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Combined Iron Tablets and Ambon Banana Improve Hemoglobin in Anemic Second Trimester Pregnancy

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Abstract

Anemia during the second trimester of pregnancy poses significant health risks to both the mother and the fetus. Food-based strategies combined with iron supplementation may improve hemoglobin response in this critical period. This study aimed to analyze the effect of combining Fe tablets and Ambon banana consumption on hemoglobin levels among second-trimester pregnant women with anemia compared to Fe supplementation alone. A quasi-experimental pretest-posttest control group design was employed. A total of 54 anemic pregnant women in their second trimester from three public health centers in Pondok Kelapa District, Central Bengkulu, were evenly divided into two groups of 27 participants each. The intervention group received one Fe tablet daily and one Ambon banana twice daily for 30 days, while the control group received one Fe tablet daily. Hemoglobin levels were measured before and after intervention using an Easy Touch GCHb Hemoglobin Meter. Both groups showed increased hemoglobin after the intervention. The post-intervention mean hemoglobin level was 11.952 ± 0.6941 g/dL and 11.093 ± 0.6108 g/dL in the intervention and control groups, respectively, with a between-group difference of 0.8593 g/dL ($p < 0.001$). Confidence intervals could not be reported because summary data lacked the standard error or standard deviation of the change score. Fe tablets combined with Ambon banana consumption were associated with a greater hemoglobin increase than Fe tablets alone among anemic second-trimester pregnant women.

Keywords: *anemia, pregnant women, Ambon banana, iron tablets, hemoglobin*

INTRODUCTION

Maternal mortality is a key indicator of maternal health system performance that reflects access, quality of care, and structural determinants. Within the framework of the Sustainable Development Goals (SDGs), the target is to reduce the global maternal mortality ratio to below 70 per 100,000 live births and to less than 140 per 100,000 live births in every country by 2030 (WHO, 2015). In 2020, the maternal mortality ratio in Southeast Asia was estimated at 134 deaths per 100,000 live births, reflecting the still substantial burden of maternal health problems in the region. Timor-Leste, Cambodia, and Myanmar were recorded as the countries with the highest maternal mortality ratios, at around 173 per 100,000 live births, while Indonesia ranked fourth highest in the region (WHO, UNICEF, UNFPA, World Bank Group, 2023). Maternal anemia is one of the preventable nutritional problems that can worsen pregnancy outcomes and indirectly contribute to maternal and neonatal morbidity through fatigue, reduced physical capacity, increased risk of infection, low birth weight, preterm birth, and complications during delivery (Lewkowitz & Tuuli, 2023).

Maternal health during pregnancy plays an important role in ensuring the quality of life of future generations. A healthy pregnancy determines not only maternal survival but also the optimal growth and development of the fetus in the womb. However, the reality in the field shows that pregnancy is often accompanied by various health problems, one of which is anemia or iron deficiency. Anemia in pregnancy should not be viewed only as a low hemoglobin condition, but as a public health problem that reflects the interaction between increased iron requirements, inadequate dietary intake, limited micronutrient availability, infection, socioeconomic constraints, and the quality of antenatal care (Lewkowitz & Tuuli, 2023). Anemia in pregnancy remains a serious public health problem, considering its significant impact on both the mother and the fetus (Siregar et al., 2022; WHO, 2025).

Globally, WHO reported that anemia affected 35.5% of pregnant women aged 15 to 49 years in 2023, indicating that anemia remains a major public health concern among women during pregnancy (WHO, 2025). In Indonesia, Riskesdas 2018 reported that the prevalence of anemia among pregnant women reached 48.9%, while the 2023 Indonesian Health Survey recorded a prevalence of 27.7% (Kemenkes, 2023; Kemenkes RI., 2018). Local data show that Bengkulu Province recorded an anemia prevalence of 20.13% among pregnant women, while in Bengkulu City it reached 16.9% (Dinas Kesehatan Provinsi Bengkulu, 2023). The Indonesian government has made efforts to prevent and manage anemia through the policy of providing iron tablets (Fe tablets) to all pregnant women, as regulated in Minister of Health Regulation No. 88 of 2014. These tablets are given once daily throughout pregnancy as a form of iron supplementation needed for red blood cell formation (Saini & Ernawati, 2025). Nevertheless, the effectiveness of Fe tablet programs is often limited by low adherence, gastrointestinal side effects, inappropriate timing of consumption, and dietary factors that inhibit iron absorption, such as tea or coffee consumption close to supplementation time.

In addition to the pharmacological approach through Fe tablets, anemia prevention can also be carried out through non-pharmacological approaches, including dietary interventions during pregnancy (Kołota, 2022). One accessible food-based option in the local context is Ambon banana consumption, considering its nutrient content and

its potential role as a complementary food to support iron supplementation. Ambon bananas contain iron, vitamin C, vitamin B6, and folic acid, nutrients that are relevant to hemoglobin synthesis and erythropoiesis (Sari et al., 2022; Widayati & Aisah, 2021). Vitamin C is particularly important because it enhances non-heme iron absorption by reducing ferric iron to ferrous iron, which is more soluble and more readily absorbed in the intestine. Folate and vitamin B6 also contribute to red blood cell formation, while potassium and other micronutrients may support maternal nutritional status during pregnancy. Therefore, Ambon banana consumption may help improve the biological response to Fe supplementation rather than replace Fe tablets as the main anemia intervention.

Several studies have demonstrated the effectiveness of combining Ambon banana consumption with Fe tablets in increasing hemoglobin levels. Previous studies found that administering Fe tablets together with Ambon bananas significantly increased hemoglobin levels among third-trimester pregnant women (Dewi et al., 2024; Setyiyaningsih et al., 2020). Similar results were also reported by Siregar, Noya, and Candriasih, who stated that consuming 100 grams of Ambon banana per day together with Fe tablets for four weeks increased hemoglobin levels from 9.09 g/dL to 10.13 g/dL (Siregar et al., 2022). Evidence from dietary intervention studies also supports the view that iron-rich foods and foods containing absorption enhancers can improve anemia prevention during pregnancy when combined with supplementation and nutrition education (Kołota, 2022; Xu et al., 2022; Engidaw et al., 2025). However, the magnitude of benefit may vary depending on baseline hemoglobin level, dietary intake, adherence to supplementation, and exposure to inhibitors of iron absorption.

Nevertheless, most existing studies are still limited to third-trimester pregnant women or have not specifically examined food-based interventions using locally available fruit in combination with Fe tablets among second-trimester pregnant women in Indonesian primary health care settings. The second trimester is an important phase because plasma volume increases more rapidly than erythrocyte mass, resulting in hemodilution and a physiological decline in hemoglobin levels (Nurhajimah Nurhajimah et al., 2024). This condition creates a research gap regarding whether a simple, locally available, food-based intervention can strengthen the hemoglobin response to standard Fe supplementation during this vulnerable trimester.

A preliminary study conducted by the researchers in the public health center areas across Pondok Kelapa District during September to October 2025 showed a fairly high prevalence of anemia. At Pekik Nyaring Public Health Center, 34 out of 60 pregnant women (56.7%) had anemia. At Sidodadi Public Health Center, 10 out of 40 pregnant women (25%) were found to have anemia, and at Srikuncoro Public Health Center, 15 out of 51 pregnant women (29.4%) had anemia. These data indicate that the area had the highest incidence of pregnancy-related anemia in Central Bengkulu Regency. Public health centers in Pondok Kelapa District have so far provided Fe tablets, vitamins, and nutritional counseling as interventions for pregnant women with anemia. However, there has been no systematic implementation of food-based local interventions such as Ambon bananas. In fact, Ambon bananas are easy to find in the area, relatively affordable, and have been empirically proven to increase hemoglobin levels (Faridah et al., 2024). The

absence of a structured local food-based strategy is important because Fe tablet distribution alone may not adequately address absorption-related and adherence-related barriers in community settings.

Based on these problems, this study was conducted to test the effectiveness of administering Ambon bananas together with Fe tablets compared with Fe tablets alone in increasing hemoglobin levels among second-trimester pregnant women. The novelty of this study lies in its focus on anemic pregnant women in the second trimester, a period marked by physiological hemodilution, and in its evaluation of a locally available food-based adjunct to standard Fe supplementation in public health center settings. Unlike previous studies that mainly focused on late pregnancy or general dietary counseling, this study directly compares Fe tablets alone with Fe tablets plus Ambon banana consumption using a pretest-posttest control group approach. This study also has practical implications for maternal health service policies in areas with a high prevalence of anemia, while also supporting the optimal use of local resources. The findings are expected to provide evidence for a feasible complementary strategy that can be integrated into antenatal nutrition education and anemia prevention programs.

METHODS

This study used a quasi-experimental design with a pretest-posttest control group approach to assess the comparative effects of iron tablet supplementation alone versus a combination of Fe tablets and Ambon banana consumption on hemoglobin levels among second-trimester pregnant women. The study was conducted at Pekik Nyaring Public Health Center, Sidodadi Public Health Center, and Srikuncoro Public Health Center in Pondok Kelapa District. The intervention and data collection were carried out from November 3 to December 13, 2025. This design was selected because the intervention was implemented in routine public health center service settings, where individual randomization was not feasible.

The respondents were then allocated using a non-random assignment procedure into an intervention group and a control group, with 27 participants in each group. Group allocation was conducted based on field feasibility and service-area coordination at the participating public health centers. To reduce potential selection bias caused by non-random allocation, baseline characteristics and baseline hemoglobin levels were compared between groups before evaluating intervention effects.

The inclusion criteria were second-trimester pregnant women, hemoglobin levels ranging from 7.0 to 10.9 g/dL, willingness to participate and sign informed consent, and absence of complications or comorbidities. The exclusion criteria included withdrawal during the study period, referral or hospitalization, or communication difficulties that hindered participation. Respondents were also excluded when they were unable to complete the 30-day intervention or had conditions requiring medical management beyond routine antenatal care.

The control group received one Fe tablet containing 60 mg of elemental iron and 0.4 mg of folic acid daily after breakfast. The intervention group received the same Fe tablet once daily after breakfast plus one Ambon banana

weighing 136 to 155 grams twice daily after meals, in the morning and evening, for 30 consecutive days. Thus, Fe tablets were administered once daily in both groups, while Ambon banana was administered twice daily only in the intervention group. Participant adherence was monitored by community health cadres and local midwives through weekly home visits and WhatsApp reminders. Daily consumption monitoring sheets were used to record Fe tablet intake and Ambon banana consumption. Respondents were reminded not to consume tea or coffee close to Fe tablet intake because these beverages may inhibit iron absorption.

Hemoglobin levels were measured before and after the intervention using the Easy Touch GCHb Hemoglobin Meter. Sociodemographic variables including age, education, and parity were collected through a structured questionnaire. The instruments used included a hemoglobin meter, daily consumption monitoring sheets, a structured questionnaire, and an observation checklist. Potential confounding variables, including age, education, parity, baseline hemoglobin level, adherence to Fe tablet consumption, and adherence to Ambon banana consumption, were documented and considered during analysis and interpretation. Information related to dietary habits that may affect iron absorption, such as tea or coffee consumption, was also monitored through the observation checklist.

Before analysis, normality testing was performed using the Kolmogorov-Smirnov test and showed a normal distribution for both pretest and posttest hemoglobin data in the two groups. Univariate analysis was used to describe respondent characteristics and hemoglobin levels using frequency, percentage, mean, and standard deviation. Baseline characteristics between the intervention and control groups were compared to assess group comparability before the intervention. Paired sample t-tests were used to analyze within-group differences in hemoglobin levels between pretest and posttest measurements. Independent sample t-tests were used to compare hemoglobin change scores between the intervention and control groups. Where appropriate, post-intervention hemoglobin levels were interpreted by considering baseline hemoglobin values because the study used a non-randomized design. Results were presented as mean ± SD, mean difference, 95% confidence interval, and p-value, with a significance level of $p < 0.05$.

This study received ethical approval from the Health Research Ethics Committee with approval number 003/KEPK/XI/2025. The ethical clearance document was prepared for submission to the journal as required. All respondents provided written informed consent after receiving an explanation regarding the study objectives, procedures, benefits, potential risks, and their right to withdraw at any time without consequences. Confidentiality of respondent data was maintained throughout data collection, analysis, and reporting.

FINDINGS AND DISCUSSION

Most respondents were in the 20-35 year age range in both the intervention and control groups, accounting for 92.6% and 88.9%, respectively. Basic education level (elementary school/junior high school equivalent) was found in 11 respondents (40.7%) in the intervention group and 10 respondents (37.0%) in the control group. The majority of respondents were multigravida, with 16 respondents (59.3%) in both the

intervention and control groups. The complete distribution of respondent characteristics is presented in Table1.

Table 1. Distribution of Respondent Characteristics

Characteristics	Intervention		Control		p-value
	f	%	f	%	
Age					
<20 years	1	3.7	3	11.1	0.364
20 to 35 years	25	92.6	24	88.9	
>35 years	1	3.7	-	-	
Education					
Basic (elementary/junior high school equivalent)	11	40.7	10	37.0	0.455
Secondary (senior high school equivalent)	10	37.0	7	25.9	
Higher education (college/university)	6	22.3	10	37.0	
Parity					
Primigravida	10	37.0	10	37.0	1.000
Multigravida	16	59.3	16	59.3	
Grandemultigravida	1	3.7	1	3.7	
Total	27	100	27	100	

Table 2 shows a difference in mean hemoglobin levels among second-trimester pregnant women between the control group, which received Fe tablets only, and the intervention group, which received Fe tablets accompanied by Ambon banana consumption. The mean hemoglobin level in the control group was 11.093 with a standard deviation of 0.6108, whereas the intervention group had a higher mean of 11.952 with a standard deviation of 0.6941. The mean difference of 0.8593 indicates a greater increase in hemoglobin levels in the group receiving the combination of Fe tablets and Ambon bananas. A p-value of 0.000 indicates that this difference was statistically significant ($p < 0.05$). Thus, Ambon banana consumption as a complement to Fe tablets had a significant effect on increasing hemoglobin levels compared with Fe tablets alone among second-trimester pregnant women.

Table 2. Differences in the Effect of Fe Tablet Consumption versus Ambon Banana and Fe Tablet Consumption on Hemoglobin Levels among Second-Trimester Pregnant Women

Hemoglobin Level	Mean ± SD	Mean Difference	p-value
Control group	11.093 ± 0.6108	0.8593	0.001
Intervention group	11.952 ± 0.6941		

DISCUSSION

The results showed that pregnant women who consumed Fe tablets together with Ambon bananas had higher mean hemoglobin levels than pregnant women who consumed Fe tablets alone. The mean hemoglobin level in the control group was 11.093 ± 0.6108 g/dL, while in the intervention group it reached 11.952 ± 0.6941 g/dL, with a mean difference of 0.8593 g/dL. This difference was statistically significant with a p-

value < 0.001. These findings should be interpreted as an association between the combined intervention and a greater hemoglobin response, because the study used a quasi-experimental design with non-random group allocation. These findings indicate that iron supplementation alone may not produce optimal results unless it is supported by dietary factors that enhance iron absorption and utilization effectively. The higher hemoglobin level in the intervention group may be explained by the additional intake of nutrients from Ambon bananas that support iron absorption and hematopoiesis.

These findings underscore the importance of an integrated nutritional approach in efforts to increase hemoglobin levels among second-trimester pregnant women. During this period, iron requirements increase physiologically along with plasma volume expansion and rising fetal demand, placing pregnant women at high risk of iron deficiency anemia. This condition remains a significant public health problem and contributes to various pregnancy complications, including maternal fatigue, impaired fetal growth, and an increased risk of adverse delivery outcomes (Widowati, 2023; Yosali et al., 2022). Therefore, anemia management during pregnancy should not only focus on the distribution of Fe tablets, but also on improving dietary quality, supplement adherence, and the timing of supplement consumption to optimize iron absorption.

Theoretically, the effectiveness of iron supplementation is strongly influenced by bioavailability, which depends on the presence of absorption enhancers, particularly vitamin C. Vitamin C plays a role in reducing ferric iron to ferrous iron, which is more readily absorbed in the small intestine, thereby increasing iron availability for hemoglobin synthesis (He et al., 2018). Ambon bananas are known to contain vitamin C as well as various other nutrients that may support this process, so their consumption together with Fe tablets can improve the hemoglobin response compared with Fe tablets alone (Adethia & Sukarni, 2022; Handayani et al., 2022). In addition, folate contributes to DNA synthesis during erythropoiesis, vitamin B6 is involved in hemoglobin synthesis, and potassium may support maternal metabolic balance. These mechanisms provide a biological explanation for why Ambon banana consumption may strengthen the response to Fe supplementation among pregnant women with anemia.

In addition to enhancing iron absorption, Ambon bananas also contain antioxidant compounds that may help reduce oxidative stress. Oxidative stress is known to interfere with iron metabolism and the erythropoiesis process, so its control contributes to supporting optimal red blood cell formation (Munekata et al., 2023). This mechanism is relevant because pregnancy is accompanied by increased oxidative demand, and poor antioxidant intake may worsen inflammatory and metabolic conditions that affect iron utilization. However, the present study did not measure oxidative stress markers, ferritin, transferrin saturation, or

inflammatory markers, so this explanation should be understood as a plausible biological mechanism rather than a directly measured pathway.

From a clinical perspective, the mean increase in hemoglobin level of 0.8593 g/dL has relevant implications, especially for pregnant women whose initial hemoglobin levels are around the anemia threshold in the second trimester. Anemia in pregnancy is currently defined based on hemoglobin levels with trimester-specific cut-off points, as recommended in the latest World Health Organization guidelines, which emphasize that the second trimester is a critical period for physiological hemoglobin decline due to hemodilution (WHO, UNICEF, UNFPA, World Bank Group, 2023). Therefore, an increase approaching one gram per deciliter may help some pregnant women move from anemia or borderline status toward a clinically safer status, although the magnitude of the effect remains influenced by baseline hemoglobin level, nutritional status, and adherence to supplementation. This interpretation should be made cautiously because the value of 0.8593 g/dL was derived from the difference in post-intervention mean hemoglobin levels. Clinical significance would be more robust if supported by comparable baseline hemoglobin levels, mean change scores, and confidence intervals.

These findings are also relevant in the context of developing local food-based interventions. The use of local foods rich in nutrients that support iron absorption, such as fruits that are sources of vitamin C, is recommended in current maternal nutrition approaches because it can improve both the effectiveness of supplementation and adherence among pregnant women (Basrowi et al., 2025; Engidaw et al., 2025; Xu et al., 2022). Ambon bananas, as a food that is easy to obtain, relatively inexpensive, and culturally acceptable, have the potential to become a practical component of community-based anemia prevention strategies.

This finding is consistent with international evidence showing that dietary interventions during pregnancy can contribute to anemia prevention when they are combined with iron-folic acid supplementation, nutrition education, and regular adherence monitoring (Engidaw et al., 2025; Kołota, 2022). It is also in line with studies reporting improved hemoglobin levels after fruit-based or micronutrient-supportive interventions, including interventions using banana, strawberry, and other nutrient-rich foods among pregnant women with anemia (Widowati, 2023; Yosali et al., 2022).

In addition, integrating nutrition education into antenatal care remains essential to maximize the benefits of iron supplementation. Recent evidence shows that nutrition counseling emphasizing the consumption of Fe tablets together with foods that support iron absorption, especially vitamin C-rich fruits, significantly improves adherence and hemoglobin outcomes among pregnant women (Basrowi et al., 2025; Engidaw et al., 2025; Xu et al., 2022). This is important because Fe tablet effectiveness is often affected by behavioral and dietary factors, including irregular tablet consumption, nausea or gastrointestinal discomfort, low intake

of absorption-enhancing foods, and consumption of tea or coffee near the time of supplementation. Therefore, Ambon banana consumption should be framed as a complementary strategy within antenatal nutrition counseling, not as a substitute for Fe tablets.

Compared with previous studies, the present findings support the evidence that combining Fe tablets with Ambon banana consumption can improve hemoglobin levels. Dewi reported that Ambon banana and Fe administration increased hemoglobin levels among third-trimester pregnant women with mild anemia (Dewi et al., 2024), while Siregar found an increase in hemoglobin after Ambon banana consumption combined with Fe tablets for four weeks (Siregar et al., 2022). Similar findings were reported by Handayani and Adethia and Sukarni, although their study populations differed from the present study. The present study adds evidence by focusing on second-trimester pregnant women, a group that is vulnerable to physiological hemodilution and often underrepresented in previous Ambon banana intervention studies (Adethia & Sukarni, 2022; Handayani et al., 2022).

Several potential confounding factors should be considered when interpreting these results. Daily dietary intake, consumption of animal-source foods, intake of vitamin C-rich fruits, tea or coffee consumption, infection status, nutritional status, pregnancy spacing, and adherence to Fe tablets may influence hemoglobin response. Although adherence was monitored through cadres, midwives, home visits, WhatsApp reminders, and consumption monitoring sheets, the study did not strictly control all daily food intake or biochemical indicators of iron status. These factors may partly explain individual variation in hemoglobin improvement between respondents.

This study has several limitations. First, the sample size was relatively small, with only 27 respondents in each group, which may limit statistical power and generalizability. Second, group allocation was non-random, so selection bias cannot be fully excluded even when baseline characteristics are compared. Third, the intervention lasted only 30 days, so the long-term sustainability of hemoglobin improvement could not be evaluated. Fourth, dietary intake, tea and coffee consumption, infection status, nutritional status, and biochemical markers such as ferritin or transferrin saturation were not comprehensively measured. These limitations mean that the findings should be interpreted cautiously and should not be generalized beyond similar primary health care settings without further evidence.

Further research is recommended using a randomized controlled trial design with a larger sample size, longer intervention duration, and stricter control of dietary intake and supplement adherence. Future studies should also measure baseline and post-intervention ferritin, transferrin saturation, inflammatory markers, nutritional status, and detailed dietary patterns to clarify whether the improvement in hemoglobin is primarily related to enhanced iron absorption, improved adherence, better overall nutrient intake, or a combination of these mechanisms.

CONCLUSIONS

In this quasi-experimental study, the combination of iron (Fe) tablets and Ambon banana consumption was associated with a greater increase in hemoglobin levels among second-trimester pregnant women with anemia than Fe tablets alone. Although both groups showed improvement, the intervention group demonstrated a greater increase. The nutritional content of Ambon bananas, such as vitamin C, vitamin B6, folate, and iron, supports hemoglobin formation

and may enhance the effectiveness of Fe supplementation. This intervention is natural, affordable, and locally accessible, making it a feasible complementary strategy for preventing anemia during pregnancy, particularly in areas with a high prevalence of anemia and adequate local resources. However, because this study used a non-randomized quasi-experimental design with a limited sample and short intervention duration, the findings should be interpreted cautiously and confirmed through further studies with larger samples, randomized allocation, longer follow-up, and better control of dietary and clinical confounding factors.

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