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Improved hemoglobin levels with combined Fe tablets and red guava juice in anemic pregnancy

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ABSTRACT

Iron deficiency anemia remains a prevalent nutritional issue among pregnant women in Indonesia. Although iron (Fe) supplementation is recommended during pregnancy, its absorption can be limited. Vitamin C, known to enhance non-heme iron absorption, is abundant in red guava juice. This study aimed to assess the effect of combining Fe tablets with red guava juice on hemoglobin (Hb) levels in pregnant women with anemia. A quasi-experimental study with a pretest-posttest control group design was conducted among 32 anemic pregnant women selected through total sampling at the Cineam Health Center, Tasikmalaya Regency. Participants were divided into an experimental group (Fe tablets + red guava juice) and a control group (Fe tablets only). The intervention was administered daily for 14 days. Hemoglobin levels were measured before and after the intervention. Data were analyzed using an independent t-test. There was a significant increase in Hb levels in the experimental group compared to the control group. The mean Hb increase in the experimental group was 0.738 g/dL ($p = 0.001$), indicating that the addition of red guava juice significantly enhanced the efficacy of Fe supplementation. Combining Fe tablets with red guava juice effectively improves hemoglobin levels in pregnant women with anemia. This simple and affordable dietary intervention has the potential to support maternal anemia management programs in low-resource settings.

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INTRODUCTION

Anemia during pregnancy remains a significant public health issue in Indonesia, with iron deficiency anemia being the most prevalent type.(1) Anemia in pregnant women has an impact on fetal growth and development that is not optimal and has the potential to cause complications of pregnancy and childbirth, such as bleeding, premature labor, increasing the risk of low birth weight in infants, increasing the risk of postpartum depression, and even causing death in mothers and children.(2)

Based on the Basic Health Research (Riskesdas) in 2018, the percentage of pregnant women with anemia was 48.9%, which increased compared to 2013 of 37.1%.(3) Data from the West Java Provincial Health Office in 2021 stated that cases of anemia in pregnant women in West Java Province in 2020 were 63,246 anemic pregnant women.(4)

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Based on data from the Tasikmalaya Regency Health Office, in 2020 there were 3,125 pregnant women with anemia out of 33,470 pregnant women. The incidence of anemia in the Cineam Health Center Working Area in 2022 was 18.1%.(5)

Despite multiple strategies being implemented to address iron deficiency anemia (IDA) during pregnancy, its prevalence remains alarmingly high in many low- and middle-income countries, including Indonesia, suggesting that current interventions are not yet fully effective. Globally recognized strategies include daily iron or iron–folic acid (IFA) supplementation(6), multiple micronutrient supplementation (MMN)(7), dietary diversification and food fortification(8), alternative iron delivery methods such as intermittent dosing or parenteral iron(9), and behavioral change communication and health education to improve adherence.(10) However, each of these strategies presents limitations. Although daily IFA supplementation has been shown to reduce anemia, adherence remains suboptimal due to gastrointestinal adverse effects (e.g., nausea, constipation), metallic taste, and a lack of motivation among pregnant women to take the tablets on a regular basis.(11,12) Based on preliminary studies conducted at the Cineam Health Center, the coverage of pregnant women who consumed 90 Fe tablets during pregnancy was 47.8% with a target of 98%. Furthermore, synthetic iron bioavailability may be influenced by dietary inhibitors and individual absorption capability, resulting in variable hematologic responses to supplementation.(13) Dietary interventions and fortification efforts are limited by the low bioavailability of non-heme iron and the presence of absorption inhibitors such as phytates and tannins. Meanwhile, parenteral supplementation is costly and less feasible in primary healthcare settings, and behavioral interventions alone often fail to translate knowledge into sustained compliance.(14) Given these restrictions, non-pharmacological therapies have become increasingly popular.

Emerging evidence suggests that combining iron supplementation with vitamin C enhances iron absorption and hemoglobin synthesis more effectively than iron alone.(15) Furthermore, it is recommended that pregnant women ingest meals rich in vitamin C, as vitamin C effectively enhances iron absorption. Red guava is a fruit abundant in vitamin C, as it contains a higher concentration of this nutrient compared to other fruits.(16) Fe in the body is more easily absorbed in ferrous form and one of the substances that help the absorption process of Fe in the body is vitamin C as contained in red guava juice.(17) Plant iron absorption can be increased four times by consuming 200 mg of vitamin C and can also help the absorption of drugs by about 30%(18). Vitamin C functions to reduce ferrous iron (Fe3+) to ferrous (Fe2+) in the small intestine so that it is easily absorbed, so the high content of vitamin C in red guava can reduce ferrous ions to ferrous ions so that the iron contained in it can be absorbed optimally by the body.(19) Red guava was chosen because it is widely cultivated in Indonesia and easily available in markets, supermarkets, and fruit shops. In addition, red guava is still affordable and is also favored by many people.(17)

Given these gaps, this study aims to investigate the effect of combining iron tablets with red guava juice on hemoglobin levels in pregnant women with anemia. It is hypothesized that the addition of red guava juice will enhance iron absorption and improve compliance, thereby leading to a more significant increase in hemoglobin levels compared to iron supplementation alone.

METHOD

This study employed a quantitative approach with a quasi-experimental pretest-posttest control group design, conducted between September and October 2023 in the working area of Cineam Health Center, Tasikmalaya Regency, Indonesia. The population consisted of 32 pregnant women diagnosed with anemia, all of whom were selected using total sampling. Participants were then randomly assigned into two groups: an intervention group receiving a combination of Fe tablets and red guava juice (*Psidium guajava* L.), and a control group receiving Fe tablets only. Inclusion criteria included pregnant women in the second or third

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trimester, hemoglobin levels between 8–11 g/dL, willingness to participate, and ability to consume Fe tablets and fruit juice orally. Exclusion criteria were comorbid conditions such as thalassemia or chronic diseases, concurrent use of other iron-enhancing supplements, and allergy to guava. The intervention group received one Fe tablet daily for 14 consecutive days, consumed together with approximately 200 mL of red guava juice (prepared from 100 grams of fresh red guava blended with 100 mL water, yielding ~200 mg of vitamin C). The juice and Fe tablet were consumed in the afternoon under observation to ensure adherence. The control group received the same Fe tablet regimen without guava juice. Hemoglobin (Hb) levels were measured before and after the intervention using a digital hemometer (Easy Touch GCHb, Taiwan)**.** Measurements were performed by trained midwives, and the device was calibrated prior to use. The hemometer has a sensitivity of ±0.1 g/dL and is certified for clinical use. The study received ethical approval from the Health Research Ethics Committee of Poltekkes Kemenkes Semarang (Approval No. 1120/EA/KEPK/2023). Written informed consent was obtained from all participants prior to data collection. Data were analyzed using SPSS version 26. Normality was assessed using the Shapiro–Wilk test. Differences in hemoglobin levels before and after the intervention within each group were tested using the paired **t-**test, while comparisons between groups were assessed using the independent t-test. A p-value < 0.05 was considered statistically significant.

RESULTS

Table 1 presents the comparison of hemoglobin (Hb) levels in the experimental and control groups before and after the intervention. Prior to the intervention, the mean Hb levels did not differ significantly between the experimental (9.90 ± 0.65 g/dL) and control (10.18 ± 0.56 g/dL) groups (p = 0.235). After the intervention, the posttest mean Hb levels also showed no significant difference between the two groups (p = 0.628).

However, the mean increase in Hb levels was higher in the experimental group (0.738 g/dL) compared to the control group (0.313 g/dL), with an *independent t-test* showing a significant difference between groups (p = 0.001). Within-group analysis using the *paired t-test* demonstrated significant improvements in both the experimental (p = 0.000) and control (p = 0.000) groups, indicating that Fe tablet supplementation with or without red guava juice effectively increased Hb levels in pregnant women with anemia. Nevertheless, the combination of Fe tablets and red guava juice produced a greater mean improvement.

Table 1. Bivariate Analysis of Hemoglobin Levels Before and After in the Experimental Group and Control Group

	Experiment	Control	P-value
Pretest			0,235*
Mean (SD)	9,900	10,181	
Min	8,2	9,1	
Max	10,8	10,9	
Posttest			0,628*
Mean (SD)	10,638	10,513	
Min	8,8	9,6	
Max	11,9	11,3	
P-value	0,000**	0,000**	
Difference Mean	0,738	0,313	0,001*

* Independent T-Test
** Paired T-Test

The results of this study indicate that both interventions Fe tablet supplementation alone and in combination with red guava juice effectively increased hemoglobin levels among pregnant women with anemia. However, the greater mean increase observed in the experimental group suggests that the addition of red guava juice, which is rich in vitamin C,

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enhances iron absorption and optimizes hematologic recovery. These findings support the hypothesis that combining Fe tablets with a natural vitamin C source may serve as a more effective nutritional strategy for managing anemia during pregnancy.

DISCUSSION

Hemoglobin Levels in Anemic Pregnant Women Before and After given Fe Tablets with Red Guava Juice

The results of the research that have been carried out obtained the average initial Hb level in the experimental group which is 9.900 gr/dL and the average Hb level in pregnant women with anemia after the intervention is 10.638 gr/dL. So that in the experimental group, the average change in Hb levels was 0.738 gr/dL after being given an intervention for 14 days by giving Fe tablets and red guava juice as much as ± 200 ml (100 grams of red guava added with 100 ml of water) with a vitamin C content of about 200 mg given in the afternoon.

In Nohistra and Khairari's research entitled The Effectiveness of Giving Iron (Fe) Tablets and Guava Fruit Juice to Increase Hemoglobin (Hb) Levels in Pregnant Women, the results showed that the initial Hb level in the experimental group was 9 gr/dL and the Hb level in pregnant women with anemia after intervention was 11.5 gr/dL. So that in the experimental group, the average change in Hb levels was 2.5 gr / dL after being given an intervention for 14 days by giving Fe tablets and 200 mL / day of red guava juice.(20) In this case there is a similarity, namely an increase in Hb levels, only the number of respondents is different, where in Nohistra and Khairari's research focused on 1 respondent while in this study there were 16 respondents in the experimental group.

The administration of Fe tablets in this study was monitored directly by the researcher who also informed the family or husband who lived with the pregnant woman to remind her to take Fe tablets and red guava juice until it ran out according to the recommendations, then pregnant women were also given counseling about the importance of foods or drinks that contain high vitamin c, one of which is red guava juice which contains higher vitamin c than other fruits. Vitamin c helps maximize iron absorption.(21) Giving Fe tablets together with other micronutrients (multiple micronutrients) is more effective in improving iron status, compared to only giving iron supplementation in a single dose. Therefore, to increase the absorption of iron in the body, iron supplementation needs to be combined with other micronutrients, such as vitamin C. Vitamin C can be obtained from vitamin C supplement tablets or from fruits and vegetables and a fruit rich in vitamin C is red guava.(19)

In Fandy, Sari, and Puspita's research entitled Red Guava Juice Increases Hemoglobin Levels in Pregnant Women, it is mentioned that red guava is known to contain a lot of vitamin C and several types of minerals that can ward off various diseases and keep the body fit. Apart from vitamin C, red guava also contains potassium and iron. Apart from being an antioxidant, vitamin C also has a function to maintain and improve the health of capillary blood vessels, prevent anemia, mouth ulcers, and bleeding gums. Red guava can also overcome anemia (lack of red blood cells) because red guava contains minerals that can accelerate the process of hemoglobin formation of red blood cells. Red guava contains vitamin C which is quite high, where the vitamin C content of red guava is twice as much as sweet oranges which are only 49 mg per 100gr. Guava vitamin C content reaches its peak when it is almost ripe. So, consuming red guava when it is ripe will be better than after it is optimally ripe and overripe.(22)

In line with the research of Elzha, Sri, and Apoina in their research conducted in 2021 entitled “The Role of Calcium and Vitamin C on Iron Absorption and its Relationship with Hemoglobin Levels in Pregnant Women: A Systematic Review”, mentioned that vitamin C affects hemoglobin levels. Vitamin C is a factor that enhances iron absorption, consuming vitamin C together with Fe tablets can increase iron absorption so that blood Hb levels also increase.(23)

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Hemoglobin Levels in Anemic Pregnant Women Before and After Fe Tablets are Given

The results of the research that has been done obtained the average initial Hb level in the control group is 10.181 gr/dL and the average Hb level in pregnant women with anemia after the intervention is 10.513 gr/dL. So that in the control group, the average change in Hb levels was 0.313 gr/dL after being given an intervention for 14 days by giving Fe tablets. In Nohistra and Khairari's research entitled The Effectiveness of Giving Iron (Fe) Tablets and Guava Fruit Juice to Increase Hemoglobin (Hb) Levels in Pregnant Women, the results showed that the initial Hb level in the control group was 9 gr/dL and the Hb level in pregnant women with anemia after the intervention was 10.2 gr/dL. So that in the control group, the average change in Hb levels was 1.2 gr/dL after being given an intervention for 14 days by giving Fe20 tablets. In this case there is a similarity, namely an increase in Hb levels, only the number of respondents is different, where in this study there were 16 respondents in the control group while in previous studies only focused on 1 respondent. The increase in Hb levels in the control group was not as great as the increase in Hb levels in the experimental group.

The administration of Fe tablets in this study was monitored directly by the researcher, who also informed the family or husband who lived with the pregnant woman to remind her to take Fe tablets. The need for iron during pregnancy increases, one of which is used for the needs of fetal growth. Fulfillment of iron needs can be taken from iron reserves and increased iron absorption adaptively through the digestive tract. If iron reserves are very low or absent while iron content and absorption from food are low, then iron tablet supplementation is needed to meet the iron needs of pregnant women.(12) Iron metabolism in the body consists of absorption, transport, utilization, storage, and excretion. Iron absorption plays an important role in the regulation of iron homeostasis. There are 3 factors that determine the amount of iron absorbed from food, namely the total amount of iron from food, iron bioavailability, and control of iron absorption in intestinal mucosal cells. Iron is then distributed to all organs of the body, with absorption occurring in the upper part of the small intestine (duodenum) with the help of specialized protein transporters.(11)

The lack of awareness of pregnant women about the recommendation to consume Fe tablets is one of the causes of anemia in pregnant women. Therefore, to overcome the low consumption pattern of Fe tablets in pregnant women, counseling is needed about anemia, how to overcome it, its treatment, and how to consume Fe tablets properly. In this case, health workers must increase knowledge about the importance of consuming Fe tablets for pregnant women. In addition to the lack of awareness of pregnant women about the importance of Fe tablets, the absence of a companion in consuming Fe tablets is also very influential because if there is a companion for pregnant women, there will always be someone to remind pregnant women to consume Fe tablets in accordance with the recommendations, namely 1 Fe tablet per day (90 tablets during pregnancy). Efforts to overcome anemia in pregnant women, including the provision of vitamins and iron, begin by giving 1 Fe tablet a day as soon as possible after the nausea disappears. Each tablet contains 320 mg Fe So4 (60 mg iron) and 500 mg folic acid, each with a minimum of 90 tablets.(19)

Effect of Fe Tablets with Red Guava Juice on Pregnant Women with Anemia

The results of the study in the experimental group before and after the intervention in the paired T-Test obtained a p-value of 0.000 which p-value <0.05, so that in this study there was an effect of giving Fe tablets with Red Guava Juice. In the Control group before and after the intervention in the paired T-Test obtained a p-value of 0.000 which p-value <0.05, so that in this study the effect of giving Fe tablets to pregnant women with anemia was obtained.

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The process of iron absorption has a greater role than the process of iron excretion in the incidence of iron deficiency anemia. Only a small portion of the iron absorbed by the body undergoes the homeostasis process. Vitamin C acts as a good promoter of iron absorption from food and can help fight phytates and tannins that will inhibit iron absorption. Giving Fe tablets with red guava fruit juice was chosen because red guava fruit contains high enough vitamin C to help maximum iron absorption. This is in line with research conducted by Tsabitha et al in 2022 which states that Fe in the body is more easily absorbed in ferrous form and one of the substances that helps the absorption process of Fe in the body is vitamin C as contained in red guava fruit.(18) In addition, there were respondents with moderate anemia, namely 8.2 gr/dL, who received Fe tablets that were different from the other respondents, namely 2 times a day but for red guava juice was still given once a day. It was found that changes in hemoglobin levels before and after being given guava juice were 9.2gr / dL increased to 11.2gr / dL, so there was an increase in hemoglobin levels after being given treatment of 2gr / dL which was carried out for 7 days with a frequency of 17 people. The results of data analysis and conclusions obtained are Z = -2.936, p = 0.003 Ha is accepted. This means there is a difference in hemoglobin levels after giving guava juice treatment. Giving guava juice to pregnant women as much as 250 mL (100 grams of guava) taken in the morning along with iron tablets. In the study of Tsabitha et al, an increase in hemoglobin levels was obtained, but the study showed the effectiveness of giving red guava juice without a combination with iron tablets and there was only one intervention group without a comparison group, besides that the study was only conducted for 7 days.

The absorption of iron in the body, especially nonheme iron of plant origin, is influenced by the type of food consumed. Vitamin C, meat, fish and poultry can increase iron absorption, while calcium and fiber inhibit iron absorption. Consumption of high doses of calcium (more than 40 mg) can inhibit iron absorption. In addition, food processing that takes too long at too high a temperature can convert heme iron into nonheme iron, affecting iron absorption. In addition to iron, adequate protein intake in daily food consumption must also be sufficient because protein contains globulin which plays a role in the formation of hemoglobin.(13)

Fe tablets should be taken with food to increase uptake. It is important to remember that additional iron should be obtained from food. In each pregnancy, the required iron requirement is 900 mg Fe, which is for the increase of maternal blood cells 500mg Fe, contained in the placenta 300mg Fe, and for fetal blood of 100mg Fe. If the supply of Fe reserves is minimal, then each pregnancy depletes the body's Fe supply and will eventually lead to anemia in pregnancy.(6) Vitamin C combined with iron forms a complex iron ascorbate compound that is soluble and easily absorbed. Research on the provision of vitamin C and iron as supplements to pregnant women who experience anemia and obtained the conclusion that the provision of vitamin C with iron as a supplement given to pregnant women who suffer from anemia has an effect in increasing blood hemoglobin levels in pregnant women effectively. Another ability of vitamin C is that it can inhibit the synthesis of hemosiderin which is difficult to mobilize to free iron when it is needed. Therefore, the risk of iron deficiency anemia can be avoided.(24)

Vitamin C acts as a pro-oxidant with its ability to reduce ferric (Fe3+) through the binding of complex formation followed by the formation of ferrous (Fe2+) and ascorbic radicals. If supported by an acidic pH state, iron will dissolve easily so that iron absorption in the proximal duodenum becomes more optimal. Vitamin C plays a role in minimizing the obstruction of iron absorption by inhibitors so that iron absorption in the proximal duodenum becomes more optimal. The use of vitamin C 100 mg can increase the absorption of iron in non-heme form in pregnant women around 37.5% - 46.0%.(25)

The absorption of plant iron can be increased fourfold by taking 200 mg of vitamin C and can also help the absorption of drugs by about 30%. The high vitamin C content in

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red guava is very beneficial for the absorption of iron in the body so as to increase hemoglobin. Where vitamin C functions to reduce ferric iron (Fe3+) to ferrous (Fe2+) in the small intestine so that it is easily absorbed, the high vitamin C content in red guava can reduce ferric ions to ferrous ions so that the iron contained in it can be absorbed optimally by the body.(19) After being absorbed through mucosal cells, it is bound by apoferitin into ferritin (Fe + apoferitin). In the serum, the bond is released, and ferrous iron is transported in the form of transferrin (Fe bonds with proteins containing 3-4 mg Fe), which is then stored in the liver, lymph, and spinal cord. A portion of the iron is used for hemoglobin synthesis (20-25 mg/day) and restoring damaged hemoglobin (20-25 mg/day); iron is 60-70% of the hemoglobin component.(20)

From a clinical and public health perspective, the results of this study have important implications. The addition of red guava juice to daily Fe supplementation offers a practical, low-cost, and culturally acceptable intervention that can be implemented within maternal health programs, particularly in resource-limited settings. Midwives and healthcare workers can encourage pregnant women to consume Fe tablets with locally available vitamin C–rich fruits such as red guava to enhance absorption. This approach aligns with WHO recommendations to integrate food-based strategies into micronutrient supplementation programs and supports Indonesia's efforts to reduce maternal anemia prevalence.

Despite its promising findings, this study has several limitations. The relatively short intervention period (14 days) and small sample size may limit the generalizability of the results. Dietary intake, infection status, and adherence to Fe supplementation were not fully controlled, which may influence hemoglobin outcomes. Future studies should employ larger sample sizes, longer intervention durations, and include biomarkers such as ferritin or transferrin saturation to assess iron status more comprehensively. Randomized controlled trials are also recommended to establish causality and evaluate long-term effects on maternal and neonatal outcomes.

In summary, this study provides empirical evidence that combining Fe supplementation with red guava juice effectively enhances hemoglobin levels in anemic pregnant women. The synergistic effect between iron and vitamin C underscores the potential of food-based approaches to strengthen anemia control strategies during pregnancy. Integrating this simple dietary modification into antenatal care could serve as a sustainable, community-based strategy to reduce maternal anemia and improve pregnancy outcomes.

CONCLUSION

This study demonstrated that the combination of Fe tablets and red guava (*Psidium guajava L.*) juice significantly improved hemoglobin levels among anemic pregnant women compared to Fe tablets alone. The increase in hemoglobin concentration was greater in the experimental group (0.738 g/dL) than in the control group (0.313 g/dL), indicating a synergistic effect between iron and vitamin C–rich guava juice in enhancing iron absorption and hemoglobin synthesis.

These findings suggest that consuming Fe supplements together with natural sources of vitamin C, such as red guava juice, can serve as a practical, low-cost, and culturally appropriate approach to improve anemia management during pregnancy. The strategy not only enhances iron bioavailability but may also increase maternal compliance due to improved tolerability and palatability. From a public health perspective, this combination can be integrated into existing antenatal care programs as part of a food-based strategy to reduce the prevalence of maternal anemia in low- and middle-income settings. Future studies with larger sample sizes, longer follow-up periods, and additional hematologic indicators such as serum ferritin or transferrin saturation are recommended to confirm the long-term efficacy and sustainability of this intervention.

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No competing interests were disclosed.

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