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Identifying Needs for Mobile Application Development to Prevent Anemia in Pregnant Women: Insights from a Qualitative Study

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ABSTRACT

Background: Anaemia during pregnancy is a significant public health concern, particularly in low- and middle-income countries (LMICs), where it contributes to adverse maternal and neonatal outcomes. Mobile health (mHealth) applications have shown promise in improving healthcare delivery, yet there is limited focus on addressing anemia prevention during pregnancy through these digital solutions. **Objectives:** This study explored the perspectives of pregnant women, healthcare providers, and community health workers to identify needs for a mobile application tailored to prevent anemia during pregnancy. **Methods:** A descriptive qualitative study was conducted among 15 participants in Sukabumi, West Java, Indonesia, including pregnant women, healthcare providers, and community health workers. Data were collected through semi-structured interviews and analysed using thematic analysis. Trustworthiness was ensured through member checking. **Results:** Three main themes emerged: (1) understanding anemia prevention, including awareness and cultural beliefs about nutrition; (2) challenges and needs in anemia prevention, encompassing barriers to accessing reliable information, low adherence to supplementation programs, and desired mobile application features; and (3) suggestions for mobile application development, emphasising the importance of cultural relevance, multilingual support, voiceovers, and regular updates. **Conclusion:** This study highlights the urgent need for culturally tailored, user-centered mobile applications to prevent anemia in pregnant women, particularly in resource-limited settings. Future efforts should prioritise co-creation with users to enhance adoption and efficacy.

Keywords: Anemia Prevention; mHealth Application; Mobile Health; Pregnancy; Qualitative Study

INTRODUCTION

Anemia during pregnancy is a persistent public health issue, especially prevalent in low- and middle-income countries (LMICs). In these settings, where healthcare access is frequently constrained, mHealth technologies offer a promising and innovative solution to address this challenge. It is a major contributor to maternal morbidity, adverse pregnancy outcomes, and neonatal complications (WHO, 2019). Iron deficiency is the leading cause of anemia in pregnancy, affecting approximately 40% of pregnant women worldwide (Owais *et al*., 2021). This condition poses heightened risks for preterm birth, low birth weight, and perinatal mortality, highlighting the urgent need for effective prevention and management strategies (Garzon *et al*., 2020). Despite advancements in healthcare, barriers such as limited awareness, restricted access to medical services, and poor adherence to iron supplementation programs continue to impede progress in reducing the burden of anemia (Al-Marzouqi, Al-Za'abi & Al-Dhoani, 2024).

Mobile health (mHealth) technologies, particularly mobile applications, have shown great promise in improving healthcare delivery and outcomes across diverse populations (Gopalakrishnan *et al*., 2020). These platforms offer interactive tools for education, reminders, and behavioral support, effectively promoting health-related behaviors such as better dietary practices and improved medication adherence. In maternal healthcare, mHealth applications have proven effective in increasing antenatal care attendance, fostering

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healthy behaviors, and enhancing awareness of pregnancy-related complications (Ameyaw, Amoah & Ezezika, 2024). However, there is a notable lack of focus on mobile applications specifically designed to address anemia prevention among pregnant women, leaving a critical gap in the existing body of research (Vellakkal & Singh, 2021).

The success of mHealth interventions depends largely on a thorough understanding of user needs, preferences, and contextual factors. Qualitative research is instrumental in uncovering these aspects, enabling the development of interventions that align with the target population's beliefs, challenges, and cultural contexts (Bilal *et al.*, 2024). Studies emphasise the importance of involving end-users and healthcare providers in the co-design process to improve usability, accessibility, and cultural relevance of mHealth solutions (Mbunge & Sibiya, 2024). This collaborative approach ensures the creation of practical and scalable interventions, particularly for resource-limited settings.

Despite the growing interest in mHealth for maternal health, critical gaps persist. Most existing mHealth tools focus broadly on maternal health or antenatal care without specifically addressing the prevention and management of anemia (Vellakkal & Singh, 2021). Additionally, there is limited qualitative research examining the barriers and facilitators that influence the adoption of mHealth solutions among pregnant women, especially in low- and middle-income countries (Al-Marzouqi, Al-Za'abi & Al-Dhoani, 2024). While mHealth tools such as mobile applications for antenatal care attendance have been developed, few have directly targeted iron deficiency anemia prevention, despite its known burden on maternal and neonatal health. Addressing these gaps is essential for designing user-centered applications tailored to the unique challenges of anemia prevention during pregnancy.

In Indonesia, cultural beliefs and low family involvement significantly affect anemia prevention among pregnant women. Misconceptions—such as avoiding iron-rich foods or skipping supplements—remain common and hinder adherence (Babah *et al*., 2024). Family support, particularly from husbands, has been shown to improve compliance with iron supplementation and diet (Juniarti, Yuriah & Sepriani, 2020). Thus, mHealth applications must be culturally sensitive and include educational content for both pregnant women and their families. This study aims to co-create a user-centered mobile application by exploring the perspectives of pregnant women and healthcare providers, thereby addressing a critical gap in mHealth research. These findings aim to bridge gaps in mHealth research by enhancing the effectiveness of digital tools for maternal and child health.

METHODOLOGY

Study Design

This study adopted a descriptive qualitative design to explore the specific needs for developing a mobile application aimed at preventing anemia in pregnant women. The descriptive qualitative approach was selected for its capacity to provide an in-depth exploration of participants' experiences, perceptions, and requirements within a naturalistic context, aligning with the methodological recommendations of Sandelowski (2000).

Sampling

This qualitative study was conducted in Sukabumi, West Java—an area noted for its high prevalence of anemia and diverse healthcare settings. The research aimed to explore the perspectives of pregnant women, healthcare providers, and community health workers. Participants were selected using purposive sampling, with eligibility criteria including pregnant women aged 18 to 45, healthcare providers with a minimum of two years of experience, and actively serving community health workers. A total of fifteen interviews were conducted, with data collection continuing until saturation was reached, in line with the guidelines of Guest, Bunce and Johnson (2006).

Interview Guideline

The study employed a semi-structured interview guideline developed through an extensive review of the

literature and consultation with experts in maternal health and mobile application development. This iterative process ensured the questions were both relevant and clear. To refine the guideline, a pilot test was conducted with two participants, allowing for adjustments based on their feedback. The content validity of the interview guideline was evaluated by three experts in qualitative research and maternal health. Using the Content Validity Index (CVI), each question achieved a score exceeding 0.80, meeting the threshold for strong validity as per (Polit & Beck, 2008). This process ensured the guideline was a reliable tool for gathering meaningful data.

The interview guideline comprised a range of questions tailored to gather detailed insights: 1) Opening Questions: Participants were asked about their current understanding of anemia prevention during pregnancy to establish context. 2) Main Questions: The discussion focused on challenges faced in accessing relevant information, participants' preferences for features in a mobile application, and their views on the role of healthcare providers in preventing anemia. 3) Concluding Questions: Participants were encouraged to share any final thoughts or recommendations related to the mobile app's development, ensuring that diverse viewpoints were fully captured.

Study Procedure

Interviews were conducted in private, comfortable settings—either in participants' homes or health centers—to ensure confidentiality. Healthcare providers were interviewed at their workplace at convenient times. Informed consent was obtained after participants were briefed on the study. Interviews followed a flexible semi-structured format, lasting 30–60 minutes, and were audio-recorded and transcribed verbatim.

Data Analysis

Data were analysed using Braun and Clarke, (2006) thematic analysis, including familiarisation, coding, theme identification, review, and definition. Manual coding allowed in-depth interpretation based on context. To ensure reliability, multiple coders analysed the data independently and resolved discrepancies through discussion.

Verbatim transcripts were returned to participants for member checking, allowing them to verify accuracy and clarify responses. This step enhanced credibility, minimised researcher bias, and fostered a collaborative research environment by positioning participants as active contributors.

Ethical Consideration

The researchers obtained ethical clearance from the Institutional Review Board (IRB) of STIKes Sukabumi, Indonesia with approval number 033/ETIK/VIII2024 on 8th August, 2024.

RESULTS

The study involved 15 participants, including pregnant women, healthcare providers, and community health workers. Pregnant women (n=5) were aged 18–45 years, distributed across various trimesters of pregnancy. Healthcare providers (n=5) had a minimum of two years of experience in maternal health services, and community health workers (n=5) were actively engaged in anemia prevention initiatives. The demographic characteristics of the participants are presented in Table 1.

Table 1: Demographic Characteristics of Participants

Participant Category	n	Age Range (Years)	Key Characteristics
Pregnant women	5	18–45	Various trimesters of pregnancy
Healthcare providers	5	30–50	≥ 2 years of experience in maternal health
Community health workers	5	25–55	Actively engaged in anemia prevention
Total	15		

Three main themes emerged from the data: understanding of anemia prevention, challenges and needs in anemia prevention, and suggestions for mobile application development (Table 2).

Table 2: Themes, Categories and Codes

Theme	Category	Code
Understanding of Anemia Prevention	Awareness	• Basic knowledge of anemia during pregnancy • Recognition of dietary practices and supplementation as preventive measures
	Cultural beliefs about nutrition	• Food taboos • Influence of elders
Challenges and Needs in Anemia Prevention	Barriers to access	• Limited access to reliable information
	Desired mobile application features	• Low adherence to supplementation programs • User-friendly interface • Integration of reminders for supplementation and appointments • Tailored educational content
	Role of healthcare providers	• Providing proactive support • Enhancing patient engagement through mobile tools
Suggestions for Mobile Application Development	Feedback and recommendations	• Inclusion of cultural context in content • Use culturally familiar visuals and terminologies • Multilingual support • Include voiceovers in multiple languages • Regular updates based on user feedback • Update content to reflect the latest guidelines

Theme 1: Understanding of Anemia Prevention

This theme included two categories: awareness and cultural beliefs.

Awareness

Participants had varying knowledge about anemia. Some pregnant women recognised the term but lacked understanding of its risks or the importance of prevention.

"I've heard of anemia, but I'm not really sure what it does to me or my baby."

Healthcare providers showed deeper understanding but noted that many women underestimated its severity.

"Many women know the term, but not how it affects pregnancy outcomes."

Community health workers observed confusion between anemia and general fatigue.

"Some think anemia just means being tired, so they ignore it."

Knowledge of iron-rich foods and supplements also varied. Misconceptions about frequency and purpose were common.

"They gave me iron pills, but I didn't know I had to take them every day."

Providers emphasised consistency, while community workers called for culturally relevant education.

"Some women think supplements alone are enough, not realising a balanced diet matters too."

Cultural Beliefs

Food taboos and traditional advice strongly influenced behavior.

"My aunt said bananas make babies too big, so I avoid them."

"There's a belief that iron tablets make the baby grow too large."

Elders often guided dietary choices, sometimes contradicting medical advice.

"My mother-in-law won't let me eat eggs. She says it makes the baby smell after birth."

Theme 2: Challenges and Needs in Anemia Prevention

This theme comprised access barriers, desired app features, and provider roles.

Barriers to Access

Reliable information was hard to access. Conflicting advice and unclear materials created confusion.

"Sometimes I hear different things from the midwife and my family."

Low supplement adherence was linked to forgetfulness and side effects.

"The tablets upset my stomach, so I stopped taking them."

Community health workers struggled with follow-up due to limited resources.

"Without a system to track them, it's hard to ensure compliance."

Desired Mobile App Features

Users wanted a simple, low-data app.

"It should be easy to use and not need much storage."

Reminders for pills and check-ups were highly valued.

"A daily reminder would help me remember my pills."

Tailored content was requested to match local diets and explain symptoms.

"I want advice on affordable foods, not just general tips."

Role of Healthcare Providers

Participants appreciated proactive engagement.

"I feel more motivated when the nurse checks on me."

Providers saw apps as tools to send reminders and monitor progress.

"Apps could help us track patient progress and personalise support."

Theme 3: Suggestions for Mobile App Development

This theme focused on cultural integration and technical improvements.

Cultural Content

Participants wanted traditional foods and practices reflected in the app.

"If it suggests spinach soup or herbal drinks, it feels made for us."

Use of local visuals and simple language was preferred.

"Avoid medical terms—explain like a mother would talk."

Multilingual Support and Voiceovers

Language inclusion was key for broader reach.

"My mother-in-law doesn't understand Indonesian. Local language would help."

Voice features were suggested for users with low literacy.

"It's easier if the app talks in our language."

Ongoing Feedback and Updates

Users wanted options to give feedback and receive updates.

"A simple survey in the app could help improve it."

Content should reflect the latest health guidance.

"If new tips come out, the app should tell us so we don't miss out."

DISCUSSION

This study investigated the perspectives of pregnant women and healthcare providers to identify essential components for developing a mobile application focused on anemia prevention during pregnancy. Thematic analysis revealed three central themes: (1) understanding of anemia prevention, (2) challenges and needs in anemia management, and (3) user-driven recommendations for mobile app development. These findings contribute significantly to the limited but growing body of research on mHealth design tailored for maternal health, particularly in low- and middle-income countries (LMICs) such as Indonesia.

Participants expressed a general awareness of anemia and its consequences during pregnancy. However, the depth of understanding varied, with many women relying on health workers or family advice rather than evidence-based sources. These results reinforce earlier studies emphasising the link between knowledge gaps and poor adherence to iron supplementation (Charanthimath *et al*., 2021). A lack of accessible and understandable health information contributes to underestimation of anemia risks and weakens motivation to comply with preventive behaviors (Babah *et al*., 2024). Importantly, healthcare providers recognised this issue and highlighted the necessity of structured, culturally appropriate educational tools to empower pregnant women. This aligns with existing evidence underscoring education and health literacy as critical determinants of successful anemia prevention strategies (Iyawa, Dansharif & Khan, 2021). Therefore, improving health education through mobile technology presents a feasible solution to address this gap.

Several barriers to effective anemia prevention were identified, including limited access to antenatal care, misconceptions regarding iron supplementation, and the influence of sociocultural beliefs. These challenges reflect broader findings in LMICs where contextual factors such as digital literacy, network connectivity, and trust in technology hinder mHealth adoption (Bhattarai *et al*., 2023; Charanthimath *et al*., 2021). In this study, pregnant women reported concerns about side effects of iron tablets, dietary taboos, and irregular clinic visits due to logistical and economic constraints. Family involvement emerged as both a barrier and an opportunity. Some participants noted a lack of support from spouses or extended family, which impacted their health decisions. Yet, how family encouragement enhanced their willingness to adhere to health advice. This dynamic emphasises the importance of integrating family-centered features into mHealth applications, such as modules designed for spouses or caregivers, to increase program effectiveness.

Participants offered valuable insights for designing a mobile application that addresses their needs. Recommended features included interactive educational content, daily reminders for iron supplementation, diet tracking, and a direct line to healthcare providers. These suggestions are supported by previous research highlighting that personalisation, visual appeal, and ease of use are critical for mobile health app engagement (Anyanwu *et al*., 2024). Furthermore, the study found strong support for incorporating culturally relevant content and language customisation, reflecting the local dialect and values. Such cultural alignment has been shown to significantly improve the acceptance and effectiveness of mHealth interventions in diverse populations (Lindayani *et al.*, 2025). The app's potential to serve as an educational platform not just for pregnant women but for their families and health workers represents a scalable solution for anemia prevention at the community level.

Clinically, integrating culturally and linguistically appropriate content into mHealth apps can enhance engagement and adherence to anemia prevention strategies. Real-time feedback, interactive features, and collaboration with providers ensure accuracy and support behavior change (Patel, Volpp & Asch, 2018). Interprofessional collaboration—enabled through digital platforms—also improves care delivery and patient outcomes (Carron *et al.*, 2021; Meyerhoff *et al*., 2023). Effectiveness of mHealth tools must be evaluated through cost-effectiveness, scalability, and barriers to adoption. User-centered design can overcome issues such as low digital literacy, privacy concerns, and limited access to smartphones or internet services. Addressing these factors is critical to ensure widespread use and improved health outcomes for pregnant women (Banke-Thomas *et al.*, 2020; Bossman, Johansen & Zanaboni, 2022; Wong *et al*., 2019).

While the study reinforces many existing findings, it also fills a critical gap in the literature by focusing specifically on mHealth design for anemia prevention—a relatively underexplored area in maternal health interventions. The study provides a concrete foundation for developing a user-centered, culturally tailored application by identifying key behavioral, environmental, and technological determinants. However, the initial draft of the discussion did not sufficiently articulate how these findings inform practical application design. By directly linking thematic findings with actionable app features—such as incorporating reminder systems to address forgetfulness, myth-busting videos to correct misconceptions, and family-focused modules to enhance support—the study offers a roadmap for effective digital intervention. Furthermore, the findings point toward the importance of collaborative content development with midwives and nurses to ensure clinical accuracy and local relevance (Rahayu *et al*., 2025; Vadsaria *et al*., 2025).

This study has clear implications for nursing practice, particularly in community and maternal health settings. Nurses play a pivotal role in delivering health education, counseling, and continuous support for pregnant women. By leveraging mobile technology, nurses can extend their reach and impact beyond clinical settings, delivering consistent and personalised messages that encourage healthy behaviors. Incorporating mHealth tools into antenatal care workflows can also support task-sharing among healthcare teams and streamline follow-up processes. Real-time data tracking and automated alerts can enhance care coordination and improve adherence monitoring. Such digital integration not only supports nurses in providing evidence-based care but also improves maternal outcomes at scale (Meyerhoff *et al.*, 2023).

Limitation

Several limitations should be acknowledged. The qualitative design limits the generalisability of findings to broader populations. Additionally, the sample was drawn from a specific geographic area, which may not reflect the diverse socio-cultural contexts of other regions. Future research should incorporate quantitative methods and include diverse populations to validate these findings. Moreover, this study focused on user needs without addressing the technical feasibility and cost-effectiveness of developing such mobile applications.

CONCLUSION

This study highlights the urgent need for innovative, user-centered mobile applications to support anemia prevention during pregnancy. The identified themes—understanding anemia prevention, challenges and needs, and suggestions for application development—offer actionable insights for designing effective digital health interventions. Future research should explore the integration of advanced technologies such as artificial intelligence and machine learning to provide personalised recommendations and adaptive interventions. Additionally, there is a need to evaluate the long-term effectiveness of these applications in diverse populations and settings to ensure broad applicability and equity. Investigating the role of cultural, social, and behavioral factors in the design and implementation of such technologies could further enhance their acceptance and impact. Collaboration between healthcare professionals, technology developers, and end-users is essential to refine these tools and address barriers to adoption. Expanding the focus to include preventive strategies for related health conditions could also provide a more holistic approach to maternal health.

Conflict of Interest

The authors have no conflicts of interest to declare.

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