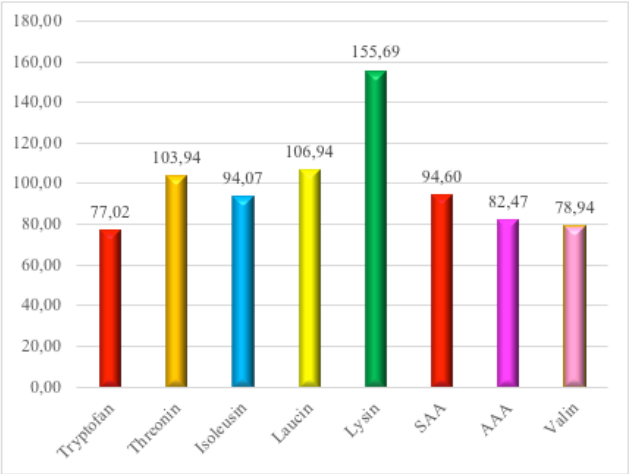

Figure 1. Protein Score Crispy Catfish and Red Bean (The unit of the protein score is the "score")

Table 4 shows the results of statistical tests using the Independent T-test at a 95 % confidence level, indicating that there was no significant difference in the food intake of respondents before the intervention between the intervention group and the control group for energy value p=0.681 (p<0.05), protein value p=0.267 (p>0.05), fat value p=0.428 (p>0.05), carbohydrate value p=0.126 (p>0.05), fiber value p=0.139 (p>0.05), and Fe value of p=0.122 (p≤0.05).

Table 4

Food Intake of Respondents Before Intervention Between the Intervention Group and the Control Group

Variable	Intervention Group (n=26)			Control Group (n=26)			Value of p*
	Min-Max	Average	SD	Min-Max	Average	SD	
Energy	1 515.20 –1 691.55	1 609.77	51.22	1 648.6 – 1 982.4	1 782.26	89.00	0.681
Protein	48.15 – 51.81	49.54	1.02	46.39 – 51.24	49.41	1.23	0.267
Fat	54.54 – 57.60	55.79	0.94	53.27 – 59.87	57.02	1.64	0.428
Carbohydrate	231.72 – 242.33	238.68	3.13	249.47 – 290.15	259.74	10.23	0.126
Fiber	19.19 – 23.81	22.08	1.50	19.27 – 22.83	21.10	1.03	0.139
Iron	7.43 – 9.45	8.91	0.44	7.01 – 8.99	8.06	0.56	0.122

*Independent Test

Table 5 shows the results of statistical tests using the Independent T-test at a 95 % confidence level, showing that there was a significant difference in protein intake after the intervention (with catfish crispy) value p=0.0001 (p<0.05) while energy intake, carbohydrates, fat, fiber, and Fe there was no difference.

Table 5

Food Intake of Respondents After Intervention (with Crispy Catfish and Red Beans Between Intervention Group and Control Group

Variable	Intervention Group (n=26)			Control Group (n=26)			Value of p*
	Min-Max	Average	SD	Min-Max	Average	SD	
Energy	1 750.38 – 1 935.26	1 851.26	52.11	1 712.26 –1 945.27	1 842.96	61.10	0.600
Protein	54.26 – 56.78	55.39	1.11	50.02 – 50.66	50.21	0.14	0.0001
Fat	59.24 – 63.23	61.04	0.89	54.25 – 63.28	60.74	1.52	0.397
Carbohydrate	272.24 – 287.25	282.18	4.25	266.24 – 287.25	280.19	6.62	0.204
Fiber	20.00 – 24.62	22.66	1.51	19.96 – 24.52	1.18	1.03	0.286
Iron	8.20 – 9.55	8.93	0.39	8.12 – 9.45	8.82	0.42	0.313

*Independent Test

Table 6 shows that there was a significant difference in change in food intake before and after intervention between the intervention group and the control group with a value of P = 0.025. This result showed that giving crispy catfish and kidney beans is effective in increasing protein intake.

Table 6

Comparison of Changes in Food Intake Before and After Intervention in Intervention Group and Control Group

Variable	Intervention Group (n=26)		Control Group (n=26)		Value of P
	Mean	SD	Mean	SD	
Energy	234.75	96.81	218.14	135.23	0.082
Protein	8.97	3.62	3.21	8.33	0.025
Lemak	11.45	4.36	10.01	4.02	0.939
Carbohydrate	39.65	20.52	35.18	18.26	0.799
Fiber	5.99	2.32	5.01	2.64	0.436
Iron	1.76	0.98	1.43	1.16	0.242

*Independent Test

Table 7 shows that the mean Hb level in the intervention group was higher than the control group, which is 12.45 g/dL in the intervention group and 11.86 g/dL in the control group.

Table 7

Hb Levels of the Intervention Group and Control Group Before and After the Intervention

Variable	Intervention Group (n=26)		Control Group (n=26)		p-value	95 % CI
	Mean	SD	Mean	SD		
Hb Levels Before	11.87	0.99	11.56	1.42	0.357	-0.37;0.99
Hb Levels After	12.45	0.48	11.86	0.39	0.0001	0.36;0.83

DISCUSSION

The results showed that there was no significant difference in the young women's food intake before the intervention between the intervention group and the control group for energy, carbohydrate, fat, fiber, and iron intake. There was a significant difference in protein intake after the intervention. At the same time, there were no differences in energy, carbohydrate, fat, fiber, and iron intake after the intervention with crispy catfish and red beans. This study is in line with other studies, which stated a significant difference in protein intake after giving red bean, banana, and tuna-based cookies (29).

100 g of crispy catfish and red beans contain 514.15 Kcal of energy and 46 % of protein calories. The highest protein score was the amino acid lysine, with a protein score value of 155.69. Lysine is important for adequate growth, and it plays an essential role in the production of carnitine, a nutrient responsible for converting fatty acids into energy and helping lower cholesterol. Humans synthesize L-carnitine from the amino acids lysine and methionine in a multi-step process occurring across several cell compartments. It can increase β-oxidation so that somebody can reduce the accumulation of body fat. In addition, lysine can increase the activities of antioxidant enzymes by upregulating Nrf2 and upregulating the expression of antioxidant enzyme genes, thereby increasing the ability of free radical scavenging to protect against oxidative damage (30).

An adequate energy and protein diet is necessary to reduce inflammation and increase iron absorption. Malnutrition of protein and energy stimulates increased cytokine production with inflammation, immune deficiency, and anemia (31). There is a mechanism to increase iron absorption in people with iron deficiency. The form of iron entering the duodenum affects its absorption. Heme iron derived from animal foods is more easily absorbed, does not depend on duodenal pH, and is not affected by inhibitory substances such as phytate and polyphenols (32). Therefore, catfish, one of the animal source foods, can be an excellent source of iron.

After the intervention, hemoglobin levels in the intervention group were higher than in the control group with crispy catfish and red beans. This study aligns with other studies that state that fried catfish cakes effectively increase hemoglobin levels and blood oxygen saturation (33).

Bioavailable heme iron is 15 %-35 %, and bioavailable non-heme iron is 2 %-20 % (34). Despite its lower bioavailability, the amount of non-heme iron in legume foods can be more significant than heme iron in most foods, so non-heme iron generally contributes more than heme iron (35). Red beans are non-heme iron. Vitamin C can help increase iron absorption because of its ability to reduce ferric to ferrous iron and its ability to chelate iron (36). The combination of catfish and red beans is recommended for snacks for anemic young women. These crispy catfish and red bean products can contribute to the nutritional adequacy of snacks for the age group of 10-15 years. This research aligns with Hastuti et al. (35), which states that red bean catfish-based products can be used as an alternative snack because they contain high protein and iron, suitable for young women with anemia.

CONCLUSION

Crispy catfish and red bean products can be alternative snacks for young women with anemia. The highest protein score is the amino acid Lysine. There is an effect on protein intake and an increase in the Hb level of young women with anemia after the intervention of giving crispy catfish and red beans.

REFERENCES

1. Puspitasari HZG, Armini NKA, Pradanie R, Triharini M. Anemia prevention behavior in female adolescents and related factors based on Theory of Planned Behavior: A cross-sectional study. J Ners. 2022;17(1):25-30.
2. WHO. World Health Statistics 2022 (Monitoring Health of the SDGs). Geneva : World Health Organization: World Health Organization. 2022:1-131. Available from: http://apps.who.int/bookorders.

3. Kinyoki D, Osgood-Zimmerman AE, Bhattacharjee N V, Schaeffer LE, Lazzar-Atwood A, Lu D, et al. Anemia prevalence in women of reproductive age in low- and middle-income countries between 2000 and 2018. Nat Med. 2021;27(10):1761-1782.
4. Kementrian Kesehatan RI. Basic Health Research. Jakarta - Indonesia; 2013.
5. Balitbang Kementrian Kesehatan RI. Riset Kesehatan Dasar 2013. Jakarta; 2013.
6. Triharini M, Mar'Ah Has EM, Nofita G. Determinant factors of anemia in pregnancy based on health belief model: A correlational study. J Ners. 2023;18(1):50-56.
7. Kaimudin N, Lestari H, Afa J. Screening and Determinants of Anemia Incidence in Young Girls at State Senior High School 3 Kendari in 2017. J Ilm Student of Health, Community Health, Unsyiah. 2017;2(6):185793.
8. Efendi F, Israfil I, Ramadhan K, McKenna L, Alem AZ, Malini H. Factors associated with receiving iron supplements during pregnancy among women in Indonesia. Electron J Gen Med. 2023;20(5).
9. Shara F El, Wahid I, Semiarti R. The relationship between nutritional status and the incidence of anemia in young women at SMAN 2 Sawahlunto. J Health Andalas. 2014;6(1):202.
10. Lutfiasari D, Martini S, Widati S. The effectiveness of peer group on adolescent anemia prevention behavior: A systematic review. J Public Health Africa. 2023;14(S2)(2542):1-5.
11. Silitonga HTH, Salim LA, Nurmala I, Hargono R, Purwandini S. Knowledge, attitude, intention, and program implementation of iron supplementation among adolescent girls in Sidoarjo, Indonesia. J Public Health Africa. 2023;14(S2):1-5.
12. Zainiyah H, Khoirul Y. Examination of Hb Levels and Counseling About Anemia and Anticipation for Al Hidayah High School Students. J Paradig. 2019;1(2):16-25.
13. Suryani D, Hafiani R, Junita R. Analysis of Diet and Iron Nutrition Anemia in Young Girls in Bengkulu City. J Health Masy Andalas. 2017;10(1):11-18.
14. Farahdiba D. Correlation between Consumption Levels of Fe, Protein and Vitamin C with Hemoglobin Levels in Students at MTSN Ngemplak, Boyolali Farahdiba Regency, Desti. Solo. Nutrition Study Program, Faculty of Health Sciences, University of Muhammadiyah Surakarta. 2018. Muhammadiyah University of Surakarta; 2018.
15. Triharini M, Armini NKA, Pitaloka SA. The correlation between family role and anemia prevention in pregnancy. Healthc Low-Resource Settings. 2023;11(S1):1-5.
16. Ministry of Health of the Republic of Indonesia. Basic Health Research. Balitbang Ministry of Health RI. 2018. Available from: https://www.kemkes.go.id/article/view/19093000001/ penyakit-jantung-penyebab-kematian-terbanyak-ke-2-di-indonesia.html
17. Sarsam SM, Al-Samarraie H, Alzahrani AI, Shibghatullah AS. A non-invasive machine learning mechanism for early disease recognition on Twitter: The case of anemia. Artif Intell Med. 2022;134(102428):1-12.
18. Sholicha, Almaratus C, Muniroh L. Correlation Between Intake of Iron, Protein, Vitamin C and Menstruation Pattern with Haemoglobin Concentration among Adolescent Girl in Senior High School 1 Manyan Gresik. Media Gizi Indonesia. 2019;14(2):147.
19. Damanti RR, Rahadian DAS, Rahadian R. Release of Quarterly 2022 Marine and Fisheries Data. Ministry of Maritime Affairs and Fisheries in 2022. 2022.
20. Ministry of Health of the Republic of Indonesia. Indonesian Food Composition Table (TKPI). 2017.
21. Hastuti W, Aminah M, Moviana Y, Amelia S, Aeni MN. Community Empowerment Through Making Crispy Red Beans for Business Actors In Cinunuk Village, Bandung Regency. 2022;000(November):16-17.
22. Central Bureau of Statistics. Vegetable Plant Production 2020. 2020. Available from: https://www.bps.go.id/indicator/55/61/2/production-tanaman-sayuran.html
23. Rahmadona, Mardiah, Rullyni NT, Respatiningrum, Harianja RR. Effect of Temvita Cookies as a Healthy Snack on Hemoglobin Levels of Young Women with Anemia. Phot J Science and Health. 2022;12(2):103-110.
24. Riana A. The Effect of Providing Iron Source Cookies on Hemoglobin Levels of Female Students at Stik Immanuel Bandung. J Immanuel Health Sciences. 2020;14(1):21-26.
25. Dewita, Syahrul, Isnaini. Utilization of Catfish Protein Concentrate (Pangasius hypopthalmus) For Biscuits and Snacks. J Indonesian Fishery Hash Processor. 2011;14(1):30-34.
26. Pakpahan C, Darmadi D, Agustinus A, Rezano A. Framing and understanding the whole aspect of oral sex from social and health perspectives: A narrative review. F1000Research. 2022;11(177):1-21.
27. Nuraini D. Ketersediaan Lisin sebagai Indikator Mutu Protein. War II/J Agro-based Ind. 1991;8(2):36-45.
28. Winarno FG, Rahman A. Protein: Sumber dan Peranannya. Bogor: FATEMETA-IPB; 1974.
29. Hastuti W, Aminah M, Mulyono GP. Interventions for Providing Cookies Based on Red Nuts, Banana, and Snakehead Fish as an Emergency Food AlternativeTowards Nutritional Status of Children. Sapporo Med J. 2020;54(10):1-11.

30. Saputra IPGAJ, Astawa IPA, Sudiastra IW. The Effect of Lysine and Methionine Amino Acids on the Percentage of Carcasses and Commercial Cuts of Broiler Carcass Aged 32 Days. J Trop Breeders. 2021;9(3):569-587.
31. Bianchi VE. Role of nutrition on anemia in elderly. Clin Nutr Espen. 2015;11(E):1-11.
32. Abbaspour N, Hurrell R, Kelishadi R. Review on Iron and its Importance for Human Health. J Res Med Sci. 2014;19(2):164-174.
33. Suryani IS, Jamil MU, Amalia NR, Pratiwi AM. The Effectiveness of Fried Catfish Cake in Increasing Hemoglobin Levels and Oxygen Saturation in Blood in Pregnant Women. PLACENTUM J Ilm Kesehat dan Apl. 2021;9(3):33.
34. Hurrell R, Egli I. Iron bioavailability and dietary reference values. Am J Clin Nutr. 2010;91(5):1461S-1467S.
35. E R Monsen, L Hallberg, M Layrisse, D M Hegsted, J D Cook, W Mertz CAF. Estimation of Available Dietary Iron. J Clin Nutr. 1978;1(1):134-141.
36. Krisnanda R. Vitamin C helps in the absorption of iron in iron deficiency anemia. J Nurse Researcher Prof. 2020;2(3):279-286.