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The Effect of Papaya Juice Consumption on Hemoglobin Levels of Pregnant Women at Depok Jaya Public Health Center

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ABSTRACT

Introduction: *Maternal anemia continues to pose a major public health challenge, especially in resource-limited areas where nutritional inadequacies are widespread. While iron supplementation is the usual intervention, its benefits can be strengthened through the inclusion of nutrient-dense foods that support iron absorption. Papaya, a locally available fruit, is rich in vitamin C and folate, both of which are crucial for hemoglobin production.*
Objectives: *The purpose of this study was to evaluate the impact of combining papaya juice supplementation with iron tablets on hemoglobin levels in pregnant women.*
Methods: *This research employed a quasi-experimental pre-test–post-test control group design and was carried out among pregnant women in the Depok Jaya Health Center area. A total of 36 participants were recruited through purposive sampling and assigned equally to intervention and control groups. The control group received iron tablets alone, whereas the intervention group was given daily papaya juice in addition to iron tablets for 14 days. Hemoglobin levels were assessed before and after treatment, with data analyzed using paired and independent t-tests.*
Results: *Results showed that mean hemoglobin levels rose sharply in the intervention group over the 14-day period, compared with a less pronounced increase in the control group. Statistical analysis indicated significant intra-group improvements and a significant inter-group difference ($p < 0.05$; $\alpha < 0.05$).*
Conclusions: *Papaya juice supplementation enhanced the effectiveness of iron tablets in improving hemoglobin levels among pregnant women. As an affordable and locally available food, papaya has the potential to be integrated into maternal nutrition programs to reduce anemia in pregnancy. Further research is recommended to confirm long-term benefits.*

Introduction

Anemia in pregnancy remains a serious global health problem, particularly in developing countries, as it is associated with increased maternal and fetal morbidity and mortality (Wang et al., 2025). A decrease in hemoglobin levels in pregnant women can lead to complications such as preterm birth, low birth weight, intrauterine growth restriction, and an increased risk of infection, all of which contribute to poor maternal and neonatal outcomes (Agarwal & Rets, 2021; Jwa et al., 2015). Despite ongoing preventive efforts, including iron and folic acid supplementation programs, the burden of anemia among pregnant women remains high, especially in low- and middle-income countries where nutritional deficiencies and limited access to health care services persist (Manickavasagam, 2021; Rohmah et al., 2025). This condition underscores that anemia in pregnancy is not only a clinical issue but also a broader public health challenge requiring special attention because it directly affects pregnancy outcomes and may

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perpetuate the cycle of poor maternal and child health (Abdullahi et al., 2023; Fikritama et al., 2024). Therefore, examining the extent of this problem at both the national and local levels is essential to determine appropriate context-specific and effective interventions.

The World Health Organization (WHO) has classified anemia in pregnancy as a primary public health concern due to its high prevalence and significant impact on maternal health, highlighting that nearly 40% of pregnant women globally are affected (WHO, 2023). In Indonesia, the incidence of anemia among pregnant women is reported to be more than 40%, with variations across regions, including Java Island, which accounts for a substantial proportion. A preliminary study at Depok Jaya Public Health Center involving five pregnant women revealed that their average hemoglobin level was below 10 g/dL, indicating the presence of anemia at the local level. These data reinforce the urgency of practical, simple, and accessible interventions to address anemia among pregnant women.

The problem of anemia in pregnancy has long been a global health concern due to its high prevalence and detrimental effects on maternal and neonatal outcomes. Various efforts have been made to address this problem, such as iron and folic acid supplementation programs and food fortification, which are considered standard interventions (Agarwal & Rets, 2021; Manickavasagam, 2021). However, in practice, these strategies often face challenges related to coverage and compliance, as many pregnant women are reluctant or inconsistent in consuming iron tablets due to side effects and lack of awareness. This persistent gap highlights the limitations of pharmacological approaches alone and strengthens the rationale for exploring complementary non-pharmacological interventions that are safer, culturally acceptable, and based on local food sources (I. Abdullah et al., 2024; Pramesti et al., 2024). The urgency of this research lies in the need for alternative interventions that are practical, acceptable, and based on locally available foods to overcome the persistent problem of anemia in pregnancy. Previous studies have shown that papaya (Carica papaya L.) contains iron, vitamin C, and other bioactive compounds that can support hemoglobin formation and improve blood quality (Nouman et al., 2022; Nurhasanah, 2023).

Several studies have reported positive effects of papaya consumption on hemoglobin levels among adolescents and pregnant women, either in fresh form or in combination with other foods (V. I. Abdullah et al., 2022; Kuntjoro et al., 2017). However, research focusing specifically on the regular consumption of papaya juice remains limited, even though juice is easier to consume and more acceptable for pregnant women than fresh fruit. Therefore, this research must fill the existing gap and provide evidence for using papaya juice as a non-pharmacological intervention. Based on this rationale, this study aims to analyse the effect of papaya juice consumption on haemoglobin levels in pregnant women at risk of anaemia as a simple, affordable, and effective strategy to improve maternal health outcomes.

Methods

This study employed a quasi-experimental design with a pre-test and post-test control group. A total of 36 pregnant women in their second and third trimesters, residing in the working area of Depok Jaya Public Health Center, were recruited using purposive sampling based on predetermined inclusion and exclusion criteria. The sample size was calculated using Federer's formula with adjustments for potential dropouts, resulting in 36 participants equally distributed into an intervention group (n = 18) and a control group (n = 18). The intervention group received 100 grams of papaya juice mixed with 100 ml of water, consumed once daily for 14 consecutive days, in addition to routine iron (Fe) supplementation, while the control group received only standard iron supplementation. Hemoglobin levels were measured at baseline (pre-test) and after 14 days of intervention (post-test) using a Hb check device (specific brand) that had been previously calibrated to ensure measurement accuracy. Data were analyzed using the

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Independent Sample t-test to assess differences in mean hemoglobin levels between the two groups.

Results

Table 1. Characteristics of Respondents (n = 36)

Characteristics	Category	n	%
Age (years)	20–30	23	63.9
	31–40	13	36.1
Parity	Primigravida	11	30.6
	Multigravida	25	69.4
Education Level	Elementary School	3	8.3
	Junior High School	5	13.9
	Senior High School	28	77.8
Total		**36**	**100**

As shown in Table 1, most respondents were in the 20–30 age group (63.9%), indicating that most pregnant women in this study were in their early reproductive years. In terms of parity, the largest proportion were multigravida (69.4%), suggesting that most participants had experienced more than one pregnancy. Regarding education, the majority had completed senior high school (77.8%), reflecting a relatively high level of formal education among the respondents.

Table 2. Hemoglobin Levels of Pregnant Women (Pre-Test)

Group	Mean (g/dL)	Median (g/dL)	SD (g/dL)	Min–Max (g/dL)	95% CI (g/dL)
Control	9.82	9.80	2.10	6.4–14.5	8.78–10.86
Intervention	9.87	9.90	1.60	6.8–12.5	9.08–10.66

As shown in Table 2, initial hemoglobin levels were relatively alike between groups. The control group recorded an average of 9.82 g/dL (95% CI: 8.78–10.86), with individual values spanning 6.4–14.5 g/dL, whereas the intervention group had a mean of 9.87 g/dL (95% CI: 9.08–10.66) and a range of 6.8–12.5 g/dL.

Table 3. Hemoglobin Levels of Pregnant Women (Post-Test)

Group	Mean (g/dL)	Median (g/dL)	SD (g/dL)	Min–Max (g/dL)	95% CI (g/dL)
Control	10.27	10.30	1.90	7.1–14.3	9.33–11.21
Intervention	12.50	12.50	1.40	9.2–14.5	11.80–13.20

As indicated in Table 3, hemoglobin concentrations improved in both groups after the 14-day intervention. Women in the control group, who consumed only Fe tablets, reached a mean level of 10.27 g/dL (95% CI: 9.33–11.21), ranging from 7.1 to 14.3 g/dL. In comparison, the intervention group that received papaya juice plus Fe tablets achieved a significantly higher mean of 12.50 g/dL (95% CI: 11.80–13.20), with values spanning 9.2–14.5 g/dL.

Table 4. Comparison of Hemoglobin Levels (g/dL) in Pregnant Women Before and After Intervention (n = 18 per group)

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Group	Measurement Time	Mean (g/dL)	Median (g/dL)	SD (g/dL)	Min–Max (g/dL)	95% CI (g/dL)	p-value (within-group)
Control	Pre-test	9.82	9.80	2.10	6.4–14.5	8.78–10.86	0.029
	Post-test	10.27	10.30	1.90	7.1–14.3	9.33–11.21	
Intervention	Pre-test	9.87	9.90	1.60	6.8–12.5	9.08–10.66	0.000
	Post-test	12.50	12.50	1.40	9.2–14.5	11.80–13.20	

As presented in Table 4, hemoglobin levels improved in both groups after the intervention. Among the control group (n = 18), given Fe tablets only, the mean rose from 9.82 g/dL (95% CI: 8.78–10.86) to 10.27 g/dL (95% CI: 9.33–11.21), reaching statistical significance (p = 0.029). In contrast, the intervention group (n = 18), which received papaya juice in addition to Fe tablets, showed a greater increase, from 9.87 g/dL (95% CI: 9.08–10.66) to 12.50 g/dL (95% CI: 11.80–13.20), with highly significant results ($p < 0.001$; $\alpha < 0.05$).

Table 5. Comparison of Post-Intervention Hemoglobin Levels Between Control and Intervention Groups (n = 18 per group)

Group	Mean Hb (g/dL)	Median (g/dL)	SD (g/dL)	Min–Max (g/dL)	95% CI (g/dL)	p-value (between-groups)
Control	10.27	10.30	1.90	7.1–14.3	9.33–11.21	0.025
Intervention	12.50	12.50	1.40	9.2–14.5	11.80–13.20	

Table 5 compared the hemoglobin levels between the control and intervention groups after 14 days of treatment. The control group, which had only received Fe tablets, recorded a mean hemoglobin level of 10.27 g/dL (95% CI: 9.33–11.21), whereas the intervention group, which had received papaya juice supplementation in addition to Fe tablets, achieved a higher mean hemoglobin level of 12.50 g/dL (95% CI: 11.80–13.20). The results of the independent sample t-test (p = 0.025) showed a meaningful statistical difference in hemoglobin levels between the intervention and control groups.

Discussion

Hemoglobin Levels of Pregnant Women Before Papaya Juice Supplementation

Prior to the intervention, the mean hemoglobin levels of women in the control and intervention groups were 9.82 g/dL and 9.87 g/dL, respectively, indicating a general condition of mild anemia. These results highlight the continued burden of anemia among pregnant women in the study setting and align with WHO standards, which define anemia in pregnancy as hemoglobin levels below 11 g/dL. The high prevalence of anemia in pregnancy has been widely documented, particularly in low- and middle-income countries, where inadequate dietary intake, increased nutritional demands during pregnancy, and limited access to quality antenatal care are contributing factors (Wang et al., 2025).

During pregnancy, the need for iron intensifies to sustain the expansion of the maternal blood supply and the development of the fetus; without adequate intake, this can cause hemodilution and a decline in hemoglobin levels. Research by Malinowski & Murji (2021) and Agarwal & Rets (2021) emphasized that iron deficiency is the leading cause of anemia during pregnancy, accounting for more than half of all cases globally. Previous studies indicate that diets deficient in iron-containing foods, along with infections and low adherence to supplementation regimens, contribute to worsening the condition. These findings align with the current study's results, where participants' baseline hemoglobin levels were in the lower range, indicating

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potential nutritional deficiencies or suboptimal compliance with supplementation guidelines (Chandra et al., 2025).

This baseline data highlights the urgency of developing targeted nutritional interventions to address maternal anemia. This study's low pre-intervention hemoglobin levels justify using additional dietary strategies beyond standard iron supplementation. Identifying food-based solutions that can enhance iron absorption, such as vitamin C-rich fruits, reduces anemia prevalence and improves maternal health outcomes. These findings further support the necessity of antenatal care strategies that involve both dietary counseling and systematic hemoglobin monitoring to facilitate early intervention for anemia.

Hemoglobin Levels of Pregnant Women After Papaya Juice Supplementation

Results revealed that hemoglobin levels improved across both groups following the 14-day intervention. Women in the control group, who took only Fe tablets, attained a mean hemoglobin concentration of 10.27 g/dL (95% CI: 9.33–11.21). In contrast, those in the intervention group, who also consumed papaya juice, achieved a significantly higher mean level of 12.50 g/dL (95% CI: 11.80–13.20).This significant rise in haemoglobin levels among the intervention group suggests that including papaya juice as a dietary supplement enhanced iron absorption and optimised the effectiveness of standard Fe supplementation (Rini Dwi Wahyuni et al., 2023; Tri Restu Handayani & Devina Anggrainy Dencik, 2024).

The results are consistent with earlier research highlighting the importance of dietary interventions in addressing anemia among pregnant women. Papaya contains vitamin C, folate, and various antioxidants that improve iron bioavailability, promoting hemoglobin synthesis (Sitepu et al., 2022; Tri Restu Handayani & Devina Anggrainy Dencik, 2024). Research has consistently shown that combining iron supplementation with vitamin C-rich foods leads to more efficient iron absorption, crucial in addressing iron deficiency anemia, the most common nutritional deficiency in pregnancy (Skolmowska et al., 2022). Additionally, Wang et al (2025) highlighted that improving maternal micronutrient intake can significantly reduce pregnancy-related complications, reinforcing the relevance of this intervention.

The observed improvements in hemoglobin levels underscore the potential of food-based strategies to complement iron supplementation programs. As an affordable and widely available fruit in Indonesia, Papaya offers a practical and sustainable approach to supporting maternal nutrition. This result indicates that when incorporated into antenatal care plans, simple dietary modifications can yield measurable improvements in maternal hematological status. However, the short duration of this study limits the ability to assess long-term outcomes; thus, further research with extended intervention periods and larger sample sizes is recommended to validate the sustained benefits of papaya juice supplementation.

Comparison of Post-Intervention Hemoglobin Levels Between Control and Intervention Groups

The results demonstrated a significant variation in hemoglobin outcomes between the two groups following 14 days of intervention. Women who consumed only Fe tablets reached a mean hemoglobin level of 10.27 g/dL (95% CI: 9.33–11.21), while those who also received papaya juice supplementation attained a higher mean of 12.50 g/dL (95% CI: 11.80–13.20). Independent sample t-test analysis verified this difference as statistically significant ($p = 0.025$), highlighting the superior effect of papaya juice combined with Fe tablets over Fe supplementation alone.

The results align with earlier research showing that the addition of vitamin C–rich fruits to iron supplementation promotes hemoglobin production more efficiently than iron intake alone (Sitepu et al., 2022; Tri Restu Handayani & Devina Anggrainy Dencik, 2024). Vitamin C acts as a

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reducing agent, converting ferric iron (Fe^{3+}) to ferrous iron (Fe^{2+}), the more absorbable form, thereby increasing iron uptake in the intestines (Agarwal & Rets, 2021). Malinowski & Murji (2021) also emphasized that dietary diversity and including bioavailable nutrients are critical components of anemia prevention strategies in pregnancy. This further supports the rationale behind integrating papaya into maternal diets.

The substantial difference between the two groups highlights the effectiveness of incorporating locally available fruits as a complementary strategy to standard antenatal supplementation programs. Papaya is an accessible, affordable, and culturally acceptable food source, making it a practical option for improving maternal nutrition in resource-limited settings. These results suggest that integrating functional foods into public health initiatives could strengthen anemia prevention efforts and reduce maternal morbidity. Nonetheless, this study's relatively small sample size and short intervention period warrant further investigation to confirm these findings and explore their long-term implications for maternal and fetal health outcomes.

Conclusion

This study found that papaya juice supplementation alongside iron tablets significantly improved hemoglobin levels in pregnant women compared to iron supplementation alone. As a nutrient-rich local fruit, papaya shows strong potential for anemia prevention, highlighting the need for larger and longer studies to confirm its effectiveness and integration into antenatal care.

Ethics approval and consent to participate

Ethical approval was granted for this research following institutional and national guidelines. Before inclusion, participants were fully informed of the study's aims, procedures, and their rights, and each provided written informed consent. The principles of confidentiality and anonymity were upheld during the entire research process.

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