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THE EFFECT OF RED GUAVA-RED SPINACH JUICE COMBINED WITH IRON SUPPLEMENTATION ON HEMOGLOBIN LEVELS IN PREGNANT WOMEN

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Abstract

Background: Anemia in pregnancy remains a major public health concern, with prevalence exceeding 20% in Indonesia. This condition is commonly associated with hemodilution and inadequate iron intake.

Objective: This study aims to analyze the effect of red guava–red spinach juice combined with iron (Fe) tablet fortification on the hemoglobin (Hb) levels of third-trimester pregnant women.

Methods: A quasi-experimental pretest–posttest design with a control group was implemented involving 60 pregnant women. Participants were divided into control (Fe tablets only) and intervention groups (Fe tablets + 200 mL red guava–red spinach juice daily for 14 days). Hemoglobin was measured using a calibrated digital hemoglobinometer. Paired and independent t-tests were used.

Result: The control group showed an Hb increase from 9.21 ± 0.18 g/dL to 12.10 ± 0.27 g/dL (mean difference 2.89 g/dL, $p < 0.001$). The intervention group increased from 8.41 ± 1.12 g/dL to 13.00 ± 0.90 g/dL (mean difference 4.59 g/dL, $p < 0.001$). An independent t-test revealed significant differences in post-test Hb levels between groups ($t = -20.4$, $p = 0.01$). Effect size (Cohen's $d = 1.21$) indicated strong clinical significance.

Conclusion: Red guava–red spinach juice combined with Fe tablets is more effective in increasing Hb levels than Fe tablets alone. This intervention can be recommended as a complementary non-pharmacological strategy for anemia prevention programs.

INTRODUCTION

Anemia in pregnancy is a persistent global and national public health issue. The World Health Organization defines anemia during pregnancy as a hemoglobin (Hb) concentration below 11 g/dl in the first trimester and below 10.5 or 11.0 g/dl in the second or third trimester (Eweis et al., 2021). The number of adolescent girls and women of reproductive age suffering from anemia worldwide reached

613.2 million (32.8%). Of these, approximately 35.3 million pregnant women (40.1%) were affected (Global Nutrition Report, 2020).

This prevalence indicates that anemia is more common in pregnant women than in non-pregnant women, among whom the rate is 32.5%. In developing and underdeveloped regions, particularly in Asia and Africa, the prevalence of anemia among pregnant women reaches as high as 48.7% and 46.3%, respectively. Additionally, around 20% of pregnant women with anemia suffer complications that can lead to maternal death (Kefiyalew et al., 2014).

Indonesia, as a developing country, continues to face high rates of anemia in pregnancy. The 2021 Basic Health Research reported a significant increase in anemia prevalence among pregnant women in Indonesia from 48.9% to 78% (Ministry of Health, 2021). This prevalence makes anemia in pregnancy a public health issue in Indonesia because the rate exceeds 20% (UNICEF, 2020). Indonesia ranks third in Southeast Asia for anemia in pregnancy, following Cambodia (55.8%) and Myanmar (53.8%) (Global Nutrition Report, 2020). In East Java Province, the prevalence of anemia among pregnant women was 19.6% in 2022, below the national target of 28%. However, certain districts, such as Lamongan, still report high rates, with a prevalence of 10.9%.

Anemia in pregnant women can lead to serious complications, including miscarriage, antepartum and postpartum hemorrhage, childbirth complications, and maternal death (Randall et al., 2019). For the fetus, anemia increases the risk of developmental problems, premature birth, low birth weight, disability, infant mortality, and impaired cognitive development, especially if the mother is iron-deficient in the third trimester (Carolin et al., 2023).

To address this issue, the Indonesian government has promoted the use of iron Fe tablets, which typically contain 60 mg of ferrous fumarate and 400 mcg of folic acid (Wu, 2016). However, the continued high prevalence of anemia suggests that this intervention alone has not been fully effective, likely due to underlying malnutrition. Research indicates that combining Fe supplementation with other micronutrients is more effective at boosting hemoglobin levels than Fe supplementation alone (Utami & Farida, 2022). Essential nutrients for preventing anemia include iron, folic acid, vitamin B12, vitamin B6, vitamin C, and protein (Dattijo et al., 2016).

Non-pharmacological interventions, such as consuming fruits and vegetables, offer a natural and low-risk approach to improving iron levels in pregnant women (Jin et al., 2024). Juices made from nutrient-rich fruits and vegetables not only taste pleasant but can also be effective in boosting hemoglobin levels. Studies have shown that consuming juices made from fruits, vegetables, or their combination can significantly improve hemoglobin levels in pregnant women (Mulyani & Sari, 2020).

Red guava (Psidium guajava L.) is particularly rich in nutrients, especially vitamin C. Its vitamin C content is six times higher than that of oranges, ten times higher than papayas, seventeen times higher than regular guavas, and thirty times higher than bananas (Hadi, 2023). Red guava can be consumed on its own or combined with other fruits and vegetables in juice form. A study by Paramitha et al. (2024) found that combining red guava and beetroot juice increased hemoglobin levels in third-trimester

pregnant women by 1.86 g/dL. Similarly, Nair et al. (2016) conducted a study on 296 pregnant women in the Pradesh district, India, and found that guava juice significantly increased hemoglobin levels by 3.3 g/dL.

Another potential dietary intervention is red spinach (Amaranthus tricolor L.), which has significantly higher iron content than regular spinach. It is also rich in vitamins C, folate, and B12, which are essential for iron absorption and red blood cell formation (Mwangi et al., 2021). A study by Safitri (2019) in Indonesia reported that combining red spinach and tomato juice increased hemoglobin levels in third-trimester pregnant women by 0.36 g/dL. Imron et al. (2020) also found that red spinach juice increased hemoglobin levels by 1.211 g/dL in the intervention group compared to 0.633 g/dL in the control group. Another study by Al-Naseem et al. (2021) demonstrated that pregnant women in their third trimester who consumed red spinach juice mixed with honey daily for 7 days experienced an average increase in hemoglobin of 1.4 g/dL. Therefore, this study aims to evaluate the effect of combining red guava–red spinach juice with Fe supplementation on hemoglobin levels among pregnant women.

METHODS

Study Design

This study is a quasi-experimental study with a two-group pretest-posttest design. Hemoglobin levels of respondents were measured before (pretest) and after (posttest) the intervention in both the control and experimental groups using a digital hemoglobinometer. The independent variables in this study were the consumption of red guava and red spinach juice, while the dependent variable was the increase in hemoglobin levels in pregnant women.

Settings

The research was conducted at the Lamongan Health Centre, East Java, Indonesia. Data collection was carried out between February and March 2025.

Research subject

The study population comprised all pregnant women who had undergone antenatal care examinations at the Lamongan Health Centre. The sample included third-trimester pregnant women, selected through purposive sampling, which involves selecting participants based on specific criteria. A total of 60 respondents were selected and divided into two groups: 30 respondents in the control group and 30 in the experimental group.

Instruments

The instruments used in the data collection process for this study were observation sheets, a digital hemoglobinometer, standard operating procedures for making red guava and red spinach juice, and red guava and red spinach juice.

Intervention and Data Collection

The data collection procedure in this study was divided into two stages, namely the preparation and implementation stages. The preparation stage involved collecting primary data from medical records in the Maternal and Child Health (KIA) section of the health centre. The data collection procedure involved the following steps: (1) Coordinating with the midwife at the Lamongan Health Centre (as the gatekeeper) to identify potential research participants. (2) Selecting respondents based on predetermined inclusion criteria. (3) Obtaining informed consent and research agreement from the respondents.

The next stage is the implementation. This stage was a step in collecting research data from respondents. The hemoglobin levels of pregnant women were measured before (pretest) and after (posttest) in the control and intervention groups using a digital hemoglobinometer. The control group received only one Fe tablet per day (1x1) at night. In contrast, the intervention group received both Fe tablets and a combination of red guava juice and red spinach juice, 200 ml (equivalent to one glass) daily for 14 days. The red guava and red spinach juice that is ready to be served is then distributed by enumerators to respondents' homes door to door every day. After the 14-day intervention, hemoglobin levels were evaluated again. Compliance with Fe tablet and red guava + red spinach juice consumption was monitored by the researchers through phone calls, SMS, or WhatsApp messages to confirm intake. Respondents were also asked to record their daily consumption in a monitoring table.

Data Analysis

Data were analyzed using IBM SPSS version 21.0. Univariate analysis was used to describe the characteristics of respondents, including age, education, occupation, reproductive history (parity and gravida), and history of anemia, presented in percentages. Bivariate analysis was conducted to assess the effect of the independent variables on the dependent variable. A paired t-test (dependent t-test) was used to evaluate changes in hemoglobin levels before and after the intervention within each group. An independent t-test was then used to compare the average post-intervention hemoglobin levels between the control and intervention groups. A p-value of <0.05 was considered statistically significant, indicating acceptance of the alternative hypothesis (Ha).

Ethical Consideration

This research was approved by the Research Ethics Commission (KEPK) from the College of Health Science of Husada Jombang, Indonesia, on January 15, 2025, with certificate number 0548-KEPKSHJ, with ethical considerations based on the study's purposes, voluntariness, and anonymity.

RESULTS

The case population in this study comprised all pregnant women who had undergone pregnancy screening at the Lamongan Health Centre. The research sample was 60 pregnant women in the third trimester who were divided into 2 groups, namely the control group and the intervention group, each consisting of 30 people. The characteristics of the respondents are shown in the table below.

Table 1. Characteristics of Respondents based on Age, Education, Employment Status, Parity, and History of Anemia at the Public Health Centre of Lamongan, East Java Province, Indonesia in 2025 (n = 60).

Characteristics	Control Group		Intervention Group	
	f	%	f	%
Age				
No Risk	25	83,3	28	93,3
Risk	5	16,7	2	6,7
Total	30	100%	30	100%
Education				
High Education	4	13,3	2	6,7
Low Education	26	86,7	28	93,3
Total	30	100%	30	100%
Employment				
Employed	9	30,0	6	20,0
Unemployed	21	70,0	24	80,0
Total	30	100%	30	100%
Parity				
Primipara	14	46,7	12	40,0
Multipara	16	53,3	18	60,0
Total	30	100%	30	100%
History of Anemia				
Yes	2	6,7	3	10,0
No	28	93,3	27	90,0
Total	30	100%	30	100%

Source: Primary Data, 2025.

Based on Table 1 above, the characteristics of respondents in the control group were as follows: 5 people (16.7%) were of high-risk age, 25 people (86%) had a high level of education, 21 people (70.0%) were unemployed, and 28 people (93.3%) had no history of anemia. In the intervention group, 28 people (93.3%) were of non-risk age, 28 people (93.3%) had a high level of education, 12 people (40.0%) were primiparous, and 3 people (10.0%) had a history of anemia.

Table 2. Average Hemoglobin Levels of Pregnant Women Before and After Giving Fe Tablets in the Control Group and Fe Tablets + Red Guava Juice + Red Spinach Juice in the Intervention Group

Group	Control			Intervention		
	Mean	Delta	SD	Mean	Delta	SD
Before	9,21	2,89	0,18	8,41	4,59	1,12
After	12,1		0,27	13,0		0,90

Source: Primary Data, 2025.

As shown in Table 2, the control group had an average hemoglobin level of 9.21 g/dL before the administration of Fe tablets, with a standard deviation of 0.18. Following the administration of Fe tablets alone (without the addition of red guava juice and red spinach), the average hemoglobin level increased to 12.1 g/dL, with a standard deviation of 0.27. The mean increase in hemoglobin levels in the control group was 2.89 g/dL.

In the intervention group, comprising 30 respondents, the mean hemoglobin level before the intervention (Fe tablets combined with red guava juice and red spinach) was 8.41 g/dL, with a standard deviation of 1.12. Post-intervention, the average hemoglobin level rose to 13.0 g/dL, with a standard deviation of 0.90. The mean increase in hemoglobin levels within the intervention group was 4.59 g/dL. These findings indicate that the administration of Fe tablets in combination with red guava juice and red spinach was more effective in increasing hemoglobin levels among pregnant women compared to the administration of Fe tablets alone.

Table 3. Effect of Consumption of Fe Tablets in the Control Group and Fe Tablets + Red Guava Juice + Red Spinach in the Intervention Group on Hemoglobin Levels

Group	Before		After		Sig.(2-tailed)
	Mean	SD	Mean	SD	
Control	9,21	0,18	12,1	0,16	0.000
Intervention	8,41	0,20	13,0	0,27	0.000

Source: Primary Data, 2025.

As shown in Table 3, the group that received only Fe tablets had an average hemoglobin (Hb) level of 9.21 g/dL before the intervention. Following the administration of Fe tablets, the average Hb level increased to 12.1 g/dL. Based on the results of the Paired Sample T-Test, a significance value (Sig. 2-tailed) of 0.000 was obtained, which is less than the alpha level of 0.05. Therefore, it can be concluded that the administration of Fe tablets significantly increased hemoglobin levels in pregnant women.

In the intervention group, which received Fe tablets along with a combination of red guava juice and red spinach, the average Hb level before the intervention was 8.41 g/dL. After the intervention, the average Hb level increased to 13.0 g/dL. The results of the Paired Sample T-Test yielded a significance value (Sig. 2-tailed) of 0.000, which is also less than the alpha level of 0.05. Thus, it can be concluded that the combination of Fe tablets with red guava juice and red spinach is effective in significantly increasing hemoglobin levels in pregnant women.

Table 4. Differences in Hemoglobin Levels of Pregnant Women between the Control Group and the Intervention Group

Groups	After		t-test	Sig.(2-tailed)
	Mean	SD		
Control	12,1	0,16	-20,4	0,01
Intervensi	13,0	0,27		

Source: Primary Data, 2025

Based on the results of the bivariate analysis presented in Table 4, the independent sample t-test conducted after the intervention yielded a t-value of 20.4 and a significance value (Sig. 2-tailed) of 0.01,

which is less than the alpha level of 0.05. This indicates a statistically significant difference in the mean post-test hemoglobin levels between the control group and the intervention group.

DISCUSSION

Average Hemoglobin Levels of Anemic Pregnant Women Before and After Administration of Fe Tablets in the Control Group and Fe Tablets Combined with Red Guava and Red Spinach Juice in the Intervention Group

The findings of this study indicated that the average hemoglobin (Hb) level in the control group before administration of Fe tablets was 9.21 g/dL, which increased to 12.1 g/dL after treatment, resulting in a delta (difference) of 2.89 g/dL. In the intervention group, the mean Hb level before treatment was 8.41 g/dL, increasing to 13.0 g/dL post-treatment, with a delta of 4.59 g/dL. Statistical analysis using the paired sample t-test yielded a p-value of 0.000, indicating a significant difference in Hb levels before and after the intervention in both groups. The higher increase in the intervention group suggests that the combination of Fe tablets and red guava juice with red spinach contributed more effectively to improving hemoglobin levels compared to Fe tablets alone.

These findings are supported by previous research. A study by Chakona & Shackleton (2019) involving 94 pregnant women in the Eastern Cape, South Africa, reported that consuming local guava effectively improved Hb levels in pregnant women. Similarly, research by Shafriani et al. (2022) in Indonesia, involving 29 third-trimester pregnant women, found that administering 200 mL of guava juice daily for two weeks successfully increased Hb levels by 1.18 g/dL.

During pregnancy, physiological changes such as increased blood volume, particularly in the first and second trimesters, lead to a condition known as hemodilution, which can lower hemoglobin concentration. Therefore, supplementation with Fe tablets in combination with vitamin C is essential, as vitamin C enhances iron absorption and supports erythropoiesis (Garzon et al., 2020).

The significant improvement in hemoglobin levels observed in the intervention group can be attributed to the inclusion of red guava in the juice. This aligns with the findings of Ariendha et al. (2024), who reported that guava is rich in vitamin C. Specifically, 100 grams of ripe, fresh guava contains approximately 1.1 mg of iron and 87 mg of vitamin C. In addition to vitamin C supplementation, increasing dietary intake of iron-rich plant foods such as red spinach is also beneficial. Red spinach has been widely recognized for its efficacy in preventing anemia among pregnant women. A study by Li et al. (2023) in China demonstrated that consumption of boiled red spinach increased Hb levels of up to 2.70 g/dL in pregnant women.

Effect of Consumption of Fe Tablets and Red Guava Juice with Red Spinach on Hemoglobin Levels in Pregnant Women

The findings of this study indicate that the average increase in hemoglobin levels among respondents in the control group, who received only Fe tablets, was 0.16 g/dL. In contrast, the

intervention group, which received Fe tablets in combination with red guava juice and red spinach, experienced a higher average increase of 0.27 g/dL. Statistical analysis revealed a significance value (Sig. 2-tailed) of 0.01 (< α = 0.05), indicating that the consumption of red guava juice combined with red spinach had a significant effect on hemoglobin levels among third-trimester pregnant women in the Lamongan Health Center area.

The intervention used in this study, namely the provision of red guava and red spinach juice, is considered to be a contributing factor in the significant increase in Hb levels observed in the intervention group. The nutritional content of these two ingredients supports iron absorption and hemoglobin synthesis. Red spinach, for example, contains approximately 6.43% mg of iron per 180 grams. This high iron content is essential, as iron plays a critical role in the production of red blood cells, which in turn contributes to elevated Hb levels when red blood cell production is adequate (Patimah et al., 2022).

Furthermore, red guava is rich in vitamin C, which facilitates iron absorption (Rerey et al., 2021). This aligns with the findings of Sitepu & Hutabarat (2020), who reported that in their study, the hemoglobin levels of the control group increased from 9.98 g/dL to 10.56 g/dL after consuming Fe tablets. In the intervention group, which received Fe tablets combined with red guava juice, Hb levels increased from 10.16 g/dL to 11.01 g/dL, demonstrating a positive effect of red guava juice consumption on hemoglobin levels in pregnant women.

Based on the researchers' observations, it can be concluded that the provision of red guava and red spinach juice, both of which are rich in essential vitamins and nutrients, can enhance hemoglobin levels. This effect occurs through the improvement of iron absorption from supplements and iron-rich foods consumed by pregnant women.

Differences in Hemoglobin Levels of Pregnant Women Between the Intervention and Control Groups

The study findings revealed that the control group, which received only Fe tablets once daily for 14 days, experienced an increase in hemoglobin (Hb) levels during the posttest, reaching an average of 12.1 g/dL with a delta score of 2.89 g/dL. In comparison, the intervention group, which received Fe tablets in combination with 200 mL of red guava juice and red spinach daily for 14 consecutive days, exhibited a greater increase in Hb levels, averaging 13.0 g/dL with a delta score of 4.59 g/dL. The results of the post-intervention statistical analysis showed a t-test value of 20.4 and a significance value (Sig. 2-tailed) of 0.01 (< α = 0.05), indicating a statistically significant difference in the mean posttest hemoglobin levels between the control and intervention groups.

These results are consistent with findings from Hadi (2023), who reported that administration of red guava juice alongside Fe tablets resulted in increased Hb levels among most participants. This can be attributed to the pharmacokinetics of iron, which suggest that iron is more readily absorbed in its ferrous (Fe^{2+}) form. Vitamin C, present in high amounts in red guava juice, facilitates the conversion of ferric iron (Fe^{3+}) to ferrous iron (Fe^{2+}) in the small intestine, thereby enhancing iron absorption. This

process is more efficient under acidic conditions. Vitamin C helps lower gastric pH, which in turn promotes iron absorption by up to 30% (Suwanwong & Boonpangrak, 2021).

Furthermore, research by Rahman (2022) emphasizes that combining Fe tablets with other micronutrients (multiple micronutrient supplementation) is more effective in improving iron status than administering Fe supplements alone. Based on these findings, it can be assumed that the combined administration of Fe tablets with red guava juice enhances hemoglobin levels more effectively than a single intervention. This is likely due to the synergistic effects of vitamin C and adequate nutritional intake during the reproductive period, which together contribute to improved anemia outcomes. The more substantial increase in hemoglobin levels observed in the intervention group can be attributed to the additional intake of red guava juice and red spinach, both of which are rich sources of vitamin C and iron. Therefore, although both groups showed improvement, the difference in average Hb levels confirms the superior efficacy of the combined intervention.

LIMITATION

Limitations include difficulty controlling dietary inhibitors of iron absorption (tea/coffee) and the absence of biochemical micronutrient measurements (serum iron, ferritin, vitamin B12).

CONCLUSION

The combination of red guava juice and red spinach has a significant impact on hemoglobin levels in pregnant women. A notable difference was observed in the average posttest hemoglobin levels between the intervention and control groups. The administration of Fe tablets in conjunction with red guava juice and red spinach proved to be more effective in increasing hemoglobin levels than the administration of Fe tablets alone.

It is hoped that the findings of this study can serve as a recommendation for improving maternal health services and addressing health issues such as anemia. One suggested approach is to provide targeted education to pregnant women on the importance of meeting their iron requirements during pregnancy. This includes the daily consumption of one 90 mg Fe tablet, complemented by iron-rich and vitamin C-rich foods such as red spinach and red guava, while also maintaining a balanced and nutritious diet overall.

AUTHOR CONTRIBUTION

Sukati Sarmin: Conceptualization and study design, writing original draft, administration, reviewing, administering the ethical clearance procedure, and collecting the data.

Restu Pangestuti: Conceptualization and study design, review and editing manuscript, supervision.

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CONFLICT OF INTEREST

There is no conflict of interest in this study.

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