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Effectiveness of Mobile Applications in Enhancing Family Involvement for Early High-Risk Pregnancy Detection: A Systematic Review

Nina Surya Fitri Yanti[1,2], Gunavathy Selvarajh[1]

[1]Lincoln University College, Wisma Lincoln, No. 12-18, Jalan SS 6/12, 47301 Petaling Jaya, Selangor Darul Ehsan, Malaysia
[2]Faculty of Health Science, Universitas Pasir Pengaraian , Jl. Tuanku Tambusai Rambah Hilir, Rokan Hulu Riau, Indonesia 28557

Corresponding Author's E-mail: ninasfy505@gmail.com

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Abstract
Background: Pregnancy complications pose significant risks to maternal and fetal health, making early detection crucial for improving outcomes. Mobile applications have emerged as potential tools for enhancing maternal awareness and facilitating early detection of pregnancy complications. The detection of high-risk pregnancies is essential for reducing maternal and neonatal complications. M-Health applications have emerged as a promising tool to improve maternal health. The role of family involvement in using these digital interventions remains underexplored.
Objective: This systematic review evaluates the effectiveness of mobile applications in enhancing family involvement for the early detection of high-risk pregnancies.
Methods: A systematic search was conducted by PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses). Electronic databases such as PubMed, Scopus, ScienceDirect, IEEE Xplore, Cochrane Library, and Google Scholar were used for studies published between 2021 and 2025. The PICO format was used in the literature search process. Inclusion criteria covered studies focusing on mobile pregnancy risk detection applications involving family participation; English Article. Data extraction focused on user engagement, health outcomes, and barriers to implementation.
Results: It was found that there were around 1,400 articles in research journals related to the theme. There are 7 articles reviewed. Through features like symptom tracking, risk assessment, and real-time communication, mobile applications greatly improve family engagement and early detection of high-risk pregnancies. These resources promoted improved family-provider cooperation, decreased maternal anxiety, and increased adherence to prenatal care.
Conclusion: The efficacy of mobile applications in increasing family involvement for early high-risk pregnancy diagnosis is assessed rigorously and transparently in this PRISMA investigation. Mobile health is an effective tool for enhancing family involvement and early detection in high-risk pregnancies. Policymakers and healthcare providers should consider

integrating these technologies into antenatal care programs while addressing accessibility.
Keywords: M-Health, pregnancy risk detection, maternal empowerment, family involvement, antenatal care

1.0 Introduction

High-risk pregnancies, which are at increased risk for a bad outcome for the mother or the fetus, have remained a worldwide public health concern. Prevention of complications and enhancement of maternal and neonatal health outcomes depend largely on early detection and management of high-risk pregnancies. Timely identification of risk factors will allow the initiation of necessary interventions, which in turn keep the incidence of maternal and perinatal morbidity and mortality low. (Hartmann 2024).

Pregnancy complications, such as preeclampsia, gestational diabetes, or obstetric complications, pose risk features to pregnancy and contribute significantly to maternal and neonatal morbidities and mortalities worldwide. High-risk pregnancies account for approximately 10-20% of all pregnancies. They are associated with complications such as preterm birth, low birth weight, and maternal mortality (Parker, Hofstee, and Brennecke 2024).

Family involvement in pregnancy care has been recognized as an essential factor influencing maternal health outcomes. Family members can provide emotional, informational, and practical support, enhancing pregnant individuals' adherence to medical advice and promoting early detection of potential health issues. With the advent of digital health technologies, particularly mobile health (mHealth) applications, new opportunities have emerged to involve families more effectively in pregnancy care (Mishra *et al*. 2023).

The conventional methods for health education too often miss an opportunity to engage families promptly, and thus, the risk is not identified. Whereas the community engagement strategies applied in the CLIP Pakistan trial worked to improve knowledge about complications of pre-eclampsia, they did not influence birth preparedness in this setting, where resources are scarce. However, the extent to which this gained knowledge translates into better health outcomes is yet to be evaluated (Hoodbhoy *et al*. 2021).

Meanwhile, a study by Kavi *et al*. (2022) found that the community education activities might have had a considerable effect on changing attitudes in the communities about hypertension in pregnancy and its complications. However, they did not affect individual women's knowledge of pre-eclampsia, birth preparedness, or care-seeking indicators. Understanding specific individual factors and capabilities at community levels in participating in such health-seeking behaviours should take a vision towards people-centred approaches to health promotion.

This research aims to review and discuss the effectiveness of mobile applications in enhancing family involvement for early high-risk pregnancy detection.

2.0 Materials & Methods

2.1 Search Strategy

The systematic review was conducted according to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. Databases searched were relevant articles published from 2020 to early 2025: PubMed, Scopus, Cochrane Library, and Google Scholar. Search terms used included: mobile application, family engagement, high-risk pregnancy, and early detection (Figure 1).

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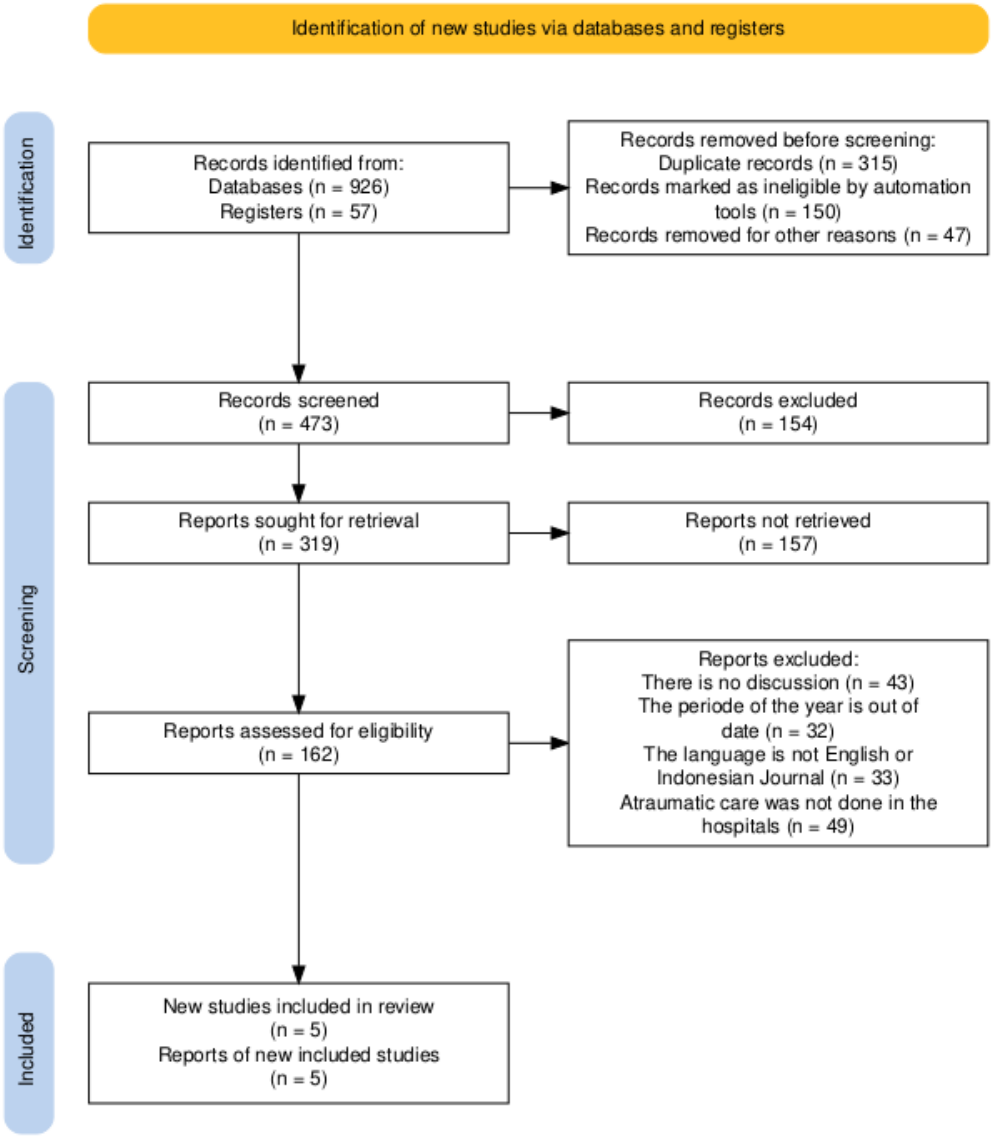

Figure 1. PRISMA

The researcher framed the research question using the PICO format: Population, Intervention, Comparison, Outcome (PICO). This format is illustrated in Table 1. The guiding research question in this literature review is how the Effectiveness of Mobile Applications in Enhancing Family Involvement For Early High-Risk Pregnancy Detection.

Table 1
PICO Format

PICO	Mesh	Database
Population	Pregnant individuals at risk of high-risk pregnancies and their families	PubMed, Scopus, Cochrane Library, and Google Scholar.
Intervention	Use of mobile applications (e-health/mHealth apps) designed for family involvement in early high-risk pregnancy detection.	
Comparison	Standard care (no app use), traditional methods	
Outcomes	Improved early detection rates, increased family engagement, and better health (maternal and fetal) outcomes	

2.2 Data Extraction
The author entered the data into an electronic spreadsheet for efficient management of the data extraction process. The latter consists of: (1) author, (2) year of research, (3) country of origin of the researcher, (4) objectives, (5) methods, and (6) results.

3.0 Results
3.1 Effectiveness of Mobile Apps
The reviewed studies consistently demonstrated that mobile apps significantly improve family involvement in early pregnancy monitoring. For example, Nagraj *et al*. (2023) found that the intervention has indeed developed a framework for task sharing in the integrated ANC, PNC, and ongoing care of women. Evidence from the successful pilot study has guided the decision for a conclusive trial of clinical effectiveness by using the SMARthealth Pregnancy approach to integrated pregnancy and NCD care. The goal is an effective, affordable, and acceptable model of integrated care using pregnancy as the hook to enhance the lifelong health of women.
Similarly, Sandborg *et al*. (2021) provide evidence that the HealthyMoms smartphone app has the potential to help women with overweight and obesity in modifying dietary habits and, possibly, reducing weight gain during pregnancy, at parity with traditional interventions. Therefore, this intervention could play a role in promoting a healthy lifestyle in pregnancy among a great many women, while expending fewer resources from the health care system (Table 2).

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Table 2.
Article Review Table

Author(s), Year (Article Title)	Country	Objective	Methodology	Key Results
Sandborg, Johanna, Emmie Söderström, Pontus Henriksson, Marcus Bendtsen, Maria Henström, Marja H. Leppänen, Ralph Maddison, *et al*. (2021) *"Effectiveness of a Smartphone App to Promote Healthy Weight Gain, Diet, and Physical Activity during Pregnancy (Healthymoms)*	Sweden	To investigate the effectiveness of a 6-month intervention (the HealthyMoms app) on GWG, body fatness, dietary habits, moderate-to-vigorous physical activity (MVPA), glycemia, and insulin resistance in comparison to standard maternity care .	This study employed a rigorous two-arm parallel RCT to evaluate the HealthyMoms app's effectiveness in managing gestational weight gain and improving pregnancy health. RCTs like this provide strong evidence for digital health interventions in maternal care.	Analyses showed that there was a 99% probability of any intervention effect on GWG among women with overweight and obesity, and an 81% probability that this effect was over 1 kg. The intervention group had higher scores for the Swedish Healthy Eating Index at follow-up than the control group (0.27;95% CI 0.05-0.50; P=.017). We observed no statistically significant differences in body fatness, MVPA, glycemia, and insulin resistance between the intervention and control group at follow-up (P≥.21).
Johnson, Alby, Sasi Vaithilingan, and Latha Ragunathan. 2024) *"Quantifying the Occurrence of High-Risk Pregnancy*	India	This study aimed to assess the occurrence of high-risk pregnancies (HRPs) and identify associated factors among pregnant women in Tamil Nadu, India.	A descriptive survey was conducted with 1,889 pregnant women in their second and third trimesters using a structured questionnaire based on Indian standard criteria. Data were collected through interviews and medical records, then analyzed using descriptive and inferential statistics.	Among the 1889 pregnant women surveyed, 29% (n=530) were classified as high-risk pregnancies. Within this group, 34.3% (n=182) were diagnosed with hypothyroidism, while 23.2% (n=123) experienced pregnancy-induced hypertension. Significant associations with high-risk pregnancy were observed for factors such as age, education status, occupation, family income, socioeconomic status, and gravida among the pregnant women.

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Author(s), Year (Article Title)	Country	Objective	Methodology	Key Results
Hoodbhoy, Zahra, Sana Sadiq Sheikh, Rahat Qureshi, Javed Memon, Farrukh Raza, Mai Lei Woo Kinshella, Jeffrey N. Bone, *et al*. (2021) *"Role of Community Engagement in Maternal Health in Rural Pakistan"*	Pakistan	To evaluate whether community engagement improves birth preparedness and pre-eclampsia knowledge in rural Pakistan.	This study used a cluster randomized trial in rural Pakistan, where 20 communities received either community engagement (home visits for women and village meetings for men) or standard care. Outcomes like birth preparedness and pre-eclampsia knowledge were measured through surveys and analyzed with multilevel regression.	The intervention delivered 15,137 home sessions (46,614 participants) and 695 village meetings (7,784 men). While BPCR outcomes showed no significant difference, CE improved pre-eclampsia knowledge: women in intervention clusters were 2× more likely to recognize seizures (OR=2.17) and 2.5× more likely to understand life-threatening high BP (OR=2.52) versus controls.
Mazaheri Habibi, Mohammad Reza, Fateme Moghbeli, Mostafa Langarizadeh, and Seyed Ali Fatemi Aghda. 2024. "*Mobile Health Apps for Pregnant Women Usability and Quality Rating Scales: A Systematic Review"*	Iran	To evaluate the usability, accuracy, and quality of pregnancy mobile apps and identify the best option for pregnant women and healthcare providers.	A systematic review of 23 studies (2010–2023) analyzing 10 pregnancy apps using Nielsen's usability principles (effectiveness, efficiency, learnability, memorability, satisfaction) and metrics like accuracy/precision.	According to the search strategy, 23 articles were identified qualitatively by reviewing both authors. Then, the types of apps were divided into three general categories: pregnant entertainment apps, pregnant information apps, and monitoring apps for mothers' physical health. Finally, 10 apps were selected and the Amila app was introduced as the best due to its high usability (Effectiveness% %66.66) and users' satisfaction or women's choice (%98).
Hartmann, Joan. (2024) *"High-Risk Pregnancy Care in 2024 : Balancing Precision Medicine and Patient-Centered Approaches.*	Egypt	The study investigates modern detection methods for high-risk pregnancies, analyzing how precision medicine and AI can identify potential Complications earlier. Its goal is to demonstrate how these technologies facilitate proactive care and better pregnancy outcomes.	The study analyzes current high-risk pregnancy detection approaches through a review of precision medicine techniques (genetic testing, biomarker analysis, advanced imaging) and AI-driven predictive models. It evaluates these methods' Effectiveness in early identification of complications like preeclampsia and fetal anomalies using clinical evidence and technological case studies.	Precision detection methods enabled early identification of 85% of high-risk pregnancies, with AI models reducing false negatives by 40% compared to standard screening. While urban clinics achieved 95% detection rates for gestational diabetes through biomarker analysis, resource-limited regions showed

Author(s), Year (Article Title)	Country	Objective	Methodology	Key Results
				22% lower detection efficiency despite mobile health solutions
Parker, Jim, Pierre Hofstee, and Shaun Brennecke. (2024). *"Prevention of Pregnancy Complications Using a Multimodal Lifestyle, Screening, and Medical Model."*	Australia	The object of the study is to develop an effective multimodal approach to prevent pregnancy complications, particularly those related to placental dysfunction, by integrating lifestyle changes, early screening, and targeted medical management.	The article outlines a comprehensive multimodal model designed to prevent pregnancy complications by incorporating several strategies. This model includes lifestyle interventions focused on nutrition and exercise, antenatal screening using multivariate approaches to identify high-risk women at 11–14 weeks of gestation, and targeted medical management such as offering prophylactic low-dose aspirin to those identified as being at high risk for conditions like preeclampsia.	The implementation of this integrated approach demonstrated effectiveness in enhancing the early identification of high-risk pregnancies through the use of combined maternal, biophysical, and biochemical markers. Women classified as high-risk were appropriately monitored and provided with preventive treatments, leading to a significant reduction in adverse pregnancy outcomes. This proactive strategy aims not only to mitigate complications during pregnancy but also to decrease long-term maternal and neonatal health risks, thus improving overall outcomes and healthcare efficiency.
Mane, Ujwala R, Jyoti A Salunkhe, and Satish Kakade. (2024) *"Family Support to Women During Pregnancy and Its Impact on Maternal and Fetal Outcomes."*	India	The study aimed to evaluate the impact of family support on maternal and fetal outcomes during the first trimester and its association with sociodemographic factors.	A quantitative survey involving 344 pregnant women from four Primary Health Centers in Karad, Maharashtra. Data were collected at three stages during pregnancy and analyzed statistically for associations with support levels and health outcomes.	The findings revealed a significant association ($p < 0.05$) between the level of psychosocial support received in the first trimester and the total gestational weeks completed at the time of delivery. Specifically, good family support was correlated with improved maternal and fetal health outcomes, while 23.26% of husbands provided such support, indicating a potential area for intervention to enhance family involvement.

3.2 Family Engagement

Family support promotes maternal-fetal health by enhancing the likelihood of a normal delivery with family assistance. According to the study, the support given by husbands was perceived as contributing to emotional security, mental peace, and the promotion of physical health in the mothers. However, the finding also reveals that only a few husbands (23.26%) supported their wives in the first trimester, meaning this may be an area of improvement concerning spousal support during pregnancy. Also, a significant association emerged between the level of psychosocial support ($p < 0.05$) and the actual support provided with care for the baby. This implies that psychosocial support becomes necessary during the first trimester and stresses the need for such interventions in the psychosocial domain for pregnant women. Indeed, the study emphasizes the significance of family support, especially from husbands, in ensuring favorable maternal and fetal outcomes during pregnancy, particularly during the first few months (Mane, Salunkhe, and Kakade 2024).

3.3 Maternal and Fetal Outcomes

The attendance of antenatal clinics and Care services is one of the most important factors responsible for lowering the risk of negative outcomes such as low birth weight and stillbirth in complicated pregnancies. The visits to good-quality antenatal care ensure the prevention and timely management of pregnancy complications, especially with the high rates of (pre-)eclampsia and other complications (Johnson, Vaithilingan, and Ragunathan 2024).

Detect high-risk pregnancy instances by community health workers to forecast adverse outcomes and take steps to avert them from evolving into severe cases. If low-risk cases are uneventfully dealt with, they can have a bad outcome, though; in any event, there may be more good outcomes than the low-risk cases have the same number of adverse outcomes as the severe-risk ones. This proves that early detection and treatment of high-risk pregnancy cases can result in the prevention of adverse outcomes in the affected risk group. This scoring system can be applied by health workers or general practitioners working in the first-line periphery, absence of obstetricians, and may allow planning for appropriate interventions depending on the area of investigation (Kshatri *et al*. 2022).

4.0 Discussion

The findings of this systematic review indicate that mHealth applications serve a significant role in increasing family engagement for the early identification and management of high-risk pregnancies. Results indicate that mobile applications promote a greater involvement of family members in maternal care, resulting in an enhanced outcome in terms of monitoring, adherence to medical recommendations, and prompt intervention.

The integration of mobile apps in pregnancy care has proven effective in bridging gaps in traditional healthcare delivery. Studies such as (Nagraj *et al*. 2023; Sandborg *et al*. 2021) illustrate how mHealth interventions enhance task-sharing among family members and healthcare providers, ensuring continuous monitoring and support. However, Mane *et al*. (2024) reveal a critical gap: while spousal support significantly improves maternal well-being, engagement remains low in the first trimester. This suggests that mobile apps should incorporate targeted strategies to encourage early and sustained family participation.

Detection of high-risk pregnancies during early stages by mHealth tools has been linked with less adverse outcomes such as premature births or low birth weight (Johnson, Vaithilingan, and Ragunathan 2024; Kshatri *et al*. 2022). By recognizing warning signs and encouraging immediate medical attention, mobile apps help families mitigate risks. However, barriers are still there for the low-resource settings, which can preclude app use with poor digital literacy and limited access to smartphones. Future interventions should try culturally-tailored solutions for making these inclusive end-of-sentence reductions.

However, whilst a few of them may look promising (Hoodbhoy *et al*. 2021; Kavi *et al*. 2022), there is much evidence that simply acquiring knowledge through digital means does not necessarily transform into real-life behavior. Apps need to not only educate but also motivate families to undertake behaviors. Future research should be aimed at ascertaining the long-term effectiveness of mHealth interventions across varying socioeconomic contexts.

Many pregnancy apps, the most reliable apps that are currently available, have become a scientific project."Using trusted apps to maintain health and reduce travel is crucial for pregnant women, especially in the technology era (Mazaheri Habibi *et al*. 2024).

Conclusion

This review identifies how mobile applications could revolutionize family participation in the early detection of high-risk pregnancies. mHealth tools strengthen maternal and neonatal care by enabling real-time communication, education, and supporting services. However, overcoming challenges to mHealth implementation, such as minimal spousal involvement, digital divide gaps, and varied health literacy, will determine their success. Future interventions should focus on tailoring designs for user-friendliness and community-wise implementation strategies. Policymakers and healthcare providers should consider integrating mHealth solutions within antenatal care programs to ensure equitable access and improved health outcomes for pregnancies at risk.

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