Indonesian Journal of Global Health Research
Volume 7 Number 1, February 2025
e-ISSN 2715-1972; p-ISSN 2714-9749
http://jurnal.globalhealthsciencegroup.com/index.php/IJGHR

PREGNANT WOMEN'S HEALTH MONITORING APPLICATION : SYSTEMATIC LITERATURE REVIEW

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ABSTRACT
Maternal mortality remains a major challenge in Indonesia, particularly due to limited access to health services and low awareness of the importance of regular pregnancy check-ups. The use of information technology in the health sector, such as telemedicine, has shown great potential in improving health services, including for pregnant women. This study aims to examine applications for monitoring the health of pregnant women with chronic energy deficiency (CED), which can support medical personnel and pregnant women in monitoring health effectively. The research design is a Systematic Literature Review of articles or journals published in 2019-2024, accessed on Google Scholar, PubMed and Scopus with the Prisma Flow technique. This study found that telemedicine and digital health applications have great potential in improving access and quality of maternal health monitoring. The Android-based system allows for effective monitoring of nutritional status, vital signs, and communication between pregnant women and medical personnel. The use of digital technology-based health applications can be an effective solution to support monitoring the health of pregnant women so that it can help reduce maternal mortality rates (MMR) and infant mortality rates (IMR) in Indonesia through wider and more efficient access to health information.

Keywords: digital health applications; health monitoring; information technology; KEK; maternal health; telemedicine

How to cite (in APA style)
A.E, N. W., Runjati, R., & Sunarjo, L. (2025). Pregnant Women's Health Monitoring Application : Systematic Literature Review. Indonesian Journal of Global Health Research, 7(1), 911-918. https://doi.org/10.37287/ijghr.v7i1.5261.

INTRODUCTION

Maternal mortality is still high in Indonesia. The use of information technology in the health sector, known as digital health or telemedicine, has many benefits, including the exchange of medical information for patients with health workers, medical services for differential diagnosis, and more efficient and cheaper health access. Along with the development of technology, many applications have been developed to meet the needs of pregnant women. (Adillah Nurazizah et al., 2023).Maternal health is an important aspect in efforts to improve the quality of life of the community, especially in the field of family health (Zuchro et al., 2022). During pregnancy, maternal health must be monitored regularly to ensure healthy fetal development and reduce the risk of complications (Eka Widyastuti et al., 2024). However, in Indonesia, access to adequate health services is still a challenge, especially for pregnant women in remote areas or areas with limited health facilities (Putri et al., 2024). Lack of understanding of the importance of pregnancy health checks is also an inhibiting factor that often causes delays in early detection of maternal and fetal health disorders (Novianto et al., 2024). This condition raises the need for a support system that can help pregnant women and medical personnel in carrying out regular and effective health monitoring, so that the risk of complications can be minimized (Yanti & Nurrohmah, 2023).

Each pregnant woman's weight gain is different, depending on her height and weight before pregnancy. Based on the calculation of BMI (Body Mass Index), weight gain during

pregnancy depends on her weight before pregnancy. Assessing the mother's weight before pregnancy is very important for the health of the mother and her baby. Various surveys have shown that chronic energy deficiency for pregnant women not only has a negative impact on the health status of her own risk of death, but also on the survival and development of the fetus she is carrying and further on the growth of the fetus until adulthood. Until now, there are still many pregnant women who experience nutritional problems. Fulfillment of nutrition for pregnant women plays a significant role in reducing the Maternal Mortality Rate (MMR), Infant Mortality Rate (IMR) and determining the quality of the child to be born. (Marianita Manik, 2022).

Pregnant women's weight gain is very important to support fetal development and prepare for the breastfeeding process (Mardiana & Ismarwanti, 2020). Nutritional parameters of pregnant women are seen from weight gain, which varies from 10-15 kg during pregnancy (Paramita, 2019). Mothers must record weight gain for monitoring, so that insufficient weight gain can be immediately made into a pregnancy nutrition program (Handayani et al., 2021). Weight monitoring as a form of early detection must be carried out by mothers using easy instruments (Gumilang & Hamidiyanti, 2020). The development of applications for monitoring the weight of pregnant women provides ease of use and reach by various user groups (Renhoran, 2023). The use of applications for monitoring nutritional status makes it easier to monitor the nutritional development of pregnant women and the growth and development of babies (Hijrawati et al., 2021).Various impacts can occur during the growth process of the fetus that will be born (Teguh et al., 2019). The nutritional status of pregnant women if they experience malnutrition or excess nutrition can cause many complications that can occur during pregnancy and have an impact on the health of the prospective baby. (Kementrian Kesehatan Republik Indonesia; Direktorat Jendral Bina Gizi dan KIA, 2014)The nutritional and health status of mothers before pregnancy, during pregnancy, and breastfeeding is a very critical period.

After reviewing the long-term and short-term impacts of the problem of KEK pregnant women, it is considered important to have a KEK Pregnant Women Monitoring Program because from a mother will give birth to future successors to the nation who can benefit the nation, so efforts must be made to ensure that pregnant women are in a healthy condition. KEK Pregnant Women Monitoring is an action to observe the development of pregnant women who have chronic energy deficiency conditions. The implementation of KEK Pregnant Women Monitoring is carried out by knowing the general condition of the pregnant woman and measuring vital signs such as blood pressure, pulse, respiration and temperature, then measuring body weight and LiLA size (Wahyuni & Huda, 2019).To overcome this problem, several studies have developed an application-based information system for monitoring the health of pregnant women (Muhimmah et al., 2023). Android is one part of a smart system that is very helpful in overcoming problems in society, one of which is in the health sector (Wicaksno and Mudiono, 2021). Currently, technological developments are very rapid and fast, including applications on mobile. The availability of mobile applications, in the future this research is very useful because of the communication features and can help in emergencies. Mobile applications are expected to be able to overcome the problems that have been explained. (Aliffiro Naufal & Muklason, 2022).

Through literature review, this study can identify current trends in the use of telemedicine and health applications, effective methods for monitoring the health of pregnant women, and challenges and opportunities in its implementation. This study also provides a strong theoretical basis for the development of technology-based information systems that are relevant to the needs of pregnant women and medical personnel. Therefore, this study is

relevant and important to support efforts to reduce the Maternal Mortality Rate (MMR) and Infant Mortality Rate (IMR) in Indonesia.This study aims to evaluate the effectivness of digital health applications, particulary for monitoring pregnant women with chronic energy deficiency (CED). Such applications are critical for addressing the unique health challenges faced by this group and ensuring timely interventions to reduce maternal and infant mortality rates (MMR and IMR). Understanding maternal weight gain, nutrition monitoring, and vital signs during pregnancy are pivotal in fostering maternal and fetal health. Many women in Indonsia still face nutritional challenges, underscoring th need for innovative, accesible tools to support health monitoring. Addressing these gaps through technology is essential for enhancing the quality of maternal health care.

METHOD

The research method used is Systematic Literature Review, with data sources in the form of journals, articles or research results in electronic databases published on the Google Scholar portal and Open Access Journal (PubMed). The inclusion criteria for the study include journal articles that are in accordance with the research topic, using Indonesian or English, published in the last 5 years (2019-2024), and can be accessed in full text. While articles or journals that cannot be accessed in full text will be executed from the study. Sampling was carried out by the first author, then reviewed by the two authors using the PRISMA diagram to select articles or journals that meet the research inclusion criteria. In addition, the selection process also considers the research questions set. If it does not answer one of the research questions, then the two authors agree to exclude the article.Relevant studies were selected based on criteria including relevance to maternal health or CED, availability in full text, and language (Indonesian or English). Data from selected articles were then extracted and synthesized to identify key trends, effective practices, and implementation barriers.

RESULT

From the literature review conducted, 10 articles were found that were relevant to the topic of maternal health monitoring. The research characteristics of these articles indicate that telemedicine technology and digital health applications have significant potential in improving access and quality of health services for pregnant women.The results of this study show a needs analysis of the development of a maternal health monitoring application. Manual recording is prone to data loss and damage if needed at any time (Lazarevic et al., 2023). The design of an Android application for pregnancy monitoring makes it easier for mothers or husbands to find out the condition of pregnant women. Health monitoring applications help in making decisions by providing guidance such as estimated gestational age, what to do during pregnancy, and also a map of the location of the nearest midwife or hospital (Renhoran, 2023). Other studies have stated that officers have difficulty monitoring the amount of nutritional fulfillment of pregnant women. It is necessary to develop technology to make it easier for the public to get information and make it easier for officers to monitor the weight and nutritional adequacy of pregnant women in an effort to reduce the risk of fetal disorders (Kholisotin et al., 2021).

Table 1.
Characteristics of literature findings articles (n= 10)

Title and Researcher	Research Design	Sample	Results
Design of Information System for Monitoring Pregnant Women's Health with Prototype Method.	Prototype method for information system development	Obstetrician and Gynecologist	The results of the study showed a 95% success rate of the application features in detecting changes in health indicators such as blood pressure, weight, and fetal heart rate. The system also has an average data processing time of 2 seconds, indicating

(Novianto et al., 2024)			good responsiveness. The notification feature has proven effective in providing early warnings to reduce the risk of pregnancy complications. In addition, the evaluation results show that the application can help pregnant women and medical personnel in monitoring health conditions in a more structured manner
Development of Healthcare Intelligence System Application for Maternal and Child Health Monitoring: Fronted Application Design. (Aliffiro Naufal & Muklason, 2022)	*Healthcare Intelligence System* application specifically for monitoring maternal and child health.	simulation using 35 *test cases* to ensure that all features in the application run according to specifications	The results of the study showed that the application was successfully developed with key features such as recording maternal and child health data, monitoring graphs, notification, and early warning systems. *Blackbox testing* showed that all application features functioned well and passed the technical test. This application is expected to help pregnant women and health workers in monitoring health more effectively. However, because the trial was conducted in a simulated environment, there is no data to prove the effectiveness of the application in the real world.
User Experience Design of Maternal Health Monitoring Application at POLINDES Based on Mobile Using Human Centered Design (HCD) Method. (Kalam et al., 2022)	Human-Centered Design (HCD) to design the user experience *of* the maternal health monitoring application at the Village Maternity Hospital (POLINDES)	5 pregnant women and 5 midwives were selected as respondents in the *usability testing.*	These results indicate that the application design is quite effective and efficient in supporting user needs, although the level of midwife satisfaction can still be improved.
Development of Mobile-Based Health Applications for Early Detection Monitoring of Growth and Development (Ddtk) of Children Aged 4-6 Years. (Wulandari & Pangastuti, 2020)	Quantitative with a modified R&D model approach	50 early childhood children and 5 pre-school teachers	The results of the study show that the mobile-based health application for monitoring early detection of growth and development (DDTK) in children aged 4-6 years has been declared valid by early childhood education experts and is suitable for use based on the results of small-scale trials.
Socialization of the Use of Stunting Case Monitoring Applications in Kemuning Lor Village, Jember Regency. (Mudiono et al., 2023)	Research and Development (R&D)	Integrated service post cadres in Kemuning Lor village, Jember Regency	As many as 90.31% of posyandu cadres said they were satisfied with the application to monitor babies with stunting. As a follow-up to this community service activity, the infant nutrition monitoring application can be developed and updated regularly. Application development can also be done from the integration side of several regions, so that it can be monitored widely for stunting cases.
NutriCare: A Nutrition Monitoring Application for Pregnant Women to Avoid Stunting by Meeting Calorie and Iron Needs.	Prototype method with stages starting from needs analysis, prototyping design, coding, implementation,	Pregnant mother	The use of the "NutriCare" application can significantly increase the efficiency and accuracy in providing food menu recommendations for pregnant women at the Hilda Alnaira Clinic.

(Maharani et al., 2022)	and maintenance.		
Android-Based Pregnant Women's Health Application. (Ardianto Pambudi, et al., 2020)	Rapid Application Development (RAD)	Pregnant women and midwives	The Maternity Health Application that has been created in the form of a prototype that can be run on the Android smartphones operating system. The use of the application is divided into two users, namely midwives and pregnant women. The superior feature of this application is that pregnant women can communicate with midwives to convey complaints, examination results and information about pregnancy. All of this data is equipped with date information, so it can be used as a pregnancy monitoring process. In addition, there is a menu for calculating the Estimated Date of Birth (HPL) which can be used to predict the baby's birth date.
Application of Patient Data and Determination of Pregnant Women's Nutrition at Sungai Tabuk Health Center. (Sari, 2019)	Observation and interview. This application is built using MySQL database with Visual Studio programming language,	Forming a group from a collection of files and data containing the purpose of utilizing data collection at the health center which still uses paper with piles of existing data.	Storage of files that take up a lot of space on the running system can be reduced with the application. The preparation and presentation of daily, monthly and even annual reports becomes easier, faster and more accurate.
The Influence of Ayo Dedis Android-Based Application on Increasing Knowledge of Balanced Nutrition Against Stunting in Pregnant Women. (SEKARWATI, 2022)	Pre-experimental design one group pretest and posttest design	20 respondents were pregnant women with an age range of 17-24 years.	Data analysis Research has the ability of balanced nutrition knowledge after being given the Ayo Dedis android application with the majority of balanced nutrition knowledge ability being good, there are 14 respondents. Proving that after being given balanced nutrition education intervention through the AyoDedis android-based early detection application, the subject's knowledge increased.
Gemas Application About Stunting Prevention Towards Increasing Knowledge And Attitude Of Pregnant Women. (Mulidah et al., 2023)	experiment with control group pretest and posttest design	Pregnant women located in the working area of Sokaraja 2 Health Center, have Android-based smartphones and are willing to be respondents.	The level of knowledge and attitudes of respondents about stunting prevention improved after being given health information on stunting prevention through the Gemas application on smartphones. Efforts to improve knowledge and attitudes can be done by using smartphone-based media because it is more practical, easy to access and almost everyone currently has the device.

DISCUSSION

The high maternal mortality rate (MMR) in Indonesia shows the need for active intervention. This literature review emphasizes the important role of information technology in improving health services for pregnant women. Digital applications and telemedicine not only increase access to health information but also facilitate communication between mothers and health care providers.Existing research underscores the utility of Android-based health applications in detecting rwal-time health indicators, such as blood pressure, weight, and fetal heart rate. For example, studies by (Maharani et al., 2022) dan (Lazarevic et al., 2023) demonstrated significant improvements in maternal health monitoring accuracy and efficiency through mobile health tools.Furthermore, user-centered designs, like the Human-Centered Design

(HCD) approach, enhance user satisfaction and adoption rates, as evidenced by Kalam et al. (2022). Community-based initiatives, such as the "Gemas" and "Ayo Dedis" applications, have effectively increased knowledge and attitudes toward nutrition and stunting prevention among pregnant women (Mulidah et al., 2023; Sekarwati, 2022).

The basic health service monitoring and evaluation information system for mothers based on android mobile is assembled with features in the form of functions that are in accordance with the needs of mothers. At this time, building and developing software requires the design of appropriate software specifications so that the software to be developed has a description of the function that is in accordance with the needs of each user (Pratama, Sulistiowati, & Maulana, 2016).Andorid mobile helps to build a system so that the system that has been created can be analyzed to determine its effectiveness such as designing applications that can be used on Android regarding maternal and child health. In this application there are several features that are very much needed by mothers.In addition (Pujiastuti, 2014) stated that the need for information about pregnancy in women who are pregnant with their first child, because it is known by women who are pregnant with their first child that there are many things that have never been felt before. Knowledge related to pregnancy is very necessary for women who are pregnant for the first time, such as experiencing the opening phase 1 to 10.

Based on research conducted by (Elliana & Kurniawati, 2015) states that with the use of mobile android technology as a health promotion strategy is expected to facilitate more complete and accurate information, reaching healthy individuals but not regularly come to health services. Based on this, the android mobile application/system that has been created can be a health promotion media especially for mothers and children.Based on the literature studied, it can be concluded that the development of digital health applications for pregnant women provides various significant benefits in supporting health monitoring. The majority of studies show that Android applications make it easier to record and monitor health indicators, such as blood pressure, weight, and fetal heart rate, which are important for early detection of the risk of pregnancy complications. These applications are also often equipped with notification features, monitoring graphs, and nutritional guides that help pregnant women and health workers.Several researchers emphasize the importance of users designed based on specific needs, such as Human-Centered Design (HCD) based designs that show a fairly high level of satisfaction although still need improvement. In addition, community-based applications such as “Gemas” and “Ayo Dedis” have proven effective in improving the knowledge and attitudes of pregnant women regarding stunting prevention and balanced nutrition.

These results are relevant to the main issue discussed in the article, namely the high maternal and infant mortality rates due to limited access to health services, especially in remote areas. Through the use of medicine technology and digital health applications, these obstacles can be overcome by providing easily accessible information and enabling more efficient communication between pregnant women and medical personnel. Thus, digital health applications can be one of the innovative solutions to support efforts to reduce maternal mortality rates (MMR) and infant mortality rates (IMR) in Indonesia.

CONCLUSION

The use of digital technology-based health applications can be an effective solution to support monitoring the health of pregnant women so that it can help reduce maternal mortality rates (MMR) and infant mortality rates (IMR) in Indonesia through wider and more efficient access to health information.

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