



The effect of giving rainbow mackerel cookies on changes in hemoglobin levels in female adolescents in coastal communities in Hajoran Village, Pandan District, Central Tapanuli Regency in 2022

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ARTICLE INFO	ABSTRACT
Article history: Received Sep 04, 2022 Revised Sep 14, 2022 Accepted Sep 30, 2022 Keywords: Cookies, Mackerel, Hemoglobin Levels.	Rainbow mackerel cookies are one type of snack made from processed mackerel. Women have a higher risk of experiencing anemia, especially adolescent girls. The purpose of this study was to determine the effect of giving rainbow mackerel cookies on changes in hemoglobin levels in adolescent girls in Hajoran Village, Pandan District, Central Tapanuli Regency. This study is a pre-experimental design study with a one group pretest and posttest design. The sampling technique was carried out by purposive sampling of 37 people. The treatment given was 10 pieces of rainbow mackerel cookies (100 grams) for 30 days to adolescent girls. This study was conducted by checking hemoglobin levels before and after giving rainbow mackerel cookies. The analysis used was the dependent T-test parametric test. The results showed that the average recall of adolescent girls 3x24 hours was Fe intake of 5.40 mg, protein intake of 40.4 grams, and vitamin C intake of 5.7 mg. In the provision of rainbow mackerel cookies, the average hemoglobin level before was 10.70 g/dL and after being given the treatment it became 12.87 g/dL with a p-value of 0.000 (<0.05) which means that there is an effect of providing rainbow mackerel cookies on the hemoglobin levels of female adolescents in Hajoran Village, Pandan District, Central Tapanuli Regency. <i>This is an open access article under the CC BY-NC license.</i>



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1. Introduction

Parenting Hemoglobin is a part of red blood cells that is used to determine anemia status. In the formation of hemoglobin, iron is needed in the body. If the iron reserves are empty or small, then the formation of hemoglobin is disrupted. (Dai, 2021), (Riski Nurul, 2020). When hemoglobin levels are below normal, it can cause diseases, one of which is anemia. The normal value of hemoglobin levels in women is 12-16 g/dL (Sholicha & Muniroh, 2019), (Faiqah, Ristrini, & Irmayani, 2018).

Adolescence is a period of human development. This period is a period of change or transition from childhood to adulthood which includes biological changes, psychological changes and social changes (Saputro, 2018), (Khasanah, Umarella, & Lating, 2019). Adolescents have unusual nutritional needs, because during this period there is rapid growth and changes in physiological maturity. Changes

during adolescence will affect nutritional needs, absorption, and how nutrients are used.(Miate & Nurdini, 2020),(Puspita, Anifah, & Adyani, 2022).

Anemia is the most common medical problem in the world, especially in developing countries. The incidence of anemia occurs as much as 27% in developing countries and 6% in developed countries.(Pemiliana, Oktafirnanda, & Santi, 2019), . Anemia often occurs in school children, especially in adolescent girls. This is because adolescent girls experience iron (Fe) loss during menstruation.(Angrainy, Fitri, & Wulandari, 2019),(Putra, Munir, & Siam, 2020).

Women have a higher risk of experiencing anemia, especially adolescent girls. Anemia has symptoms caused by iron deficiency which results in the transport of oxygen in the blood which is characterized by fatigue, weakness, lethargy, pale face, brittle nails, lack of appetite, and affects cognitive functions such as not concentrating on learning and slowing down comprehension in school-age children.(Rahmadona, Mardiah, Rullyni, Respatiningrum, & Harianja, 2022),(Miyanti, 2021).

Anemia occurs due to several factors, namely accidents or menstruation, suffering from worms or infectious diseases, and also lack of nutrient consumption. Lack of nutrient intake, especially iron and other substances that can increase iron absorption, namely vitamin C and protein, can increase the risk of anemia.(Sholicha & Muniroh, 2019),(Kulsum, 2020). Based on the 2019 AKG, the iron adequacy for female adolescents aged (13-15 years) is 15 mg/day. % do not receive TTD from school. Female adolescents who consume TTD <52 tablets are 98.6% and ≥52 tablets are 1.4%(CAHYATI, Simanjuntak, Rizal, Okfrianti, & Nurhayati, 2020).

As an alternative to fulfilling food diversity, cookies can be one of the snacks for anemia sufferers. As a dry feed product, cookies are classified as not easily damaged and have a relatively long shelf life.(Dewi, 2017). Cookies can also be used as a feeding technique to prevent and treat nutritional problems.(Safrina & Putri, 2022),(Ardian, Puspareni, & Ilmi, 2022).

In Sela's research (2019), rainbow mackerel fish cookies used various formulations, namely mackerel fish flour formula with tempeh flour formula. From the results of the organoleptic test that had been carried out, the most preferred acceptance was in F2 or the second formula for making rainbow mackerel fish cookies. Nadimin (2019) in his research concluded that the addition of bran flour and mackerel fish flour could not affect the organoleptic quality of the color and texture aspects of cookies(WINATA, n.d.), z. However, the aroma and taste of regular cookies are more preferred compared to cookies with added bran flour and mackerel.(Mustadir, 2015).

Mackerel is a fish that lives in sea waters, the catch is quite abundant. Mackerel is one of the fish whose price is quite economical to be reached by the community.(Sembiring, Fattah, & Wahyudi, 2019),(Azhar, 2022). Fish meal in this product is one of the processed fish products that is dried using a mill and is sieved or meshed which can be used for other food ingredients.(Purnanila, 2010).

In Vitando's research (2019), there were changes in protein and calcium before making mackerel flour, the protein content in fresh mackerel was 15.91% and the protein calcium content was 223.98 mg/kg. After making mackerel flour at a temperature of 2000C, the protein content was 72.67% and the calcium content was 31684.46 mg/kg.(Suryana, 2013).

Cookies are one type of snack that is popular with the public. Cookies are known by many people, both children, teenagers and adults, who live in rural areas and in districts. Cookies are cakes made from basic flour ingredients which are generally made from wheat flour, powdered sugar, chicken eggs, vanilla, margarine, cornstarch, baking powder, and instant powdered milk. The texture of cookies has a crunchy texture and is not easily crushed like dry cakes in general. The color of these cookies is also slightly yellowish brown due to the influence of instant powdered milk and the addition of margarine (Aprilana, 2017).

Lailiyana (2012) revealed that cookies are rich in nutrition, both tuna and non-tuna, each piece weighs 10 grams, 100 grams of cookies consists of 10 pieces. The energy value of cookies in tuna is 501.61 kcal/100g and non-tuna 497.79 kcal/100g. This means that each piece for both types of cookies rich in nutrition (10 g) contains calories between 49.78 - 50.16 kcal. For this reason, the serving size of cookies rich in nutrition as a snack for anemic teenagers to meet 10% of the energy needs of teenagers (235 kcal) is 4 - 5 pieces per serving.

Quintero, et al (2012) in their research entitled "Acceptability and use of heme-iron concentrate product added to chocolate biscuit filling as an alternative source of a highly available form of iron" showed that regular consumption of 6 pieces of chocolate biscuits/day enriched with heme iron with 9.5 mg of iron significantly increased hemoglobin concentration in adolescent girls after 13 weeks (65 days).

Based on the results of a preliminary research survey on January 13, 2020 in Hajoran Village, Pandan District, Central Tapanuli Regency, out of 10 female adolescents, 4 female adolescents experienced anemia with an average hemoglobin level of 11.5 g/dL.

2. Methods

2.1 Research design

The design used in this study was a pre-experimental design with a one group pretest and posttest design. This design uses a pretest used before treatment is given and a posttest used after treatment. The treatment given was in the form of rainbow mackerel cookies weighing 100 gr/10 pieces/day to young women. This study was conducted by checking the first hemoglobin levels (pretest) before being given rainbow mackerel cookies. After that, observations were made again through a posttest to see the results of differences in hemoglobin levels in young women after being given rainbow mackerel cookies. This study used one group, namely young women who were given 100 gr/10 pieces/day of rainbow mackerel cookies for 1 month (30 days).

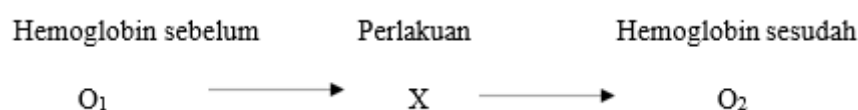


Figure 1. Treatment Design

2.2 Conceptual Framework

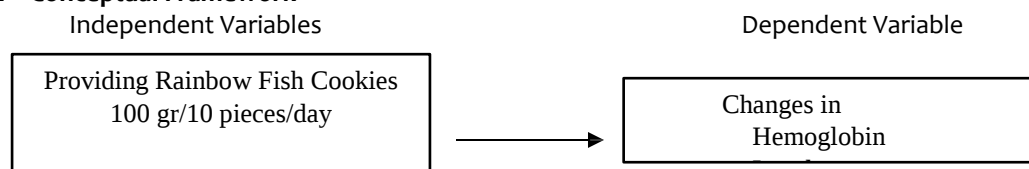


Figure 2. Conceptual Framework

2.3 Place and Time of Research

This research was conducted in 2 places, namely the Nutrition Laboratory of the Ministry of Health Polytechnic of Central Tapanuli, in Hajoran Village, Pandan District, Central Tapanuli Regency in February - March 2020.

2.4 Population and Sample

a. Population

Population is the entire object of research or the object being studied (Notoatmojo, 2010). The population in this study were female teenagers who attended school in Hajoran Village, Pandan District, Central Tapanuli Regency. The population in this study was 77 people.

b. Sample

The sample in this study were female students with hemoglobin levels <12 g/dL in Hajoran Village, Pandan District, Central Tapanuli Regency. The technique used in sampling was purposive sampling.

3. Results and Discussion

This study was conducted in Hajoran Village, Pandan District, Central Tapanuli Regency, North Sumatra Province. This study aims to see the effect of giving rainbow mackerel cookies on changes in hemoglobin levels of female adolescents in Hajoran Village, Pandan District, Central Tapanuli. The data taken in this study were the hemoglobin levels of female adolescents before giving rainbow mackerel cookies (Pre-test) and after giving rainbow mackerel cookies (Post-test).

During the intervention, the female adolescents were given cookies directly by the researchers in their respective classes, but some were also in the school environment. Meanwhile, on holidays, the female adolescents were given cookies directly by the researchers at the Pancasila Islamic boarding school, namely in the female dormitory. Compliance monitoring was carried out after the cookies were given, so the researchers remained in place until the female adolescents finished consuming the cookies. In addition to providing rainbow mackerel cookies, the researchers also conducted a 3x24-hour recall, namely at the beginning of the intervention, in the middle, and at the end of the intervention to determine the intake of Fe, vitamin C, and protein of the female adolescents. This study tested three formulations. Of the three formulations, the one chosen was formulation 2 with a composition of 30 grams of mackerel flour and 40 grams of tempeh flour.

The recall and hemoglobin data obtained are then entered into the master data for further analysis. After the data is processed

3.1 Univariate Analysis

Based on the Kolmogorov-Smirnov normality test on the hemoglobin level variable, the value ($p > 0.05$) shows that the variable is normally distributed, so the researcher used the parametric T-test dependent test.

3.2 Respondents' Hemoglobin Levels Before and After Intervention

Examination of hemoglobin levels of 37 female adolescent respondents using an easy touch measuring tool and assisted by health analysts. A description of the respondents' hemoglobin levels before and after the intervention can be seen in Table 1

Table 1.
Description of Hemoglobin Levels Before and After Intervention of Adolescent Girls in Hajoran Village, Pandan District, Central Tapanuli

Variables	N	Mean $\pm$ SD	Min	Max
Hemoglobin Levels Before Intervention	37	10.70 $\pm$ 0.91	8.10	11.90
Hemoglobin Levels After Intervention	37	12.87 $\pm$ 1.41	10.40	16.00

Table 1 shows that the average hemoglobin level increased, namely before the intervention 10.70 g/dL. After the intervention was given it increased to 12.87 g/dL, so it increased by 2.17 g/dL.

3.3 Description of Respondents' Fe, Vitamin C and Protein Intake During Intervention in Adolescent Girls in Hajoran Village, Pandan District, Central Tapanuli

The average intake of Fe, vitamin C, and protein of respondents was obtained based on the results of 3x24-hour recall during the study. An overview of the intake of Fe, vitamin C, and protein of respondents can be seen in table 2 below:

Table 2.
Distribution of Fe, Vitamin C and Protein Intake in Adolescent Girls in Hajoran Village, Pandan District, Central Tapanuli

Intake Variables	Mean	Min	Max
Fe (mg)	5.40	3.78	7.20
Vitamin C (mg)	5.7	4.10	11.10
Protein (g)	40.4	32.63	52.30

Table 2 shows the average Fe intake of female adolescents obtained from the results of a 3x24-hour recall, which is 5.40 mg, vitamin C intake is 5.7 mg and protein intake is 40.4 grams.

3.4 Bivariate Analysis

Table 4.
The Effect of Giving Rainbow Mackerel Cookies on Hemoglobin Levels of Adolescent Girls in Hajoran Village, Pandan District, Central Tapanuli

Variables	N	(Minimum-Maximum)	Mean $\pm$ SD	<i>p</i> -value
Hemoglobin Levels Before Intervention	37	(8.10 – 11.10)	10.70 $\pm$ 0.91	0,000
Hemoglobin Levels After Intervention	37	(10.40-16.00)	12.87 $\pm$ 1.41	

Based on table 3, it shows the results of the dependent t-test statistical test between before and after the intervention was given with a *p*-value (0.000), which means there is a difference in hemoglobin levels before and after giving cookies.

From the explanation above, it can be concluded that there is an effect of giving rainbow mackerel cookies on hemoglobin levels in female adolescents in Hajoran Village, Pandan District, Central Tapanuli.

3.1. Discussion

a. Description of Hemoglobin Levels Before and After Intervention of Adolescent Girls in Hajoran Subdistrict, Pandan District, Central Tapanuli

The average pre-test hemoglobin level of 10.70 g/dL is classified as anemia. The average post-test hemoglobin level of 12.87 g/dL is classified as normal. The minimum pre-test hemoglobin level is 8.1 g/dL and the maximum value is 11.9 g/dL. While the minimum post-test hemoglobin level is 10.5 g/dL and the maximum value is 16 g/dL. From the pre-test conducted, there are still many anemias that occur in adolescent girls. This is in line with the prevalence of anemia in Indonesia based on Riskesdas data (2013), which reached 21.7%. From the percentage data, women dominate the anemia rate of 23.9% and the highest is in the 5-14 year age group, which is 26.4% (Ministry of Health of the Republic of Indonesia, 2013).

The increase in hemoglobin levels after this intervention is the same as that found by Syahwal (2018), namely an increase in hemoglobin levels of 11.65 g/dL before the intervention and after the intervention it increased to 12.69 g/dL in adolescent girls who were given snack bars made from nagara peanut flour and haruan fish. Likewise, Fajar (2016) stated that in adolescent girls who were given synbiotic fermented tempeh milk for 13 weeks, Hb levels increased from 10.39 g/dL to 13.11 g/dL.

After giving cookies, there were still 8 respondents whose hemoglobin levels were <12 g/dL. While 29 respondents were categorized as normal, namely >12 g/dL. This can be caused by the fact that each individual's iron absorption is different, this is influenced by the dietary regulator, namely after giving iron, the absorptive cells will be resistant to iron absorption for some time (Diah, 2019).

During the provision of rainbow mackerel cookies, respondents finished the cookies given on average. The level of compliance in consuming rainbow mackerel cookies greatly influences a person in preventing anemia. These cookies can be additional food for young women. The more obedient or routine the respondents are in consuming cookies, the more they will be aware that preventing anemia is very beneficial for health, with this awareness will form a concern especially for one's own health in preventing anemia.

b. Description of Respondents' Fe, Vitamin C and Protein Intake During Intervention in Adolescent Girls in Hajoran Subdistrict, Pandan District, Central Tapanuli

The average result of the 3x24-hour recall obtained Fe intake of adolescent girls, which was 5.40 mg, vitamin C intake of 5.7 mg and protein intake of 40.4 grams. Based on the recommended 2019 nutritional adequacy figures (AKG), Fe, vitamin C and protein intake are still below adequacy. For nutritional values in girls aged 13-15 years, namely Fe 15 mg, vitamin C 65 mg and protein 65 grams per day. Inadequate intake of food sources of Fe, vitamin C and protein in adolescent girls can be caused by a lack of combination of foods consumed. This can also be caused by the lack of variety of food from the Islamic boarding school dormitory. Daily food intake can affect hemoglobin levels in the body such as Fe, protein and vitamin C. This is in line with the research of Setyaningsih (2018) which states that there is a relationship between protein, Fe, and Vitamin C intake and hemoglobin levels.

Percentage of protein intake of rainbow mackerel cookies in adolescent girls in one day compared to the average 3x24 hour recall, namely $(19.89: 40.4) \times 100\% = 49.23\%$. Percentage of Fe intake of rainbow mackerel cookies in adolescent girls in one day compared to the average 3x24 hour recall, namely $(1.78: 5.40) \times 100\% = 33\%$. Percentage of Vitamin C intake of rainbow mackerel cookies in adolescent girls in one day compared to the average 3x24 hour recall, namely $(1.42: 5.7) \times 100\% = 24.9\%$. There was a significant increase in hemoglobin levels in adolescent girls after the intervention of rainbow mackerel cookies, namely 2.17 g/dL.

Giving rainbow mackerel cookies as much as 100 grams/day for 1 month with 19.89 grams of protein, Vit. C 1.42 mg, Fe 1.78 mg affects hemoglobin levels. This is due to the increase in Fe, protein and vitamin C intake which can affect hemoglobin levels. The formation of red blood cells requires iron, then converted into hemoglobin, then circulated throughout the body's tissues which function as oxygen carriers (Irianto, 2015). The need for iron is influenced by stomach acidity and the biological availability of iron consumed. The level of stomach acidity increases the solubility of iron, making it easier to absorb (Almatsier, 2011). Iron status in the body can affect the efficiency of iron absorption. Adolescents with iron deficiency will have more efficient absorption than those who do not experience iron deficiency (Maryam, 2016).

The relationship between iron and hemoglobin levels plays an important role in blood formation (hemopoiesis), namely synthesizing hemoglobin. Iron absorption can be accelerated by the presence of vitamin C. Vitamin C is an essential element that is needed by the body for the formation of red blood cells. Vitamin C can inhibit the formation of hemosiderin which is difficult to mobilize to release iron when needed. The presence of vitamin C in the food consumed will facilitate the reduction of ferric iron to ferro which is easily absorbed by the small intestine. Absorption of iron in nonheme form increases fourfold when there is vitamin C (Adriani and Wirjatmadi, 2012).

c. The Effect of Giving Rainbow Mackerel Cookies on Hemoglobin Levels of Adolescent Girls in Hajoran Village, Pandan District, Central Tapanuli

Based on the results of the statistical test, the p-value was 0.000 ($p < 0.05$), meaning that there was a significant difference between the hemoglobin levels before and after. After giving cookies, there were 8 respondents whose hemoglobin levels were below normal, while the other 29 respondents were categorized as normal. This can be seen from the average hemoglobin level before the intervention of 10.70 g/dL with a standard deviation of 0.91. While the average hemoglobin level after the intervention was 12.87 g/dL with a standard deviation of 1.41. It can be seen that the mean difference between the first and second measurements was 2.17 g/dL with a standard deviation of 0.5, the results of the dependent t-test statistical test which had previously tested the normality of the data and obtained normally distributed data obtained a p-value (0.000) then it can be concluded that there is an effect of giving rainbow mackerel cookies on the hemoglobin levels of female adolescents in Hajoran Village, Pandan District, Central Tapanuli in 2020.

This study is in line with Syahwal (2018) who concluded that giving snack bars of nagara peanut flour and haruan fish can increase hemoglobin levels in adolescent girls. This study was conducted for 1 month by giving snack bars of nagara peanut flour and haruan fish as much as 50 grams 3 times a week, obtained a p-value of 0.016 which shows that snack bars made from haruan fish meat and nagara nuts have an effect on increasing hemoglobin levels.

This study is in line with Diastari (2019) who concluded that giving 100 grams of tamban fish sticks for 30 days to 25 adolescent girls showed an effect before and after giving tamban fish sticks on increasing hemoglobin levels in adolescent girls with anemia with a p-value of 0.001.

Mackerel is a fish that contains high protein and fat. Fish also contains Omega-3 EPA fatty acids which are very beneficial for health, namely reducing the risk of heart disease and inhibiting narrowing of blood vessels. Omega-3 can also improve blood pressure in people with hypertension and diabetes (Fitriani, 2006).

The nutritional content of rainbow mackerel cookies based on the calculation of DKBM (Food Composition List) in 10 pieces of 100 grams contains 363 kcal of energy, 19.89 grams of protein, 17.36 grams of fat, 31.63 grams of carbohydrates, Vit. C 1.42 mg, Fe 1.78 mg. Based on Lailiyana's research (2012), the nutritional content of 100 grams of nutritious cookies, namely tuna cookies, is known to have 501.61 kcal of energy, 24.47-25.41 g of fat, 7.50-7.70 g of protein, 60.53-61.89 g of carbohydrates, 4.07-8.67 mg of iron, and 0.25-0.68 mg of vitamin C. There was an increase in hemoglobin levels in adolescent girls after being given rainbow mackerel cookies for 30 days. This shows that rainbow mackerel cookies made from mackerel flour and tempeh flour have an effect on increasing hemoglobin levels. Fish meat as an ingredient in making cookies is a source of iron. The results of research by Sari, et al. (2015) stated that the iron contained in biscuits added with snakehead fish flour has the highest bioavailability of up to 76.32%. In addition to being a source of iron, fish is also a source of protein. Animal protein found in fish can increase iron absorption.

This study is in line with that conducted by Mansyur (2017), obtained the average hemoglobin level of pregnant women after being given tempeh brownies for 30 days, which was 1.46 g/dL with a hemoglobin level before administration of 10.15 g/dL and increased after administration to 11.61 g/dL. It can be concluded that tempeh brownies are effective in increasing hemoglobin levels. This study is in line with Dani (2009), after receiving treatment, the average Hb level in elementary school children with a total of 8 people in group I became 13.03 g/dL or increased by 0.90 g/dL with a p-value of 0.003 (<0.05). This increase in Hb levels shows that tempeh supplementation has been proven to be able to increase blood hemoglobin levels

4. Conclusion

The average hemoglobin level before the intervention of giving rainbow mackerel cookies to teenage girls in Hajoran Village was 10.70 g/dL. The average hemoglobin level after the intervention of giving rainbow mackerel cookies to teenage girls in Hajoran Village was 12.87 g/dL. There was an effect of giving rainbow mackerel cookies to teenage girls in Hajoran Village with a p-value <0.05, namely 0.000. The average recall of teenage girls 3x24 hours was Fe intake of 5.40 mg, vitamin C intake of 5.7 mg and protein intake of 40.4 grams.

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