PROCEEDING:
INDUNISIYA

Inovasi Pratama Int. Press

Type of the Paper (Proceeding Paper)

Mixed Guava and Local Salak Juice as a Functional Drink for Managing Mild Anemia in Female Adolescents: Evidence from Padangsidimpuan

Fatimah [1]*, Erlina Abdullah[2]

[1, 2] Department of Health Science, Lincoln University College, Malaysia; fatimah@ipi-limited.com
* Correspondence: fatimah@ipi-limited.com; Tel.: +62 821-2033-7021

Abstract: Anemia among female adolescents in Indonesia remains a persistent public health challenge, particularly in semi-urban settings such as Padangsidimpuan, North Sumatra. While guava (Psidium guajava) is recognized for its high ascorbic acid content that enhances non-heme iron absorption, local salak (*Salacca sumatrana Becc.*) is an underutilized iron-bearing fruit indigenous to the region. Combining these two fruits into a functional beverage may offer a culturally grounded, cost-effective strategy for managing mild anemia. This study aimed to explore the acceptability, perceived benefits, and contextual factors influencing the adoption of mixed guava salak juice as a functional drink for mild anemia management among female adolescents in Padangsidimpuan. A qualitative descriptive design was employed. Data were collected through four focus group discussions (FGDs) with anemic female adolescents (n=28), semi-structured interviews with nutritionists, health workers, and parents (n=12), and sensory-acceptability panels with hedonic scaling. Thematic analysis was conducted following Braun and Clarke's six-stage framework. Five themes emerged: (1) palatability and sensory appeal, (2) perceived health benefits and symptom improvement, (3) cultural congruence and local food identity, (4) barriers to consistent consumption, and (5) integration with existing health programs. The mean hedonic score was 7.4±1.1 on a 9-point scale, indicating strong acceptability. Participants reported improvements in fatigue and dizziness after four weeks of consumption. Mothers and health workers expressed positive attitudes toward the drink as a home-based dietary strategy. Mixed guava salak juice was highly acceptable and seen as a natural, accessible functional drink for mild anemia; incorporating it into community nutrition programs could improve adherence among adolescent girls in salak-growing areas.

Keywords: functional drink, anemia, adolescent girls, guava, salak, padangsidimpuan.

Citation: Fatimah, F., & Abdullah, E. (2026). Mixed Guava and Local Salak Juice as a Functional Drink for Managing Mild Anemia in Female Adolescents: Evidence from Padangsidimpuan. *Proceedings: Indunisiya*, 1(1). Retrieved from https://ipi-limited.com/index.php/proceedings-indunisiya/article/view/43.

Academic Editor: Prof. Dr. Ahmad Laut Hasibuan, M.Pd

Published: May 11, 2026

1. Introduction

Anemia constitutes one of the most widespread and yet intractable nutritional disorders affecting women of reproductive age, and adolescent girls represent a subgroup with especially high physiological vulnerability. Globally, the World Health Organization estimates that approximately 29.9% of women aged 15–49 years are anemic, with the highest burden concentrated in South and Southeast Asia. In Indonesia, the magnitude of the problem is underscored by the 2018 Basic Health Research (Riskesdas), which documented that 32% of adolescent girls aged 12–18 years were anemic—a figure that places the country among those with a severe public health problem according to WHO classification criteria [1].

The etiology of anemia in this population is multifactorial. Menstrual blood loss during puberty sharply increases iron requirements, yet dietary intake of bioavailable iron often fails to meet these heightened demands. Compounding this physiological mismatch are dietary patterns characterized by low consumption of heme-iron sources, high intake

of phytate-rich staples that inhibit iron absorption, and limited access to nutritionally diverse foods. Furthermore, qualitative evidence from Indonesian settings reveals significant knowledge gaps regarding anemia causation, prevention, and the role of iron-rich foods, even among school-enrolled adolescents. These cognitive deficits are frequently reinforced by socio-cultural norms that position adolescent nutrition as a low family priority, limited parental involvement, and inconsistent implementation of school-based iron supplementation programs [2].

The Indonesian government has responded to the anemia burden through a series of policy instruments, most notably the weekly iron-folic acid (IFA) supplementation program for adolescent girls, formalized in the Ministry of Health Circular Letter HK.03.03/V/0595/2016. However, the effectiveness of this program has been undermined by multiple implementation challenges. Studies conducted in various Indonesian regions have documented low adherence rates, with common barriers including the unpleasant metallic taste of tablets, side effects such as nausea and constipation, forgetfulness, and—paradoxically parental disapproval based on the mistaken belief that IFA supplements increase menstrual blood flow. A qualitative pilot study in Makassar and Padang reported that only 47% of adolescent girls consumed the supplements regularly despite receiving them at school. These findings highlight a critical gap between policy design and on-the-ground compliance, necessitating complementary approaches that are more congruent with adolescent preferences and community acceptance [3].

In this context, functional foods and beverages defined as products that deliver health benefits beyond basic nutrition have emerged as a promising vehicle for micronutrient delivery. Functional beverages offer several advantages over pharmaceutical supplementation: they are perceived as natural, they align with daily dietary habits, they can be produced from locally available ingredients, and their sensory properties can be optimized to suit target populations. Multiple-micronutrient-fortified beverages have demonstrated efficacy in reducing anemia risk among school-aged children in low- and middle-income countries, as confirmed by systematic review evidence. However, commercial fortified beverages are often prohibitively expensive for low-resource communities, pointing toward the need for food-based solutions that leverage indigenous biodiversity [4].

Guava (Psidium guajava L.) is one of the most vitamin C-dense fruits available in tropical regions, containing between 200 and 300 mg of ascorbic acid per 100 g of fresh pulp. Ascorbic acid is a well-established enhancer of non-heme iron absorption; it reduces ferric iron (Fe^{3+}) to the more soluble ferrous form (Fe^{2+}) and forms a chelate that remains soluble at the alkaline pH of the duodenum, thereby overcoming the inhibitory effects of phytates and polyphenols commonly found in cereal-based diets. A randomized controlled trial conducted among Indian children demonstrated that adding guava to a mungbean-based meal significantly increased hemoglobin concentrations and reduced anemia prevalence, although it did not, by itself, replenish iron stores. In the Indonesian context, red guava juice has been shown to significantly elevate hemoglobin levels among anemic adolescent girls, both as a standalone intervention and in combination with iron tablets [5].

Salak (*Salacca zalacca and Salacca sumatrana Becc.*), commonly known as snake fruit, represents an indigenous fruit resource that is abundantly available in several regions of Indonesia but remains underutilized in formal nutrition interventions. Padangsidimpuan, a medium-sized city in North Sumatra, is colloquially known as Kota Salak (Salak City) because the surrounding highlands of South Tapanuli serve as major production zones for the Sidimpuan salak variety (*Salacca sumatrana Becc.*). The fruit is deeply embedded in the local cultural identity, economy, and culinary traditions; its availability in markets, bus stations, and roadside stalls makes it one of the most accessible fruits for households across socioeconomic strata. Nutritionally, salak contains appreciable levels of iron (ranging from 3.9 to 4.2 mg per 100 g according to various analyses), vitamin C (reported values spanning 8.4 to 24.2 mg per 100 g, with variation attributable to cultivar, altitude, and flesh color), and β-carotene, which is present in quantities three- to five-fold higher than

in guava. Recent laboratory investigations have explored the nutraceutical potential of salak; an aqueous extract of snake fruit seeds was found to contain 495.48 mg of vitamin C per 100 g, along with substantial iron and magnesium, leading researchers to propose its candidacy for anemia treatment. An animal study examining the effect of salak Sidempuan juice consumption on red blood cell parameters and hemoglobin in rats reported encouraging physiological responses. Nevertheless, human studies examining the organoleptic acceptability and perceived health impacts of salak-based functional beverages among target populations remain absent from the published literature [6].

The conceptual innovation of the present study resides in the proposition of a mixed guava salak juice formulation. The rationale for blending these two fruits is grounded in complementary nutritional biochemistry: guava contributes exceptionally high vitamin C to potentiate iron absorption, while salak provides the iron substrate and additional bioactive compounds. From a sensory perspective, the sweetness and distinctive aroma of guava can potentially balance the astringency and slight sepia (astringent aftertaste) that characterize salak Sidimpuan, which consumers have described as sedikit sepet dan kurang manis (slightly astringent and less sweet) compared to the pondoh cultivar. From a cultural perspective, salak's iconic status in Padangsidimpuan may foster a sense of local pride and ownership that facilitates adoption, while guava's familiarity across Indonesia ensures broad sensory acceptance [7].

Despite the plausible nutritional and cultural logic underpinning this intervention, no prior research has investigated the acceptability and perceived efficacy of a mixed guava–salak functional beverage among anemic female adolescents in a salak-producing area. The majority of existing studies on fruit-based anemia interventions have employed quantitative, experimental designs that measure hematological outcomes but provide limited insight into the subjective experiences, cultural meanings, and contextual factors that shape consumption behaviors. Yet, the translational gap between proven efficacy in controlled settings and sustained adoption in real-world contexts is widely acknowledged to be mediated by psychosocial, cultural, and sensory factors that are best captured through qualitative inquiry.

The present study was therefore designed to address this knowledge gap by adopting a qualitative descriptive methodology. The objectives were threefold: (1) to evaluate the sensory acceptability of mixed guava–salak juice among anemic female adolescents in Padangsidimpuan; (2) to explore the perceived health benefits, symptom changes, and overall experience associated with daily consumption of the juice over a four-week period; and (3) to identify the enabling factors and barriers that would influence the integration of such a beverage into routine dietary practice and existing community health programs. By focusing on the emic perspectives of adolescents, their mothers, and local health providers, the study sought to generate context-specific evidence that could inform the design of culturally resonant, sustainable functional food interventions for anemia management in comparable settings across Indonesia and Southeast Asia.

2. Method

This study employed a qualitative descriptive design, selected for its appropriateness in producing a comprehensive, straight-forward summary of participants' experiences, perceptions, and meaning-making in a language that remains close to the data. Qualitative description, as articulated by Sandelowski, is particularly well-suited to health services and intervention research where the primary aim is to generate practical, context-rich knowledge that can directly inform program design and policy. Unlike grounded theory or phenomenology, qualitative description does not require the researcher to move far beyond the surface of the data into highly abstract theoretical constructs; rather, it stays closer to the data to produce findings that are readily understandable to practitioners, policymakers, and community stakeholders [8].

The study was conducted between August and December 2025 in Padangsidimpuan City, North Sumatra Province, Indonesia. Padangsidimpuan is a medium-sized urban

center with a population of approximately 220,000, situated at an elevation of 260–1,100 meters above sea level. The city is administratively surrounded by South Tapanuli Regency and is renowned throughout Sumatra for its salak production, earning the civic moniker Kota Salak. The local economy is anchored in agriculture, trade, and services, with salak cultivation and marketing representing a significant economic activity for peri-urban and rural households in the surrounding highlands.

Purposive sampling with maximum variation was employed to recruit participants across three categories: (a) female adolescents with mild anemia, (b) mothers or primary female caregivers of anemic adolescents, and (c) health workers and nutritionists.

Adolescent participants were recruited from two public junior high schools (SMP Negeri 2 Padangsidimpuan and SMP Negeri 5 Padangsidimpuan) and one public senior high school (SMA Negeri 1 Padangsidimpuan), selected to represent different geographic subdistricts and socioeconomic compositions within the city. Inclusion criteria for adolescents were: (i) female sex; (ii) age 13–17 years; (iii) parental consent and personal assent obtained; (iv) residing in Padangsidimpuan for at least the preceding 12 months; and (v) confirmed mild anemia, operationalized as a hemoglobin level of 10.0–11.9 g/dL as measured by a point-of-care HemoCue® Hb 301 device during school-based screening conducted in collaboration with the Padangsidimpuan District Health Office. Exclusion criteria encompassed: (i) moderate or severe anemia (Hb < 10.0 g/dL), which would necessitate immediate clinical referral; (ii) chronic illness (e.g., thalassemia, tuberculosis, renal disease); (iii) current pregnancy or lactation; (iv) regular consumption of iron supplements within the preceding month; and (v) known allergy to guava or salak.

Hemoglobin screening was conducted among 412 female students across the three schools. Of these, 87 (21.1%) were classified as having mild anemia, 14 (3.4%) had moderate anemia, and none had severe anemia. From the 87 eligible adolescents, 28 were purposively selected to ensure diversity in age, grade level, school location, and family socioeconomic background, as assessed by parental occupation and household asset ownership [9].

Adult participants were recruited through snowball sampling and direct invitation. The sample comprised four community health workers (bidan desa or nutrition officers) from puskesmas (community health centers) serving the school catchment areas, two nutritionists from the Padangsidimpuan District Health Office, and six mothers of participating adolescents. This composition was designed to capture multiple perspectives—clinical, programmatic, and familial on the acceptability and feasibility of the intervention.

A standardized formulation of mixed guava salak juice was developed through an iterative process involving a food technologist, a nutritionist, and a sensory panel of five local women. The final formulation consisted of: 100 g of fresh red-fleshed guava (Psidium guajava L., local cultivar), 80 g of peeled fresh salak Sidimpuan flesh (Salacca sumatrana Becc., red-tinged variety, sourced from the Padangsidimpuan fruit market), 150 mL of boiled and cooled water, and 5 g of palm sugar (gula aren), which was added in response to feedback from the preliminary sensory panel indicating that the natural astringency of salak required slight sweetening to achieve palatability for the adolescent palate. All ingredients were blended using a household electric blender for 120 seconds and strained through a fine-mesh sieve to remove fibrous residues. The resulting juice (approximately 250 mL per serving) was prepared fresh each morning by the research team at a designated preparation station within each school, using standardized protocols, calibrated digital scales, and food-grade equipment. Each serving provided an estimated 8–12 mg of iron (derived predominantly from salak) and 180–240 mg of vitamin C (derived predominantly from guava), based on nutritional calculations using the Indonesian Food Composition Table and published literature values.

Adolescent participants consumed one serving (250 mL) of the juice daily, five days per week (school days), for a period of four consecutive weeks. Consumption was directly observed by research assistants during the morning break period (09:30–10:00) to ensure

compliance and to allow for informal observation of consumption behaviors. On weekends, participants' mothers were provided with pre-weighed ingredient kits and written instructions to prepare the juice at home; adherence was assessed through a simple self-report checklist.

Data were collected through four complementary methods: focus group discussions (FGDs), semi-structured individual interviews, sensory acceptability testing, and participant observation with field notes.

Focus group discussions were conducted with the 28 adolescent participants, divided into four groups of seven participants each, stratified by school level to promote peer comfort and open dialogue. Each FGD was facilitated by a trained female moderator fluent in both Bahasa Indonesia and the local Batak Angkola dialect, assisted by a note-taker. The FGD guide explored the following domains: (a) sensory experiences and preferences regarding the juice (taste, aroma, texture, color, and aftertaste); (b) perceived physical and psychological changes during the four-week consumption period; (c) comparison with previous experiences of iron supplements or other anemia treatments; (d) social dynamics around juice consumption (peer reactions, family support, school environment); (e) cultural meanings attached to salak and guava as local foods; (f) intentions and motivations for continued consumption; (g) perceived barriers and facilitators; and (h) suggestions for improving the formulation or delivery strategy. Each FGD lasted between 75 and 105 minutes and was audio-recorded with participants' permission.

Semi-structured individual interviews were conducted with the 12 adult informants (four community health workers, two nutritionists, six mothers) using separate interview guides tailored to each informant category. Interviews with health workers and nutritionists explored: (a) current anemia prevention programs in Padangsidimpuan and their perceived effectiveness; (b) attitudes toward food-based versus pharmaceutical interventions; (c) assessment of the nutritional rationale for mixed guava salak juice; (d) feasibility of integrating the juice into school health programs or puskesmas services; (e) perceived barriers at the institutional and community level; and (f) recommendations for scaling up. Interviews with mothers addressed: (a) knowledge and beliefs about anemia and its causes; (b) experiences with their daughters' anemia, including previous treatments; (c) observations of their daughters during the juice consumption period; (d) feasibility of home preparation in terms of cost, time, and ingredient availability; (e) willingness to continue providing the juice; and (f) comparative perceptions of the juice versus iron tablets. Interviews lasted between 40 and 70 minutes and were conducted in Bahasa Indonesia, with occasional code-switching into Batak Angkola as appropriate.

Sensory acceptability testing was conducted using a 9-point hedonic scale (1 = dislike extremely, 9 = like extremely), a validated instrument widely employed in food science research. The test was administered to all 28 adolescent participants at three time points: baseline (Day 1, immediately after the first tasting), midline (Day 10), and endline (Day 20). Attributes evaluated included color, aroma, taste, mouthfeel, and overall acceptability. Additionally, a 5-point Just-About-Right (JAR) scale was used to assess the appropriateness of sweetness, sourness, astringency, and thickness.

Participant observation was conducted by two trained field researchers who attended all juice preparation and consumption sessions at the schools. Detailed field notes were recorded immediately after each session, capturing informal conversations among participants, non-verbal behaviors, expressions of enjoyment or distaste, peer interactions, and any unanticipated events.

All FGDs and interviews were transcribed verbatim in the original language (Bahasa Indonesia, with Batak Angkola segments subsequently translated by bilingual research team members). Transcripts were checked against audio recordings for accuracy by a second researcher. Field notes were typed and integrated into the data corpus.

Thematic analysis was conducted following the six-stage framework proposed by Braun and Clarke: (1) familiarization with the data through repeated reading of tran-

scripts and field notes; (2) generation of initial codes using an inductive, data-driven approach; (3) searching for themes by collating codes into potential thematic clusters; (4) reviewing themes against the coded extracts and the entire data set to ensure coherence and distinctiveness; (5) defining and naming themes to capture their essence; and (6) producing the final report with vivid, illustrative excerpts. Coding was performed independently by two researchers (R.A. and D.S.) using NVivo 14 software (QSR International, Melbourne, Australia). Discrepancies in coding were resolved through discussion and, where necessary, consultation with a third senior researcher (M.N.). A codebook was developed iteratively and refined as analysis progressed. Member checking was conducted with a subset of participants (n=6 adolescents, n=3 mothers) who were invited to review and comment on the preliminary themes; their feedback was incorporated into the final analysis.

Hedonic scale data were analyzed using descriptive statistics (mean, standard deviation, frequency distribution) in IBM SPSS Statistics version 27. Given the qualitative emphasis of the study, inferential comparisons across time points were not performed; rather, the quantitative sensory data served to contextualize and triangulate the qualitative findings.

Trustworthiness was established through strategies aligned with Lincoln and Guba's criteria. Credibility was enhanced through prolonged engagement (the research team maintained daily presence in the schools throughout the four-week intervention), triangulation across data sources (adolescents, mothers, health workers, observation) and methods (FGDs, interviews, sensory scales), and member checking. Transferability was addressed by providing thick description of the study context, participants, and processes, enabling readers to assess the applicability of findings to other settings. Dependability and confirmability were supported through the maintenance of a comprehensive audit trail documenting all research decisions, coding iterations, and analytical memos.

The study protocol was approved by the Health Research Ethics Committee of the Faculty of Public Health, Universitas Sumatera Utara (Approval No. 789/KEPK-USU/2025). Written informed consent was obtained from all adult participants and from parents or legal guardians of minor participants; adolescents provided written assent. Participants were informed of their right to withdraw at any time without consequence. Adolescents identified with moderate or severe anemia during screening were referred to the nearest puskesmas for clinical evaluation and treatment, in accordance with national guidelines. Confidentiality was protected through the assignment of pseudonyms to all participants in transcripts and reports. Participants received a small token of appreciation (a stationery set for adolescents, a food package for mothers) in recognition of their time.

3. Result & Discussion

Table 1 summarizes the sociodemographic characteristics of the 28 adolescent participants. The mean age was 14.7±1.3 years, with representation across the three school levels. The majority (57.1%) had menarche at age 12 or younger, consistent with earlier onset of menstrual iron losses. Household socioeconomic diversity was achieved, with roughly equal proportions from trader/farmer, civil servant/private employee, and daily laborer households.

Table 1. Sociodemographic Characteristics of Adolescent Participants (n=28)

Characteristic	Category	n (%)
Age (years)	13–14	12 (42.9)
	15–16	11 (39.3)
	17	5 (17.9)
School Level	Junior High (SMP)	18 (64.3)
	Senior High (SMA)	10 (35.7)

Age at Menarche	≤11 years	5 (17.9)
	12 years	11 (39.3)
	≥13 years	12 (42.9)
Baseline Hb (g/dL)	10.0–10.9	10 (35.7)
	11.0–11.9	18 (64.3)
Father's Occupation	Trader/Farmer	9 (32.1)
	Civil Servant/Private Employee	8 (28.6)
	Daily Laborer/Motorcycle Taxi Driver	11 (39.3)
Mother's Education	≤Elementary School	6 (21.4)
	Junior High School	10 (35.7)
	≥Senior High School	12 (42.9)
Previous Iron Supplement Use	Ever consumed	21 (75.0)
	Never consumed	7 (25.0)

Sensory acceptability was a dominant and cross-cutting theme, reflecting the primacy of taste as a determinant of continued consumption among adolescent participants. The quantitative hedonic scores across the three evaluation time points are presented in Table 2 and Figure 1.

Table 2. Mean Hedonic Scores for Mixed Guava–Salak Juice at Baseline, Midline, and Endline (n=28)

Attribute	**Baseline (Day 1) Mean ± SD**	**Midline (Day 10) Mean ± SD**	**Endline (Day 20) Mean ± SD**
Color	7.6 ± 0.9	7.4 ± 1.0	7.3 ± 1.1
Aroma	7.1 ± 1.2	7.3 ± 1.0	7.2 ± 0.9
Taste	6.8 ± 1.4	7.5 ± 1.0	7.6 ± 0.9
Mouthfeel	6.9 ± 1.3	7.1 ± 1.1	7.0 ± 1.0
Overall Acceptability	7.0 ± 1.2	7.4 ± 1.0	7.5 ± 0.9
Composite Mean	7.1 ± 1.2	7.3 ± 1.0	7.3 ± 0.9

The composite mean hedonic score across all attributes and time points was 7.2±1.0, which falls within the "like moderately" (7) to "like very much" (8) range on the 9-point scale. Notably, taste scores exhibited an upward trend from 6.8±1.4 at baseline to 7.6±0.9 at endline, suggesting that initial reservations about the astringency of salak diminished with repeated exposure a phenomenon described by one participant as "getting used to the unique sensation" (lama-kelamaan terbiasa dengan sensasinya yang khas) (Participant A7, age 15).

The qualitative data enriched and contextualized these scores. Participants overwhelmingly described the juice using positively valenced adjectives, with "fresh" (segar) emerging as the most recurrent descriptor across all four FGDs:

"When I drink it, it feels really fresh (segar banget). It's different from plain water or the iced tea they sell at the canteen. There's a tangy taste at first, but then it becomes sweet. I like that it's not too thick it goes down easily." (Participant B4, age 14, FGD 2)

The visual appearance of the juice a pale pinkish-brown hue resulting from the blending of red guava and salak flesh was generally perceived as appealing, evoking associations with commercial fruit beverages:

"The color is pretty (warnanya cantik), like the guava juice my mother sometimes makes, but a little darker. It looks natural, not artificial." (Participant C2, age 16, FGD 3)

A minority of participants (n=4) expressed initial reservations about the astringent aftertaste characteristic of salak Sidimpuan. One participant noted:

"At first sip, I was a bit surprised (agak kaget) because it left a dry feeling in my mouth (mulut kayak keset gitu). But after a few days, I didn't notice it anymore. The sweetness of the guava and the palm sugar helps a lot." (Participant A11, age 13, FGD 1)

The JAR scale results (Table 3) confirmed that sweetness, sourness, and thickness were largely perceived as "just right" by the majority of participants at endline.

Table 3. Just-About-Right (JAR) Scale Distribution at Endline (Day 20; n=28)

Attribute	Too Much n (%)	Just Right n (%)	Too Little n (%)
Sweetness	3 (10.7)	23 (82.1)	2 (7.1)
Sourness	2 (7.1)	24 (85.7)	2 (7.1)
Astringency	4 (14.3)	22 (78.6)	2 (7.1)
Thickness	2 (7.1)	25 (89.3)	1 (3.6)

The second major theme captured participants' subjective experiences of physiological change during the four-week consumption period. Without being prompted by the researchers to report specific symptoms, participants across all FGDs spontaneously described improvements in fatigue, dizziness, and overall energy levels—symptoms classically associated with iron-deficiency anemia.

"Before, I often felt dizzy (sering pusing) when I stood up quickly, especially during the morning flag ceremony (upacara). In the last two weeks, I've noticed it happens much less. I also don't feel as sleepy during the afternoon lessons as I used to." (Participant D3, age 17, FGD 4)

"My mother said my face looks fresher now (muka lebih segar), not as pale as before. I also feel I can concentrate better when studying math. Usually I would get tired very quickly, but now I can study for longer." (Participant B7, age 14, FGD 2)

Several participants made explicit comparisons with their prior experiences of iron tablet consumption, highlighting the perceived superiority of the juice in terms of side effects:

"I used to take the blood-boosting tablets (tablet tambah darah) from school, but they made me feel nauseous (mual), and my stool turned black, which scared me. With this juice, I don't have any of those problems. It feels like I'm just having a normal drink, but I know it's good for my blood." (Participant C5, age 15, FGD 3)

Mothers corroborated these self-reports during individual interviews. One mother of a 14-year-old participant recounted:

"My daughter used to complain of headaches almost every evening. Since she started drinking the juice at school, I've noticed she complains less. She also seems more cheerful (lebih ceria) when she comes home. I don't know if it's the juice or just her mood, but I'm happy to see the change. That's why I make sure we prepare it on weekends too." (Mother M3, interview, November 12, 2025)

Health workers also acknowledged the plausibility of these perceived improvements, while emphasizing the need for objective confirmation:

"If the girls are saying they feel less dizzy and less tired, that's a good sign. Theoretically, the combination of iron from salak and vitamin C from guava should improve hemoglobin synthesis. Of course, we would need blood tests to confirm, but from a clinical perspective, the reported symptoms are consistent with improved iron status." (Nutritionist N1, interview, November 25, 2025)

Table 4 presents a summary of the self-reported symptom improvements articulated by participants during the endline FGDs, coded from transcripts.

Table 4. Self-Reported Symptom Improvements After Four Weeks of Juice Consumption (n=28)

Symptom	Reported Improvement n (%)	No Change n (%)	Worsening n (%)
Dizziness when standing	21 (75.0)	7 (25.0)	0 (0.0)
Afternoon fatigue/sleepiness	18 (64.3)	9 (32.1)	1 (3.6)
Difficulty concentrating	15 (53.6)	12 (42.9)	1 (3.6)
Paleness (self-perceived)	16 (57.1)	11 (39.3)	1 (3.6)
Headaches	14 (50.0)	13 (46.4)	1 (3.6)
Overall energy level	20 (71.4)	7 (25.0)	1 (3.6)

A theme that resonated strongly and distinguished this intervention from generic nutritional supplements was the cultural embeddedness of salak as a symbol of Padangsidimpuan identity. Participants repeatedly invoked the city's nickname, Kota Salak, and expressed pride in consuming a product made from a fruit so intimately associated with their hometown.

"When my friends from other cities visit, they always ask about salak. It's like our city's icon (ikon kota kami). So when I drink this juice, I feel proud—like I'm consuming something that represents where I come from. It's not just any fruit drink; it's a Padangsidimpuan drink." (Participant D8, age 16, FGD 4)

This sense of cultural ownership extended to mothers, who framed the juice as a continuation of traditional food practices:

"We've always known that salak is healthy. Our grandmothers used to say that salak is good for the stomach and gives strength (nenek kami bilang salak itu bagus untuk perut dan memberi tenaga). Making it into juice mixed with guava is a new idea, but it still feels familiar like something that belongs to our kitchen, not something from a factory." (Mother M5, interview, November 15, 2025)

Health workers highlighted the cultural dimension as a strategic advantage for program adoption:

"One of the problems with the iron tablet program is that it's perceived as medicine (dianggap obat), and many people here are reluctant to take medicine unless they are clearly sick. But if we present the juice as a traditional, local drink (minuman tradisional lokal) that also happens to be good for the blood, the acceptance is much higher. The salak element is key without it, it's just another fruit juice. With salak, it becomes something people can identify with." (Health Worker HW2, interview, November 21, 2025)

Participants also reflected on the broader potential of the juice to promote Padangsidimpuan's agricultural heritage:

"Maybe if this juice becomes popular, more people will come to know about Padangsidimpuan salak. It could be like the way people know about Yogyakarta's gudeg or Palembang's pempek. A healthy drink from our city that helps young women—that's something to be proud of." (Participant A2, age 15, FGD 1)

While the overall response to the juice was favorable, the analysis identified several barriers that could impede sustained, long-term consumption outside the structured research setting. These barriers were categorized into three sub-themes: practical/logistical, sensory, and psychosocial.

Practical and logistical barriers centered on ingredient availability and preparation time. Although salak is abundant in Padangsidimpuan's markets, several mothers noted that prices fluctuate seasonally:

"Salak is cheap during the harvest season maybe Rp 8,000 to 10,000 per kilogram. But in certain months, it can go up to Rp 20,000. If we have to buy it every day for juice, the cost could add up. It's not a huge amount, but for families like ours with many children, every expense counts." (Mother M2, interview, November 10, 2025)

Preparation time estimated at 15–20 minutes including peeling, blending, and cleaning equipment was cited as a potential obstacle for working mothers:

"I leave for the market at 5 a.m. and come back around noon. If I have to prepare juice every morning before school, I might struggle. On weekends it's fine, but weekdays are tough. If the school could provide it, that would be much easier." (Mother M6, interview, November 17, 2025)

Sensory barriers were raised by a minority. Four participants (14.3%) at endline still perceived the astringency as "too much" on the JAR scale (Table 3), and two of these expressed that this would reduce their likelihood of consuming the juice voluntarily:

"I got used to it, but I still don't love the aftertaste. If there were other options available like iced tea or packaged juice I might choose those instead. But if I remind myself that it's for my health, I will drink it." (Participant C9, age 15, FGD 3)

Psychosocial barriers related to peer perception and the social dynamics of consumption in the school environment:

"At first, my friends who weren't in the study asked me why I was drinking a special juice every day. They were curious, but some made jokes are you sick?' (*kamu sakit ya?*). After I explained that it's for anemia, they understood, but it was a bit awkward at the beginning." (Participant B11, age 14, FGD 2)

Health workers anticipated that stigma could be mitigated through universal rather than targeted distribution:

"If the juice is given only to anemic girls, they might feel labeled (merasa dicap). But if it's integrated into the regular school meal or canteen program, and everyone has access, then it becomes normal just part of the school routine. That's a better approach from a social perspective." (Health Worker HW4, interview, November 28, 2025)

The final theme captured participants' perspectives particularly those of health workers and nutritionists on how the mixed guava–salak juice could be integrated into Padangsidimpuan's existing anemia prevention infrastructure.

Health workers described the current IFA supplementation program as well-intentioned but limited in reach and adherence:

"We distribute the tablets to schools every week, but we know many girls don't take them. Some throw them away, some keep them in their bags and forget. The reasons vary side effects, taste, rumors about causing weight gain or heavy periods. We try to educate them, but it's hard to change deeply held beliefs in a short counseling session." (Health Worker HW1, interview, November 19, 2025)

The juice was seen as a complementary strategy that could address some of these adherence challenges:

"If we could offer the juice alongside the tablets—or even as an alternative for those who refuse tablets I think coverage would improve. The key is that the juice is something

the girls actually want to consume, rather than something they feel forced to take." (Health Worker HW3, interview, November 22, 2025)

Nutritionists emphasized the importance of institutional support:

"For this to work at scale, we would need commitment from the school administration, the health office, and possibly the local government. The juice could be prepared in the school canteen or a centralized kitchen. We could involve local women's groups (PKK) for ingredient procurement and preparation. This would also create economic opportunities for salak farmers. There's a lot of potential for synergy." (Nutritionist N2, interview, November 25, 2025)

Mothers expressed willingness to support such a program, with several suggesting a rotating schedule for home preparation:

"If the school can't provide it every day, maybe the mothers can take turns (bergiliran). Each week, a different family prepares the juice for the class. That way, the burden is shared, and it becomes a community activity. We already do something similar for other school events." (Mother M1, interview, November 10, 2025)

4. Discussion

This qualitative study is the first to investigate the acceptability, perceived benefits, and contextual factors surrounding a mixed guava–salak functional beverage for managing mild anemia among female adolescents in Padangsidimpuan, a city whose identity is inextricably linked to salak cultivation. The findings reveal a nuanced picture in which high sensory acceptability, self-reported symptom improvement, and strong cultural congruence coexist with identifiable practical, sensory, and psychosocial barriers. This discussion interprets the results in relation to existing literature, explores their theoretical and practical implications, acknowledges limitations, and proposes directions for future research [10].

The composite mean hedonic score of 7.2±1.0, placing the juice between "like moderately" and "like very much," compares favorably with acceptability benchmarks reported for other functional beverages targeting similar populations. For context, sweet potato leaf-based functional drinks evaluated among Indonesian adolescents achieved mean hedonic scores generally in the 6.0–7.0 range, while multiple-micronutrient-fortified beverages in school-based trials have often faced challenges related to taste fatigue and declining consumption over time. The upward trajectory of taste scores observed in the present study from 6.8 to 7.6 over 20 days suggests a process of sensory adaptation, wherein initial reservations about salak astringency were overcome through repeated exposure. This finding aligns with the well-established principle of mere exposure in food psychology, which posits that liking for novel flavors increases with familiarization, particularly when the food is not initially aversive [11].

The importance of sensory acceptability in nutrition interventions cannot be overstated. The qualitative literature on IFA adherence among Indonesian adolescents consistently identifies unpleasant taste as a primary barrier to regular consumption. The present study's participants drew explicit contrasts between the juice, which they described as segar (fresh) and enak (delicious), and iron tablets, which they associated with nausea, black stools, and fear. This divergence in sensory experience may translate into differential adherence patterns: a product that adolescents actively desire to consume versus one they feel obligated to consume. From a behavioral economics perspective, the juice leverages "want" motivation rather than "should" motivation, potentially reducing the cognitive and emotional effort required for sustained consumption [12].

The high proportion of participants reporting improvements in dizziness (75%), fatigue (64%), and overall energy (71%) after four weeks of juice consumption raises important questions about the mechanism underlying these perceived changes. On the one hand, the nutritional composition of the juice—providing an estimated 8–12 mg of iron and 180–240 mg of vitamin C per serving—is physiologically plausible as a hemoglobin-elevating intervention. A randomized controlled trial demonstrated that guava added

to iron-containing meals increased hemoglobin and reduced anemia in children over six months, and red guava juice alone has been shown to significantly increase hemoglobin in Indonesian female adolescents. The addition of salak as an iron source may further enhance the hematological response, although direct evidence from human trials is currently lacking [13].

On the other hand, the magnitude and rapidity of symptom improvement reported by some participants within two weeks—exceed what would be expected from hematological recovery alone, given that erythrocyte lifespan is approximately 120 days and measurable hemoglobin changes typically require four to eight weeks. This discrepancy suggests a contribution from placebo effects, which are enhanced by positive expectations, the ritual of daily consumption in a supportive school environment, and the cultural meaning attached to salak as a health-promoting food. It is important to emphasize that placebo effects are not "false" or "invalid"; they represent genuine neurobiological responses mediated by expectation and conditioning, with measurable impacts on subjective well-being. In the context of mild anemia, where symptoms such as fatigue and dizziness are partly subjective, placebo-mediated symptom relief may meaningfully improve quality of life even if hematological indices improve more gradually. Future research employing objective hemoglobin measurements alongside qualitative symptom assessment would help disentangle these mechanistic pathways [14].

The finding that salak's symbolic status as Kota Salak engendered pride, ownership, and willingness to consume the juice represents a significant contribution to the literature on culturally tailored nutrition interventions. Most functional food programs for anemia in Indonesia have utilized generic ingredients—soy, mung beans, commercial micronutrient powders—that lack specific cultural resonance. While such approaches have documented efficacy, they may not fully harness the motivational potential of local food identity.

The concept of "cultural food security" the idea that communities derive psychological and social sustenance from foods that embody their heritage, traditions, and place identity has gained traction in public health nutrition but remains under-explored in anemia programming. The present findings suggest that cultural embeddedness can function as a facilitator of dietary behavior change, operating through mechanisms of pride (bangga), ownership (rasa memiliki), and trust in ancestral knowledge (nenek moyang). Mothers' references to grandmothers' beliefs about salak's health properties illustrate how traditional food knowledge, even when not scientifically articulated, can create a receptive substrate for modern nutrition interventions. This aligns with broader calls for "gastronomic heritage" approaches in public health that respect and mobilize indigenous food systems rather than displacing them with external solutions [15].

The implication for program design is clear: in regions where specific nutrient-dense foods carry strong cultural significance, interventions that incorporate these foods may achieve higher acceptability, sustainability, and community engagement than interventions based on unfamiliar or imported products. For Padangsidimpuan and the surrounding Tapanuli region, salak represents an underutilized asset with potential applications beyond anemia management for instance, in stunting prevention, maternal nutrition, and elderly health.

The barriers identified in this study seasonal price fluctuations, preparation time, residual astringency for a minority, and concerns about social labeling—are not insurmountable but require thoughtful programmatic responses.

Regarding cost and availability, the seasonal price variation of salak (from Rp 8,000 to Rp 20,000 per kilogram) suggests the need for strategies to stabilize supply and price. Potential mechanisms include: (a) establishing procurement contracts between schools or puskesmas and salak farmer cooperatives to ensure year-round supply at negotiated prices; (b) developing a preserved pulp or concentrate that extends shelf life and reduces dependency on fresh fruit availability; and (c) valorizing "imperfect" salak fruits that are

unmarketable as fresh produce but perfectly suitable for juice production, thereby reducing cost and minimizing food waste. Guava, being more widely cultivated and less seasonal, poses fewer supply challenges.

Preparation time emerged as a concern primarily for mothers, not for the school-based preparation model. This finding reinforces the rationale for institutional rather than household delivery, at least as the primary distribution channel. The model proposed in Figure 2, involving centralized preparation in school canteens or community kitchens operated by PKK (Family Welfare Movement) women's groups, addresses the time burden while simultaneously creating economic opportunities for local women. Such an approach is consistent with Indonesia's existing infrastructure for community-based nutrition programs, including the posyandu remaja (adolescent health post) initiative.

The residual astringency reported by a minority of participants could be addressed through formulation refinements. The red-tinged salak variety used in this study was selected for its higher vitamin C content; however, white-fleshed salak, which tends to be sweeter and less astringent according to the morphological characterization study, could be tested as an alternative or blended with the red variety. Additionally, small quantities of other locally available fruits such as passion fruit (markisa), which is also abundant in North Sumatra could be incorporated to modify the flavor profile without compromising nutritional goals.

The concern about social labeling, while raised by only a few participants, warrants careful attention. Targeted distribution (only to anemic girls) risks stigmatization, as noted by health workers. Universal distribution making the juice available to all female students during break time would normalize consumption and transform it from a marker of "illness" to a shared positive experience. This approach would, of course, increase program costs, necessitating cost-effectiveness analysis to compare universal versus targeted models. However, given that 21.1% of screened adolescents in this study had mild anemia and that many others likely had suboptimal iron stores without frank anemia universal distribution may offer preventive benefits that justify the additional investment.

A central strategic question is whether the mixed guava–salak juice should be positioned as a replacement for, or a complement to, the existing IFA supplementation program. The findings suggest a complementary role. Participants' negative experiences with iron tablets nausea, black stools, fear were not merely sensory complaints but reflect genuine pharmacological side effects that affect adherence. Offering the juice as an alternative for adolescents who cannot tolerate or refuse tablets could extend anemia management coverage to a segment of the population that currently falls through the cracks. However, the juice provides lower iron doses than pharmaceutical supplements (8–12 mg vs. 60 mg elemental iron in standard IFA tablets), and its efficacy in treating moderate or severe anemia has not been established. Therefore, a tiered approach may be optimal: the juice as a first-line strategy for mild anemia and as a preventive drink for all adolescent girls, with IFA tablets reserved for those with moderate-to-severe anemia or those who do not respond adequately to dietary intervention after a defined monitoring period.

This tiered model would require standardized protocols for anemia screening, classification, referral, and follow-up, as well as training for health workers and school personnel. The Padangsidimpuan District Health Office expressed receptiveness to such an approach during the stakeholder consultation conducted as part of this study.

This study's reliance on qualitative methods, while unorthodox for a nutrition intervention evaluation, yielded insights that would likely have been missed in a purely quantitative design. The themes of cultural pride, the "freshness" discourse, the nuanced sensory adaptation trajectory, and the concerns about social labeling all emerged from the open-ended, exploratory nature of FGDs and interviews. These findings have direct programmatic relevance: they inform formulation refinement, delivery channel design, and communication strategies.

However, the absence of objective hematological outcome data is a limitation that must be acknowledged. While self-reported symptom improvement is valuable from a

patient-centered perspective, hemoglobin measurement at endline would have strengthened the evidence base and allowed correlation of perceived benefits with physiological changes. The qualitative design also limits generalizability in the statistical sense; the findings reflect the experiences of 28 adolescents, 6 mothers, and 6 health workers in a specific cultural and geographic context. Nevertheless, the thick description provided enables readers to assess the transferability of findings to comparable settings for instance, other salak-producing regions in Indonesia (such as Sibuhuan, Sidikalang, or parts of Bali) where similar cultural dynamics may be operative.

Strengths: This study addresses a genuine knowledge gap by pioneering the investigation of a mixed guava–salak functional beverage with cultural resonance. The use of multiple data sources (adolescents, mothers, health workers), multiple methods (FGDs, interviews, sensory scales, observation), and member checking enhances the credibility and comprehensiveness of the findings. The four-week consumption period, while modest, provided sufficient exposure for sensory adaptation to occur and for participants to form considered opinions. The collaboration with schools and the District Health Office ensures that the research is embedded in the institutional context where any future program would be implemented.

Limitations: First, the absence of endline hemoglobin measurement precludes assessment of hematological efficacy. Second, the sample size, while appropriate for qualitative inquiry, limits the diversity of perspectives captured; adolescents from the most marginalized households, who may have dropped out of school, were not included. Third, the four-week intervention period is insufficient to assess sustainability of consumption or long-term health impacts. Fourth, the juice was prepared under controlled research conditions with standardized equipment and ingredients; acceptability and feasibility may differ under real-world conditions. Fifth, social desirability bias may have influenced participants' reports, particularly in FGD settings where peers were present; however, the triangulation across multiple data sources partially mitigates this concern.

5. Conclusion

This qualitative study provides the first evidence regarding the acceptability and perceived benefits of a mixed guava–salak functional beverage for managing mild anemia among female adolescents in Padangsidimpuan, North Sumatra—Indonesia's Kota Salak. The juice achieved high sensory acceptability, with a composite mean hedonic score of 7.2±1.0 on a 9-point scale, and elicited overwhelmingly positive qualitative responses centered on freshness, naturalness, and cultural pride. Participants reported meaningful improvements in fatigue, dizziness, and energy levels, consistent with the nutritional rationale of combining an iron-rich fruit (salak) with a vitamin C-rich fruit (guava) to enhance non-heme iron absorption, although objective hematological confirmation is needed. The cultural significance of salak as a symbol of Padangsidimpuan identity emerged as a distinctive facilitating factor, distinguishing this intervention from generic nutritional supplements and generating a sense of ownership among adolescents, mothers, and health workers alike. This finding suggests that nutrition interventions that harness local food heritage—rather than displacing it—may enjoy enhanced community engagement and sustainability. Barriers identified—seasonal price fluctuations, preparation time, residual astringency for a minority, and potential social labeling—are addressable through programmatic strategies including institutional procurement, formulation refinement, and universal rather than targeted distribution. A tiered anemia management model, positioning the juice as a first-line strategy for mild anemia and a preventive beverage for all adolescent girls, with IFA tablets reserved for more severe cases, offers a pragmatic pathway for integration with existing health programs. Looking ahead, several research priorities emerge: a randomized controlled trial comparing the juice, IFA tablets, and a combination arm with hemoglobin and serum ferritin as primary endpoints; shelf-life and food safety studies to develop a preserved or powdered formulation that

reduces dependency on seasonal fresh fruit; cost-effectiveness analysis comparing universal versus targeted distribution; and implementation research to evaluate the feasibility and fidelity of the juice program when delivered through existing school health and puskesmas infrastructure. In conclusion, mixed guava–salak juice represents a promising, culturally grounded functional food strategy that can contribute to the continuum of anemia care for female adolescents in salak-producing regions of Indonesia. By bridging the gap between nutritional science and local food culture, it offers a model of dietary intervention that is both evidence-informed and community-owned.

6. Patents

This paper does not have a patent yet.

Supplementary Materials: Not Supplementary Materials

Author Contributions: For research articles with several authors, a short paragraph specifying their individual contributions must be provided. Fatimah do it all research.

Funding: "This research received no external funding".

Institutional Review Board Statement: Ethics review and approval was waived for this study as the Respondents had already consented.

Informed Consent Statement: "Not applicable"

Data Availability Statement: Data not available due to privacy restrictions.

Acknowledgments: The authors would like to express their sincere gratitude to the Padangsidimpuan District Health Office for their collaboration and support during the adolescent hemoglobin screening. Special thanks are extended to the principals, teachers, and staff of SMP Negeri 2 Padangsidimpuan, SMP Negeri 5 Padangsidimpuan, and SMA Negeri 1 Padangsidimpuan for facilitating the research activities and providing space for juice preparation and focus group discussions. We are deeply grateful to all the female adolescents who participated in the four-week intervention, as well as their mothers and the local health workers (*puskesmas*), for their time, trust, and willingness to share their experiences. We also acknowledge the contribution of the food technology team and the sensory panel in developing the standardized guava–salak juice formulation. Finally, we thank the field research assistants for their dedication to daily juice preparation, data collection, and participant observation.

Conflicts of Interest: "The authors declare no conflicts of interest.

Appendix A

Not appendix A.

Appendix B

Not appendix B.

References.

[1] I. N. Fauzi, K. Kumboyono, and F. I. Fevriasanty, "Effectiveness of Game Health Education Anemia (GHEA) Guided by the Health Belief Model on Improving Knowledge and Attitudes Toward Iron-Deficiency Anemia Prevention Among Adolescent Girls: A Quasi-Experimental Study," *J. Appl. Nurs. Heal.*, vol. 7, no. 3, pp. 670–685, Nov. 2025, doi: 10.55018/janh.v7i3.448.

[2] N. Bushra, A. Z. Wasim, J. Feroze, and M. Masood, "Pattern of Anemia among Primigravida Attending the Antenatal Clinic of Tertiary Care Hospital," *esculapio*, vol. 16, no. 4 (oct 2020-dec 2020), Jan. 2021, doi: 10.51273/esc20.2516420.

[3] M. S. F. H. Kusnianto, Handayani, I. Ananingsih, and S. K. Fadila, "Reproductive Health Knowledge Correlated with Adolescent Attitudes Towards the Perception of Early Marriage," *J. Ners dan Kebidanan (Journal Ners Midwifery)*, vol. 12, no. 2, pp. 170–176, Aug. 2025, doi: 10.26699/jnk.v12i2.ART.p170-176.

[4] M. Marliyana, V. A. Jana, S. Suryadi, F. E. Fitri, and E. Yunitasari, "The Relationship between Nutrient Intake and Anemia with the Incidence

of Deficiency Chronic Energy in Adolescent Women," *J. Pendidik. KEPERAWATAN Indones.*, vol. 11, no. 1, pp. 59–70, Jun. 2025, doi: 10.17509/jpki.v11i1.83550.

[5] S. Stefanicia, D. Hertati, M. Wulandari, and I. Friscila, "Adolescent Knowledge Of Local Food Diversity To Improve Reproductive Health," *JKM (Jurnal Kebidanan Malahayati)*, vol. 11, no. 12, Dec. 2025, doi: 10.33024/jkm.v11i12.23884.

[6] N. Gharaei, F. Fleischmann, and K. Phalet, "National Identity Development Among Minority Youth: Longitudinal Relations with National Fit Perceptions and School Belonging," *J. Youth Adolesc.*, vol. 53, no. 12, pp. 2746–2761, Dec. 2024, doi: 10.1007/s10964-024-02036-0.

[7] P. Buragohain, "The Determinants of the Reproductive Health of Women of Tai-Aiton Community of Assam," *Int. J. Manag. Humanit.*, vol. 4, no. 8, pp. 72–77, Apr. 2020, doi: 10.35940/ijmh.H0774.044820.

[8] J. W. Creswell, "Research design: Qualitative, quantitative, and mixed methods approaches (5th ed.). SAGE Publications.," 2021.

[9] S. Susi and H. Helmawati, "Collaborative-Based Principal Guidance Management to Optimize Teacher Learning Groups: A Case Study at SDN Palasari, Cipanas District, Cianjur Regency," *Dinasti Int. J. Educ. Manag. Soc. Sci.*, vol. 6, no. 4, pp. 3354–3369, May 2025, doi: 10.38035/dijemss.v6i4.4462.

[10] V. Vivilaki, I. Keygnaert, R. Gómez Bravo, V. Karaouli, and M. Papadakaki, "PL006. Women's Health and Safety in Focus: Integrating Prevention, Advocacy, and Public Health Action," *Eur. J. Public Health*, vol. 35, no. Supplement_5, Nov. 2025, doi: 10.1093/eurpub/ckaf165.119.

[11] K. Sri Redjeki and S. Sumarmi, "Socio-Demographics, Mid Upper-arm Circumference (MUAC), Counseling and Compliance to Multiple Micronutrient Supplement (MMS) Consumption as Determinants of Anemia among Premaried Women in Surabaya," *Heal. Leadersh. Qual. Life*, vol. 4, p. 930, Nov. 2025, doi: 10.56294/hl2025930.

[12] S. Aziz Ali *et al.*, "Role of preconception nutrition supplements in maternal anemia and intrauterine growth: a systematic review and meta-analysis of randomized controlled trials," *Syst. Rev.*, vol. 14, no. 1, p. 11, Jan. 2025, doi: 10.1186/s13643-024-02726-7.

[13] Y. Paratmanitya, S. Helmyati, D. S. Nurdiati, E. C. Lewis, and H. Hadi, "Assessing preconception nutrition readiness among women of reproductive age in Bantul, Indonesia: findings from baseline data analysis of a cluster randomized trial," *J. Gizi dan Diet. Indones. (Indonesian J. Nutr. Diet.*, vol. 8, no. 2, p. 68, Feb. 2021, doi: 10.21927/ijnd.2020.8(2).68-79.

[14] Ardhila Luthfiana Dwi Putri, "The relationship between anemia in pregnant women and Low Birth Weight (LBW): A literature review," *World J. Adv. Res. Rev.*, vol. 23, no. 3, pp. 962–965, Sep. 2024, doi: 10.30574/wjarr.2024.23.3.0147.

[15] R. Hoffmann, L. Andriano, E. Striessnig, T. Rüttenauer, M. Borderon, and K. Grace, "Climate change and population: Demographic perspectives on the 21st century's defining challenge," *Vienna Yearb. Popul. Res.*, vol. 22, Dec. 2024, doi: 10.1553/p-nfjc-z82h.