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MOBILE APPS AND TELEMONITORING IMPROVE IRON SUPPLEMENT ADHERENCE IN PREGNANCY: LITERATURE REVIEW

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ABSTRACT
Anemia during pregnancy remains a major public health problem and is associated with increased maternal and fetal morbidity and mortality. Iron and folic acid supplementation is an effective strategy to prevent anemia; however, adherence to iron tablet consumption among pregnant women remains low. Mobile health (mHealth) applications and telemonitoring have emerged as innovative approaches to improve adherence through education, reminders, and monitoring. This literature review aimed to investigate the effectiveness of mobile applications and telemonitoring on adherence to iron supplementation in pregnant women. A literature review was conducted following the PRISMA guidelines. Articles published between 2018 and 2025 were identified through Google Scholar, PubMed, and ScienceDirect. The search strategy used the following keywords: ("mobile application" OR "mHealth") AND ("telemonitoring") AND ("adherence" OR "compliance") AND ("iron folic acid supplementation" OR "iron tablet") AND ("pregnant women"). Eligible studies were quantitative studies involving pregnant women receiving mobile application- or telemonitoring-based interventions, with adherence to iron supplementation as an outcome. The initial search identified 946 articles, of which 12 studies met the inclusion criteria and were included in the narrative synthesis. Most studies demonstrated that mobile applications and telemonitoring significantly improved adherence to iron tablet consumption among pregnant women. Several interventions also increased knowledge, enhanced attitudes toward supplementation, improved monitoring, and increased hemoglobin levels. Reminder features, health education, and continuous monitoring were identified as the main factors contributing to improved adherence.

Keywords: adherence; anemia; iron supplementation; mhealth; mobile application; pregnant women; telemonitoring

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INTRODUCTION

Development of the health sector is a key strategy for improving the quality of human resources (Kaloko et al., 2025). This commitment is reflected in the National Medium-Term Development Plan (RPJMN) and the Ministry of Health's Strategic Plan for 2020–2024, which focus on improving maternal and child health, addressing stunting, and strengthening the health system (Kementerian Kesehatan Republik Indonesia, 2023). Although various interventions have been implemented, the Maternal Mortality Rate (MMR) in Indonesia has not yet reached the expected target, so it remains a priority in efforts to improve health outcomes (Madani et al., 2022).

The global MMR declined by 40 percent, from 328 to 197 deaths per 100,000 live births, between 2000 and 2023, but remains far from the SDG target of 70 deaths per 100,000 live births by 2030 (United Nations Children's Fund, 2025). According to the results of the 2020 Long-Form Population Census (LFSP), the MMR in Indonesia stands at 189 deaths per 100,000 live births (Badan Pusat Statistik, 2023). Complications during pregnancy are one of the leading causes of maternal mortality, and anemia is a key factor contributing to these complications (Obeagu & Obeagu, 2025).

Anemia has adverse intergenerational consequences, including an increased risk of pregnancy complications, maternal mortality, and morbidity. Anemia remains a global health issue, with a prevalence of 35.5% among pregnant women in 2023—higher than the 30.7% prevalence among women of reproductive age in general (World Health Organization, 2025). Data from the 2023 Indonesian Health Survey (SKI) indicate that the prevalence of anemia among pregnant women in Indonesia reached 27.7% (Kementerian Kesehatan Republik Indonesia, 2025). Anemia in pregnant women is defined as a condition in which hemoglobin or hematocrit levels are below the recommended normal range—specifically, hemoglobin levels of less than 11 g/dl during the first, second, and third trimesters of pregnancy. Iron deficiency is the primary cause of anemia in pregnant women, but deficiencies in folic acid or vitamin B12, or other medical conditions, can also cause it (Litaqia & Cahya Mulat, 2025). Severe anemia during pregnancy can lead to short-term and long-term negative health on the mother, fetus and newborn baby, leading to the risk like miscarriage, gestational hypertension, preterm birth, and low birth weight (Wang et al., 2025).

The iron and folic acid supplementation is recommended for iron-deficiency anemia prevention by WHO (Atmadani et al., 2023). A body of scientific evidence confirms that iron supplementation contributes to a substantial reduction in the burden of iron-deficiency anemia, with an estimated prevention of 12,500 DALYs per year in Europe and approximately 2.5 million DALYs in Africa and Southeast Asia (Shahzad et al., 2025).. In Indonesia, pregnant women take one iron supplement tablet daily with the aim of reaching a minimum of 90 tablets from pregnancy through the postpartum period (Peraturan Menteri Kesehatan Nomor 21 Tahun 2021 Tentang Penyelenggaraan Pelayanan Kesehatan Masa Sebelum Hamil, Masa Hamil, Persalinan, Dan Masa Sesudah Melahirkan, Pelayanan Kontrasepsi, Dan Pelayanan Kesehatan Seksual, 2021).

Adherence to iron and folic acid supplementation in pregnant women is measured by consump minimum of 90 tablets during pregnancy (Seidu et al., 2024). Although the coverage of iron supplement distribution to pregnant women in Indonesia has improved, the increase has been minimal, rising from 87.23% in 2023 to 87.27% in 2024 for the provision of at least 90 tablets (Kementerian Kesehatan Republik Indonesia, 2025). Improving and maintaining adherence to iron tablet intake among pregnant women requires a more innovative approach. For instance, through community-based educational and communication media, accompanied by a daily reminder system capable of supporting sustained supplement intake.

Various media have been utilized to improve adherence to iron tablet intake among pregnant women, ranging from interpersonal support to technology-based media. Empirical evidence shows that mobile health (mHealth) and telemonitoring-based interventions are effective in improving adherence to iron supplement intake globally (Belay et al., 2026; Knop et al., 2024; Shao et al., 2024). With mobile service coverage reaching approximately 95% of the world's population, various mobile phone-based interventions—including counseling and telemonitoring—have proven effective in improving education, awareness, and the management of anemia in pregnant women while maintaining user confidentiality and comfort (Sharma et al., 2023). Latest study reported the advancement of digital technology, mobile apps, SMS reminders, and audiovisual media have proven effective as educational tools and reminders capable of increasing knowledge about anemia and improving adherence to iron tablet intake among pregnant women (Sariyati et al., 2026a).

In Indonesia, the implementation of mHealth has also demonstrated similar benefits in supporting the management of maternal health issues through improved adherence to iron supplement intake (Falah et al., 2022; Nureliza et al., 2026a). With the use of mHealth is increasingly recognized as an innovative strategy for expanding access to health services and supporting the achievement of the 2030 SDGs. However, research on digital interventions remains scattered across various designs and platforms, thus failing to provide a comprehensive picture of the effectiveness of mHealth and telemonitoring on iron supplement adherence among pregnant women. Therefore, this study aims to

update the latest evidence on the effectiveness of mobile applications and telemonitoring in improving adherence to iron supplement intake among pregnant women.

METHOD

A literature review design employed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Literature sources were obtained through a systematic search of three electronic databases: Google Scholar, PubMed, and ScienceDirect. The search for articles focused on publications released between 2018 and 2025 using the following keyword combination: ("mobile application" OR "mHealth") AND ("telemonitoring") AND ("adherence" OR "compliance") AND ("iron folic acid supplementation" OR "iron tablet") AND ("pregnant women"). The Boolean operators AND and OR were used to broaden and narrow the search results according to the study's focus.

The inclusion criteria for this study were: (1) quantitative research articles, such as randomized controlled trials (RCTs), quasi-experimental, cohort, cross-sectional, or observational studies; (2) published in Indonesian or English; (3) available in full text; (4) involving pregnant women as subjects; (5) using interventions in the form of mobile applications or telemonitoring; and (6) measuring adherence to iron supplement intake as one of the study outcomes. Exclusion criteria included: (1) duplicate articles; and (2) non-systematic review articles, editorials, or opinion pieces.

The article selection process was conducted in several stages according to the PRISMA flowchart, namely: identifying articles from databases, removing duplicate articles, screening titles and abstracts, assessing eligibility based on the full text, and determining which articles met the criteria for analysis. Next, the methodological quality of each article was assessed using the JBI Critical Appraisal Tools to evaluate internal validity, data reliability, and the alignment of the study design with the review's objectives. Data were extracted from articles meeting the quality criteria, including the researchers' names, year of publication, study design, sample size, type of intervention, compliance measurement instruments, and primary study outcomes. The extracted data were analysed descriptively and narratively by comparing results across studies to identify the effectiveness of mobile applications and telemonitoring in improving adherence to iron supplement intake among pregnant women.

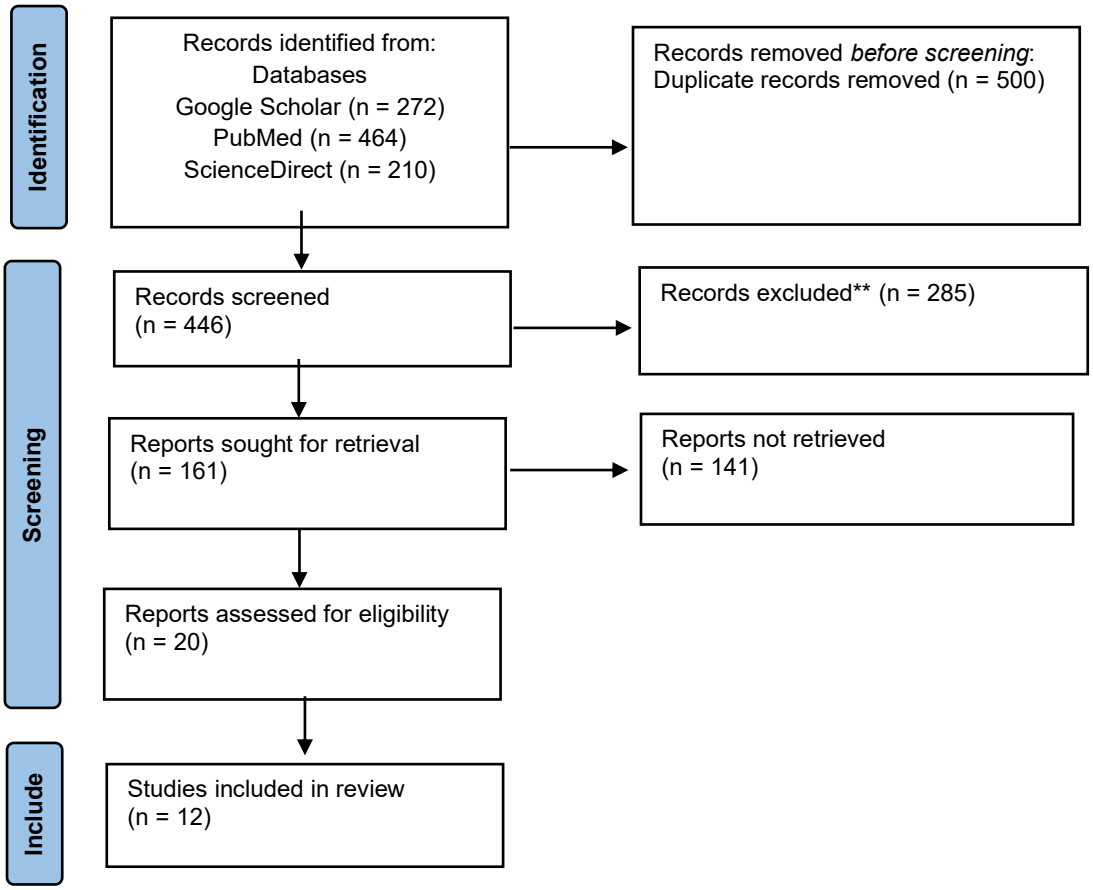


Figure 1. PRISMA Flow Chart

RESULT

In the initial stage of the literature search, 946 articles were identified using relevant keywords from various databases. Next, duplicates were removed, resulting in the elimination of 500 articles. After removing duplicates, the titles and abstracts were screened, yielding 446 articles relevant to the research topic. Of these 161 articles, 141 were inaccessible or did not have full-text versions available. Subsequently, 20 articles were further evaluated through a full-text review; however, 8 articles did not meet the inclusion criteria or were not aligned with the research objectives. Thus, the 12 articles that met the criteria were used as the primary sources in this literature review, as shown in Table 1.

Table 1.
Data extraction from the included studies on the effectiveness of mobile apps and telemonitoring in improving pregnant women's adherence to iron supplements

No.	Author (Year)	Title	Study Design	Sample Size	Result	Conclusion
1.	Permatasari et al. (2023)	Penggunaan Model Edukasi Berbasis Aplikasi Mobile Eduma terhadap Perubahan Pengetahuan dan Kepatuhan Ibu Hamil Mengkonsumsi Tablet Tambah	Quasy Experiment	26 pregnant women	The t-test for knowledge yielded a p-value of 0.045 and a p-value of 1.000 for compliance. The conclusion of this study shows that the only variable that showed a significant difference before and after the 21-day use of the "EDUMA" mobile app-	The use of the "EDUMA" mobile app-based educational model for 21 days can help improve the knowledge of pregnant women but does not affect their adherence to taking iron

No.	Author (Year)	Title	Study Design	Sample Size	Result	Conclusion
		Darah			based educational model was knowledge.	supplements.
2.	Rukmaini et al. (2018)	Effect of Mobile Control Application on the Compliance of Ferrum Tablets Consumption Among Pregnant Women	Quasy Experiment	86 pregnant women	The results of the study showed that the majority of participants had low adherence to taking iron tablets (33.7%), which increased to 72.1% after the intervention. The mobile app program had a significant effect on adherence to taking iron tablets (t = -3.183, p = 0.002)	The introduction of a mobile app can improve adherence to iron tablet intake among pregnant women in Kaduhejo, Banten, Indonesia.
3.	Sariyati et al. (2026)	The effectiveness of an Android-based reminder application in ensuring compliance with iron tablets for pregnant women in Yogyakarta Indonesia	Quasy Experiment	125 pregnant women	The average compliance score for pregnant women in the intervention group increased, from a pretest score of 4.74 to a posttest score of 5.60. The results of the Wilcoxon statistical test showed a P-value of 0.031. The results of the Mann–Whitney statistical test showed a P-value of 0.008.	There was a difference in compliance scores between pregnant women monitored using an Android-based iron tablet reminder app and those who did not use such an app.
4.	Susilawati et al. (2021)	The Impact of an Android Application on Compliance with Iron Supplementations in Pregnant Women	Quasy Experiment	60 pregnant women	Hasil yang diperoleh dariThe results of the initial examination showed that the minimum Hb level was 7.3 g/dL and the maximum measured level was 11.2 g/dL. After the intervention, Hb levels increased to a minimum of 7.6 g/dL and a maximum of 12.2 g/dL. Data from the Mann-Whitney U test showed a significant difference in the level of adherence to iron supplementation among pregnant women (P=0.010).	Monitoring via an Android app improved pregnant women's adherence to taking iron supplements and showed a linear effect on the increase in their Hb levels.
5.	Krismawati et al. (2022)	Pengaruh Aplikasi Sahabat Ibu Hamil (Asih) terhadap Kepatuhan Minum Tablet Fe dan Kadar Hb Ibu Hamil	Quasy Experiment	66 pregnant women	Data analysis was performed using the Mann-Whitney and Spearman's rank tests. Pregnant women who used the Sahabat Ibu Hamil (ASIH) app showed improvements in their knowledge scores, iron tablet adherence, and attitudes. An increase in iron tablet adherence scores can raise Hb levels by 18.4%; each increase	The Sahabat Ibu Hamil (ASIH) app improves iron tablet adherence and significantly increases Hb levels in pregnant women.

No.	Author (Year)	Title	Study Design	Sample Size	Result	Conclusion
					in iron tablet adherence scores can raise Hb levels by 0.02.	
6.	Irdianty et al. (2025)	The Effect of Smart Monitoring System on Attitudes and Adherences of Consuming Iron Supplement Tablets in Pregnant Women	Quasy Experiment	50 pregnant women	Based on the Paired T-Test, with a p-value of 2.61 (greater than 0.05), the smart monitoring system did not change the attitudes of pregnant women. Meanwhile, based on the Wilcoxon test, with a p-value of 0.000 (less than 0.05), the smart monitoring system was shown to increase pregnant women's adherence to taking iron tablets.	There is a difference in the effect of using the smart monitoring system on the attitudes of pregnant women in the service area of the Klego 1 Community Health Center.
7.	Vadsaria et al. (2025)	Efficacy of a Personalized mHealth App in Improving Micronutrient Supplement Use Among Pregnant Women in Karachi, Pakistan: Parallel-Group Randomized Controlled Trial	Randomized Controlled Trial	306 pregnant women	A personalized mHealth app significantly increased the use of antenatal vitamin D supplements among pregnant women, improved iron intake, and reduced anemia; however, it did not significantly improve overall supplement use or the use of folic acid and calcium compared with conventional in-person counseling.	A properly implemented mHealth intervention can improve antenatal vitamin D supplementation.
8.	Nureliza et al. (2026)	Effectiveness Of The 'Ceting' M-Health Application In Enhancing Iron Supplementation Adherence And Hemoglobin Levels Amongpregnant Women	Quasy Experiment	50 pregnant women	The intervention group showed a significant increase in adherence (6.32 to 7.88; p = 0.001) and Hb levels (10.48 to 11.12 g/dL; p = 0.001). In the control group, adherence increased slightly (5.48 to 6.36; p = 0.042), but the change in Hb levels was not statistically significant (10.32 to 10.56 g/dL; p = 0.083). An between-group analysis confirmed the significant effectiveness of the CETING app (p = 0.001).	The "CETING" app is effective in improving adherence to iron supplementation and hemoglobin levels in anemic pregnant women, making it suitable for use as a complementary tool for maternal health services in primary health care facilities.
9.	Sa'adah & Rizky (2025)	Aplikasi Mytheraphy dalam Peningkatan Kepatuhan Konsumsi Tablet Fe pada Ibu Hamil Trimester III	Quasy Experiment	48 pregnant women	Most non-compliant respondents did not take their iron tablets (70.8%) before using the reminder app. A small proportion of non-compliant respondents did not take their iron tablets (47.9%) before using the MyTherapy reminder	There was an effect of using the MyTherapy reminder app on iron tablet adherence among pregnant women in their third trimester in Nyalindung

No.	Author (Year)	Title	Study Design	Sample Size	Result	Conclusion
					app. There was an effect of using the MyTherapy reminder app on iron tablet adherence (p=0.013).	Village, within the service area of the Nyalindung Community Health Center, Sukabumi Regency, in 2024 (p=0.013).
10.	Nurherliyany et al. (2022)	Pengaruh Aplikasi Fe-Mnhy terhadap Keberhasilan Pemantauan, Pengetahuan dan Sikap Mengonsumsi Tablet Fe pada Ibu Hamil di Puskesmas Ciamis Kabupaten Ciamis Periode 2021	Quasy Experiment	48 pregnant women	The use of the Fe-MNHY app improved the success rate of monitoring iron tablet intake, increased pregnant women's knowledge (from 6.21 to 7.35, a 35% increase), and boosted positive attitudes (from 56% to 94%); thus, this app had a significant impact on monitoring, knowledge, and attitudes regarding iron tablet intake among pregnant women.	The Fe-MNHY app influenced the success of monitoring iron tablet intake among pregnant women at the Ciamis Community Health Center in Ciamis Regency during 2021.
11.	Sharma et al. (2023)	Telephonic intervention to combat non-adherence to oral iron-folic acid supplementation in pregnancy: A randomized controlled trial	Randomized Controlled Trial	286 pregnant women	The intervention group showed a 44.9% increase in adherence, while the control group showed only a 13.8% increase (P < 0.001). The main reasons for nonadherence were forgetting to take the supplements (24%), nausea and vomiting (23.2%), and constipation (18.8%). Hemoglobin levels increased by 0.8 g/dL (P < 0.001) in the intervention group, whereas in the control group they increased by only 0.2 g/dL (P < 0.807).	In addition to improving adherence to oral IFAS intake, the telephone intervention was also able to reduce side effects and increase hemoglobin levels in pregnant women with anemia. The increase in adherence in the intervention group was three times greater than the relatively small increase in the control group. Therefore, this study recommends the implementation of telephone interventions as a strategy to improve adherence to oral IFAS intake among pregnant women with anemia.
12.	Sontakke et al. (2022)	Effect of Mobile Phone Call Reminders With Standard Therapy Versus Standard Therapy Alone on	Randomized Controlled Trial	240 pregnant women	Adherence to iron supplement intake was higher in the intervention group than in the control group, with adherence ranging from 48% to	This study concluded that providing reminders via cell phone calls, combined with

No.	Author (Year)	Title	Study Design	Sample Size	Result	Conclusion
		Compliance With Iron Supplementation in Antenatal Women With Iron Deficiency Anemia: A Randomized Controlled Trial			93%. At the time of delivery, both groups showed an increase in hemoglobin levels compared to the time of enrollment. The mean hemoglobin level in the intervention group increased from 9.74 g/dL to 10.69 g/dL, while in the control group it increased from 9.48 g/dL to 10.06 g/dL. The average increase in hemoglobin levels in the intervention group (0.96 g/dL) was statistically significantly higher (p = 0.001) than that in the control group (0.59 g/dL).	standard iron supplementation therapy, was able to improve pregnant women's adherence to iron supplementation and resulted in a greater increase in hemoglobin levels compared to standard therapy alone in pregnant women with iron-deficiency anemia.

DISCUSSION

The reviewed studies indicate that mobile apps and digital monitoring systems are increasingly being used as strategies to improve adherence to iron supplement intake among pregnant women. All of the studies share the same goal to help pregnant women take their iron supplements more regularly but the approaches used vary. These differences are evident in the features highlighted, ranging from intake reminders, tracking tablet use, monitoring adherence, health education, to two-way communication with healthcare providers.

Reminder features are the component most consistently associated with improved adherence. Studies by Rukmaini et al. (2018), Sariyati et al., (2026), and Sa'adah & Rizky, (2025) show that periodic notifications help pregnant women reduce instances of forgetting to take their iron supplements. In the study by Rukmaini et al. (2018), the Mobile Control served as a routine reminder that encouraged regular intake, whereas the Android-based reminder app in the study by Sariyati et al., (2026) included daily schedule tracking, allowing users to evaluate their own adherence. In the MyTherapy app, reminders are combined with tablet usage tracking so that pregnant women can independently monitor their consumption history. These findings indicate that continuously provided reminders act as behavioral reinforcers that help establish the habit of taking iron supplements.

The effectiveness of the intervention appears to be greater when reminders are combined with adherence monitoring. The Fe-MNHY app, the smart monitoring system, ASIH, and CETING not only remind users of medication times but also enable continuous adherence monitoring and provide feedback on user behavior (Nurherliyany et al., 2022; Irdianty et al., 2025; Krismawati et al., 2022; Nureliza et al., 2026). In the study by Susilawati et al., (2021), the combination of reminders and monitoring was also associated with an increase in the regularity of iron supplement intake. Active monitoring helps pregnant women determine whether their intake aligns with the prescribed schedule, ensuring that consumption behavior relies not only on momentary memory but also on continuous self-assessment.

In addition to monitoring, some apps incorporate educational components to strengthen pregnant women's understanding of the importance of iron supplementation. A study by Nurherliyany et al. (2022) showed that the Fe-MNHY app improved pregnant women's knowledge and attitudes, along

with successful monitoring of iron tablet intake. However, different results were found in a study by Permatasari et al. (2023). The EDUMA app successfully increased pregnant women's knowledge regarding iron supplement intake but did not result in a significant change in adherence. This discrepancy indicates that increased knowledge does not necessarily lead to behavioral change. Information about the benefits of iron supplements is indeed important as a foundation for understanding, but without reminders and monitoring to help apply that knowledge in daily routines, changes in adherence tend to be more difficult to achieve.

Another aspect that distinguishes this study is the presence of two-way communication in the telemonitoring intervention. Studies by Sharma et al. (2023) and Sontakke et al. (2022) show that reminders via phone calls serve not only as medication intake alerts but also as a means of consultation. Through direct communication, healthcare providers can identify barriers experienced by pregnant women such as nausea, vomiting, constipation, or difficulty following the intake schedule and then provide appropriate solutions. This approach offers emotional and motivational support that is not available through automated reminder apps. With ongoing follow-up, pregnant women feel more cared for and are therefore more motivated to maintain adherence over a longer period.

The study by Vadsaria et al. (2025) adds the dimension of personalization to digital interventions. Personalized mHealth apps provide reminders and information tailored to users' needs, making the messages they receive more relevant than general educational content. This approach demonstrates that the success of digital interventions depends not only on the availability of technology but also on the app's ability to tailor the content of messages to the individual circumstances and needs of each pregnant woman. Personalization allows users to receive information that is more specific and relevant to the situations they face, thereby increasing their engagement with the intervention.

Overall, a synthesis of all the studies shows that the main difference between interventions lies not in the goals they aim to achieve, but in the level of engagement established between the app and the user. Apps that provide only education tend to increase knowledge; apps with reminders help establish consumption routines; apps with monitoring reinforce behavioral consistency; while telemonitoring and personalized systems provide more comprehensive support in maintaining long-term adherence. Thus, the success of digital interventions in improving adherence to iron supplement intake appears to be determined more by a combination of reminders, monitoring, relevant education, and ongoing communication than by the mere delivery of information.

CONCLUSION

Mobile applications and telemonitoring are effective digital health interventions for improving adherence to iron supplementation among pregnant women. The evidence synthesized in this literature review consistently demonstrates that digital reminder systems and telemonitoring support better compliance with iron tablet consumption compared with conventional care. The integration of these technologies into routine antenatal care may provide a practical and accessible strategy to enhance adherence to iron supplementation, thereby supporting efforts to prevent iron-deficiency anemia during pregnancy.

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