



The Effectiveness of mHealth in Improving Adherence to Antenatal Care Among Pregnant Women: A Systematic Literature Review

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Abstract

Antenatal care (ANC) is an essential service in efforts to improve maternal and infant health; however, adherence to ANC visits among pregnant women remains a challenge in many countries, particularly in regions with limited access to health services. Advances in digital technology through mobile health (mHealth) offer innovative solutions to improve this adherence through digital reminders, health education, and communication between pregnant women and healthcare providers. This study aims to analyze the effectiveness of mHealth in improving antenatal care adherence among pregnant women through a systematic literature review. The study was conducted by reviewing ten relevant scientific articles from various academic databases, including systematic reviews, meta-analyses, scoping reviews, and implementation studies in various countries, including Indonesia. The results of the synthesis indicate that mHealth interventions consistently improve adherence to ANC visits, whether in terms of increased visit frequency, timely checkups, or continuity of pregnancy monitoring. Interventions based on SMS reminders and mobile applications were the most prevalent and effective forms, particularly in healthcare settings with limited access. This study confirms that mHealth holds significant potential in supporting the digital transformation of maternal healthcare services. The implications of these findings highlight the need to integrate mHealth technology into primary healthcare systems to sustainably improve the quality and coverage of antenatal care.

Keywords: mHealth; antenatal care; adherence among pregnant women; digital health; systematic literature review

INTRODUCTION

Maternal health remains a global priority on the sustainable development agenda because maternal mortality rates in many countries—particularly low- and middle-income countries—remain at alarming levels. The World Health Organization reports that the majority of maternal deaths are actually preventable through early detection of complications and quality health care during pregnancy, childbirth, and the postpartum period. Antenatal care (ANC) is one of the essential interventions designed to monitor the health of the mother and fetus, provide health education, and identify obstetric risk factors early on. The WHO recommends a minimum of eight ANC visits to optimize maternal and neonatal outcomes. However, coverage of ANC visits that meet standards remains uneven, particularly in areas with limited access to services, geographical barriers, low health literacy, and socioeconomic constraints. This situation also remains a challenge in Indonesia, where non-adherence to the ANC schedule contributes to delayed detection of pregnancy complications and increases the risk of maternal and perinatal morbidity (Mishra et al., 2023; Knop et al., 2024).

Antenatal care (ANC) is a key component of maternal health services that plays a vital role in reducing maternal and neonatal morbidity and mortality rates. However, pregnant women's adherence to ANC visits remains a global challenge, particularly in low- and middle-income countries. Various

barriers—such as limited access to health services, low health literacy, and the lack of appointment reminder systems—result in suboptimal utilization of ANC services (World Health Organization, 2022; <https://doi.org/10.2471/BLT.20.270421>). In this context, digital innovations through mobile health (mHealth) are increasingly being developed to improve the accessibility and effectiveness of maternal health services.

Advances in mHealth show significant potential for improving the health behaviors of pregnant women through various mechanisms, such as SMS-based reminders, educational apps, and digital pregnancy monitoring systems. Global studies indicate that mobile-based interventions can significantly increase ANC visits compared to conventional interventions (Chen et al., 2021; <https://doi.org/10.1186/s12884-021-04025-8>). Furthermore, SMS reminders have proven effective in improving adherence to antenatal visit schedules in various developing countries (Dehghani-Tafti et al., 2022; <https://doi.org/10.1186/s12911-022-01834-2>). This demonstrates that even simple technologies can have a major impact on the health behaviors of pregnant women.

Although various studies have demonstrated the effectiveness of mHealth, results still vary depending on the implementation context, digital literacy, and health infrastructure. Several studies indicate that the effectiveness of interventions is higher in regions with strong primary health care systems and adequate access to technology (Källander et al., 2022; [https://doi.org/10.1016/S2589-7500\(21\)00232-6](https://doi.org/10.1016/S2589-7500(21)00232-6)). Therefore, a more comprehensive synthesis of scientific evidence is needed to understand the patterns of mHealth effectiveness in improving ANC adherence globally.

Advances in digital technology have spurred the emergence of mobile health (mHealth) as an innovation that enables the delivery of information, reminders, consultations, and health monitoring via mobile devices. mHealth interventions, such as pregnancy apps, short message service (SMS), automated notifications, and teleconsultations, have been widely used to improve access to maternal health services. Various studies indicate that mHealth can enhance knowledge, strengthen communication between mothers and healthcare providers, and facilitate adherence to ANC visits. Nevertheless, the available research findings still show variation in intervention design, implementation context, and the resulting effect sizes. Some studies report significant increases in ANC attendance, while others indicate moderate effectiveness or effectiveness that depends on user characteristics and the readiness of the health system. This variability creates an academic need for a systematic synthesis of the available evidence to gain a more comprehensive understanding of mHealth's effectiveness in improving ANC adherence (Amoakoh et al., 2022; Kusyanti et al., 2022).

Conceptually, the effectiveness of mHealth can be explained through the digital health engagement framework, which emphasizes that the use of health technology influences behavior by improving access to information, providing reminders, offering social support, and facilitating two-way communication with healthcare providers. In the context of midwifery services, mHealth serves as a mechanism to reduce behavioral and logistical barriers that have long led to irregular ANC visits. This intervention strengthens the dimensions of perceived usefulness and perceived ease of use, as

described in the Technology Acceptance Model, thereby promoting technology adoption and changes in health behavior. Additionally, mHealth supports continuity of care by providing real-time information and facilitating the monitoring of pregnant women's conditions. Thus, mHealth serves not only as a communication tool but also as a strategic instrument for enhancing maternal engagement in prenatal care (Hasibuan et al., 2022; Sakamoto et al., 2022).

Based on this background, the research question in this study is: How effective are mHealth interventions in improving adherence to antenatal care among pregnant women, based on available scientific evidence? This study aims to identify, evaluate, and synthesize research findings related to the use of mHealth on adherence to ANC visits. This study employs a Systematic Literature Review approach to critically examine various studies involving mobile applications, SMS reminders, telemonitoring, and other forms of digital technology used during pregnancy.

The primary focus of the study is to assess changes in the frequency of ANC visits, punctuality, and regularity of contact with healthcare providers as indicators of antenatal care adherence (Lee et al., 2023; Pimmer et al., 2021).

This study aims to analyze the effectiveness of mHealth in improving adherence to antenatal care through a systematic literature review (SLR) approach. The focus of the study is on identifying types of mHealth interventions, implementation patterns, and their impact on adherence to ANC visits among pregnant women in various geographic contexts. This article makes a scientific contribution by providing a synthesis of the latest evidence on the effectiveness of mHealth specifically regarding ANC adherence, rather than just general maternal outcomes. Compared to previous studies that examined psychosocial aspects, costs, or the utilization of maternal health services broadly, this study focuses on ANC adherence as a behavioral indicator that is critical to the successful early detection of pregnancy complications. The novelty of this article lies in its integration of the latest evidence from various national contexts to provide a more targeted understanding of the mechanisms, benefits, and implementation potential of mHealth in midwifery care. The study's findings are expected to serve as a scientific foundation for developing policies on the digital transformation of maternal health, strengthening technology-based midwifery practices, and designing effective and sustainable interventions in Indonesia and other developing countries (Mishra et al., 2023; Knop et al., 2024)..

METHOD

This study uses a systematic literature review (SLR) approach to analyze the effectiveness of mHealth in improving adherence to antenatal care among pregnant women. This approach enables a systematic, transparent, and replicable synthesis of scientific evidence based on a standardized literature search protocol (Page et al., 2021).

All data sources used were secondary data, specifically primary scientific articles published in reputable national and international journals and available via open access. The literature was

obtained from several electronic databases with broad coverage in the health field, including PubMed, Scopus, ScienceDirect, SpringerLink, and Google Scholar. Multiple databases were utilized to minimize the risk of missing relevant articles and to enhance the comprehensiveness of the search results (Bramer et al., 2017). The types of articles used as data sources included quantitative studies, quasi-experimental studies, randomized controlled trials, cohort studies, and mixed-methods studies that evaluated the use of mHealth technology among pregnant women.

The literature search was conducted in May 2026 using the following combination of keywords and Boolean operators: (“mHealth” OR “mobile health” OR “digital health”) AND (“antenatal care” OR “prenatal care”) AND (“adherence” OR “compliance” OR “attendance”) AND (“pregnant women”). The literature search strategy utilized keywords such as “mHealth,” “antenatal care,” “pregnancy,” “SMS reminder,” and “mobile application”. The literature selection process followed the PRISMA flowchart, which consists of identification, screening, eligibility, and inclusion. Studies that were irrelevant, not open-access, or did not address ANC outcomes were excluded from the analysis. (Page et al., 2021).

Study inclusion criteria included: (1) articles published between 2021 and 2026; (2) available in full text and open access; (3) written in English or Indonesian; (4) involving pregnant women as the study population; (5) using mHealth interventions such as mobile apps, SMS reminders, telemonitoring, or digital health platforms; and (6) reporting outcomes related to antenatal care adherence, such as the number of visits, timeliness of visits, or attendance rates. Exclusion criteria include: (1) review articles, editorials, commentaries, or study protocols; (2) articles without full-text access; (3) studies that do not specifically assess ANC adherence; and (4) studies focusing on digital technologies for purposes other than pregnancy care. These criteria were developed based on the PICOS framework (Population, Intervention, Comparison, Outcomes, Study Design) to ensure the suitability and relevance of the selected studies (Pollock et al., 2023).

Data analysis was conducted using narrative synthesis due to heterogeneity in study design, intervention type, implementation duration, and the outcome indicators used. The analysis stages included data reduction, grouping studies based on intervention characteristics, comparing results across studies, and interpreting patterns of findings.

The results of the synthesis are presented in the form of tables of study characteristics and thematic descriptions highlighting the effectiveness of mHealth in improving ANC adherence, factors supporting implementation, and barriers to technology use. The narrative synthesis approach is considered appropriate for integrating evidence from various study designs when a meta-analysis is not feasible (Popay et al., 2006).

RESULTS AND DISCUSSION



The results of a synthesis of the 11 studies analyzed indicate that mobile health (mHealth) interventions tend to be consistently effective in improving adherence to antenatal care (ANC), both in the Indonesian and global contexts. In general, the majority of studies showed an increase in adherence to ANC visits, timely checkups, and improved communication between pregnant women and health workers following the implementation of mobile-based digital technology.

In terms of intervention types, the analysis indicates that there are three dominant forms of mHealth: maternal health mobile apps, SMS-based reminder systems or digital notifications, and digital platform-based pregnancy monitoring systems. Reminder-based interventions (Kartikasari, 2022; Feroz et al., 2021) have demonstrated high effectiveness in improving adherence to ANC visits because they are simple, easily accessible, and do not require a high level of digital literacy. Meanwhile, more complex mobile applications (Sari et al., 2023; Simanjuntak et al., 2024) have a broader impact because they include education, two-way communication, and continuous monitoring of pregnancy conditions.

From a geographic perspective, studies in Indonesia dominate the literature (approximately 70%) and indicate that mHealth implementation is still in the stage of developing and optimizing basic services. These studies show that mHealth is effective in improving health literacy among pregnant women, ANC adherence, and access to services at primary health care facilities. However, its effectiveness is highly dependent on the readiness of digital infrastructure, support from healthcare workers, and the level of digital literacy among pregnant women.

Meanwhile, global evidence from Cochrane reviews and international systematic reviews (Mbuagbaw et al., 2021; Velez et al., 2022) reinforces that the effectiveness of mHealth is consistent across countries, particularly in low- and middle-income countries. However, global studies also highlight variations in effectiveness based on the implementation context, health system integration, and the sustainability of technology use.

Thematically, the analysis results can be grouped into three main patterns: (1) improved ANC adherence through digital reminder systems, (2) improved health literacy and education for pregnant women through mobile applications, and (3) strengthening of digital-based pregnancy monitoring systems for early risk detection. These three themes demonstrate that mHealth functions not only as a reminder tool but also as a comprehensive intervention in maternal health care.

The results of this systematic literature review confirm that mobile health (mHealth) is an effective digital intervention for improving adherence to antenatal care (ANC) among pregnant women in various contexts, both in Indonesia and globally. This effectiveness is demonstrated by an increase in ANC visits, timely checkups, and improved communication between pregnant women and healthcare providers. These findings align with global evidence that digital health can strengthen access to and continuity of maternal health services, particularly in low- and middle-income countries (World Health Organization, 2023; Tomlinson et al., 2020).

Thematically, the synthesis results highlight three main mechanisms of mHealth effectiveness: digital reminder systems (SMS/reminders), maternal health mobile apps, and digital pregnancy monitoring systems. Reminder systems have proven to be the simplest yet most effective in improving adherence to ANC visits, particularly among populations with limited digital literacy (Agarwal et al., 2022). Meanwhile, mobile apps provide a more comprehensive impact because they integrate education, monitoring, and two-way communication between pregnant women and healthcare providers, thereby strengthening the continuity of antenatal care (Sari et al., 2023).

In the context of technology adoption, the effectiveness of mHealth can be explained through the Technology Acceptance Model (TAM) framework, in which successful implementation is heavily influenced by perceived usefulness and perceived ease of use. Studies show that simple interventions such as SMS reminders tend to be more readily accepted by users, while more complex applications require a higher level of digital literacy (Chib & Chen, 2021). This is further supported by studies indicating that the acceptance of health technology is highly dependent on perceptions of benefits and ease of use in the context of primary care (Lund et al., 2021).

Compared to previous studies, these findings are consistent with global meta-analyses and systematic reviews showing that mHealth significantly increases ANC utilization in developing countries (Lee et al., 2022; Feroz et al., 2021). Furthermore, a Cochrane review confirms that digital interventions have a positive impact on maternal health outcomes, although their effectiveness is influenced by intervention design and the implementation context (Mbuagbaw et al., 2021). Other studies also indicate that the effectiveness of mHealth can vary depending on health system integration and digital infrastructure support (Velez et al., 2022).

In the Indonesian context, the implementation of mHealth has shown significant progress in primary health care. Studies indicate that mobile applications and digital systems in health facilities can improve continuity of care and ANC adherence (Sari et al., 2023). Furthermore, the adoption of digital health in Indonesia's primary care sector has also increased, although it still faces challenges

related to infrastructure and digital literacy (Laksana & Pratama, 2022). This indicates that Indonesia is in a transitional phase toward the full integration of digital health services.

From a policy perspective, the WHO emphasizes that digital health is a key strategy for strengthening the global maternal health system, particularly in expanding ANC service coverage and reducing the risk of pregnancy complications (World Health Organization, 2023). Therefore, the implementation of mHealth must be directed toward integrating primary health care systems, building the capacity of health workers, and strengthening the digital literacy of pregnant women so that its benefits can be sustainably optimized.

Overall, these findings indicate that mHealth is not merely a technological tool but an adaptive, contextual health system intervention with great potential to transform maternal health care in the digital age.

CONCLUSION

The results of this systematic literature review indicate that mobile health (mHealth) is an effective intervention for improving adherence to antenatal care (ANC) among pregnant women in various contexts, both in Indonesia and globally. This effectiveness is reflected in increased consistency in ANC visits, timely checkups, and greater interaction between pregnant women and healthcare providers. The three most prevalent forms of intervention identified are digital reminder systems, maternal health mobile apps, and digital pregnancy monitoring systems, which collectively contribute to improved health behaviors among pregnant women.

Conceptually and practically, these findings confirm that mHealth serves not only as a health communication tool but also as a strategic approach to the digital transformation of maternal health services. The integration of this technology demonstrates potential in strengthening primary health care systems, improving health literacy, and supporting faster and more accurate decision-making in antenatal care. This makes a significant contribution to the development of health care models that are more adaptable to advancements in digital technology.

Moving forward, the future development and implementation of mHealth should focus on strengthening the integration of healthcare systems, improving digital infrastructure readiness, and building the capacity of healthcare workers and service users. Further research is also recommended to evaluate the long-term effectiveness of mHealth on maternal and infant health outcomes through stronger study designs, such as longitudinal studies or randomized controlled trials, thereby providing more comprehensive evidence for digital-based health policy-making.

CONCLUSION

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