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Exploring Moringa Leaves on Hemoglobin Levels: An MBKM Activity by Universitas Indo Global Mandiri Student's

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ABSTRACT

The challenges faced by young women are closely linked to their health, specifically anemia, characterized by a reduction in hemoglobin levels. Anemia is defined as a condition where the quantity of red blood cells is insufficient to meet the body's physiological needs. The management of anemia in adolescents has been planned through the use of blood supplement tablets (TTD). However, the consumption of TTD has not been maximized due to taste issues and side effects that manifest after intake. Moringa leaves (Moringa oleifera) are known to contain various nutritional elements, including iron, vitamin C, protein, vitamin A, calcium, and potassium, making them a potential alternative for anemia treatment. The iron content in Moringa leaves is 28.2 mg. This research adopts a pre-experimental design with a one-group pretest-posttest approach, involving a sample size of 24 and utilizing paired t-test analysis. A significant difference was observed in Hb levels before and after the administration of Moringa leaf extract ($p < 0.05$). The average value before treatment was 10.83, with a standard deviation of 0.8641, and after treatment, it increased to 12.72, with a standard deviation of 0.9399. The findings indicate that Moringa leaf extract is effective in increasing hemoglobin levels in adolescent girls.

Keywords: Anemia, Moringa Leaf Extract, Hb Levels, Adolescent Girls

1. Introduction

Moringa leaves and their relationship with hemoglobin levels can be part of the Student-Based Internship (MBKM) activities of students. Moringa leaves (Moringa oleifera) are known as one of the plants rich in nutrients, including iron, vitamin A, vitamin C, and protein (Hertati et al., 2021; Hertati & Heryati, 2023). The content of these nutrients may play an important role in increasing hemoglobin levels in low blood. Moringa leaves are known to contain iron, and therefore, research can be focused on the potential of moringa leaves in increasing hemoglobin levels in iron-deficient individuals. Moringa leaves also contain antioxidant compounds such as beta-carotene and vitamin C. Antioxidants can help protect body cells from oxidative damage, which can contribute to general health and nutritional balance, including hemoglobin production. Research can be focused on the effect of moringa leaf extract on hemoglobin levels in subjects with iron deficiency or anemia problems (Syafarudin & Hertati, 2020). Research methods may include the administration of moringa extract in supplement form or the use of moringa in the daily diet.

Environmental factors such as soil type, climate and farming techniques can affect the nutrient content in moringa leaves. This study could take into account environmental influences on the quality of moringa leaves and their impact on health effects, including increased hemoglobin levels. In addition to individual health aspects, this study could involve social and economic aspects by examining the potential implementation of moringa use in the community, especially in areas prone to malnutrition. MBKM can

involve students in various stages of research, from planning, data collection, analysis, to presentation of results (Nauly et al., 2022). In addition, students can also be involved in activities to disseminate information to the public about the benefits of moringa leaves for health. By considering these aspects, this research can make a positive contribution to both the health field and student learning in the context of MBKM.

Adolescence is known as a period of rapid growth and development characterized by physical, psychological, and cognitive changes where in the physical aspect there is a process of sexual maturation and posture growth that makes a person start paying attention to physical appearance. WHO defines an adolescent as someone who has an age range of 10-19 years. Adolescence is a period where a person's secondary sexual signs have developed and reached sexual maturity. Adolescents also experience physical, psychological, and social maturation.

Adolescence Growth Spurt occurs very quickly so that it requires relatively many nutrients. Adolescents are at high risk of anemia, especially iron nutrition anemia. This happens because in adolescence higher nutrients are needed for growth and development where iron is also included. Adolescent girls have a higher risk than young men, research in India also found that adolescent girls are a vulnerable group to anemia. This is because adolescent girls experience menstruation every month. Adolescent girls also tend to pay attention to their body shape in great detail so that they will limit the food consumed and have many restrictions on food such as doing a vegetarian diet.

Adolescent girls are the nation's assets that need to be maintained health, considering that young women are prospective mothers who will become pregnant and give birth to a baby, thus increasing the risk of maternal mortality, babies born prematurely and low birth weight. Based on data from the World Health Organization (WHO) in the worldwide prevalence of anemia in 2015 shows that the prevalence of anemia in the world ranges from 40 - 88%. In Southeast Asia, 25-40% of adolescent girls experience mild and severe levels of anemia. Meanwhile, based on Riskesdas 2013 data, the proportion of anemia in women (23.9%) is higher than in men (18,4%). The proportion of anemia in the age group of 15-24 years was 18.4% in 2013, and based on the 2018 Riskesdas data, the proportion of anemia in women (27.2%) was higher than in men (20.3%). The proportion of anemia in the age group of 15-24 years was 32% in 2018 (Hertati et al., 2023).

Anemia is defined as a condition where the number of red blood cells is insufficient to meet the physiological needs of the body (Purnamasari & Hartati, 2023). The physiological needs of an individual vary according to age, gender, place of residence, smoking behavior and stage of pregnancy. The causes of anemia are usually due to lack of knowledge about anemia, inadequate intake of iron, folic acid, vitamin B12 and vitamin A (Hertati et al., 2023).

Based on the data collected, it shows that anemia cases are still high in adolescents. Data obtained from the North Sumatra Health Office, 2017, where for the North Sumatra region there are around 322 thousand adolescent girls experiencing symptoms of anemia. The high number of these cases if not handled will certainly have an unfavorable impact. Several efforts have been made to overcome anemia in adolescents, both pharmacologically and non-pharmacologically (Safkaur & Hertati, 2020). Pharmacologically, of course, by providing Fe tablets which are a government program and non-pharmacological provision, namely by utilizing natural resources in the area to overcome it. One of the efforts made is the utilization of Moringa leaves which also grow in South Sumatra (Purwati et al., 2023).

One of the studies on the use of moringa leaves for anemia conducted by Erma in the effect of moringa leaf flour on increasing hemoglobin levels in adolescent girls stated that there were changes in haemoglobin levels when adolescents were given moringa leaf flour (Hertati et al. 2023). And according to Nurhidayat in The effect of moringa capsule consumption on Hb levels in pregnant women states that there is a significant relationship between before and after consumption of moringa capsules on increasing the Hb levels of pregnant women (Hertati & Safkaur, 2021). Moringa leaves are one of the local plants that have been known for centuries as a versatile, nutrient-rich and medicinal plant. The results of the study stated that moringa leaves contain a lot of vitamin A, vitamin B, vitamin C, calcium, potassium, iron and protein in very high amounts where these substances are digested easily by the human body. The high level of iron (Fe) contained in dried moringa leaves as well as in the form of processed moringa leaf flour is 25 times higher than the Fe content found in spinach so that it can be used as an alternative to overcome the problem of anemia in adolescents naturally (Hertati et al., 2021). The content of moringa compounds in the form of flour has been

studied and reported by Gopalakrishnan which states that moringa leaf flour has an iron content of 28.2 mg in 100 grams. Given the high nutritional content of moringa, and the variation in the type and amount of doses given by previous researchers, researchers are interested in conducting research on moringa leaves in the form of extracts for adolescent girls who experience anemia in high schools in South Sumatra (Haryanto et al., 2007).

2. Methodology

This study is a Pre-experimental study with the design of the one group pretest-posttest design where in this study observations were made twice, namely before and after the experiment. The population is high school students in South Sumatra with a sample size of 24 people taken with nonprobability sampling techniques, namely purposive sampling with inclusion criteria, namely students who experience anemia, are willing to be studied and sign informed consent, have menstruation, Hb levels <12 gr/dl%, are not taking additional vitamins or supplements and are not experiencing diseases such as lumps under the stomach, diarrhea and colitis. Girls who did not take supplements for more than a week (Marlina et al., 2023). And refused to continue taking moringa tablets will be excluded from being included in the sample (Drop Out) (Syafarudin & Hertati, 2020)

The research materials used were moringa leaves processed into moringa leaf extract packaged in 500 mg capsules and then given to adolescents with a dose taken 2 times a day, in the morning and at night for 2 weeks regularly (14 days) and a digital hemoglobinometer (Easy touch) for checking Hb levels before and after the study. Data analysis using paired sample T-test.

Supplementation to Hemoglobin Levels by Students in the MBKM Program" Identifying the main nutrient content in Moringa leaves that can affect hemoglobin levels (Hertati & Safkaur, 2020). Determine the effectiveness of moringa leaf extract supplementation in increasing hemoglobin levels in subjects who may have iron deficiency or anemia. Empowering the community through knowledge of the benefits of moringa and how to integrate it into their daily diet. Provide practical experience for students in planning, implementing, and evaluating moringa-based health intervention programs (Rabiah et al., 2022). Select a group of participants involving local communities or student groups with a high risk profile for iron deficiency. Conduct a counseling session to provide an understanding of the benefits of Moringa leaves on hemoglobin levels and how to process them. Provide moringa extract-based supplements to the participant group for a certain period. Conduct baseline and follow-up measurements of participants' hemoglobin levels to assess the effectiveness of supplementation. Monitor and evaluate the progress of the participants during the intervention period, and identify factors that may affect the results (Hertati et al., 2021).

Moringa leaves contain chlorophyll, a green pigment similar to the molecular structure of hemoglobin. Although it does not directly increase hemoglobin levels, chlorophyll can help promote red blood cell health and improve blood quality. Antioxidant compounds in moringa, such as beta-carotene and quercetin, can protect red blood cells from oxidative damage. This helps maintain red blood cell health and supports the normal function of hemoglobin. Moringa leaves contain several essential amino acids, including those necessary for the formation of hemoglobin. Amino acids are the main building blocks of proteins, including the proteins in red blood cells. Some studies suggest that moringa may also help regulate blood sugar. Well-controlled blood sugar can support healthy blood vessels and red blood cell function.

Present research results and experiences in seminars or workshops, and disseminate information through social media or health campaigns in the neighborhood. Demonstrated a significant increase in hemoglobin levels in participants who received moringa supplementation (Hertati & Safkaur, 2020). Communities have better knowledge of the benefits of moringa and how to integrate it into their daily diet. Students gain hands-on experience in designing and implementing health interventions, and understand the impact on the community. Provide a model for regional development through the utilization of local resources to improve community health and well-being. Through this activity, students can contribute to the improvement of community health while developing their skills and knowledge in health and community development (Rabiah et al., 2022).

3. Results and Discussion

3.1. Results

The characteristics of adolescent respondents who experience anemia at the South Sumatra high school level seen based on Body Mass Index (BMI) and the menstrual cycle experienced are listed in the following table:

Table 1. Distribution of characteristics of anemic adolescent respondents at the South Sumatra High School Level

Characteristics	Total	Percentage (%)
BMI according to WHO		
< 18,5 (Underweight)	5	20,8
18,5 – 22,9 (Normal)	17	70,8
23 – 24,9 (Overweight)	2	8,4
25 – 29,9 (Obesity I)	0	0
≥ 30 (Obesity II)	0	0
Menstrual Cycle		
Regular	23	95,8
Irregular	1	4,2
Total	24	100

Based on the table above, the Body Mass Index (BMI) of anemic adolescents at SMU Negeri 1 Pancur batu is mostly in the normal category (70.8%) although still overweight with regular menstrual cycles as much as 95.8% with a standard deviation of 0.8641 and after giving moringa leaf extract is 12.72 with a standard deviation of 0.9399.

Table 2 Differences in Hb Levels Before and After Administration of Moringa Leaf Extract in adolescents at the South Sumatra high school level

Treatment	Max	Min	Mean Hb level	*Mean difference*	p
Before	11,8	9,3	10,83 ± 0,8641		
				-1,89 ± 0,5144	0,001
After	14,7	11,2	12,72 ± 0,9399		

Based on the results of the study, the average value of Hb levels before giving moringa leaf extract was 10.83 ± 0.8641 gr/dL and after was 12.72 ± 0.9399 gr/dL with a mean difference of -1.89 ± 0.5144 gr/dL. The results of statistical analysis of paired t test can be seen that there is a significant difference in Hb levels before and after giving moringa leaves. Moringa leaves (Moringa oleifera) have several uses that can contribute to increasing hemoglobin levels in the body. Moringa leaves contain iron, a mineral essential for hemoglobin production. Consuming enough iron is essential to prevent and treat anemia, which can result from iron deficiency. Moringa leaves also contain vitamin C, which can increase the absorption of iron in the body. The combination of iron and vitamin C helps to increase the effectiveness of iron absorption from food. Vitamin A in moringa has an important role in the formation of red blood cells. Vitamin A deficiency can affect hemoglobin production and increase the risk of anemia. Several types of B vitamins, such as vitamin B6, B2, and folic acid, contained in moringa leaves, also support normal metabolism and the production of red blood cells, including hemoglobin.

It is important to remember that while moringa may contribute to increased hemoglobin levels, consumption of a balanced diet rich in other nutrients is also an important factor in maintaining healthy blood

and preventing anemia. Before making any significant changes in diet or taking supplements, it is best to consult a healthcare professional.

3.2. Discussion

Anemia is a condition where there is a decrease in hemoglobin (Hb), hematocrit, and red blood cell count below normal values. Low Hb levels are one of the health problems often experienced by a woman, including adolescents. Based on the results of the study, it can be stated that Moringa leaf extract (Moringa oleifera L.) can significantly increase haemoglobin levels in high school students in South Sumatra. (Hasan et al., 2023). This can be seen from the difference in average hemoglobin levels before and after the administration of moringa leaf extract. In this study, the dose used was 1 x 2 capsules per day, taken in the morning and evening for 14 consecutive days. One capsule contains 500 mg of moringa leaf extract, so the daily dose is 1000 mg. ($p<0,05$). From the results of this study it can be stated that Moringa leaf extract (Moringa oleifera L.) is effective in increasing haemoglobin levels in adolescent girls who experience anemia at the South Sumatra high school level (Endarwati, 2021) .

From the results of the study, the average value of hemoglobin levels before the administration of moringa leaf extract was 10.83 ± 0.8641 gr/dL with the lowest Hb level of 9.3 gr/dL and the highest Hb level of 11.8 gr/dL and the average Hb level after the administration of moringa leaf extract was 12.72 ± 0.9399 gr/dL with the lowest Hb level of 11.2 gr/dL and the highest Hb level of 14.7 gr/dL. It can be seen from the results of this study that there was an increase in Hb levels before and after giving moringa leaf extract with the lowest increase of 1.7 gr/dL and the highest increase of 2.9 gr/dL, so that the average increase in Hb levels before and after giving moringa leaf extract was 1.89 ± 0.5144 gr/dL. The results of this study are in accordance with research conducted by (Pratiwi, 2019) about the effect of giving moringa leaf tea (moringa oleifera tea) and blood supplement tablets on increasing haemoglobin levels in anemic adolescents in Sidrap district which states that there is a significant increase in the intervention group given the moringa leaf for 4 weeks with an average Hb level before giving moringa leaf tea is 10.5 mg/dL and the average Hb level after giving moringa leaf tea increases to 12.26 gr/dL (Hertati et al., 2023).

The results of this study are also in line with research conducted by (Indriani et al., 2019) which states that there is an effect of giving education and moringa powder capsules in increasing hemoglobin levels significantly with the dose used, namely 1 x 3 capsules, one capsule contains 700 mg of moringa powder, so the daily dose is 2100 mg with a duration of 30 days. So that the average results obtained before being given moringa leaf powder capsules were 10.65 with a Standard Deviation of 0.69 and after consuming moringa leaf powder capsules, the average HB level of pregnant women was 12.40 and a Standard Deviation of 0.59 with an average increase of 1.76 ± 0.80 g / dL (Hertati & Safkaur, 2020b).

In this study it was also seen that BMI in adolescent girls with normal nutritional status was more likely to experience anemia (70.8%), so there was no relationship between BMI and the incidence of anemia in adolescent girls at SMA Negeri 1 Pancur Batu, this is in line with research conducted by (Harahap et al., 2019) which states that there is no relationship between BMI and the incidence of anemia at the high school level in South Sumatra (Syafarudin & Hertati, 2020).

During the study, before respondents consumed moringa leaf extract, there were several respondents who complained that they often felt dizzy in the morning when they wanted to get out of bed and their bodies often felt weak and after consuming moringa leaf extract for 14 days, the complaints they felt before were reduced, this is due to the high nutritional content. Moringa leaves contain Vitamin A 4 times higher than carrots, calcium content higher than milk, iron higher than spinach, Vitamin C which is almost the same as oranges which are important for strengthening our immune system and fighting infectious diseases including flu and colds (Awalia et al., 2022). Moringa leaves are useful in helping to repair weak bones, overcome blood deficiency in mothers and help mothers to fulfill nutrition in babies who are malnourished. Helps teenagers and pregnant women increase haemoglobin levels, helps breastfeeding mothers increase breast milk quantity, etc. Based on the results of the analysis of the nutritional content in moringa leaves, it has the potential to complement the nutritional needs of the body very well (Hertati et al., 2023). By consuming moringa leaves,

the balance of nutrients in the body will be fulfilled so that people who consume moringa leaves will be helped to increase energy and endurance (Hertati & Safkaur, 2020b).

Based on the results of this study, it can be seen that Moringa leaf extract is effective in increasing the hemoglobin levels of anemic adolescent girls. According to some previous research results, Moringa leaves (Moringa oleifera L.) are known as one of the sources of iron. Research conducted in 2014 at the Spice and Medicinal Plants Research Center showed the results that in 1 kg of moringa leaves there was an Fe content of 54.92 mg (Hertati et al., 2023). Iron has several essential roles in the body including as a means of transporting oxygen from the lungs to body tissues, a means of transporting electrons in cells as well as an integrated part of various enzyme reactions in human body tissues. (Nugraha et al., 2023). In addition, it is mainly required in hemopobesis (blood formation), i.e. in the synthesis of hemoglobin (Hb) (Azmi et al., 2023).

The total amount of iron in the body averages 4-5 grams, approximately 65 percent of which is found in the form of hemoglobin. About 4 percent is found in the form of 5 myoglobin and 1 percent is found in the form of various heme compounds that can increase intracellular oxidation while 0.1 percent joins the transferrin protein in the blood plasma, 15-30 percent is mainly stored in the reticuloendothelial system and liver parenchyma cells, especially in the form of ferritin (Hertati et al., 2020). Iron deficiency in the body can cause disturbances or obstacles to growth, both body cells and brain cells, even individuals suffering from iron deficiency will experience a decrease in body immunity, besides iron deficiency can also reduce hemoglobin levels (Puspitawati et al., 2023). The status of iron in the human body depends on the absorption of iron (Hertati, 2023.).

Things that can increase iron absorption include enhancers that play a major role in iron absorption. Iron enhancers include vitamin C and vitamin A (Hertati, 2012). In this study, in addition to iron, Moringa leaves (Moringa oleifera L.) also contain vitamin A and vitamin C. Vitamin A can affect the excretion of iron from the liver. Vitamin A supplementation with iron improves vitamin A status and improves iron status (Hertati & Puspitawati, 2023.). Vitamin C functions as an enhancer because vitamin C can help absorb non-heme iron by remodeling the ferrous form into ferrous which is more easily absorbed. Moringa leaves (Moringa oleifera L.) also contain protein. Protein has an important role in iron transportation in the body. Lack of protein intake in the body will have an impact on the inhibition of iron transportation, causing iron deficiency and resulting in a lack of hemoglobin levels in the blood. The lower the protein intake, the lower the hemoglobin level (Cahyani & Hertati, 2023.).

Supplements based on Moringa leaf extract to a group of participants for a specified period. Conduct baseline and follow-up measurements of participants' hemoglobin levels to assess the effectiveness of supplementation (Hertati et al., 2023). Monitor and evaluate the progress of participants during the intervention period, and identify factors that may affect the outcome. Present research results and experiences in seminars or workshops, and disseminate information through social media or neighborhood health campaigns. Demonstrate a significant increase in hemoglobin levels in participants receiving moringa supplementation (Endarwati, 2021).

Communities have better knowledge of the benefits of moringa and how to integrate it into their daily diet. Students gain hands-on experience in designing and implementing health interventions, and understand the impact on the community. Provide a model for regional development through the utilization of local resources to improve community health and well-being. Through this activity, students can contribute to the improvement of community health while developing their skills and knowledge in health and community development (Hertati et al., 2023).

4. Conclusion

The administration of moringa leaf extract at a dose of 500 mg given twice a day for 14 days proved effective in increasing Hb levels ($p<0.05$), where before being given moringa leaf extract in adolescent girls, the average Hb level was 10.83 ± 0.8641, and after being given moringa leaf extract to 12.72 ± 0.9399. The use of moringa leaves can be used as an alternative to increase Hb levels, therefore for individuals who experience anemia can consume moringa leaves regularly in their daily menu so that the problem of anemia can be overcome. For other studies should be able to examine other effects of moringa on the physiology of the human

body, especially on important organs because it is still necessary to know the level of safety. By using these methods, students can gain practical experience in planning, conducting, and analyzing research, while contributing to scientific knowledge about the benefits of moringa leaves on hemoglobin levels.

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