



The Effect of Green Spinach Leaf Consumption on Hemoglobin Level Changes in Pregnant Women with Anemia

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Abstract

Anemia has detrimental intergenerational consequences, including adverse pregnancy and birth outcomes, increased risks of mortality and morbidity, and impaired cognitive and motor development in children. These consequences, based on maternal status, indicate that anemia remains a major public health concern. This study aimed to analyze the effect of green spinach leaf vegetable consumption on changes in hemoglobin levels among pregnant women with anemia. A quasi-experimental study with a pretest-posttest group design was employed. The intervention involved administering 200 grams of green spinach vegetable daily for 7 days while temporarily discontinuing iron (Fe) tablet supplementation during the study period. The sampling technique used purposive sampling, involving 10 pregnant women diagnosed with anemia. The dependent variable was anemia, and the independent variable was the consumption of green spinach vegetables. Data were analyzed using the Shapiro-Wilk test and paired t-test to assess differences in hemoglobin levels before and after the intervention and to determine the effect of green spinach consumption on hemoglobin level changes in anemic pregnant women. The findings showed that the mean hemoglobin level before the intervention was 9.91 g/dL with a standard deviation of 0.612, which increased to a mean of 11.70 g/dL with a standard deviation of 0.878 after the intervention. The p-value was 0.000, which is less than 0.05, indicating a statistically significant increase in hemoglobin levels following the consumption of green spinach.

Introduction

Anemia leads to detrimental intergenerational consequences, including poor pregnancy and birth outcomes, higher risks of maternal and infant mortality and morbidity, and impaired cognitive and motor development in children. These adverse outcomes, particularly when linked to maternal status, indicate that anemia remains a significant global public health concern (Kabir et al., 2022; Rahman et al., 2016; Shi et al., 2022; Koblinsky, 1995). Current trends show that the world is not on track to meet global anemia reduction targets. Globally, it is estimated that 40% of children aged 6–59 months, 37% of pregnant women, and 30% of women aged 15–49 years are affected by anemia. The leading causes include dietary iron deficiency, thalassemia, sickle cell disease, and malaria (World Health Organization, 2023; Muriuki et al., 2021; Fasano et al., 2022; Hess et al., 2023).

In cases of mild iron deficiency during pregnancy, iron transport is prioritized for fetal needs, and clinical symptoms in the mother may not yet be apparent. However, in moderate to severe

deficiency, iron depletion affects the maternal unit, placenta, and fetus, increasing the risk to both mother and fetus and resulting in short- and long-term risks for the newborn. Maternal outcomes are closely associated with the severity of anemia (Smith et al., 2019; Kathuria et al., 2023; Young et al., 2023; Benson et al., 2021).

According to the 2024 Indonesian Health Survey, 3 out of 10 pregnant women experience anemia. Maternal anemia is a significant pregnancy-related complication that increases the risk of both maternal and infant mortality and morbidity (Obeagu et al., 2025; Patel et al., 2025; Mahmud et al., 2025). The maternal mortality rate (MMR) in Indonesia in 2020 was 189 per 100,000 live births higher than other Southeast Asian countries. Additionally, Indonesia had the third-highest infant mortality rate in the region, at 9.3 deaths per 1,000 live births in 2022–2023. The number of maternal deaths increased from 4,005 to 4,129, while neonatal deaths rose from 20,882 to 29,945. According to the WHO, 40% of maternal deaths in developing countries are associated with pregnancy-related anemia. In South Sulawesi Province, maternal mortality ranked fourth highest nationally in 2021–2022.

The second leading cause of maternal mortality is postpartum haemorrhage, accounting for 741 out of 1,000 maternal deaths. According to the World Health Organization (WHO), approximately 14 million cases of postpartum haemorrhage occur globally each year, with around 140,000 resulting in death equivalent to one maternal death every four minutes. Anemia is a significant risk factor for postpartum haemorrhage, increasing the likelihood of complications due to low hemoglobin levels and decreased oxygen supply to body tissues, which subsequently affects uterine contractions. This highlights the urgent need for early detection, nutritional status monitoring, and comprehensive antenatal care services to prevent maternal complications (Ayu et al., 2024; McCauley et al., 2022; Botutihe et al., 2025; Arsenault et al., 2024).

In the working area of Watampone Health Center, hemoglobin testing conducted on 30 pregnant women during a community health (posyandu) activity showed that 10 of them had hemoglobin levels between 9–10 g/dL, while one pregnant woman had a hemoglobin level of 8 g/dL.

Anemia prevention and management in pregnancy require an integrated approach combining pharmacological and non-pharmacological therapies. Although pharmacological interventions such as iron tablet supplementation (Fe tablets) are widely implemented, the prevalence of anemia among pregnant women has not declined significantly, and postpartum haemorrhage due to anemia remains prevalent (Nurjannah, 2024; Gul et al., 2025; Omotayo et al., 2021; Shi et al., 2022).

Interviews conducted during this study revealed that some pregnant women did not consume the provided Fe tablets due to side effects such as nausea and abdominal discomfort. As an alternative, natural iron sources derived from animal and plant-based proteins may serve as substitutes. A previous study conducted by the researcher involved the administration of snakehead fish (*Channa striata*) to anemic pregnant women, which showed an increase in hemoglobin levels from a pretest mean of 9.88 g/dL to a posttest mean of 10.93 g/dL, an increase of 1.05 g/dL with statistically significant results ($p = 0.000 < 0.05$). This finding supports the potential of animal protein, such as snakehead fish, to replace Fe tablets by enhancing iron absorption. However, animal-based protein sources are relatively expensive compared to plant-based alternatives, prompting the researcher to explore affordable, iron rich plant sources accessible to all segments of the population (Tay et al., 2023; McClements, 2023).

One such plant based source is green spinach, which is rich in iron and widely regarded as the "king of vegetables" due to its high nutritional value. Green spinach contains vitamins A, B, and C, as well as essential minerals such as calcium, phosphorus, and iron. Cooked spinach contains approximately 8.3 mg of iron per 100 grams. The iron content in spinach contributes

to the formation of hemoglobin, as it includes both organic and inorganic compounds necessary for the body. Specifically, the organic iron (Fe) content in green spinach plays a critical role in supporting hemoglobin production in red blood cells (Qadri et al., 2022; Sari & Radhia, 2025; Gunawan et al., 2023).

This study aimed at determining whether the consumption of green spinach vegetables without Fe tablet supplementation is effective in increasing hemoglobin levels among anemic pregnant women in the service area of the Watampone Health Center.

Methods

In the current research, a one-group pretest-posttest design was used to develop a quantitative methodology based on a quasi-experimental design. The design was chosen because it will allow a close observation of variation in hemoglobin level before and after intervention, in the same group of respondents, and provide clear picture of green spinach intake effects on pregnant women with known anemia. The operational area of the Watampone Public Health Center, which is the primary health service facility and also actively involved in offering antenatal care services to the local people, was chosen as the operational area of the research. The timeframe of data collection was 3 months (May through July 2025) to guarantee that there was enough time to recruit participants, administer the intervention and evaluate the effect.

The study population included all pregnant women attending the antenatal care services in the integrated health posts in the jurisdiction of Watampone Public Health Center around the time that the study was done. The total number of pregnant women who qualified as per the general population criteria was 33. A sample of 10 pregnant women was chosen out of this population through purposive sampling. This sampling method was selected because it ensured that the respondents satisfied certain criteria that are pertinent to the aims of the study especially the existence of anemia as it is established by examination of hemoglobin.

Pregnant women who had been diagnosed with anemia, and who was voluntarily willing to take part and had the capacity of adhering to the intervention protocol were only included. Interviewees who still used iron tablet supplementation throughout the research period were left out a priori to eliminate any confounding effects.

After the selection of samples, baseline data was taken to find out the initial level of hemoglobin of all the participants. Easy Touch hemoglobin measuring system was used to measure the hemoglobin level, and it is the commonly used hemoglobin measuring device in primary health care facilities to provide a quick and accurate measure. This baseline measurement was the pretest figure, which acted as a baseline by which changes after the intervention would be measured.

The intervention involved the seven-day intake of 200 {g} of green spinach vegetables per day. The researcher also prepared the spinach and supplied it to maintain consistency in the portion size and to reduce the difference in the nutritional value. The participants were advised against taking iron pills or iron supplements during the intervention period. This was done to determine the influence of the intake of green spinach on the hemoglobin levels in the body and to gain more insight on how it might be employed as a non-pharmacological measure of controlling anemia in pregnant women.

During the intervention, the compliance of the participants was observed strictly using an observation sheet. Follow-up was done daily to ensure that the spinach was taken as stipulated and any complications during the intervention period were recorded. Such a monitoring process was necessary to sustain the integrity of the intervention, and to be sure that the observed results may be ascribed to the fact that green spinach is consumed.

The post-test hemoglobin levels were measured on the same Easy Touch device after the seven-day period of the intervention process. The fact that the same measuring instrument was used

during the pre-intervention period and post-intervention period also contributed to consistency and minimization of measurement bias. The comparison of the pre-test and post-test hemoglobin levels was the foundation of the assessment of the effectiveness of the consumption of green spinach as a way to enhance hemoglobin levels of anemic pregnant women.

Statistical software was applied to analyze data. The Shapiro-Wilk test was used to determine normality of the data distribution before the hypothesis was tested. Because the hemoglobin data has been identified to be normally distributed, a paired t test was later employed to test the differences in pre-test and post-test hemoglobin levels. The statistical significance was set at a confidence interval of 95 Percent and a p value below 0.05 was regarded as a significant effect.

The research process was conducted with a lot of consideration on ethical issues. Ethical consent of this research was granted by the Ethics Committee of Nani Hasanuddin School of Health Sciences on May 31 2025 with approvals number 5580 STIKES NH KEPK V 2025. The participants were made aware of the purpose, the procedures, possible benefits as well as risks of the study beforehand. Each participant was provided with informed consent written and the information concerning personal and closely related health concerns was kept confidential.



Figure 1. Tools and materials used in research

Source : (Okvitasari,et all,2021)

Result and Discussion

Characteristics of Respondents based on Maternal Age

Table 1. Frequency Distribution of Maternal Age

Charactesristics	F	%
High-Risk < 17 > 35 Years	7	70%
Low-Risk 17 -35 Years	3	30%
Total	10	100%

Based on Table 1, out of 10 pregnant women, 7 (70%) were classified as high-risk based on maternal age, while 3 (30%) were classified as low-risk.

Characteristics of Respondents Based on Pregnancy Trimester

Table 2. Frequency Distribution of Pregnancy Trimester

Charactesristics	F	%
High-Risk (Trimester II and III)	10	100%
Low-Risk (Trimester I)	-	0%
Total	10	100%

Based on Table 2, all 10 pregnant women were classified as high-risk for anemia during pregnancy according to their gestational trimester.

Univariate Analysis

Table 3. Characteristics of Pregnant Women with Anemia

Characteristics	F	%
Anemia in Pregnancy	10	30,3%
without Anemia in Pregnancy	23	69,7,%
Total	33	100%

Based on Table 3, out of 33 pregnant women who underwent antenatal examinations, 10 (30.3%) were found to have pregnancy-related anemia, while 23 (69.7%) had normal hemoglobin levels.

Bivariate Analysis

The initial analysis used the Shapiro-Wilk test. The p-value for hemoglobin levels before the intervention was 0.591, and after the intervention was 0.175, indicating that the data were normally distributed.

Table 4. Differences in Hemoglobin Levels Before and After Green Spinach Consumption

	Pre-Test		Post-Test		Score P
	Mean	Deviation Standard	Mean	Deviation Standard	
Hb Level	9.91	0.612	11.70	0.878	0.000

Changes in hemoglobin levels were observed both before and after the consumption of green spinach. Table 4 shows that the mean hemoglobin level before the intervention was 9.91 g/dL with a standard deviation of 0.612, and it increased to a mean of 11.70 g/dL with a standard deviation of 0.878 after the intervention. The p-value was 0.000, which is less than 0.05, indicating a statistically significant difference. This suggests that hemoglobin levels in pregnant women with anemia increased significantly following the consumption of green spinach.

Anemia during pregnancy increases the risk of both maternal and fetal morbidity and mortality. It can lead to postpartum haemorrhage, perinatal infections, intrauterine growth retardation (IUGR), low birth weight (LBW), preterm birth, neonatal anemia, and impaired cognitive and mental development in infants by six months of age. According to the 2023 Indonesia Health Survey (SKI), the second leading cause of maternal death after hypertensive disorders in pregnancy remains postpartum haemorrhage, which is frequently associated with pregnancy-related anemia (Ustadi et al., 2025; Mustary et al., 2024). Both leading causes hypertensive disorders and postpartum haemorrhage are critical conditions requiring immediate medical attention. Early detection, routine antenatal check-ups, and proper management are essential to reduce maternal mortality (Sarkar et al., 2021; Alkhatib et al., 2023; Wuna et al., 2025; Tanberika et al., 2024).

The most common cause of anemia is iron-deficiency anemia, which results from depleted iron stores due to blood loss, impaired iron absorption, inadequate dietary intake of iron, and pregnancy itself (Kolarš et al., 2025; Saboor et al., 2021; Kumar et al., 2022). In high-income countries, approximately 38% of non-pregnant women of reproductive age experience iron deficiency without anemia, and about 13% suffer from iron-deficiency anemia. During the third trimester of pregnancy, iron deficiency affects up to 84% of pregnant women.

The findings of this study, as shown in Table 1, revealed that 7 out of 10 anemic pregnant women were in the high-risk age group, suggesting that maternal age may be a contributing

factor to anemia in this population. The ideal age range for pregnancy is between 21 and 35 years (Ningsih et al., 2018; Consensus, 2022; Correa-de-Araujo & Yoon, 2021; Rottenstreich et al., 2022).

Based on the results presented in Table 3, the mean hemoglobin level before the intervention was 9.91 g/dL (SD = 0.612), which increased to 11.70 g/dL (SD = 0.878) after the intervention with green spinach consumption. The p-value of 0.000 ($p < 0.05$) indicates a statistically significant increase in hemoglobin levels among pregnant women with anemia. These results are consistent with previous studies showing that the consumption of green spinach can improve hemoglobin levels in anemic pregnant women (Susilawati et al., 2024).

The iron content in spinach is beneficial for the formation of hemoglobin in the blood.¹² Green spinach contains iron in the form of ferrous (Fe^{2+}), which is highly bioavailable. Every 100 grams of green spinach contains approximately 3.5 mg of iron. It also has a high vitamin C content, which enhances iron absorption. Vitamin C, along with vitamin E, acts as an effective antioxidant to protect erythrocytes from excessive oxidative stress. During pregnancy, the total iron requirement for both the mother and fetus is approximately 1,000 mg. From the second trimester through to the end of pregnancy, iron needs increase significantly to support maternal erythropoiesis, placental development, and fetal growth. It is estimated that iron requirements can reach up to 7.5 mg/day during the third trimester (Wibowo et al., 2021).

Conclusion

Green spinach has proven beneficial in increasing hemoglobin levels in pregnant women with anemia due to its high iron and vitamin C content. These nutrients play an important role in maintaining overall organ function and supporting the effective production of red blood cells. It is recommended that future studies involve a larger sample size of pregnant women with anemia to strengthen the findings.

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