



## **Effectiveness Of Android Based Antenatal Care Application To Enhance Antenatal Care Adherence And Pregnant Mothers Health: A Literature Review**

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### **Abstract**

**Introduction:** Even though antenatal care checks are incredibly crucial for monitoring the health development of both mothers and newborns, the reality is that a significant number of pregnant women do not go to their appointments as much as is recommended. This is because pregnant women are frequently tardy in doing prenatal care checks since there is a lack of information regarding the significance of antenatal checks for the development of health. Experts are attempting to progress in the health sector by using mobile devices in health services to monitor antenatal care (ANC) for pregnant women. This is being done in light of the rapidly evolving technology of the 4.0 age. This application will serve to remind pregnant women of the scheduled examination appointments suggested for them. Additionally, it can potentially improve health services for pregnant women and identify issues that may arise during pregnancy. **Methods:** Conduct a systematic data analysis by examining existing research findings on the efficacy of Android-based antenatal care applications in enhancing adherence to antenatal care and improving maternal health. Articles about the specified theme were chosen from 2018 to 2023 using electronic databases like Science Direct, PubMed, Google Scholar, and open knowledge maps for the search. The researcher employed the PRISMA methodology to analyze the literature study comprehensively. **Results:** Of 184 papers, ten studies were deemed suitable and thoroughly examined and studied regarding their research objectives, samples, methodology, and findings with keywords Antenatal Care Application, Android, Antenatal Care Adherence, and Pregnant Mothers Health. The selection process for this study is presented in Figure 1. **Conclusion:** An Antenatal Care Application





based on Android has the potential to enhance compliance with Antenatal Care, enhance the health of pregnant women, augment maternal knowledge and behavior, improve health services for pregnant women, and facilitate the detection of pregnancy issues.

**Keywords:** Antenatal Care Application, Android, Antenatal Care Adherence, Pregnant Mothers Health

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## 1. Introduction

Antenatal care, often known as ANC, refers to the evaluation of the mother while she is pregnant. ANC service visits by the standard, namely with as many as two ANC visits during the first trimester of gestation, as many as one ANC visit during the second trimester, and as many as three ANC visits during the third trimester of gestation. According to Ala et al (2021) research, antenatal care services aim to carry out early detection to prevent difficulties during pregnancy and initiate preparations for labor and physiological birth. According to Alem et al (2022) another advantage of ANC visits is that they ensure that pregnant women remain healthy throughout their pregnancy, both during and after delivery. Early diagnosis of pregnancy hazards is also carried out, and maximum treatment management is planned. All of these factors are predicted to contribute to a reduction in the death rate of both mothers and infants.

Midwives conduct antenatal care (ANC) visits to monitor the mother and fetus's progress during pregnancy using the Maternal and Child Health book. However, the recording of the mother and fetus's development in the KIA book is still done manually by midwives. Additionally, pregnant women frequently forget to bring their KIA book during ANC examinations (Pasaribu et al., 2023). The advancement of technology, particularly in the realm of communication, has been swift. Cell phones have become a prevalent means of communication across all age groups and economic backgrounds, including Indonesia, where many cellphone users exist. The mobile phone has evolved and adapted to work as





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**International Journal of Health Sciences (IJHS)**Journal Homepage : <https://jurnal.agdosi.com/index.php/IJHS/index>

Volume 1 | Number 4 | Desember 2023 |



a compact computer, equipped with a range of applications that assist in fulfilling the community's electronic and surfing requirements (Tan et al., 2022).

The advancements in information technology during the 4.0 era have the potential to bring about substantial transformations in the healthcare industry, particularly in midwifery. These advancements aim to enhance individuals' accessibility to midwifery services. The growing utilization of telemedicine yields beneficial effects on health (Stoumpos et al., 2023). The percentage of people using the internet increased to 64.8% in 2018. As many as 51.06% of consumers use the Internet as a medium to find information about health services, including information on midwifery services (Mauliana et al., 2022). The 21st century has witnessed significant technological advancements, which can offer high-quality ANC services to enhance the MCH program. Technology facilitates the effortless acquisition and convenient accessibility of diverse information about ANC services (Ningsih et al., 2023).

Regular antenatal care examinations are crucial for monitoring the health progress of expectant mothers and their babies. However, it is observed that a significant number of pregnant women fail to adhere to the suggested appointment schedule. This is attributed to a lack of information regarding the significance of antenatal care examinations for enhancing health, resulting in pregnant women frequently delaying the scheduling of these check-ups. As a result of this delay, health providers may face challenges in monitoring the progress of pregnancy and identifying potential difficulties in the early stages (Ahmed & Manzoor, 2019). By adhering to recommended antenatal care examinations, pregnant women might potentially prevent the occurrence of pregnancy problems. Antenatal care examinations for pregnant women are crucial in maintaining patient safety in healthcare (Haftu et al., 2018).

One of the reasons that is offered for non-compliance in the process of completing prenatal care checks during pregnancy is forgetting the control schedule. Some of the other reasons are also listed. To this point, medical professionals have carried out monitoring in the patient's medical record file and the patient's record book; however, the effectiveness of this monitoring has been diminished because patients do not do pregnancy checks as





suggested (Whitehead et al., 2018). Experts are attempting to achieve advances in the health sector by implementing ANC monitoring of pregnant women using mobile devices in health services. This is being done because the technology of the year 4.0 is currently undergoing development. This application will serve to remind pregnant women of the examination schedule that is advised for them. Additionally, it can potentially improve health services for pregnant women and identify issues that may arise during pregnancy (Lattof et al., 2020).

## 2. Research Method

This study is a literature review of existing literature. Articles were chosen based on the specified theme from 2018 to 2023. The inclusion criteria consisted of full-text papers that were readily accessible and utilized research designs such as randomized controlled trials (RCTs), quasi-experiments, or experimental studies. The exclusion criteria encompassed conference papers, chapters, editorials, and unopened access materials.

The data sources utilized in this study included papers obtained from the electronic databases Science Direct, PubMed, and Google Scholar and open knowledge maps in article searches. The researchers employed a search method in every database, utilizing specific keywords. An Android-based application for Antenatal Care Compliance. The researchers employed the Preferred Reporting Items for Systematic Reviews and Meta-analysis Statement (PRISMA) method to adhere to the appropriate study protocol (Haddaway et al., 2022), as illustrated in Figure 1.

## 3. Results And Discussions

### a. Result

Of 184 papers, ten studies were deemed suitable and thoroughly examined and studied regarding their research objectives, samples, methodology, and findings with keywords Antenatal Care Application, Android, Antenatal Care Adherence, Pregnant Mothers Health. The selection process for this study is presented in Figure 1.



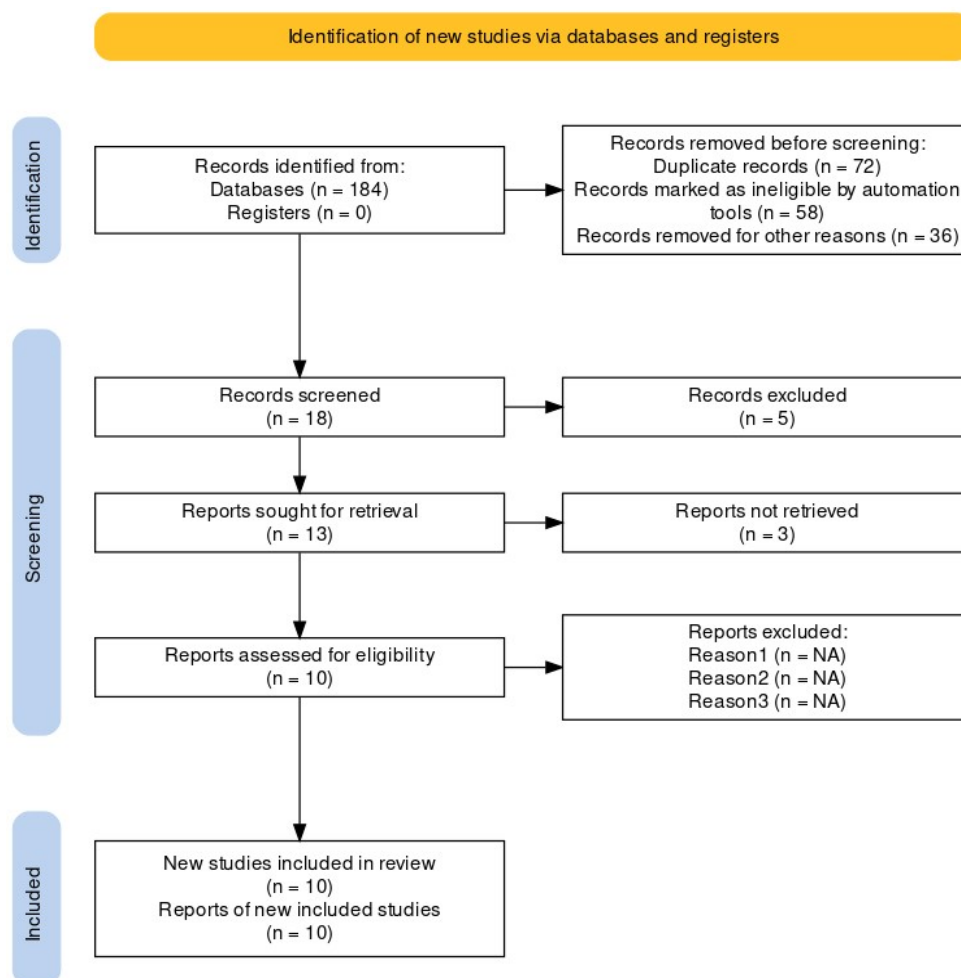


Figure 1 Selection Process of Studies Based on PRISMA (Haddaway et al., 2022)

**Table 1. Result of Article Analysis**

| Author               | Aims                                                                                                                                                                   | Sample            | Method                                                              | Result                                                                                                                                                                                                                                                                                                                                     |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|---------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| (Souza et al., 2021) | This study aims to determine whether or not a mobile application designed for mobile phones can improve pregnant women's compliance with their prenatal consultations. | 88 pregnant women | A clinical trial that was randomized and controlled was the method. | Compared to the control group (CG) participants, pregnant women who utilized the application (IG) were found to have attended a more significant number of consultations. This finding indicates a statistically significant difference between the two groups ( $p < 0.05$ ). It turned out that the app was an efficient piece of health |





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Volume 1 | Number 4 | Desember 2023 |



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|                             |                                                                                                                                                                                                                                                                              |                      |                                                                                                                                             | technology that allowed for better adherence to prenatal treatment.                                                                                                                                                                                                                                                                                                                                      |
| (Puspitarsi et al., 2020)   | This study aims to discover how the mobile health application may be used to increase knowledge, attitudes, and behaviors among pregnant women to prevent pregnancy danger indicators.                                                                                       | 58 pregnant women    | Research method with quasi-experiment                                                                                                       | Compared to the MCH book, the m-health application significantly impacts the degree of information that pregnant women possess regarding the risk indicators associated with the third trimester of pregnancy, with a value of ( $p < 0.05$ ).                                                                                                                                                           |
| (Benski et al., 2020)       | This study used mobile health (mHealth) to give prenatal care (ANC) to 1,446 pregnant women living in rural parts of Madagascar. Additionally, the quality of ANC delivered by a health system designed to modify the behavior of both providers and patients was evaluated. | 1.446 Pregnant Women | Study cross-sectional                                                                                                                       | Through the utilization of mobile health systems, it is possible to enhance the quality of antenatal care (ANC), alter the behavior of providers by standardizing ANC visits, and alter the behavior of patients by improving their readiness to return for subsequent appointments and encouraging ANC attendance at an earlier stage in pregnancy.                                                     |
| (R. Rahmawati et al., 2020) | Assess the efficacy of utilizing the MCH book and the Monsca application among midwives for applying the Antenatal care guidelines.                                                                                                                                          | 36 Respondent        | A quasi-experimental pre-test post-test non-equivalent control design was utilized as the data collection approach in the research project. | There is a significant difference in the effectiveness of utilizing the KIA book with the Monsca application, as indicated by a p-value of less than 0.001, which is lower than the significance level $\alpha$ of 0.05. The Monica application surpasses the MCH Book regarding user-friendliness, speed, security, and precision. The Monsca application is deemed more efficacious than the MCH book. |
| (Farhati et al., 2018)      | Doing research into the impact that the implementation of                                                                                                                                                                                                                    | 61 Respondent        | Pre-post quasi-experimental test                                                                                                            | The study's findings indicated a noteworthy distinction in the quality of                                                                                                                                                                                                                                                                                                                                |







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Volume 1 | Number 4 | Desember 2023 |



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|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                       | Sahabat Ibu Hamil has had on the enhancement of the standard of antenatal care                                                                                                                                                                                |                    | with a control group.                                                                                                                                                                                       | antenatal care between the control group and the treatment group, as shown by a p-value of less than 0.01. There is a correlation between the application of the application Sahabat Ibu Hamil (ASIH) and an increase in the percentage of midwives who comply with antenatal care requirements by 47.2% and an increase in the total satisfaction of pregnant women by 43.8%.                             |
| (Misago et al., 2023) | Developing and evaluating a digital intervention that makes use of a reminder model to improve the number of women who attend at least four scheduled ANC visits                                                                                              | 132 Pregnant Women | It developed an uncontrolled single-arm pre- and post-study with a baseline follow-up that lasted for six months, an intervention that lasted for twelve months, and an endline cross-sectional evaluation. | As a result of the intervention, 73.7% of women joined the African National Congress (ANC) in the subsequent months. Since the beginning of the fourth intervention, about eighty percent of women have consistently referred to the African National Congress (ANC). This represents a significant increase of over two hundred percent from the twenty-three percent threshold for ANC pre-intervention. |
| (Wagnew et al., 2018) | The purpose of this study is to assess whether or not the usage of short messaging services (SMS) has a positive impact on the number of focused antenatal care (FANC) visits undertaken by qualified clinicians in low- and middle-income countries (LMICs). | 7 Respondent       | RCT                                                                                                                                                                                                         | It has been observed that the utilization of SMS has increased the number of competent birth attendants and FANC visits in developing and emerging countries. Providing short message services is a significant and cost-effective strategy to increase maternal health-seeking behavior. These services are directed toward pregnant women.                                                               |





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| (I. Rahmawati et al., 2019) | To develop a pregnancy guide application directed toward women who are pregnant to acquire knowledge and information regarding the care of pregnant women                                                       | 55 pregnant women                                                                             | The SDLC (System Development Life Cycle) method                                                                                                                                                                     | An application for Android-based mobile devices that provides pregnancy care resources. Based on the Function Point connection, this application receives a score of 9.638 (on a scale from 1 to 10), which means it benefits users. As a result, the use of this application is highly practicable because all of the features that have been produced are things that pregnant women require to provide daily care for their pregnancy. |
| (Murthy et al., 2020)       | This study aims to evaluate the effects of a mother intervention delivered by voicemail on maternal knowledge, attitudes, practices, and health outcomes.                                                       | 2016 Pregnant women                                                                           | A quasi-experimental study with a controlled design, where the participants are unaware of the treatment allocation.                                                                                                | A beneficial influence on maternal healthcare practices and an improvement in maternal health outcomes are both demonstrated by this study, which provides proof that mobile voicemail can have such an impact.                                                                                                                                                                                                                           |
| (Garcia et al., 2021)       | To discuss the findings of the WAWARED randomized controlled trial and to evaluate the advantages of using SMS messaging during antenatal care visits, behavioral outcomes, and maternal and neonatal outcomes. | The study included 576 pregnant women in the intervention group and 586 in the control group. | RCT. SMS messages are sent based on gestational age and specific pathologies determined by the Electronic Medical Record (EMR). These messages provide reminders for ANC appointments and provide health education. | Electronic Medical Record and Short Message Service enhances the frequency of antenatal care visits and the well-being of mothers and children.                                                                                                                                                                                                                                                                                           |

## b. Discussion

According to the findings of the literature review that was carried out, the utilization of ANC monitoring applications for pregnant women that are accessible through mobile devices in health services has the potential to enhance the number of pregnant women who







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Volume 1 | Number 4 | Desember 2023 |



comply with ANC examinations that are performed in health services. The results of a study Souza et al (2021) that aimed to evaluate the effectiveness of mobile applications for cellular phones in the compliance of pregnant women's checks to conduct prenatal consultations in 88 pregnant women revealed that the application proved to be an effective health technology to improve compliance with prenatal care. The research objective was to evaluate the effectiveness of mobile applications for cellular phones in compliance with pregnant women's checks.

These findings align with the study conducted by Puspitasari et al (2020) , which investigated the efficacy of the M-Health application in enhancing the knowledge, attitudes, and behaviors of pregnant women. The study concluded that using M-Health can positively influence the attitudes of pregnant women, motivating them to seek recommended healthcare services during pregnancy regularly. This, in turn, improves overall health and facilitates early detection of pregnancy complications. Farhati et al (2018) also reported similar findings in their research on implementing the Pregnant Mother's Friends Application (ASIH) to enhance the standard of antenatal care. Their study revealed a noteworthy increase in pregnant women's adherence to antenatal check-ups following the implementation of ASIH. These enhancements are feasible due to the application's components that can guide the developed work processes within the program. Enhancements in compliance with antenatal care appointments among expectant mothers can improve maternal and fetal well-being by ensuring regular check-ups.

In their study, Benski et al (2020) examined 1,446 pregnant women and found that utilizing the mHealth system can enhance the quality of antenatal care (ANC). This includes standardizing ANC visits, influencing provider behavior, and promoting patient behavior by increasing the likelihood of returning for subsequent visits and encouraging attendance during early pregnancy. In a study by R. Rahmawati et al (2020) , the effectiveness of using the MCH book and the Monsca application in implementing antenatal service standards was compared among 36 midwives. The study revealed a significant difference in effectiveness between the MCH book and the Monsca application, with a p-value of  $<0.001$ , less than the predetermined significance level  $\alpha$  (0.05). The





Monsca application surpasses the MCH book regarding user-friendliness, speed, security, and precision. The Monsca application is deemed more efficacious than the MCH book. In addition, according to Rohmaningrum (2021), the design of the ANC Mia Care application has the potential to enhance adherence to prenatal care among pregnant women and decrease the occurrence of anemia and stunting.

According to the findings of a study conducted by (Misago et al., 2023) on 132 pregnant women, it was found that 73.7% of the women continued to be members of the African National Congress (ANC) after the intervention was completed. As of the fourth month after the intervention, over eighty percent of women have confirmed that they had joined the African National Congress (ANC) in the following month. This represents a significant increase of more than two hundred percent from the twenty-three percent of women who had joined the ANC before the intervention. According to the findings of a study that was carried out by Wagnew et al (2018) to examine the efficacy of short messaging service (SMS) on Focused Antenatal Care (FANC) visits, it was discovered that SMS had a favorable impact on the uptake of FANC visits and competent delivery support in developing and emerging nations. A valuable and cost-effective intervention to increase maternal health-seeking behavior is a short messaging service that is directed toward pregnant women. The reason for this is that the utilization of ANC applications has the potential to enhance the adherence of health personnel to service standards, ultimately leading to an improvement in the quality of prenatal care services provided to pregnant women.

Murthy et al (2020) conducted a study on 2016 pregnant women to evaluate the effects of a voicemail-based maternal intervention on maternal knowledge, attitudes, practices, and health outcomes. The study demonstrated that mobile voicemail can positively influence maternal healthcare practices and lead to improved maternal health outcomes. Garcia et al (2021) reported findings from the Wawared randomized controlled trial (RCT) that examined the advantages of utilizing SMS messages in antenatal care (ANC) visits. The study evaluated the impact of these messages on behavioral outcomes and maternal and neonatal outcomes. It is discovered that using Wawared (Electronic et al.





Service) leads to a rise in antenatal care attendance and enhances the well-being of both mothers and children.

In addition, the literature study revealed that employing ANC monitoring applications on mobile devices in healthcare settings can simplify the gathering of clinical data and allow for the development of electronic patient records. This finding aligns with the research conducted by Simamora & Rahman (2020) , which examined the use of mHealth in implementing screening for depressive symptoms in pregnant women during antenatal care visits. The findings of Simamora & Rahman (2020) study demonstrate that mHealth offers several benefits, including providing a convenient and cost-effective method for real-time symptom collection in patients, facilitating communication with healthcare professionals to discuss results, and enhancing the quality of prenatal care follow-up. It is anticipated that effective communication channels can lead to greater satisfaction among pregnant women in addressing perinatal depression-related issues. Evidence demonstrates that the utilization of mobile devices can expedite patient data gathering in an electronic format and in real-time.

In addition to having a positive impact on maternal and child health, the use of apps designed specifically for pregnant women has been shown to improve the quality of care that is provided, as well as to improve health indicators, reduce the number of maternal deaths, assist primary health practices, and lower the costs that are incurred by the health system. ANC is highly successful for pregnant women because it can make it easier for midwives to deliver services to pregnant women. Using the application allows health workers to carry out pregnancy services more effectively, which is why it is very effective for pregnant people. The ease with which one can obtain or download the desired application for free or at no cost, the stability and resilience of Android applications, the flexibility with which they can be programmed, the high level of security, the support from a variety of communities within the community, the simplicity of database management, the ability to support transactions, and the development of the software that is used are some of the advantages of Android applications (Kusyanti et al., 2022) (Musiiementa et al., 2022).





According to Sudirman (2017) , which expresses the opinion that the application is an effective method at this time because everyone uses a smartphone, pregnant women need the application to monitor pregnancy, pregnant women do not need to carry a KIA book with enough Android data on maternal and fetal development can be monitored and viewed through the Mya ADA application, and pregnant women need the application in monitoring pregnancy. Android applications are particularly influential in evaluating the effectiveness of information systems using the Systel Utility approach, according to research conducted by Widodo et al (2017) This research says that Android applications are quite influential. The user can obtain the needed information through mobile applications using a cell phone connected to the internet. This provides the user the convenience of utilizing mobile applications wherever they are as long as they are within the range of internet services.

#### 4. Conclusion

The effectiveness of the Antenatal Care Application, which is based on Android, can potentially increase compliance with antenatal care and the health of mothers. Antenatal care applications based on Android can be used to monitor antenatal care (ANC) for pregnant women using mobile devices in health services. These applications can also facilitate clinical data collection, increase pregnant women's compliance to routinely check their pregnancy, improve the quality of antenatal care services, provide information about the management and identification of risks during pregnancy, and increase the satisfaction of pregnant women. The Antenatal Care application system, which is based on Android and can be used on mobile devices, would be able to be utilized by all healthcare institutions that offer antenatal care services to enhance the quality of health services. By making prenatal care more accessible and giving pregnant women the knowledge and tools they are required to participate actively in their prenatal care, the Antenatal Care application, which is built on Android, has transformed the field of prenatal care.

#### 5. Compliance with ethical standards

##### Acknowledgements





The researchers would like to extend their sincere appreciation to all those who have contributed to the completion and publication of this study.

### Disclosure of conflict of interest

In this study, the researchers have stated there is no potential for a conflict of interest.

### Statement of informed consent

In our capacity as researcher, every action we perform constitutes a joint agreement or consent.

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