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A comparative study of processed Moringa leaves and Fe tablet supplementation on hemoglobin levels among mildly anemic pregnant women

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Abstract

Background: Anemia is a condition characterized by hemoglobin (Hb) levels below normal physiological values based on age and sex. Among pregnant women, anemia poses serious health risks to both the mother and the fetus, including miscarriage, preterm birth, infection, hemorrhage, intrauterine fetal death, low birth weight, congenital anomalies, perinatal mortality, and reduced infant intelligence. In Bekasi City, the prevalence of anemia among pregnant women increased from 14.3% in 2021 to 20% in 2022, largely due to poor adherence to iron (Fe) tablet supplementation, often caused by side effects such as nausea and unpleasant taste.
Purpose: To compare the effectiveness of processed Moringa leaves (*Moringa oleifera*) and Fe tablets in improving hemoglobin levels among pregnant women with mild anemia.
Method: A quantitative experimental design with a two-group pretest–posttest approach was used. The study was conducted at Mrs. Ida Roningsih's Independent Midwife Practice from August 1 to September 31, 2024, involving all pregnant women in the working area, totaling 44 participants. Data were collected through hemoglobin measurements before and after intervention and questionnaire responses. Statistical analyses included univariate and bivariate analysis, the Shapiro–Wilk normality test, and T-test or Wilcoxon test as appropriate.
Results: The mean increase in hemoglobin levels among pregnant women in the Moringa leaf group was 1.35 g/dL (6.15%), compared to only 0.09 g/dL (0.4%) in the Fe tablet group. A significant difference was observed between the intervention and control groups (p = 0.000). The relative risk (RR) of 2.375 indicates that pregnant women receiving Moringa leaf capsules were 2.375 times more likely to experience an increase in Hb levels compared to those taking Fe tablets.
Conclusion: Processed Moringa leaves (*Moringa oleifera*) were proven to be more effective than Fe tablets in increasing hemoglobin levels among pregnant women with mild anemia, showing a more than twofold greater improvement in Hb levels.

Keywords: Experiment; FE Tablets; Hemoglobin; Moringa Leaves.

INTRODUCTION

The effectiveness of maternal health programs is often evaluated through the Maternal Mortality Rate (MMR), which serves as a key health indicator. Maternal mortality refers to deaths caused by complications related to pregnancy and childbirth. Globally, bleeding remains one of the leading causes of maternal death, accounting for up to one-quarter of all maternal fatalities, with its proportion ranging from less than 10% to nearly 60%. Postpartum hemorrhage, a major type of obstetric bleeding, significantly contributes to this mortality, and anemia—particularly during adolescence and pregnancy—is recognized as one of its primary underlying causes.

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According to the World Health Organization, more than 700 women die every day from preventable pregnancy- and childbirth-related causes (World Health Organization, 2024a). In Indonesia, maternal deaths reached 4,627 cases in 2020, increasing from 4,221 cases in 2019 (Ministry of Health of the Republic of Indonesia, 2020). WHO further reports that the global prevalence of anemia in pregnant women remains high at 40.1%, with regional variations: 48.2% in Asia, 57.1% in Africa, 24.1% in the Americas, and 25.1% in Europe (World Health Organization, 2024b).

Anemia reduces the oxygen-carrying capacity of the blood, leading to decreased oxygen supply to the uterus and impaired uterine contractions, which can hinder placental separation and cause postpartum hemorrhage. Women with anemia are estimated to have a sixfold higher risk of experiencing postpartum bleeding compared to non-anemic women (Lenau, Hardiningsih, Hartati, & Sulistyorini, 2023).

In Indonesia, the prevalence of anemia among pregnant women has shown a worrying upward trend over the past five years. The proportion increased from 37.15% in 2013 to 48.9% in 2018, representing an 11.8% rise. The highest prevalence occurred among women aged 15–24 years (84.6%), followed by 25–34 years (33.7%), 35–44 years (33.6%), and 45–54 years (24%) (Ministry of Health of the Republic of Indonesia, 2013; 2019). A preliminary interview with five pregnant women at the Independent Midwife Practice of Ida Roningsih revealed that many did not take Fe tablets regularly due to their unpleasant taste and side effects such as nausea. This highlights the need for alternative approaches to prevent anemia in pregnancy.

Anemia is defined as a condition in which red blood cell count or hemoglobin (Hb) levels fall below normal physiological values, varying by age and sex. Hb levels below 13.5 g/dL in men and 12 g/dL in women are classified as anemic (Muhayati & Ratnawati, 2019). Prevention and treatment of anemia can be achieved through pharmacological measures, such as iron (Fe) tablet supplementation, which typically contains 200 mg of ferrous sulfate (equivalent to 60 mg of elemental iron) and 0.25 mg of folic acid. Iron plays a vital role in oxygen transport, energy production, and the formation of hemoglobin and myoglobin (Sari, Sulastri, & Endrinaldi, 2023).

The Indonesian government has implemented the iron supplementation program recommending the consumption of at least 90 Fe tablets during pregnancy. However, compliance remains a major challenge due to factors such as infrequent antenatal care (ANC) visits, limited tablet availability, and side effects like nausea, dizziness, and dark stools (Retnorini, Widatiningsih, & Masini, 2017).

In addition to pharmacological approaches, non-pharmacological interventions such as dietary intake of iron-rich foods—including red meat, liver, fish, eggs, milk, green vegetables, fruits, and legumes—are also recommended (Sitepu, Pangestu, & Febriyani, 2024). The Ministry of Health further promotes non-pharmacological methods through the consumption of nutrient-dense foods such as spinach, dates, guava juice, and Moringa leaves (Siagian, Djogo, Nahak, Tedjasulaksana, Manek, Sormin, & Pieter, 2023).

Among these, Moringa (*Moringa oleifera*) leaves stand out as a promising source of iron, containing about 31% of the daily recommended value per 100 grams, which is 25 times higher than spinach (Djaba & Marfu'ah, 2023). Moringa leaves are rich in calcium, potassium, protein, iron, and vitamins A and C, and are easily digestible, making them highly beneficial for pregnant women (Usman & Umar, 2022). Research among adolescent girls at the Ciumbuleuit Bandung Air Force Polytechnic (2024) demonstrated that combining Moringa leaf extract with Fe supplementation significantly increased Hb levels compared to Fe alone (Sitepu et al., 2024). Similarly, another study found that Moringa leaf administration contributed to slight Hb improvement and had no adverse impact on Fe and Zn intake among anemic pregnant women (Badri, Indarto, Ardyanto, & Avelia, 2024).

Given the low adherence to Fe tablets due to their side effects and taste, Moringa leaf capsules could serve as a more acceptable and natural alternative for managing anemia during pregnancy. However, comparative research on the effectiveness of Moringa leaves versus Fe tablets remains limited. Therefore, this study aims to compare the effects of processed Moringa leaves and Fe tablets on mild anemia among pregnant women to determine which intervention is more effective in improving hemoglobin levels.

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RESEARCH METHOD

An experimental design using a two-group pretest–posttest comparative approach, consisting of an intervention group given Moringa leaf capsules and a control group given Fe tablets in accordance with Antenatal Care (ANC) standards at the community health center. The study population included all pregnant women within the working area of the Independent Midwife Practice of Ida Roningsih, totaling 44 individuals.

The sample comprised pregnant women with anemia who met the following inclusion criteria: (a) diagnosed with mild anemia, (b) willing to consume processed Moringa leaf capsules for 14 consecutive days, and (c) willing to participate as research respondents. The exclusion criteria included: (a) pregnant women with moderate anemia (Hb 9–10 mg/dL), (b) those with severe anemia (Hb 7–8 mg/dL), and (c) pregnant women with anemia accompanied by serious illnesses.

The sampling technique applied was total sampling. The research was carried out in the working area of Mrs. Ida Roningsih's Independent Midwife Practice in Bekasi from August to September 2024. Data were collected using a questionnaire and an Easy Touch hemoglobin meter during ANC visits. Participants in the intervention group received Moringa leaf capsules once daily for 14 consecutive days, taken in the morning after meals at a dosage of 3 grams per day. The capsules were consumed independently at home, with assistance and supervision from community health volunteers every two days. Interventions took place at the participants' homes, while monitoring was conducted during ANC visits. Hemoglobin examinations were performed by midwives using a calibrated Easy Touch device, which was checked weekly by laboratory staff.

Uncontrolled factors included the use of other dietary supplements, prescribed medications, and health conditions occurring during the intervention period. These factors were documented in each participant's diary and accounted for during data analysis. The questionnaire used in this study was tested for validity and reliability among 10 respondents outside the study site, yielding a correlation coefficient (r) greater than 0.6 and a Cronbach's alpha value above 0.7.

The research data were analyzed using univariate analysis and bivariate analysis, the Shapiro-Wilk normality test, and the T test or Wilcoxon.

This research has been declared to have passed ethical review by the Binawan University Health Research Ethics Committee with number 207/KEPK-UBN/X/2024.

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RESEARCH RESULTS

Table 1. Characteristics of the Participants (N=44)

Variables	Results		p-value
	Intervention (n=22)	Control (n=22)	
Age (Mean±SD)(Year)	(30.55±5.697)	(29.09±5.959)	
20 to 35	14/63.64	16/72.73	0.216
< 20 > 35	8/36.36	6/27.27	
Education (n/%)			
Elementary - Secondary	1/4.55	4/18.18	1.000
High School	18/81.81	16/72.73	
Diploma/University	3/13.64	2/9.09	
Employment Status (n/%)			
Employed	10/45.45	7/31.82	0.113
Unemployed	12/54.55	15/68.18	
Parity (n/%)			
Primipara	9/40.91	4/18.18	0.077
Multipara	11/50.00	15/68.18	
Grand Multipara	2/9.09	3/13.64	
Gestational Age (n/%)			
Trimester 1	1/4.55	19/86.36	
Trimester 2	4/18.18	3/13.64	0.424
Trimester 3	17/77.27	0	
History of Anemia (n/%)			
Yes	6/27.27	3/13.64	1.000
No	16/72.73	19/86.36	

Table 1 indicates that the majority of participants in both the intervention and control groups were aged between 20 and 35 years (63.64% and 72.73%, respectively). Regarding educational background, high school graduates were the most prevalent in both groups (81.81% in the intervention group and 72.73% in the control group). In terms of employment status, most participants were unemployed (54.55% in the intervention group and 68.18% in the control group). For parity, multiparous women were predominant in both groups (50.00% in the intervention group and 68.18% in the control group). Concerning gestational age, most participants in the intervention group were in the third trimester (77.27%), whereas the control group was mostly in the first trimester (86.36%). Additionally, the majority of participants in both groups had no history of anemia (72.73% in the intervention group and 86.36% in the control group).

The results of the homogeneity analysis between the two groups, namely the intervention and control groups, showed that their variances were equal or homogeneous. This finding is supported by the characteristics of age, education, occupation, parity, gestational age, and anemia history, all of which had p-values greater than 0.005. Therefore, there were no significant differences between the two groups, indicating that they were comparable and suitable for further analysis.

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Table 2. Analysis of the effect of Moringa leaves and FE tablets on increasing HB levels (N=44)

Variable	Group (Mean±SD) Median (Range)		p-value
	Intervention (n=22)	Control (n=22)	
HB Score			
Pretest	(9.94±0.780) 10 (9 – 11)	(9.96±0.810) 10 (9 – 11)	0.327***
Posttest	(11.29±0.629) 11.30 (10 – 12)	(10.05±0.787) 19.50 (9 – 11)	0.708***
p-value	0.000*	0.000**	
Difference (Improvement)	(-1.354±0.519) -1.4 (-2 – -0.4)	(-0.09±0.081) -0.10 (0 – 0)	0.000***
% Increase	1.35 (6.15%)	0.09 (0.4%)	

*Description: *) Wilcoxon test, **) T test ***) Mann Whitney test*

Table 2 indicates that the mean pretest hemoglobin levels between the intervention and control groups did not differ significantly (p = 0.327), as the p-value was greater than 0.05. Similarly, there was no significant difference in the mean posttest hemoglobin levels between the two groups (p > 0.05). However, significant differences were found between the pretest and posttest hemoglobin levels within both the intervention group (p < 0.000) and the control group (p < 0.000), as well as in the overall increase in mean hemoglobin levels between pretest and posttest in both groups (p < 0.005). Furthermore, the table shows that the mean hemoglobin level of pregnant women in the intervention group increased by 1.35 g/dL (6.15%) after receiving Moringa leaf capsules, which was higher than the increase observed in the control group receiving iron (Fe) tablets, with only a 0.09 g/dL (0.4%) improvement.

Table 3. Differences in hemoglobin levels in posttest between the two groups

Group	HB		Total	p-value*
	11	12		
Control	3/27.3	0/0	3/13.6	0,000
Intervention	8/72.7	11/100	19/86.4	RR 2.375 CI (1.402-4.024)

*Remarks: *) chi square test*

Table 3 reveals that 72.7% of pregnant women in the Moringa leaf group experienced an increase in hemoglobin levels (>11 g/dL), whereas only 27.3% of those in the Fe tablet group showed a similar improvement. A significant difference in hemoglobin levels was found between the intervention and control groups (p < 0.001). The relative risk (RR) analysis indicated that pregnant women who received Moringa leaf capsules were 2.375 times more likely to experience an increase in hemoglobin levels compared to those who received iron supplement tablets.

DISCUSSION

A total of 72.7% of pregnant women in the Moringa leaf group experienced an increase in hemoglobin (Hb) levels (>11 g/dL), compared to 27.3% in the Fe tablet group. The relative risk (RR) value of 2.375 indicates that pregnant women who consumed Moringa leaves were 2.375 times more likely to experience an increase in Hb levels than those who took Fe tablets.

These findings align with a study conducted in Pariaman, which reported a significant effect of Moringa leaf capsules (*Moringa oleifera*) on hemoglobin levels among anemic pregnant women in the working area of the Kurai Taji Health Center (Rishel, 2023). However, another study involving 210 pregnant women found that the combination of Fe tablets and dates was more effective in improving hemoglobin levels compared to Moringa leaf and Fe supplementation (Kahirah, Nashrillah, Royani, Susanti, Riance, & Lasmita, 2024).

The increase in Hb levels following Moringa leaf administration is attributed to its high iron content. One hundred grams of Moringa leaf powder contains approximately 44.1 mg of iron, equivalent to 196% of the recommended daily intake. The iron concentration

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in dried Moringa leaves is about 25 times higher than that of spinach, making it a promising natural source of iron for anemic pregnant women (Agustini, Sunarsih, Rachmawati, & Astriana, 2024). Similarly, a study at the Jayanti Health Center reported that both Moringa leaves and mung beans contain essential nutrients, particularly iron, and can serve as alternative remedies for anemia in pregnant women who are reluctant to consume medicinal supplements (Suheti, Indrayani, & Carolin, 2020).

Although Moringa leaf and Fe supplementation were less effective than the Fe and date combination (Kahirah et al., 2024), these findings suggest that Moringa leaves have strong potential as an alternative or complementary source of iron, especially for pregnant women in areas with limited access to pharmaceutical supplements or those who experience side effects from Fe tablets. Studies further indicate that Moringa leaves can enhance hemoglobin levels when used as adjunct or alternative therapy, with minimal adverse effects (Kalam, Noor, Ishak, & Yusoff, 2024).

Moringa leaves are rich in iron—approximately 27.1 grams per 100 grams of dried leaves (Agustini et al., 2024)—which plays a key role in hemoglobin synthesis. Moreover, Moringa leaf flour-based biscuits have been shown to improve hemoglobin levels as well as iron and zinc intake among anemic pregnant women (Manggul, Hidayanty, Arifuddin, Ahmad, Hadju, & Usman, 2021). The efficacy of Moringa leaves is not limited to pregnancy; supplementation with 3000 mg of Moringa leaf capsules for 60 days has also been found to increase Hb levels in women of reproductive age with iron deficiency anemia (Siagian et al., 2023).

Experimental studies in anemic pregnant rats demonstrated that Moringa leaf capsules significantly affected hepcidin and ferritin levels, comparable to Fe tablets (Sari et al., 2023). Additionally, combining Moringa leaves with Fe tablets or dates may produce synergistic effects (Kahirah et al., 2024), suggesting the potential for Moringa to be used as a complementary therapy rather than a sole alternative. Importantly, no severe side effects were observed in pregnant women consuming Moringa leaf capsules, indicating greater tolerability compared to Fe tablets, which are often associated with gastrointestinal discomfort (Bloor, Schutte, & Hobson, 2021).

The notable difference in Hb improvement may be due to the high iron and vitamin C content in Moringa leaves, which enhances non-heme iron absorption and counteracts the inhibitory effects of compounds such as phytates and tannins. Moringa can even be developed into consumer-friendly preparations, such as effervescent beverages with appealing taste characteristics (Zubaydah, Fia, Adawia, Novitasari, Rahmasari, & Hasanuddin, 2019). Nonetheless, it should be recognized that the bioavailability of plant-based iron is generally lower than that of iron from Fe tablets.

This study has certain limitations, including a relatively short intervention period of 15 days and the use of Moringa leaf capsules as the sole intervention form. Future research should explore different Moringa-based preparations and longer treatment durations. Although Moringa leaves demonstrated a 2.375-fold increase in Hb levels statistically, further investigation is necessary to determine whether this improvement is clinically sufficient to substitute Fe tablets as a standalone therapy.

CONCLUSION

The administration of Moringa leaf capsules demonstrated greater effectiveness in increasing hemoglobin levels than Fe tablets, as evidenced by a relative risk (RR) of 2.375 and a p-value of < 0.05. These results suggest that Moringa leaves may serve as a promising alternative or complementary supplement for managing mild anemia in pregnant women, particularly in regions with limited access to conventional pharmaceutical products. Nevertheless, further studies involving larger sample sizes and extended intervention periods are required to strengthen and validate the generalizability of these findings.

SUGGESTION

Based on the study findings and supporting literature, Moringa leaves show strong potential as an effective supplemental therapy for improving hemoglobin levels in pregnant women with mild anemia. However, confirming their efficacy as a primary substitute for Fe tablets requires further investigation through randomized controlled trials (RCTs) involving larger samples and longer intervention durations. Future research is also

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encouraged to examine the combined use of Moringa leaves and Fe tablets to identify possible synergistic effects. Moreover, Moringa leaves hold significant economic value due to their ease of cultivation and versatility, as they can be processed into various acceptable forms such as capsules, teas, biscuits, or other functional food products suitable for pregnant women.

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