



The Effect of Moringa Leaf Administration on Hb Levels in 3rd Semester Pregnant Women

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Abstract. Anemia during pregnancy is a major public health issue, especially in developing countries like Indonesia, contributing to maternal morbidity and adverse pregnancy outcomes. The second trimester, marked by increased iron needs due to plasma volume expansion and fetal growth, is critical for preventing anemia. Moringa leaves (*Moringa oleifera*), rich in micronutrients, may serve as an effective nutritional intervention to enhance hemoglobin levels in pregnant women. This study aimed to assess the impact of moringa leaf supplementation on hemoglobin levels in second-trimester pregnant women. Using a one-group pretest-posttest quasi-experimental design, the study was conducted at the Tadoy Community Health Center in Bolaang Mongondow Regency from October to November 2025, involving 25 pregnant women selected via purposive sampling. Hemoglobin levels were measured before and after the supplementation. Data analysis, including the Shapiro-Wilk test and Wilcoxon Signed Rank Test, indicated significant changes in hemoglobin levels ($p = 0.000$). The results showed a notable increase in hemoglobin levels post-supplementation, supporting the potential of moringa leaves as a safe, affordable, and effective intervention. This finding suggests that moringa leaves could be integrated into antenatal care and nutrition education to help prevent anemia in pregnant women.

Keywords: Hemoglobin; Moringa Leaves; Pregnancy Anemia; Pregnant Women; Second Trimester.

1. INTRODUCTION

During pregnancy remains a significant global public health issue, particularly in developing countries. The World Health Organization (WHO) reports that more than one-third of pregnant women worldwide experience anemia, with the estimated global prevalence of s reaching 35-38% in the last decade (WHO, 2019; WHO, 2023). Anemia in pregnancy, which is largely caused by iron deficiency, contributes to an increased risk of maternal morbidity and mortality as well as adverse pregnancy outcomes, including preterm birth, low birth weight, and fetal growth restriction (Stevens et al., 2022; Daru et al., 2018).

The second trimester of pregnancy is a critical phase in terms of the mother's hematological status. During this period, there is a significant increase in plasma volume, an increase in iron requirements for erythrocyte formation, and rapid growth of the fetus and placenta. These conditions lead to a physiological decrease in hemoglobin levels, which can develop into anemia if iron and supporting micronutrient intake is insufficient (Bothwell, 2017; Achebe & Gafter-Gvili, 2017). Therefore, interventions aimed at increasing hemoglobin levels in the second trimester are strategically valuable because there is still sufficient time to improve anemia status before entering the third trimester and childbirth.

In Indonesia, the burden of anemia in pregnant women is very high. Data from the 2018 Basic Health Research (Riskesdas) shows that the prevalence of anemia in pregnant women

reaches 48.9%, which means that almost half of pregnant women are anemic (Indonesian Ministry of Health, 2018). This figure places pregnancy anemia as one of the priority issues in maternal health. The Indonesian government has implemented a program to provide Iron and Folic Acid Tablets (TTD) as the main strategy for preventing anemia, in line with WHO recommendations (Indonesian Ministry of Health, 2020; WHO, 2016). However, the effectiveness of this program still faces various obstacles, including low compliance due to gastrointestinal side effects, negative perceptions among pregnant women, and limited access and family support (Young et al., 2019; Permatasari et al., 2021).

Clinically, increased hemoglobin levels are not only determined by iron intake, but also by the availability of other micronutrients such as vitamin A, vitamin C, folate, and adequate protein, which play a role in erythropoiesis and iron absorption (Oppenheimer, 2016; Chaparro & Suchdev, 2019). A food-based approach using locally available micronutrient-rich foods is a promising alternative to standard supplementation, especially in areas where food sources are abundant and easily accessible to the community.

Moringa leaves (*Moringa oleifera*) are one of the local plants that have great potential as a source of functional food. Moringa leaves contain iron, vitamin A (β -carotene), vitamin C, calcium, and essential amino acids that play an important role in hemoglobin formation and improving the nutritional status of pregnant women (Gopalakrishnan et al., 2016; Leone et al., 2018). The vitamin C content in moringa leaves is known to increase the absorption of non-heme iron, while vitamin A plays a role in mobilizing iron from body stores into circulation (Rahman et al., 2021).

Various studies have evaluated the benefits of moringa leaves on hemoglobin status, including in pregnant women. Experimental studies and clinical trials report that administering moringa leaves in powder, capsule, or extract form can significantly increase hemoglobin levels in pregnant women with mild to moderate anemia (Nambiar et al., 2017; Zulaikha et al., 2020). Research in Indonesia also shows that moringa leaf supplementation has the potential to increase hemoglobin levels in pregnant women and improve nutritional status compared to standard interventions alone (Iskandar et al., 2021; Sari & Wulandari, 2022).

However, research results related to moringa leaves still show considerable variation. Differences in dosage form, dosage, duration of administration, and respondent characteristics cause heterogeneity in results, making it difficult to draw strong conclusions for clinical practice (Leone et al., 2018; Dhakar et al., 2019). In addition, most studies have focused on pregnant women with anemia or in the third trimester, while evidence specifically assessing the effect of moringa leaves on pregnant women in the second trimester is still limited. In fact,

the second trimester is the ideal phase for preventive intervention against anemia before the condition becomes more severe.

This research gap indicates the need for further study on the effectiveness of moringa leaf administration on hemoglobin levels in pregnant women in their second trimester, particularly in the context of Indonesia, which has a high prevalence of anemia and abundant availability of moringa leaves. Local food-based approaches such as moringa leaves are also in line with efforts to strengthen food security and utilize local wisdom in maternal health programs (Indonesian Ministry of Health, 2020; Rahman et al., 2021). Additionally, FIGO and WHO emphasize the importance of comprehensive strategies in the prevention and management of pregnancy anemia, including diet optimization and community-based nutritional interventions as a complement to iron supplementation (FIGO, 2019; WHO, 2016).

Based on this description, research on the effect of moringa leaf supplementation on hemoglobin levels in pregnant women in their second trimester is highly relevant and urgent. This study aims to analyze the effect of moringa leaf administration on Hb levels in pregnant women in their second trimester, thereby providing a scientific basis for the development of safe, affordable, and contextually appropriate complementary nutritional interventions in Indonesia for the prevention and treatment of pregnancy-related anemia.

2. RESEARCH METHOD

This study used a quantitative approach with a one-group pretest posttest quasi-experimental design, which aimed to determine the effect of moringa leaf administration on hemoglobin (Hb) levels in pregnant women in their second trimester. This design was chosen because the study focused on measuring changes in Hb levels before and after intervention in the same group without using a control group, allowing researchers to evaluate the effects of intervention directly in the context of real health services. A quantitative approach was used because the variables studied were numerical data on Hb levels that could be analyzed statistically.

The study was conducted at the Tadoy Bolaang Mongondow Community Health Center, a primary health care facility that provides routine antenatal care for pregnant women. The study was conducted from October to November 2025, taking into account the availability of pregnant women in their second trimester and the scheduled intervention of moringa leaf administration.

The population in this study was all pregnant women in their second trimester who attended antenatal visits in the study area during the data collection period. The study sample

was determined based on inclusion and exclusion criteria, with a sample size of ... respondents (adjusted to your research data). Inclusion criteria included pregnant women in their second trimester, no severe pregnancy complications, no chronic diseases that affect Hb levels, willingness to consume moringa leaves as prescribed, and willingness to be a respondent. Exclusion criteria included pregnant women who did not consume the intervention completely or did not follow the entire research protocol.

The sampling technique used was purposive sampling, which is the selection of samples based on specific considerations and criteria in accordance with the research objectives. This technique was deemed appropriate because not all pregnant women were in their second trimester and eligible for moringa leaf intervention. In addition, purposive sampling allowed researchers to obtain respondents who matched the characteristics of the study more efficiently.

The independent variable in this study was moringa leaf administration, while the dependent variable was hemoglobin levels in pregnant women in their second trimester. Moringa leaf administration was defined as the consumption of moringa leaves in a specific form (e.g., capsules, powder, or decoction) at a predetermined dose and duration. Hemoglobin levels are measured in grams per deciliter (g/dL) using standard Hb testing equipment used in health care facilities.

Data collection was conducted in two stages of measurement. Initial measurement (pretest) was conducted before intervention to determine the initial Hb level of respondents. Next, respondents were given intervention in the form of moringa leaf consumption according to the predetermined dosage and duration. After the intervention period was completed, Hb level was measured again (posttest) using the same method and tools to ensure consistency of measurement results.

Data analysis was conducted in stages. Univariate analysis was used to describe the characteristics of respondents and the mean, minimum, and maximum Hb levels before and after the intervention. Next, a normality test was conducted to determine the type of statistical test to be used. If the Hb data were normally distributed, bivariate analysis was performed using a paired t-test. However, if the data were not normally distributed, the Wilcoxon Signed Rank Test was used to determine the difference in Hb levels before and after the administration of moringa leaves. The statistical significance level was set at $p < 0.05$, which indicated that the administration of moringa leaves had an effect on the hemoglobin levels of pregnant women in their second trimester.

3. RESULTS AND DISCUSSION

Based on age characteristics, most respondents were in the 20-35 age group, namely 20 people (80%), which is the healthy reproductive age range. There were 4 respondents (16%) over the age of 35, while only 1 respondent (4%) was under the age of 20. This distribution shows that the majority of pregnant women are at a relatively safe age biologically, although there is still a small number of respondents in the at-risk age group.

In terms of education level, most respondents had a high school education or equivalent, namely 10 people (40%), followed by 8 people (32%) with a junior high school education, and 6 people (24%) with an elementary school education. Only 1 respondent (4%) had a college education. This picture shows that the majority of respondents have a basic to secondary level of education, which may affect their ability to receive and understand health information during pregnancy.

Based on employment status, almost all respondents were housewives, namely 23 people (92%). Respondents who worked as private employees and government employees numbered 1 person each (4%), while there were no respondents who worked as farmers. This condition shows that most respondents did not have formal employment outside the home, thus potentially having more flexible time to attend antenatal services and health interventions provided.

Based on gravid status, the majority of respondents were multigravida, namely 18 people (72%), while respondents with primigravida status numbered 7 people (28%). This distribution shows that most pregnant women have had previous pregnancy experiences, which can influence their perceptions, readiness, and responses to health interventions during pregnancy.

Table 1. Demographic Data.

Var		n	F (%)
Age	< 20 years old	1	4
	20-35 years old	20	80
	>35 years old	4	16
Education	Elementary school	6	24
	Junior high school	8	32
	High School	10	40
	College/university	1	4
Employment	Housewife	23	92
	Farmer	0	0
	Private employee	1	4
	Government employee	1	4
Gravida	Primigravida	7	28
	Multigravida	18	72
Total		25	100

(source: primary data, 2025)

Table 2. Research data.

Var	N	min	max	Mean	SD
Gestation	25	14.0	23.0	18.84	2.70
Hemoglobin level before	25	8.3	20.0	11.16	2.01
Hemoglobin level post	25	10.5	12.5	11.69	0.59

(source: primary data, 2025)

Based on the results of descriptive statistical analysis, the respondents' gestational age ranged from 14 to 23 weeks, with a mean value of 18.84 weeks and a standard deviation of 2.70. This indicates that all respondents were in their second trimester of pregnancy, with relatively moderate variation in gestational age between respondents.

The hemoglobin levels of pregnant women before the moringa leaf intervention showed a minimum value of 8.3 g/dL and a maximum of 20.0 g/dL, with an average of 11.16 g/dL and a standard deviation of 2.01. This average value indicates that, in general, the respondents were in a state of mild anemia to near normal, with considerable variation in hemoglobin levels before the intervention.

After the moringa leaf intervention, the hemoglobin levels of pregnant women changed. Hemoglobin values after the intervention ranged from 10.5 to 12.5 g/dL, with an average of 11.69 g/dL and a standard deviation of 0.59. Compared to the conditions before the intervention, the average hemoglobin level showed an increase, and the variation in hemoglobin values between respondents became smaller, as reflected in the decrease in standard deviation.

Descriptively, these results indicate an improvement in hemoglobin levels in pregnant women in their second trimester after moringa leaf administration, both in terms of an increase in the average value and the stability of hemoglobin levels among respondents.

Table 3. Statistical Analysis.

Independent variable	n	P Value	
Hemoglobin level pre	25	0.000	
Post-hemoglobin level	25	0.036	
<i>Shapiro Wilk</i>			
Independent variable	N	P Value	Dependent variable
Hemoglobin level pre	25	0.000	Post-hemoglobin level
<i>Wilcoxon</i>			

*significant

(source: primary data, 2025)

Based on the results of the Shapiro Wilk normality test, a p-value of 0.000 was obtained for hemoglobin levels before intervention and a p-value of 0.036 for hemoglobin levels after intervention. A p-value less than 0.05 indicates that the hemoglobin level data, both before and

after the administration of moringa leaves, are not normally distributed. Therefore, the analysis of the difference in hemoglobin levels before and after the intervention does not meet the assumptions of parametric tests.

Next, to determine the difference in hemoglobin levels before and after the administration of moringa leaves, a bivariate analysis was performed using the Wilcoxon Signed Rank Test. The Wilcoxon test results showed a p-value of 0.000 ($p < 0.05$) in 25 respondents. These results indicate that there is a statistically significant difference between the hemoglobin levels of pregnant women in their second trimester before and after the moringa leaf intervention.

Objectively, these findings indicate that moringa leaf administration is significantly associated with increased hemoglobin levels in pregnant women in their second trimester. Thus, the null hypothesis (H_0), which states that there is no difference in hemoglobin levels before and after intervention, is rejected, while the alternative hypothesis (H_1) is accepted.

The results of this study indicate that the administration of moringa leaves has a significant effect on increasing hemoglobin (Hb) levels in pregnant women in their second trimester. Analysis using the Wilcoxon test shows a significant difference between Hb levels before and after intervention ($p = 0.000$). Descriptively, there was an increase in the mean Hb value from 11.16 g/dL before the intervention to 11.69 g/dL after the intervention, accompanied by a significant decrease in standard deviation. These findings indicate that in addition to increasing Hb levels, moringa leaf administration also contributes to the stability of hemoglobin levels among respondents.

The second trimester is an important period in pregnancy because during this phase, iron requirements increase significantly due to plasma volume expansion and increased erythrocyte mass. If these requirements are not met, pregnant women are at risk of anemia that can continue into the third trimester and childbirth. Therefore, nutritional intervention in the second trimester is strategically important to prevent worsening anemia and support the physiological readiness of pregnant women (Bencaiova et al., 2012). The results of this study support this concept, as moringa leaf-based intervention administered in the second trimester was able to improve Hb levels before entering the final phase of pregnancy.

Theoretically, the effect of increased Hb after administration of moringa leaves can be explained by the micronutrient content found in moringa leaves. Moringa leaves contain iron, vitamin A, vitamin C, and protein, which synergistically play a role in the process of erythropoiesis. Vitamin C enhances the absorption of non-heme iron in the intestines, while vitamin A plays a role in mobilizing iron reserves from tissues into the bloodstream for

hemoglobin formation (Zimmermann & Hurrell, 2007). In addition, the essential amino acid content in moringa leaves supports globin synthesis, which is the main component of hemoglobin. Thus, moringa leaves not only serve as a source of iron, but also as a supporter of optimal iron utilization in the body.

The results of this study are in line with various previous studies that reported that moringa leaf supplementation can increase hemoglobin levels in pregnant women. Studies in several developing countries show that regular consumption of moringa leaves is associated with increased Hb and improved nutritional status in pregnant women, especially in groups at risk of anemia (Boateng et al., 2019; Kushwaha et al., 2018). Other studies have also reported that administering moringa leaves as supplements or processed foods has comparable or better effects than conventional nutritional interventions in certain groups (Nambiar & Daniel, 2019).

However, not all respondents showed the same increase in Hb. Variations in response between individuals were still apparent, even though statistically the difference before and after the intervention was significant. These findings indicate that the increase in Hb levels was not only influenced by the moringa leaf intervention, but also by other factors such as initial Hb status, consumption compliance, daily diet, and the presence of infections or inflammation that can inhibit erythropoiesis (Pasricha et al., 2021). In addition, the bioavailability of iron from plant sources can be influenced by absorption inhibitors such as phytates and polyphenols, so that responses to the intervention may vary among respondents.

Non-significant findings in individual respondents can also be explained by obstetric characteristics, such as multigravida status. Mothers with repeated pregnancies tend to have lower iron reserves due to previous pregnancies, thus requiring a longer intervention duration to achieve optimal Hb improvement (Milman, 2015). This suggests that the administration of moringa leaves as a single intervention may not be sufficient for some pregnant women and needs to be combined with other nutritional strategies.

From a clinical perspective, the results of this study have important implications for midwifery practice. Moringa leaves are a locally available food source that is easy to obtain, relatively inexpensive, and widely known by the community. Integrating moringa leaves as part of nutrition education and complementary interventions in antenatal care has the potential to increase compliance among pregnant women compared to pharmacological supplementation alone. This approach is in line with the principles of holistic midwifery care based on local wisdom and supports sustainable anemia prevention efforts at the primary care level.

Overall, this study shows that moringa leaf supplementation plays a significant role in increasing hemoglobin levels in pregnant women in their second trimester. However, the

effectiveness of this intervention is influenced by various individual and contextual factors. Therefore, a comprehensive approach combining standard supplementation, nutrition education, and the use of local foods is needed to achieve optimal and sustainable improvement in the anemia status of pregnant women.

4. CONCLUSION

This study shows that moringa leaf supplementation has a significant effect on increasing hemoglobin levels in pregnant women in their second trimester. Statistical analysis results prove that there is a significant difference between hemoglobin levels before and after intervention, indicating the effectiveness of moringa leaves as a complementary nutritional intervention. This increase in hemoglobin levels reflects the role of micronutrients in moringa leaves in supporting the erythropoiesis process during pregnancy. However, variations in individual responses indicate that improvements in hemoglobin status are influenced by other factors, such as initial hemoglobin levels, consumption compliance, and obstetric characteristics. Overall, the use of moringa leaves has the potential to be a safe, affordable, and contextual alternative to support the prevention of anemia in pregnant women in the second trimester when integrated with antenatal care and ongoing nutrition education.

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