Original Article

Effectiveness Of Pisbro Cookies In Improving Hemoglobin Levels Among Pregnant Women: A Quasi-Experimental Study

Damayanty S[1], Erin Padilla Siregar[1], Hazizah Sabilah Siagian[1], Aurel Sessfy Kalira[1]

[1] Department of Midwifery, STIKes Mitra Husada Medan, Medan, North Sumatra, Indonesia

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Correspondence

Damayanty S; 1Departement of Midwifery, STIKes Mitra Husada Medan, Medan, North Sumatra, Indonesia.

Email:

maydamayanti24@gmail.com

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ABSTRACT

Background: Anemia in pregnancy remains a major cause of maternal complications, low birth weight, and stunting. Although iron–folic acid supplementation is widely implemented, there is a lack of culturally appropriate, food-based interventions using locally available ingredients that can sustainably improve hemoglobin levels in low-resource settings. This gap highlights the need for innovative, community-adaptable nutritional interventions that complement existing programs. The objective was to evaluate the effectiveness of Pisbro cookies (banana–broccoli cookies) in improving hemoglobin levels among pregnant women with anemia.

Methods: This study used a quasi-experimental two-group pretest–posttest design and followed the TREND reporting guideline. A purposive sampling method was used to recruit 40 pregnant women with mild–moderate anemia from the Sentosa Baru Health Centre, Medan. Inclusion criteria included: (1) confirmed anemia based on Hb examination, (2) gestational age 12–36 weeks, (3) willingness to participate for 30 days, (4) adherence to Fe tablet consumption. Exclusion criteria included pregnancy complications, chronic illness, allergies to ingredients, and incomplete follow-up. The intervention group received 5 Pisbro cookies/day for 30 days, while the control group received routine antenatal care without additional intervention. Hemoglobin levels were measured at baseline and after 30 days using a calibrated hemoglobin meter. Data were analyzed using an independent t-test at $\alpha = 0.05$.

Results: The intervention group showed an increase in mean hemoglobin levels from 9.56 ± 0.48 g/dL to 9.79 ± 0.51 g/dL, while the control group decreased from 9.62 ± 0.47 g/dL to 9.40 ± 0.50 g/dL. The difference between groups was statistically significant ($p = 0.019$), indicating a positive effect of Pisbro cookies on maternal hemoglobin levels.

Conclusion: Pisbro cookies were effective in improving hemoglobin levels among pregnant women with anemia. As a low-cost, culturally acceptable food-based intervention using locally available ingredients, Pisbro has potential to complement maternal nutrition programs and support anemia and stunting prevention efforts.

Keywords: Anemia, Hemoglobin, Pregnant Women, Broccoli, Banana, Food Intervention, Quasi-Experimental.

Implications for Practice:

- Pisbro cookies can function as an affordable, culturally adaptable, and scalable food-based intervention to reduce anemia among pregnant women in low- and middle-income settings.
- The findings support integrating Pisbro production and distribution into community health centre programs, including antenatal classes and local nutrition initiatives.

Implications for Practice:

- This innovation contributes to stunting prevention strategies by providing a practical, locally sourced supplementary food option that can be implemented in resource-limited communities.

Introduction

Anemia in pregnancy remains a major global public health problem, particularly in low- and middle-income countries (LMICs), where limited dietary diversity, inadequate micronutrient intake, and socioeconomic barriers contribute to persistent maternal undernutrition. In 2019, anemia affected 32 million pregnant women (37%) worldwide, increasing the risks of low birth weight, preterm birth, perinatal mortality, and impaired fetal development (Niraula et al. 2025; Stevens et al. 2022; WHO 2021b). Indonesia, like many LMICs, continues to struggle with maternal anemia despite national supplementation programs, due in part to low adherence, gastrointestinal side effects, and limited access to nutrient-rich foods (Utomo, Cuciati, and Risnanto 2023).

Although iron–folic acid supplementation is widely promoted, a research gap remains: most existing interventions rely heavily on supplementation and counselling, while evidence on culturally acceptable, food-based strategies using local ingredients remains limited, especially in Indonesia. Food-based approaches have the potential to improve adherence, reduce side effects, and promote sustainable nutrition behaviors; however, few Indonesian studies have examined whether locally produced nutrient-dense foods can effectively improve haemoglobin levels in pregnant women.

From a theoretical standpoint, this study is guided by a food-based intervention conceptual framework, integrating nutritional biochemistry and the micronutrient synergy model. Broccoli provides non-heme iron, antioxidants, folate, and vitamin C, while Ambon banana supplies vitamin C, folate, vitamin B6, iron, and carbohydrates—nutrients essential for erythropoiesis (Ifa Nurhasanah 2022; Sunarni, Litasari, and Rizqiyani 2024). According to the nutrient-interaction theory, vitamin C enhances iron absorption by reducing ferric iron (Fe^{3+}) to ferrous iron (Fe^{2+}), the form most readily absorbed in the intestine (Widayati and Aisah 2021). This synergy forms the basis for developing Pisbro cookies, a locally produced broccoli–banana innovation designed to improve iron absorption and haemoglobin synthesis among pregnant women.

The LMIC relevance of this approach is substantial. Countries such as Indonesia need low-cost, culturally acceptable, scalable nutritional innovations that align with local eating patterns and community resources. Pisbro cookies utilize ingredients that are widely available, affordable, and acceptable in local diets, making them particularly suitable for community-level maternal nutrition programs (Sinaga et al. 2022).

Despite national-level maternal nutrition programs, Indonesia still faces high rates of anemia among pregnant women, including in North Sumatra, where anemia contributes to maternal morbidity (Dinkes Sumut, 2024). There is limited evidence on whether a locally formulated product, such as Pisbro cookies, can significantly improve haemoglobin levels, representing a meaningful research gap that this study seeks to address.

Pregnant women play a larger part in the health care system created by Indonesia's Health Ministry, whereas husbands' contributions are not given their full potential. While the husband's

involvement is limited to attending his wife to midwife appointments, midwives typically engage directly with pregnant women during checkups. Similarly, health professionals usually recommend only prenatal workouts to prepare for childbirth. Seldom is an attempt made to get the husband more involved(Laksono et al. 2022; Sinaga et al. 2022; Wisesa et al. 2025)

Anemia affects a nation's economic development because it is linked to impaired cognitive and motor development in children and reduced labour capacity in adults. Iron deficiency anemia in pregnant women can result in growth and developmental abnormalities and is linked to unfavourable reproductive outcomes such as low birth weight (LBW) and early birth. If the prevalence of anemia is not reduced, children's growth and educational success will be hampered, and millions of women will experience a decline in their health and quality of life. Anemia indicates a health problem and suboptimal nutritional status. According to 2019 data, 37% of pregnant women (32 million) and 30% of non-pregnant women of reproductive age (15–49 years) suffer from anemia(Niraula et al. 2025; Stevens et al. 2022; WHO 2021b).

The Golden Indonesia 2045 vision is initially based on the 2025–2045 National Long-Term Development Plan (RPJPN). In line with Asta Cita point 4, strategic actions will be taken to achieve the presidential vision for the 2025–2029 timeframe, which includes advancing gender equality, education, health, research, technology, and human resources (HR). Healthy moms will give birth to healthy children, as the next generation of the country is formed during pregnancy and is directly influenced by the mother's health.(Kemensetneg 2025).

The National Medium-Term Development Plan (RPJMN) goal of 183 maternal deaths per 100,000 live births in 2024 appears within reach. However, additional efforts are required to reduce maternal mortality in Indonesia to meet Sustainable Development Goal (SDG) Target 3.1, which aims to lower the maternal mortality ratio to less than 70 deaths per 100,000 live births by 2030 (Statistik 2025). The target for stunting reduction in Indonesia aligns with the global WHA target, which aims to reduce prevalence by 40% by 2025 compared to 2013. In addition, under the SDGs, the goal is to eliminate all forms of malnutrition by 2030, so accelerated efforts are needed to reduce stunting prevalence to 22% by 2025 (Kemenkes SSGI 2022).

North Sumatra Province's 2023 MMR, when converted to the MMR area, was 82.33 per 100,000 live births (202 maternal deaths out of 245,345 live births). With 27 fatalities, Medan City and Deli Serdang Regency had the highest rates of maternal mortality. Several prenatal risk factors, including anemia, CED, and obesity, as well as postpartum problems involving anemia, hypertension, diabetes, and other comorbidities, contribute to the elevated MMR (Dinkes Sumut 2024). The National Medium-Term Development Plan (RPJMN) reflects the government's emphasis on maternal and child health, and the Sustainable Development Goals (SDGs) have garnered international attention for their targets. In 2023, 104 expectant mothers at Medan City's Sentosa Baru Community Health Centre suffered from obstetric problems (Medan 2024).

Lower-than-normal haemoglobin (HB) levels in the blood are a defining feature of anemia. Pregnancy-related anemia can cause significant problems and even death for the mother and the fetus. Pregnancy-related anemia also raises the Risk of low birth weight (LBW), which raises the Risk of stunting (Lilis, Setiawati, and Utami 2023). Due to insufficient fetal nutrition, anemia during pregnancy can result in stunted babies. Stunting is four times more likely to

occur in children whose mothers suffered from anemia during pregnancy. Haemoglobin level is one of the factors linked to stunting. Since each person is susceptible to complex nutritional problems, anemia and stunting can coexist(Azzahra, Hidayati, and Widiyaningsih 2024; Mirza, Sunarti, and Handayani 2023).

Using local knowledge and the staple ingredients of broccoli and bananas, Broccoli Vegetables is an alternative method for raising haemoglobin levels in expectant mothers. Vitamins C, E, and beta-carotene are natural antioxidants found in broccoli that may help lower free radicals either directly or indirectly. Broccoli has 61.10 mg of vitamin C and 1.20 mg of iron. Broccoli contains additional antioxidants that help control the body's ion balance, including iron, selenium, calcium, manganese, phosphorus, zinc, and potassium(Ifa Nurhasanah 2022; Mahdieh Raeeszadeh, Pouria Karimi, Nadia Khademi 2022)

One food that can help meet vitamin C requirements is broccoli. This vegetable is widely accessible and reasonably priced. Broccoli juice has 2,002 milligrams of vitamin C per 10-milligram drink. This sum is sufficient to cover a person's daily expenses(Ifa Nurhasanah 2022)

The nutritional composition of a ripe Ambon banana includes 116 kcal, 1.60 g protein, 0.20 g fat, 25.80 g carbohydrates, 8.00 mg calcium, 32.00 mg phosphorus, 0.50 mg iron, and 72.90 g water. The body readily absorbs the minerals it contains. Aside from beta-carotene (provitamin A), which is present at 45 mg per 100 g of dry substance, this banana also contains 72.0 mg of vitamin C, 0.08 mg of vitamin B1, 0.5 mg of vitamin B6 (pyridoxine), and B-complex vitamins including thiamine, riboflavin, and niacin (Sunarni, Litasari, and Rizqiyani 2024).

Folic acid, also known as vitamin B6, is found in bananas. The fetus readily absorbs it through the womb, and it is necessary for the production of haemoglobin and nucleic acids in red blood cells. A naturally occurring water-soluble vitamin, folic acid is often referred to as vitamin B6 (0.4 mg) (Widayati and Aisah 2021). When the concentration of haemoglobin, or the quantity and size of red blood cells, drops below a certain threshold, the blood's capacity to carry oxygen throughout the body is diminished, leading to a condition known as anemia(Damayanty et al. 2024).

Despite extensive national efforts, a research gap persists in developing culturally adaptable, food-based interventions that use locally available ingredients to improve haemoglobin levels. Most existing strategies focus on supplementation and behavioural counselling, with minimal integration of local food innovations that could increase micronutrient intake more sustainably. This gap is particularly relevant in LMIC contexts, where community-based nutritional innovations have high potential for scalability and cost-effectiveness.

From a nutrition and food-based intervention perspective, micronutrient-rich local foods—such as bananas and broccoli—provide iron, vitamin C, folate, antioxidants, and other hematopoietic nutrients essential for haemoglobin synthesis. The conceptual rationale is that combining iron-containing foods with vitamin C–rich ingredients enhances non-heme iron absorption, thus improving maternal haemoglobin status. A food-based approach aligns with behavioural health models that emphasize culturally acceptable, familiar, and sustainable dietary practices.

Pisbro, a locally developed cookie made from broccoli and Ambon banana, represents an innovative food product designed to improve maternal nutrition

through accessible, low-cost, and community-scalable ingredients. Such locally sourced products are particularly relevant for LMIC health systems, where integrating community-driven food innovations into antenatal care could strengthen anemia-reduction strategies.

Therefore, the objective of this study was to measure the haemoglobin levels of pregnant women and analyze the effectiveness of Pisbro cookies—a locally developed broccoli and banana product—in increasing haemoglobin levels at the Sentosa Baru Community Health Centre.

Methods

Study Design

This study employed a quasi-experimental two-group pretest–posttest design, developed in accordance with the Transparent Reporting of Evaluations with Nonrandomized Designs (TREND) reporting guidelines. The TREND framework was used to ensure transparency in reporting participant flow, intervention delivery, outcome measurement, and potential sources of bias in nonrandomized public health interventions. In this study, no randomization procedures were applied. Respondents were assigned to the intervention and control groups using a non-random, purposive approach based on eligibility criteria established by the research team. This approach is consistent with quasi-experimental methodologies commonly used in community-based maternal health research, where random allocation is not feasible due to ethical, operational, and programmatic considerations.

The selection of a quasi-experimental design was justified for several reasons. First, the study was conducted in a real-world community health centre setting where full randomization could disrupt routine maternal services and create inequities in access to potential nutritional benefits. Second, the design allows for baseline comparison between groups through pre-intervention haemoglobin measurements, enabling the evaluation of changes attributable to the Pisbro cookie intervention. Third, quasi-experimental methods are widely accepted in public health nutrition research when interventions involve food products or community practices that cannot be blinded or randomly distributed. This design was therefore selected to ensure practical implementation, maintain ethical standards, and still allow for robust measurement of intervention effectiveness on haemoglobin levels among pregnant women.

Participants

The participants in this study were pregnant women with mild to moderate anemia registered at the Sentosa Baru Community Health Centre. Population data were obtained directly from the Puskesmas, which identified 40 eligible pregnant women during the study period. Sample selection used a purposive sampling approach based on predetermined criteria. The inclusion criteria were: (1) diagnosed anemia based on haemoglobin examination; (2) willingness to participate for one month; (3) currently consuming Fe tablets according to the national program; and (4) absence of comorbidities affecting haemoglobin levels. Exclusion criteria included pregnancy complications, discontinued participation, or allergies to Pisbro ingredients. All eligible women from this population were included in the study using a total population approach, ensuring that no potential participants were excluded at the recruitment stage.

Recruitment was conducted in collaboration with Puskesmas midwives who approached eligible women during routine antenatal care (ANC) visits.

Midwives provided information on the study's purpose, procedures, and minimal risks, after which mothers who agreed were invited to provide informed consent. This recruitment process adhered to TREND guidelines, ensuring transparency and ethical participant engagement. Because the entire eligible population consisted of only 40 women, a census approach was used, and no power analysis was performed, as all available participants were included to maximize internal validity.

Throughout the study, all 40 participants completed both pretest and posttest haemoglobin measurements, and no dropouts occurred. Weekly monitoring supported adherence to the intervention and minimized potential missing data. As the dataset was complete, no imputation procedures were required. This complete participation strengthened the reliability of findings and reduced bias commonly encountered in quasi-experimental designs.

Instruments

The instruments used in this study consisted of data recording instruments and physiological measurement instruments. The data recording instrument was an observation sheet containing respondents' characteristics, including maternal age, history of anemia, iron tablet consumption, and interpregnancy interval. This observation sheet was developed according to the research requirements and verified by the research team to ensure its suitability and feasibility as a basic data recording instrument.

The primary instrument for measuring hemoglobin levels was the EasyTouch® Hemoglobin Monitoring System with EasyTouch® Hemoglobin Test Strips. This device operates using the reflective photometry method and has been widely used for capillary blood-based hemoglobin testing due to its accuracy meeting the manufacturer's standards. All measurements were conducted by trained healthcare personnel at two key points: before the intervention (pretest) and after the intervention (posttest), with weekly monitoring throughout the study period. To ensure the accuracy of results, the device was used according to standard operating procedures, including strip code installation (code chip), storage of strips at 4–30°C, and automatic internal calibration conducted each time the device was powered on. These procedures ensured that each hemoglobin measurement had good reliability and measurement stability.

The intervention instrument in this study was Pisbro Cookies, a biscuit formulated from a mixture of Ambon banana and broccoli. These ingredients were selected due to their rich content of vitamin C, iron, folate, and antioxidants, which theoretically contribute to enhanced iron absorption and utilization in the body. Pisbro Cookies also underwent preliminary feasibility testing during product development to ensure that the composition and processing were safe and suitable for pregnant women. Validity testing using Pearson correlation showed significant correlation values ($r = 0.698$; $p = 0.000$), indicating that both items were valid. Reliability testing yielded a Cronbach's Alpha of 0.813, indicating that the data recording instrument was reliable ($\alpha > 0.70$).

No pilot testing was conducted, as the main instrument, the hemoglobin measurement device, is a standard medical device with manufacturer validation, while the observation sheet merely functioned as a record of respondents' characteristics, and therefore did not require structural refinement as is commonly done for questionnaires.

Intervention

The Pisbro cookies used as the intervention in this study were specifically

formulated for pregnant women with anemia using a combination of Ambon banana and broccoli. Each cookie weighed 20 grams, and pregnant women in the intervention group consumed five cookies per day (a total of 100 grams per day) for 30 consecutive days. Laboratory analysis conducted by the PTKI Development Laboratory (2025) confirmed the nutritional composition per 100 grams of cookies, consisting of carbohydrates (57.54%), protein (18.89%), fat (7.19%), and iron (26.96 mg/100 g), along with naturally occurring folate, vitamin C, vitamin B6, and antioxidants derived from banana and broccoli. This nutritional profile aligns with the requirements needed to support haemoglobin synthesis during pregnancy.

The intervention was developed based on theoretical and scientific rationale supporting the combination of broccoli and banana to increase haemoglobin levels. Broccoli provides non-heme iron, vitamin C, folate, and antioxidant compounds that reduce oxidative stress and enhance iron metabolism. Ambon banana contains vitamin C, vitamin B6, folate, and small amounts of iron, all of which play essential roles in erythropoiesis. The synergy between iron (from broccoli) and vitamin C (from both banana and broccoli) is supported by well-established mechanisms in which vitamin C reduces ferric iron (Fe^{3+}) to the more absorbable ferrous iron (Fe^{2+}), thereby enhancing non-heme iron absorption in the intestines. This combination also reflects a food-based strategy commonly recommended in low- and middle-income countries (LMICs), where culturally acceptable, affordable, and locally sourced foods can improve adherence compared to pharmacological supplementation alone.

Before implementing the intervention, a preliminary feasibility assessment was conducted using small-scale testing to evaluate the acceptability and palatability of the recipe among pregnant women at the community health centre. This assessment confirmed that the cookies were well accepted, easy to consume, and suitable for daily intake even for women experiencing nausea, making cookies an appropriate delivery form for this nutritional intervention.

Adherence to the intervention was closely monitored to ensure fidelity. Each pregnant woman in the intervention group received a daily portion of five cookies (a total of 100 g/day) and recorded her consumption using a daily compliance checklist. Field enumerators conducted weekly home or clinic visits to verify diary entries, count remaining cookies, and ensure complete consumption. Compliance in this study was high, with all participants reporting and verifying full daily consumption throughout the 30-day intervention period.

The control group did not receive the Pisbro cookies and continued with routine antenatal care, which included daily iron–folic acid (Fe) tablets as recommended by the health centre. No additional food-based intervention or placebo was provided to avoid confounding effects.

To reduce bias between groups, several procedures were implemented. Both groups were measured using the same haemoglobin device, following standardized measurement protocols carried out by trained healthcare personnel. Both groups received the same frequency of monitoring (weekly visits), thereby minimizing differential attention bias. Baseline characteristics were also assessed to ensure comparability between groups prior to the intervention. All participants received the same counselling on standard antenatal nutrition, ensuring that differences in haemoglobin outcomes were attributable to the Pisbro intervention rather than unequal health education.

Data Collection

Data collection was conducted through three main stages: recording respondent characteristics, monitoring intervention compliance, and measuring haemoglobin levels. In the first stage, baseline respondent characteristics were recorded through structured interviews using observation sheets, supported by medical records from the community health centre.

The second stage is monitoring the intervention's implementation, during which researchers record compliance with Pisbro consumption using daily checklists and direct confirmation during weekly visits. This approach is taken to reduce the Risk of bias due to respondent non-compliance.

The third stage involved trained healthcare workers measuring haemoglobin levels with a haemoglobin meter. Measurements were taken at five time points: before the intervention (day 0), the first week, the second week, the third week, and the fourth week. All data was systematically recorded and input into a data processing system for further analysis.

Data confidentiality and security were strictly maintained throughout the study. Respondents' names were replaced with unique identification codes, and all personal information was stored separately from outcome data. Manual records were kept in locked cabinets, while electronic data were stored in encrypted files accessible only to authorized members of the research team. All procedures adhered to the ethical approval received from the Health Research Ethics Committee, ensuring that participant privacy and data security were upheld at all stages of the study.

Data Analysis

Data analysis in this study was conducted using SPSS version 22, following the TREND reporting standards for quasi-experimental research. The analysis began with descriptive statistics to present respondent characteristics—including age, parity, gestational age, and initial haemoglobin levels. Prior to conducting comparative tests, statistical assumptions were examined. The Shapiro–Wilk test was used to assess whether haemoglobin levels were normally distributed.

Once assumptions were met, the paired t-test was applied to analyze changes in haemoglobin levels within each group before and after the intervention, while post-intervention comparisons between the intervention and control groups were analyzed using the independent t-test. If the data were not normally distributed or if variances were not homogeneous, alternative non-parametric analyses such as the Mann–Whitney U test or Wilcoxon Signed Rank Test were employed. In addition to reporting p-values, the study calculated the mean difference between groups and presented 95% confidence intervals (95% CI) to enhance the precision and interpretability of the findings.

To evaluate the clinical strength of the intervention effect, effect size was calculated using Cohen's d, which provides insight into the magnitude of differences between groups beyond statistical significance. Cohen's d values were interpreted as indicating small, medium, or large effects. Reporting of p-values adhered to international scientific standards by presenting exact values, avoiding the use of "p = 0.000."

The selection of statistical tests was based on the quasi-experimental pretest–posttest design involving two groups, the characteristics of the data, and TREND recommendations emphasizing methodological transparency, justification for test selection, and the reporting of confidence intervals and effect sizes. This analytical approach allowed the

researchers to assess the effectiveness of the Pisbro cookies intervention comprehensively, considering both statistical significance and clinical relevance.

Ethical Considerations

This study received ethical clearance from the Health Research Ethics Committee of the Faculty of Medicine, Islamic University of North Sumatra (Ethical Approval Reference No. 285/KEPK/FK-UISU/VI/2025). All procedures involving human participants were conducted in accordance with the ethical standards of the institutional research committee and the principles of the Declaration of Helsinki. Before data collection, all participants were provided with a detailed explanation of the study objectives, procedures, potential benefits, and possible risks. Written informed consent was obtained from every respondent prior to participation. Confidentiality of participants' personal information was strictly maintained, and all data were used solely for research purposes.

Results

The results of this study describe the characteristics of pregnant women in the intervention and control groups, followed by an analysis of haemoglobin outcomes after administration of Pisbro cookies. The characteristics of respondents were assessed to determine baseline comparability and identify potential maternal risk factors that could influence haemoglobin levels, including age, pregnancy history, and pregnancy spacing. These characteristics provide an important context for interpreting the effectiveness of the nutritional intervention.

Table 1. Characteristics of Pregnant Women (n = 40)

Variables	Frequency	Percentage
Maternal Age		
Not Risk (20-35 years)	18	45.0
At Risk (<20 and >35 years)	22	55.0
Pregnancy History		
Anemia	20	52.5
Not Anemic	20	52.5
Pregnancy Spacing		
Risky	22	55.0
No Risk	18	45.0

The analysis of respondent characteristics in **Table 1** shows that the majority of pregnant women were in the at-risk age group, namely, <20 years or >35 years, accounting for 22 (55.0%). In comparison, pregnant women in the non-risk age group (20–35 years) numbered 18 (45.0%). This condition indicates that more than half of the respondents were in an age range that is physiologically more vulnerable to pregnancy complications, including anemia. This age distribution is also an important factor that can influence haemoglobin status and the body's response to nutritional interventions.

Pregnancy history showed a balanced distribution, with 20 respondents (50.0%) reporting a history of anemia and 20 (50.0%) not reporting a history of anemia. This equality reflects the initial homogeneity among respondents regarding anemia-related health history. Meanwhile, pregnancy spacing also showed a risk trend, with 22 mothers (55.0%) in the risky pregnancy spacing category and 18 mothers (45.0%) in the non-risk pregnancy spacing category. Overall, these characteristics suggest that the study population was dominated by pregnant women with risk factors that can affect haemoglobin levels, so nutritional interventions, such as providing Pisbro, are important for

improving the haematological status of pregnant women.

Table 2. Average Haemoglobin (Hb) Levels Before and After Intervention

Group	N	Pre-Hb Test (Mean ± SD)	Post Hb Test (Mean ± SD)	Average Difference (ΔHb)
Intervention (Pisbro cake)	20	9.580 ± 0.4873	9.795 ± 0.5145	0.215
Control (No Pisbro)	20	9.585 ± 0.4782	9.400 ± 0.5005	–0.185

The descriptive analysis results in **Table 2** show a difference in haemoglobin levels between the intervention and control groups. In the intervention group receiving Pisbro Cookies, haemoglobin levels increased from 9.580 ± 0.4873 g/dL in pre-intervention measurements to 9.795 ± 0.5145 g/dL after the intervention, with an average increase of 0.215 g/dL. This increase indicates that consuming Pisbro for 30 days improved haemoglobin levels in pregnant women with anemia.

In contrast, the control group that did not receive intervention showed a decrease in haemoglobin levels, from 9.585 ± 0.4782 g/dL in the pre-test to 9.400 ± 0.5005 g/dL in the post-test, with an average difference of -0.185 g/dL. This decrease in haemoglobin levels shows that, without additional intervention, anemia in pregnant women tends not to improve and may even worsen. The difference in the pattern of change between the two groups indicates a positive effect of Pisbro administration on increasing haemoglobin levels compared with the group that did not receive treatment.

Table 3. Results of an Independent t-Test Comparing Post-Test Haemoglobin Levels Between Groups

Variables	Group	Mean ± SD	t-value	p-value	95% CI for Mean Difference	Effect Size (Cohen's *d*)
Haemoglobin (g/dL)	Intervention	9.795 ± 0.5145	2,461	0.019	0.0701 – 0.7199	0.778
	Control	9.400 ± 0.5005				

Table 3, based on the independent t-test analysis showed a significant difference in post-intervention haemoglobin levels between the intervention and control groups. The average haemoglobin level in the intervention group was 9.795 ± 0.5145 g/dL, while the control group had an average haemoglobin level of 9.400 ± 0.5005 g/dL. The t-value of 2.461 and p-value of 0.019 indicate that the difference is statistically significant at the 0.05 level. The 95% Confidence Interval (CI) for the mean difference ranged from 0.0701 to 0.7199, confirming that the difference in haemoglobin levels between groups was significant. Furthermore, the calculated effect size (Cohen's *d*) was 0.778, indicating a medium-to-large magnitude of effect for the Pisbro intervention. These findings indicate that Pisbro Cookies administration increased haemoglobin levels compared to the untreated group.

Discussion

The results of the Table above show that the majority of mothers aged <20 and

>35 years were 33 (55.0%), while the minority of mothers aged 20-35 years were 18 (45.0%). Based on the Table, the history of anemia in pregnant women is 20 (52.5%), and the history of no anemia in pregnant women is 20 (52.5%). Based on the Table, the majority of mothers at Risk of <2 years are 22 or 55.0% and the minority who are not at Risk are 18 or 45.0%.

The present study demonstrated that the Pisbro cookie intervention led to a measurable improvement in haemoglobin levels among pregnant women with anemia. While the intervention group experienced an average Hb increase of 0.215 g/dL, the control group showed a decline of 0.185 g/dL during the same period. These results indicate that locally developed, nutrient-dense food products can effectively support anemia reduction in pregnant women, aligning with evidence that anemia remains a major contributor to adverse pregnancy outcomes and maternal morbidity(Utomo, Cuciati, and Risnanto 2023; WHO 2021a).

Pregnancy should be planned two to five years after the previous birth. A shorter interval, less than two years, is associated with a higher risk of miscarriage, low birth weight (<2,500 grams), and fetal and infant death. Because the mother's nutritional status has not been fully recovered, pregnancies that are too close together carry the Risk of anemia. Furthermore, complications such as infection, premature rupture of membranes, and bleeding can also occur.(Hardi, Wardani, and Bakara 2023).

The effectiveness of Pisbro can be theoretically explained by the biochemical synergy between iron and vitamin C. Broccoli contains non-heme iron and antioxidants (Ifa Nurhasanah 2022; Raeeszadeh et al. 2022), while Ambon banana provides vitamin C, folate, and vitamin B6—micronutrients essential for erythropoiesis (Sunarni, Litasari, and Rizqiyani 2024; Widayati and Aisah 2021). Vitamin C enhances non-heme iron absorption by reducing ferric iron (Fe^{3+}) to its more absorbable ferrous form (Fe^{2+}), thereby improving haemoglobin synthesis. Antioxidants in broccoli may also protect red blood cells from oxidative damage, improving erythrocyte survival. This nutritional synergy theoretically supports the haemoglobin increases observed among women receiving Pisbro.

The findings of this study are consistent with international evidence from LMICs showing that food-based interventions can significantly improve haemoglobin levels. Research conducted in India and Bangladesh demonstrated that snacks fortified with iron-rich and vitamin C–rich natural ingredients increased haemoglobin more effectively than supplementation alone due to higher adherence and better tolerability (Chaudhary, Kumari, and Vyas 2024). Studies in Nigeria and Ethiopia also found that locally formulated porridges and biscuits improved anaemia status among pregnant women, supporting the role of culturally familiar foods in public health nutrition programs. These parallels strengthen the relevance of Pisbro as a culturally grounded, community-based intervention, particularly in resource-limited settings similar to Indonesia.

Despite their potential, food-based strategies like Pisbro have inherent limitations. Non-heme iron found in plant-based foods such as broccoli is less bioavailable than iron from supplements, and absorption can be inhibited by dietary components like phytates and tannins (WHO 2021a). Therefore, food-based interventions may not be sufficient for managing moderate or severe anemia. Pisbro should be viewed as a complementary approach—supporting but not replacing mandatory iron–folic acid supplementation (Pramono et al. 2024). Moreover, factors such as dietary variation, Fe tablet adherence, and maternal

comorbidities may also influence haemoglobin outcomes but could not be fully controlled in this study.

Anemia persists in LMICs due to low dietary diversity, poor micronutrient intake, limited access to supplements, and low adherence caused by gastrointestinal side effects of Fe tablets (WHO, 2021). Indonesia faces similar barriers, as seen in the low adherence to iron supplementation in North Sumatra(Sumut 2024). Pisbro addresses these challenges by using accessible, low-cost local ingredients—broccoli and banana—that are widely consumed and culturally acceptable.

According to the study's findings, consuming Ambon bananas raised haemoglobin levels. The untreated women's haemoglobin levels increased by only 0.9 g/dL, whereas the treated women's levels increased by 2.367 g/dL. This indicates that the treated women's haemoglobin levels rose more effectively than those of the untreated women.(Hardiani, Choirunissa, and Rifiana 2020). The review by Chaudhary, Kumari, and Vyas (2024) highlights that iron-deficiency anemia among lactating women in India remains highly prevalent due to low dietary iron intake, increased iron requirements during lactation, and limited access to health services and nutrition education. The study found that the most effective strategies to address anemia include regular iron–folic acid supplementation, community-based food fortification, increased consumption of iron-rich foods paired with vitamin C, and continuous nutrition education for breastfeeding mothers. In addition, government-supported programs and routine health monitoring were shown to improve haemoglobin levels and reduce the Risk of anemia in this population. The study by Ruspita and Rahmi (2022) examined the effect of consuming Ambon bananas on haemoglobin levels in pregnant women. The findings showed that regular consumption of Ambon bananas significantly increased haemoglobin concentration, indicating an improvement in maternal anemia status. This effect is attributed to the nutritional content of Ambon bananas, particularly their iron, vitamin C, and folate components, which support erythropoiesis and enhance iron absorption. Overall, the study concludes that Ambon banana intake can serve as an effective, natural, and accessible dietary intervention to help improve haemoglobin levels in pregnant women.(Syamsudin 2019) The study found that administration of broccoli extract significantly increased haemoglobin levels compared with the control group, demonstrating its protective role against smoke-induced oxidative stress and anemia.

A notable strength of Pisbro is its cultural adaptability. Bananas and broccoli are widely available in Indonesian households and affordable across socioeconomic groups, making this intervention feasible for community-level adoption. Converting local ingredients into cookies improves palatability and supports adherence, especially among pregnant women experiencing nausea or aversion to Fe supplements. This aligns with previous findings showing that culturally embedded dietary practices increase acceptability and sustainability of maternal nutrition interventions (Sinaga et al. 2022). Given its low production cost and simplicity, Pisbro can be integrated into antenatal care, maternal classes, and stunting prevention campaigns to complement national efforts to reduce maternal anemia and early childhood malnutrition (Kemenkes SSGI 2022).

Implications and limitations

Optimizing hemoglobin levels in pregnant women through consumption of Pisbro (banana and broccoli cookies) can help prevent the occurrence of anemia

during pregnancy, which is one of the main risk factors for stunting and can provide healthy, easy-to-make, and economical food alternatives based on local ingredients (bananas and broccoli) that can be practiced by the community independently at home. The number of respondents was relatively small, which limits the generalizability of the findings to a broader population. In addition, external factors such as daily diet, compliance with Fe tablet intake, and other health conditions of the respondents cannot be fully controlled, which may influence the research results.

Relevance to Practice

The results of this study are highly relevant to healthcare practices, particularly for pregnant women. Pisbro, made from bananas and broccoli, can be used as a local food innovation to increase haemoglobin levels in pregnant women. Health workers such as midwives, nurses, and nutritionists at the Sentosa Baru Community Health Centre can utilize it as an additional alternative food in prenatal classes and in stunting prevention efforts during pregnancy. Furthermore, Pisbro is easy to make, affordable, and can be used independently by the community, thus potentially improving the nutritional status of pregnant women and supporting the national stunting prevention program.

Conclusion

This study demonstrated that consuming Pisbro Cookies (cookies made from Ambon bananas and broccoli) for 30 days was effective in increasing haemoglobin levels among pregnant women with anemia. The intervention group showed an increase in haemoglobin of 0.215 g/dL, while the control group experienced a decrease of 0.185 g/dL, with the difference being statistically significant ($p = 0.019$). This improvement is supported by the nutritional content of bananas and broccoli, which provide vitamin C, iron, folate, and antioxidants that play essential roles in enhancing iron absorption and haemoglobin synthesis. Therefore, Pisbro can serve as a nutritious, affordable, and culturally acceptable local food supplement to support anemia and stunting prevention programs, particularly within the service area of the Sentosa Baru Community Health Centre.

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CrediT Authorship Contributions Statement

Damayanty S: Conceptualization, Methodology, Supervision, Writing - Original Draft, Investigation,

Erin Padilla Siregar: Software, Validation, Formal Analysis, Writing - Review & Editing, Data Curation, Writing - Original Draft.

Hazizah Sabilah Siagian: Investigation, Resources, Project Administration

Aurel Sessfy Kalira: Visualization, Funding Acquisition

Conflicts of Interest

There is no conflict of interest.

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