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Effectiveness of a Reminder System in Increasing Antenatal Care Utilisation among High-Risk Pregnant Women in Indonesia: A Quasi-Experimental Study

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ABSTRACT

Background: Antenatal care is crucial for high-risk pregnancies, but utilisation remains suboptimal in Indonesia due to barriers like limited access and low awareness. Digital interventions can improve healthcare adherence globally. **Objective:** To evaluate the effectiveness of a mobile-based reminder system in increasing Antenatal Care (ANC) utilisation among high-risk pregnant women in Indonesia. **Methods:** A quasi-experimental pretest-posttest control group design was carried out in Bekasi, Indonesia, from May to August 2024. The trial included 150 high-risk pregnant women who were randomly assigned to one of two groups: intervention (75) or control (75). The intervention group received personalised reminders via SMS and mobile app notifications, whereas the control group received conventional ANC services. ANC usage was evaluated using the World Health Organization's (WHO) ANC Quality Assessment Tool. The data was analysed using paired *t*-tests and ANCOVA to assess within-group changes and between-group differences. **Results:** The intervention group improved ANC utilisation significantly in all domains, including facility support (mean difference = 1.3, $p < 0.001$), routine care (mean difference = 1.5, $p < 0.001$), and complication management (mean difference = 1.4, $p < 0.001$). In contrast, no significant differences were seen in the control group. ANCOVA showed that the intervention group had significantly higher post-test scores than the control group ($p < 0.001$). **Conclusion:** The reminder system significantly improved ANC utilisation among high-risk pregnant women in Indonesia. Future research should explore long-term impacts and scalability of such interventions.

Keywords: Antenatal Care; Digital Health Interventions; High-Risk Pregnancy; Mobile Health; Reminder System

INTRODUCTION

Antenatal care (ANC) is a cornerstone of maternal health services, aiming to ensure positive health outcomes for both mothers and their unborn children. According to the World Health Organization (WHO), 2022, high-risk pregnancies present a number of substantial issues on a global scale, including a higher risk of morbidity and mortality within the mother and the newborn. According to (Correa-de-Araujo & Yoon, 2021), high-risk pregnant women, who may have pre-existing medical illnesses, issues that are caused by pregnancy, or other risk factors, require ANC visits that are more frequent and specialised as compared to other pregnant women. However, in low- and middle-income countries (LMICs) like Indonesia, the utilisation of antenatal care (ANC) continues to be poor, particularly among high-risk pregnant women. This is due to a number of hurdles, including limited availability, low awareness, and conflicting socio-economic objectives (Wulandari *et al*., 2021). When it comes to high-risk pregnant populations, there is an immediate need for effective measures that can improve the usage of ANC and reduce the likelihood of poor consequences (Albarqi, 2025).

The use of digital interventions, particularly reminder systems, has shown promise in addressing gaps in healthcare utilisation. Reminder systems have been effective in improving adherence to medical

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appointments, medication regimens, and preventive health services (Wang et al., 2025). Studies in various contexts have demonstrated that these systems increase health service utilisation, especially in resource-limited settings where healthcare access is often constrained (Bossman Johansen & Zanaboni, 2022). For instance, a study found that reminders significantly improved ANC attendance among pregnant women (Kachimanga *et al*., 2025). Similarly, mHealth interventions have been shown to improve maternal and newborn health outcomes in randomised controlled trials in sub-Saharan Africa and South Asia (Kante & Målqvist, 2025). Regardless of these results, there is still a lack of data that is unique to high-risk pregnancies, especially in Indonesia.

In Indonesia, where maternal mortality remains a significant public health issue, existing research highlights the potential of mHealth tools to address maternal health challenges. The Ministry of Health has introduced various initiatives to promote maternal and child health, yet high-risk pregnant women continue to face unique barriers to ANC utilisation (Indonesian Ministry of Health, 2022). While some studies have explored the impact of digital health interventions on general maternal health behaviours, the specific effectiveness of reminder systems in increasing ANC utilisation among high-risk pregnant women remains understudied (Hailemariam *et al*., 2025). For instance, Dasgupta *et al*. (2024) examined the impact of AI-based interventions on health and behavioural outcomes in maternal health programmes, suggesting potential benefits for ANC utilisation. Although reminder systems have been widely studied in global maternal health contexts, there is a lack of research focusing on their application among high-risk pregnant populations in Indonesia. Most existing studies in Indonesia have primarily targeted low-risk pregnancies or generalised maternal health outcomes, leaving a critical gap in understanding the effectiveness of reminder systems for high-risk pregnancies (Anitasari & Andrajati, 2017). Additionally, cultural, socio-economic, and systemic factors unique to Indonesia necessitate localised research to determine the feasibility and scalability of such interventions (Dewanti, Sitoayu & Idarto, 2024). Given Indonesia's unique cultural and systemic healthcare landscape, context-specific nursing research is needed to evaluate the feasibility, acceptability, and impact of mHealth interventions. Addressing this gap will enable nurses to lead evidence-based, technology-supported ANC strategies that are tailored to the needs of vulnerable populations (Susanti *et al*., 2022).

The purpose of this research is to determine the effectiveness of a reminder system in increasing antenatal care utilisation among high-risk pregnant women in Indonesia. The results will shed light on practical ways to improve maternal health outcomes in low- and middle-income countries (LMICs) and fill a major knowledge vacuum in the field of digital health interventions.

METHODOLOGY

Study Design

The study employed a quasi-experimental approach that included a control group and administered tests before and after the intervention. In order to improve antenatal care (ANC) attendance, one group was given a mobile-based reminder system, while the other group received regular ANC treatments. Research took place from May to August 2024 in various community health centres in Bekasi, West Java, Indonesia.

Sample

Participants were chosen based on the following inclusion criteria: (1) pregnant women who were deemed to be at a high risk according to the guidelines provided by the Ministry of Health; (2) individuals who were at least 18 years old; (3) individuals who were in the second trimester of their pregnancy; (4) individuals who owned smartphones; and (5) individuals who were able to effectively provide informed consent. The following were some of the criteria that were used to exclude participants from the study: (1) medical contraindications to standard ANC techniques; (2) an inability to handle a smartphone; and (3) participation in other maternal health interventions during the study.

G*Power version 3.1.9.7 was used to estimate the sample size, and the parameters were set to 80% power, a 5% significance level (alpha = 0.05), and an effect size of 0.30 (Faul *et al*., 2007). These values were generated from prior studies that were conducted on interventions that were very similar. Following this

computation, a minimum requirement of 134 participants was determined, with 67 persons belonging to each of the groups. In order to account for the possibility of a dropout rate of ten percent, the final sample size was modified to 150 participants. Community health clinics and hospitals that provide care for high-risk pregnancies were the locations where recruitment was carried out utilising convenience sampling. The participants who were eligible for the study were identified by professionals in the healthcare field and invited to take part.

Instrument

The primary tool for measuring antenatal care utilisation was the World Health Organization's ANC Quality Assessment Tool (2016). This instrument evaluates the quality of antenatal and postpartum outpatient care provided to women and newborns, focusing on facility support systems, routine care, and complication management. A Cronbach's alpha value of 0.89 was reported for the instrument, indicating that it held a high degree of dependability. In the context of this investigation, a Bahasa Indonesia version was validated by means of a pilot study that included thirty participants. The results of this study yielded a Cronbach's alpha of 0.87, which indicates that the version is reliable.

Procedure

Permissions were obtained from the health centres that participated in the study in Bekasi, which is located in West Java, Indonesia. Before enrolment, participants who were eligible for the study were screened, and written informed permission was obtained from them.

The intervention group utilised a mobile-based reminder system designed to enhance adherence to ANC visits. This system incorporated two components: SMS reminders and in-app notifications. Participants received automated SMS messages three days, one day, and the morning of their scheduled ANC appointments. Messages were personalised with the participant's name, appointment details, and healthcare facility location. For example: *"Dear [Name], your ANC visit is scheduled for [Date] at [Time] at [Facility Name]. Please confirm your attendance by replying 'Yes' or reschedule by calling [Contact Number]."*

Participants using the mobile application received push notifications at similar intervals. Notifications appeared at 9:00 AM three days before the appointment, 5:00 PM the day prior, and 7:00 AM on the day of the appointment. The app also included a "Mark as Attended" feature, enabling participants to update their attendance status, which synchronised with system records. Missed appointments triggered follow-up SMS notifications and were flagged for healthcare staff, who contacted participants to address barriers and assist with rescheduling.

The reminders were provided in the local language for accessibility and cultural relevance. Participants could customise their reminder preferences, including timing and communication mode (SMS or app notifications). The system aligned reminders with national ANC guidelines, prompting reminders at key pregnancy milestones (e.g., monthly visits during the first two trimesters, biweekly visits during the third trimester, and weekly visits after 36 weeks of gestation). Feedback on the system's usability was collected during routine interactions with the research team.

The control group received standard ANC services without reminders. Participants in both groups completed pretest questionnaires during their initial ANC visits. The intervention lasted for 12 weeks, after which post-test questionnaires were administered. Structured interviews were conducted to gather feedback on the intervention.

Data Analysis

The analysis of the data was carried out with the help of IBM SPSS Statistics version 27. A summary of the demographic and baseline data was achieved by the utilisation of descriptive statistics, which included the utilisation of means, standard deviations, and frequencies. In the beginning of the study, we compared the groups by using independent t-tests for continuous variables and chi-square tests for categorical data. These tests allowed us to detect the differences that existed between the groups. Comparative analysis of variance (ANCOVA) was utilised to evaluate differences between groups after controlling for baseline values. On the

other hand, paired t-tests were utilised to analyse variations in the utilisation of ANC within groups. At a level of $p < 0.05$, statistical significance was determined to have been established.

Ethical Consideration

The researchers obtained ethical approval from the Institutional Review Board (IRB) of STIKes Abdi Nusantara, Indonesia with reference number ETIK-Abnus/2024-078 on 7th February 2024.

RESULTS

Table 1 presents the demographic characteristics of participants in both the intervention and control groups, each consisting of 75 pregnant women. The mean age of participants in the intervention group was 29.5 years (SD = 5.2), while in the control group it was 30.1 years (SD = 5.5). The difference in age between groups was not statistically significant ($p = 0.402$), indicating that age was comparable across both groups. In terms of education level, the distribution among primary, secondary, and tertiary education was similar between groups, with the majority of participants in both groups having completed secondary education (60.0% in the intervention group vs. 53.3% in the control group). The differences in education level were not statistically significant ($p = 0.528$), suggesting comparable educational backgrounds between groups. Employment status was also evenly distributed, with 46.7% of participants in the intervention group and 50.7% in the control group being employed. The difference was not significant ($p = 0.641$), indicating a balanced employment profile between the two groups. Regarding parity, 37.3% of participants in the intervention group and 41.3% in the control group were primiparous, while the remaining participants were multiparous. The distribution of parity did not differ significantly between groups ($p = 0.614$).

Table 1: Demographic Characteristics of Participants

Characteristic	Intervention Group (n = 75)	Control Group (n = 75)	*p*-value
Age (mean ± SD, years)	29.5 ± 5.2	30.1 ± 5.5	0.402
Education Level, n%			
Primary	15 (20.0%)	18 (24.0%)	0.528
Secondary	45 (60.0%)	40 (53.3%)	
Tertiary	15 (20.0%)	17 (22.7%)	
Employment status, n %			
Employed	35 (46.7%)	38 (50.7%)	0.641
Unemployed	40 (53.3%)	37 (49.3%)	
Parity, n %			
Primiparous	28 (37.3%)	31 (41.3%)	0.614
Multiparous	47 (62.7%)	44 (58.7%)	

Table 2 presents the results of paired *t*-tests for the intervention and control groups, analysing changes in antenatal care (ANC) utilisation across domains of the ANC Quality Assessment Tool. Significant improvements were observed in all domains for the intervention group ($p < 0.05$), while the control group showed no significant changes in most domains.

Table 2: Paired t-Test Results for ANC Utilisation by Domain

Domain	Group	Pretest Mean (SD)	Post-test Mean (SD)	Mean Difference (SD)	*t*-value	*p*-value
Facility Support	Intervention	3.2 (0.8)	4.5 (0.7)	1.3 (0.5)	15.21	<0.001
	Control	3.3 (0.9)	3.4 (0.8)	0.1 (0.3)	1.89	0.062
Routine Care	Intervention	3.1 (0.7)	4.6 (0.6)	1.5 (0.6)	17.05	<0.001
	Control	3.2 (0.8)	3.3 (0.7)	0.1 (0.4)	1.52	0.132
Complication Management	Intervention	3.0 (0.9)	4.4 (0.8)	1.4 (0.7)	13.67	<0.001
	Control	3.1 (1.0)	3.2 (0.9)	0.1 (0.5)	1.14	0.257

ANCOVA was conducted to evaluate the effectiveness of the intervention in increasing ANC utilisation while controlling for baseline scores. Table 3 summarises the adjusted means for each domain and the statistical significance of between-group differences. The intervention group demonstrated significantly higher scores in all domains compared to the control group ($p < 0.001$).

Table 3: ANCOVA Results for ANC Utilisation by Domain

Domain	Group	Adjusted Mean (SE)	F-value	*p*-value
Facility Support	Intervention	4.5 (0.1)	65.43	<0.001
	Control	3.4 (0.1)		
Routine Care	Intervention	4.6 (0.1)	72.15	<0.001
	Control	3.3 (0.1)		
Complication Management	Intervention	4.4 (0.1)	59.87	<0.001
	Control	3.2 (0.1)		

DISCUSSION

In this study, the intervention group showed a considerable improvement in antenatal care (ANC) usage across multiple domains after the deployment of a reminder system, as compared to the control group. Previous studies have shown that digital reminders can increase healthcare service consumption among pregnant women, which is in line with these results. For instance, (Ameyaw, Amoah & Ezezika, 2024; McKelvin, Thomson & Downe, 2021) reported that mobile-based reminders could effectively address barriers to accessing healthcare services, thereby improving maternal health outcomes. Similarly, Venkataramanan *et al*. (2022) observed an increase in scheduled ANC attendance following the use of SMS reminders, underscoring the potential of mobile health interventions in closing gaps in maternal healthcare access. Additional evidence from Kante and Målqvist (2025) supports the notion that mobile-based interventions positively influence maternal and newborn health outcomes, positioning reminder systems as a cost-effective strategy to bolster ANC adherence.

This study contributes to the growing body of evidence by demonstrating improvements across multiple domains of ANC, suggesting that reminder systems not only encourage attendance but also facilitate comprehensive care utilisation. Reminder systems play a critical role in improving adherence to healthcare schedules by addressing barriers such as forgetfulness, lack of awareness, and logistical challenges (Vatsa *et al*., 2025). By sending timely and personalised notifications, these systems ensure that pregnant women are reminded of their scheduled visits, enhancing compliance and reducing missed appointments. Kante & Målqvist (2025) highlighted that mobile-based interventions effectively improved maternal health outcomes by increasing access and engagement in care. Additionally, a systematic review by Lu *et al*. (2025) emphasised that digital reminders tailored to user preferences improved healthcare adherence significantly, showcasing the adaptability and efficiency of these systems in diverse populations. In contrast, a study by Bulcha *et al*. (2024) reported limited improvement in follow-up care adherence, which could be attributed to differences in intervention implementation fidelity and the demographic characteristics of the study population. These discrepancies underscore the need for tailored approaches that consider local contexts and user needs.

The findings of this study underscore the pivotal role of reminder systems in improving ANC utilisation, particularly among high-risk pregnant women. Such interventions address critical barriers, including forgetfulness and limited awareness of scheduled visits. For healthcare providers, integrating reminder systems into routine ANC services could enhance timely care delivery, improve maternal and neonatal outcomes, and reduce disparities in healthcare access (Putri, Maryati & Solehati, 2025). For instance, a study by Bulcha *et al*. (2025) demonstrated that reminder systems effectively increased vaccination rates among mothers and newborns. Policymakers should prioritise the scaling up of reminder systems, especially in low-resource settings, to complement existing maternal health initiatives. Moreover, tailoring reminders to align with patient preferences, cultural contexts, and literacy levels could further amplify their effectiveness and user satisfaction (Widiyono & Sumarni, 2025). As digital health continues to evolve, integrating reminder systems with other innovative tools, such as teleconsultations and electronic health records, could create a more holistic approach to maternal healthcare (Marfuah, Sansuwito & Ayakannu, 2025).

Limitation

This study has several limitations, despite the fact that it offers some encouraging findings. Initially, the research was carried out in a specific geographical location, which restricts the extent to which the findings may be generalised to a wider range of groups. It is recommended that future research make use of multicentre designs to validate these findings across a variety of situations. Second, while the intervention showed significant improvements in ANC utilisation, the study did not evaluate long-term adherence or maternal and neonatal health outcomes. These aspects are crucial for understanding the sustained impact of reminder systems. Third, potential confounding variables, such as socioeconomic status, literacy levels, and access to mobile devices, were not controlled in this study. Addressing these factors in future research could provide more robust evidence on the effectiveness of digital reminders.

CONCLUSION

The findings of this study underline the significant impact of a reminder system on improving antenatal care (ANC) utilisation among high-risk pregnant women, contributing to the expanding body of evidence that supports digital health interventions to enhance maternal healthcare access and outcomes. The future scope of this research includes evaluating the long-term effectiveness of reminder systems on both maternal and neonatal health outcomes, particularly in diverse socio-cultural and healthcare settings. Furthermore, future studies should consider integrating reminder systems with complementary digital tools, such as teleconsultations, mobile health records, or decision-support systems, to create a more holistic maternal care pathway. Qualitative research exploring user satisfaction, acceptability, and cultural responsiveness will also be essential in tailoring interventions to local needs and maximising their impact. Collectively, these efforts will inform more nuanced, patient-centred digital health strategies that support universal access to quality maternal healthcare.

Conflict of Interest

The authors have no conflicts of interest to declare.

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