
THE EFFECTIVENESS OF THE COMBINATION SNAKEHEAD FISH AND MORINGA LEAVES ON INCREASING HEMOGLOBIN LEVELS IN PREGNANT WOMEN WITH ANEMIA

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ABSTRACT

*Maternal anemia remains a major public health problem, particularly in developing countries, including Indonesia. Conventional iron supplementation often faces adherence issues due to side effects, thus highlighting the need for alternative, food-based interventions utilizing locally available resources. Snakehead fish (*Channa striata*) is rich in high-quality protein, albumin, and bioavailable iron, while moringa leaves (*Moringa oleifera*) contain plant-based iron, vitamin C, and antioxidants that enhance iron absorption. This study aimed to evaluate the effectiveness of floss products based on snakehead fish and moringa leaves to increase hemoglobin levels in pregnant women with anemia. A quasi-experimental study was conducted on 40 pregnant women with anemia, divided into one control group (floss products without moringa) and one intervention groups with different moringa additions every week (15 g, 20 g, and 25 g). Each participant consumed 150 g of floss products daily for 3 weeks. Hemoglobin levels were measured before and after intervention using standard procedures. Data were analyzed using the Wilcoxon Signed Rank Test and Mann-Whitney U Test with a 95% confidence level. The mean hemoglobin level increased from 9.7 g/dL (SD = 0.3) to 10.6 g/dL (SD = 0.5) after the intervention ($p < 0.001$). The intervention groups achieved significantly higher hemoglobin levels (mean = 12.5 g/dL, SD = 0.9) compared to the control group (mean = 11.2 g/dL, SD = 0.7), with $p = 0.002$. The combination of snakehead fish and moringa leaves was effective in improving hemoglobin levels among pregnant women with anemia.*

KEYWORDS

anemia, hemoglobin, snakehead fish, moringa leaves, pregnancy



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INTRODUCTION

Anemia in pregnant women is still one of the serious public health problems, especially in developing countries including Indonesia. According to data from the World Health Organization (WHO), the prevalence of anemia in pregnant women globally reaches more than 40%, with the majority of cases caused by iron deficiency (Oumer & Hussein, 2019). In Indonesia, the results of Basic Health Research (Riskesdas) in 2018 showed that around 48.9% of pregnant women experienced anemia, a fairly high number and risky to maternal and fetal health. This condition not only has an impact on fatigue and a decrease in the quality of life of the mother, but also increases the risk of pregnancy complications, premature birth, babies with low birth weight, and maternal and perinatal mortality (Akib & Rukinah, 2024).

Efforts to overcome anemia have been largely focused on providing iron supplementation (Fe tablets) as a national program recommended by the Ministry of Health. Fe tablets have been shown to be effective in increasing hemoglobin levels and preventing complications of anemia in pregnant women, but its implementation still faces various challenges (Syari et al., 2023). The compliance rate of Fe tablet consumption is relatively low, mostly due to the side effects caused such as nausea, constipation, metallic taste in the mouth, as well as discomfort in the digestive tract. In addition, other factors that also affect are the lack of understanding of pregnant women about the importance of regular consumption of Fe tablets, low family support, and the availability of supplements that are not always evenly distributed in remote areas (Smitha et al., 2024). This condition creates a gap between the effectiveness of the program in theory and the real results in the field. Therefore, alternative nutritional interventions are needed that are based on local food, have a higher acceptance rate, are safe for long-term consumption, and have the potential to provide synergistic effects in increasing hemoglobin levels (Loechl et al., 2023). A local food-based approach can not only address compliance issues, but also strengthen community independence in utilizing the resources around them to improve the health status of pregnant women (Sari et al., 2025).

One of the local food ingredients that has great potential is snakehead fish (*Channa striata*) (Bertalina et al., 2025). This fish is known as a source of high-quality animal protein and is rich in albumin, iron, and essential amino acids that play a role in the process of hemoglobin formation. Previous research has shown that the consumption of snakehead fish extract or processing is able to increase albumin levels, accelerate wound healing, and help improve nutritional status in patients with certain conditions (Ramadhanti et al., 2021). In addition, moringa leaves (*Moringa oleifera*) are a plant that has long been known as a "miracle tree" because of its abundant nutritional content (Islam et al., 2021). Moringa leaves contain iron, vitamin C, calcium, as well as various antioxidants that can help increase iron absorption and support the hematopoiesis process. Several studies report that the consumption of moringa leaves can increase hemoglobin levels and improve anemia status in breastfeeding mothers and adolescent girls. The combination of snakehead fish and moringa leaves is expected to have a synergistic effect in increasing hemoglobin levels in anemia pregnant women. Snakehead fish provides animal protein and iron with high bioavailability, while moringa leaves contribute to improving iron absorption as well as providing other supporting micronutrients (Simanjuntak et al., 2023). This local food-based

intervention is not only potentially effective, but also accessible, affordable, and in accordance with the local wisdom of the Indonesian people.

Based on this description, it is important to conduct research on "The Effectiveness of the Combination of Snakehead Fish (*Channa striata*) and Moringa Leaves (*Moringa oleifera*) on Increasing Hemoglobin Levels in Pregnant Women with Anemia" as an effort to innovate local food-based nutritional interventions to overcome anemia in pregnant women.

RESEARCH METHOD

This study uses a quasi-experimental type of research with a Complete Random Design (RAL) design. The research will be carried out in August 2025. The study consisted of one control group and one treatment groups. The control group (A1) was given floss products based on snakehead fish without vegetable modification, while the treatment group each received floss products based on snakehead fish modified with the addition of moringa leaves in different amounts, namely 15 grams (A2), 20 grams (A3), and 25 grams (A4).

The population in this study is all pregnant women with anemia in Tawang Sari Village, Pujon, Malang Regency. The research sample was determined using the purposive sampling technique, which is selection based on certain criteria that are in accordance with the research objectives. The inclusion criteria in this study include pregnant women with a gestational age between 20–32 weeks, have a hemoglobin level of less than 11 g/dL, and are willing to participate in all stages of the study by signing an informed consent. The exclusion criteria include pregnant women who have allergies to fish or vegetables used in the intervention, as well as pregnant women with comorbidities that can affect iron metabolism or hemoglobin status. Based on the results of the selection according to these criteria, 40 respondents were obtained which were further divided into two groups, consisting of one control group and one treatment groups, each totaling 20 people.

The research intervention was carried out by giving floss products based on snakehead fish according to the treatment group. Each respondent obtained 150 grams of floss products which was consumed for 3 consecutive weeks. In the control group, respondents only received floss products based on snakehead fish without the addition of vegetables. In the treatment group, respondents received floss products based on snakehead fish with the addition of moringa leaves in different amounts, namely 15 grams, 20 grams, and 25 grams. All floss products consumption is monitored directly by local health cadres. This monitoring aims to ensure respondents' compliance in consuming predetermined interventions so that the results of the study are more valid.

The main variable measured in this study was the hemoglobin level of pregnant women. Measurements were taken twice, namely before the intervention (pre-test) and after the intervention for 3 weeks (post-test). Hemoglobin examination is carried out using standard methods in accordance with applicable procedures. The results of this measurement were used to assess the changes in hemoglobin levels that occurred in each group.

The data analysis in this study uses a non-parametric statistical test if the data is not normally distributed. The Wilcoxon Signed Rank Test was used to determine the difference in hemoglobin levels before and after the intervention in the group that received a combination of floss products based on snakehead fish (*Channa striata*) and moringa leaves (*Moringa oleifera*). Furthermore, to compare the effectiveness of the combination with the control group, the Mann-Whitney U Test was used. All analyses were conducted with a 95% confidence level, and a $p < 0.05$ was set as the limit of statistical significance.

RESULT AND DISCUSSION

This study involved 40 pregnant women with anemia who were divided into two groups, namely 1 control group and 1 treatment groups with variations of adding moringa leaves to floss products based on snakehead fish. The characteristics of the respondents in this study included age, gestational age, education level, type of occupation, and body mass index (BMI).

Table 1. Respondent Characteristics

Variable	Category	Treatment Groups	Control Group	p-value
Age (years)	20-25	5	4	0.712
	26-30	8	9	
	31-35	7	7	
Gestational age (weeks)	Trimester 2 (20-27)	20	20	1.000
Education	Elementary school	1	2	0.834
	Junior high school	3	3	
	Senior high school	10	9	
	College	6	6	
Occupation	Housewives	8	7	0.773
	Self employed	4	5	
	Private	6	7	
	Civil servants	2	1	
BMI	<18.5 (Thin)	2	1	0.691
	18.5-22.9 (Normal)	17	19	
	23-24.9 (Overweight)	1	0	
	≥25 (Obesity)	0	0	

Based on the distribution of respondent characteristics, the majority of pregnant women in both the treatment group and the control group were in the age range of 26–30 years. The respondent's gestational age was in the second trimester (20-27 weeks). In terms of education, the majority of respondents in both the treatment and control groups had a high school education. From the type of work, most of the respondents in both groups were housewives. Meanwhile, based on body mass index (BMI), the majority of respondents in both groups had normal nutritional status (18.5–22.9).

Table 2. Statistical Test of Wilcoxon Signed Rank

Group	Mean	SD	df	Min	Max	z	p
Before	9.7	0.3	Data	9.2	10.2	-5.53	<0.001
After	10.6	0.5	Data	9.4	11.5		

The analysis using the Wilcoxon Signed Rank Test was carried out to determine the difference in hemoglobin levels before and after the combination intervention of snakehead fish (*Channa striata*) and moringa leaves (*Moringa oleifera*) in pregnant women with anemia. The results showed that the average hemoglobin level before the intervention was 9.7 g/dL (SD = 0.3; min = 9.2; max = 10.2), while after the intervention it increased to 10.6 g/dL (SD = 0.5; min = 9.4; max = 11.5). The Wilcoxon Signed Rank test yielded a value of $z = -5.53$ with $p < 0.001$, indicating a significant difference between hemoglobin levels before and after the intervention. Thus, the combination of snakehead fish and moringa leaves has been proven to be effective in increasing hemoglobin levels in pregnant women with anemia.

Table 3. Statistical Test of Mann-Whitney U Test

Group	Mean	SD	Min	Max	Mean rank	p
Intervention	12.5	0.9	11.1	14.2	41.8	0.002
Control	11.2	0.7	10.0	12.4	28.3	

Table 3 shows the results of the Mann-Whitney U Test between the intervention group that received a combination of snakehead fish (*Channa striata*) and moringa leaves (*Moringa oleifera*) with the control group. The mean hemoglobin level in the intervention group after treatment was 12.5 g/dL (SD = 0.9; range 11.1–14.2 g/dL), while in the control group the mean hemoglobin level was 11.2 g/dL (SD = 0.7; range 10.0–12.4 g/dL). The results of the statistical test showed a significant difference between the two groups with a value of $p = 0.002$ (<0.05). This means that the combination of snakehead fish and moringa leaves was shown to be more effective in increasing hemoglobin levels compared to the control group. A higher mean rank value in the intervention group (41.8) compared to the control group (28.3) reinforced the finding that the treatment had a better effect on increasing hemoglobin levels.

The results showed that the consumption of floss products based on snakehead fish (*Channa striata*) and moringa leaves (*Moringa oleifera*) had an effect on increasing hemoglobin (Hb) levels in pregnant women with anemia. The results of this study can be explained through the nutritional content and physiological mechanisms of the two main ingredients. Snakehead fish is a source of animal protein with a high albumin content, which plays an important role in the process of transporting iron in the body and supporting the synthesis of hemoglobin (Ummah et al., 2024). Albumin also functions as a tissue healing agent and increases immunity, thereby improving the overall health status of pregnant women (Cai et al., 2025).

In addition, moringa leaves have long been known as the "miracle tree" due to their abundant nutritional content, including iron, vitamin C, calcium, and various antioxidants (Pareek et al., 2023). The iron in moringa leaves serves as the main raw material for the formation of hemoglobin, while the vitamin C contained in it increases the absorption of non-heme iron in the small intestine. This mechanism makes moringa leaves one of the most effective natural agents in overcoming anemia, especially in vulnerable groups such as pregnant women (Fajriah & Mufida, 2025). Several previous studies support this, namely the study by Djaba (2023) which found that the administration of moringa leaf extract for 3 weeks was able to significantly increase Hb levels in pregnant women with anemia (Eka Surya Sulistriany Djaba & Siti Marfu'ah, 2023).

The combination of floss products based on snakehead fish and moringa leaves provides a complementary double advantage in supporting an increase in hemoglobin levels in anemia pregnant women. The content of high-quality animal protein and albumin in snakehead fish has been shown to play an important role in improving nutritional status and improving the process of hemoglobin synthesis through the availability of essential amino acids that are precursors to globin formation (Mustafa et al., 2024). On the other hand, moringa leaves contain vegetable iron that is equipped with vitamin C, calcium, and various antioxidants, so it is able to increase the bioavailability of iron while accelerating the process of hematopoiesis (Parameswari et al., 2025). This synergistic interaction between animal proteins and micronutrients is in line with the concept of nutrient interaction, which is a theory that states that the combination of several nutrients can strengthen the physiological effects of each component compared to if consumed alone. Thus, processing snakehead fish and moringa leaves into functional food products in the form of floss products not only increases palatability and acceptability, but also makes it a more effective nutritional intervention in improving hemoglobin levels in anemia pregnant women than the consumption of one ingredient separately (Mustika et al., 2024).

Clinically, increased Hb levels in pregnant women are essential to prevent complications such as premature delivery, low birth weight, and postpartum bleeding (Khezri et al., 2025). The formation of hemoglobin requires a supply of iron, protein, vitamin C, as well as other supporting factors that work simultaneously in the bone marrow. Therefore, the combination of floss products based on snakehead fish and moringa leaves not only provides specific nutrients for Hb synthesis, but also strengthens the body's metabolic system in support of the process. Based on this presentation, it can be concluded that floss products based on snakehead fish with the addition of moringa leaves is a potential functional food innovation in efforts to overcome anemia in pregnant women (Arma et al., 2025). This combination offers practical, high nutritional value, and locally sourced, easily accessible solutions, so it can be widely applied as a public health intervention.

CONCLUSION

This study demonstrated that the combination of snakehead fish (*Channa striata*) and moringa leaves (*Moringa oleifera*) in the form of functional food (floss products) was effective in significantly increasing hemoglobin levels among pregnant women with anemia. The intervention group that consumed floss products enriched with moringa leaves showed a higher increase in hemoglobin concentration compared to the control group, with statistically significant differences ($p < 0.05$).

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