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Evaluating The Impact Of Android-Based Education On Early Preeclampsia Detection, Prompt Treatment, Antenatal Care Adherence, And Complication Prevention

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Abstract:

Background

This systematic review aims to comprehensively evaluate the impact of phone software application education on early preeclampsia detection, prompt treatment, antenatal care adherence, and the prevention of complications.

Methodology

The systematic screening process was aligned with PRISMA guidelines and used the help of key words placed on search engines. Inclusion and exclusion criteria were used to eliminate other studies. A thematic review was done and the 5 themes were based on detection (theme 1), prompt treatment (theme 2), antenatal care (theme 3), antenatal adherence (theme 4), and complication prevention (theme 5). To ascertain the quality of the selected studies, a thorough assessment of each study's methodological rigor was conducted using standardized tools such as the Newcastle-Ottawa Scale for observational studies and the Cochrane Risk of Bias tool for randomized controlled trials.

Results and Findings

Evaluating the impacts of android-based education software application on early preeclampsia detection, and the mhealth prompt treatment, antenatal care adherence on mobile phone-based telemonitoring programs, and complication prevention on app-based software revealed a multifaceted antenatal maternal healthcare with an examination of the My Healthy Pregnancy app's potential in improving the identification of high-risk pre-eclampsia patients emphasized the significance of prompt treatment.

Conclusion

In the pursuit of advancing antenatal maternal health outcomes, a synthesis of new knowledge emerges from the exploration of five key themes: detection, prompt treatment, antenatal care, antenatal adherence, and complication prevention.

Keywords: Android, preeclampsia, mobile, systematic review

Introduction

This systematic review aims to comprehensively evaluate the impact of phone app education on early preeclampsia detection, prompt treatment, antenatal care adherence, and the prevention of complications.

Preeclampsia, a hypertensive disorder occurring during pregnancy, poses significant risks to maternal and fetal health. Early detection and prompt treatment are crucial in preventing complications and ensuring optimal outcomes for both mother and child. In recent years, mobile health interventions, particularly those utilizing phone software platforms, have gained prominence as tools for healthcare education and management (Jongsma et al., 2021).

Preeclampsia, characterized by high blood pressure and organ damage, remains a leading cause of maternal and fetal morbidity and mortality globally (Adu-Gyamfi et al., 2020; Yoder et al., 2022). Timely identification of symptoms and adherence to antenatal care recommendations are vital components in the management of this condition. The integration of mobile technologies, specifically Android-based applications, offers a promising avenue for enhancing healthcare education and promoting proactive engagement with antenatal care protocols.

Antenatal care is a critical determinant of pregnancy outcomes, and have the potential to address barriers to maternal health (Bahri Khomami et al., 2021). By providing user-friendly interfaces and delivering culturally sensitive content, these applications can overcome geographical, linguistic, and cultural barriers that often hinder traditional healthcare delivery methods. The systematic review will explore the effectiveness of Android-based education in improving ANC adherence, considering factors such as user satisfaction, frequency of ANC visits, and overall pregnancy experience.

Complications arising from preeclampsia can have lasting implications for both mother and child (Buono et al., 2020). Android-based educations can play a pivotal role in preventing adverse outcomes by promoting awareness, education, and early intervention. The review will delve into existing literature to assess the impact of Android-based education on reducing complications associated with preeclampsia, including preterm birth, low birth weight, and maternal morbidity.

Methodology

The initial phase involved conducting an exhaustive literature search utilizing electronic databases, with key terms entered into search engines such as "preeclampsia," "Android-based education," and related variations, aimed at capturing a broad spectrum of articles pertinent to the systematic review's focus. To conduct a thorough and systematic examination aligned with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2021), this review meticulously searched electronic databases, including PubMed, Scopus, and Proquest.

A total of 80 studies were retrieved using key terms such as "preeclampsia," "Android-based education," and related variations. Truncation options were thoughtfully applied, and Boolean operators (AND, OR) were strategically used to refine the search and ensure the identification of relevant studies.

Following the initial screening of titles and abstracts, guided by the PRISMA guideline, the selected articles underwent a comprehensive full-text review for eligibility, ensuring strict adherence to the systematic approach (Selcuk, 2019). Inclusion criteria encompassed studies conducted within the time frame of 2020 to 2023, focusing specifically on the impact of Android-based education on early preeclampsia detection, prompt treatment, antenatal care adherence, and complication prevention. After a rigorous screening process, a targeted selection of articles, directly relevant to the systematic review's objectives, was achieved.

The systematic screening process, aligned with PRISMA guidelines and demonstrated in figure 1, ensures transparency, reproducibility, and accuracy throughout the evaluation. This meticulous approach aims to provide a robust synthesis of existing literature, evaluating the impact of Android-based education on the multifaceted aspects of preeclampsia management, including early detection, prompt treatment, antenatal care adherence, and complication prevention.

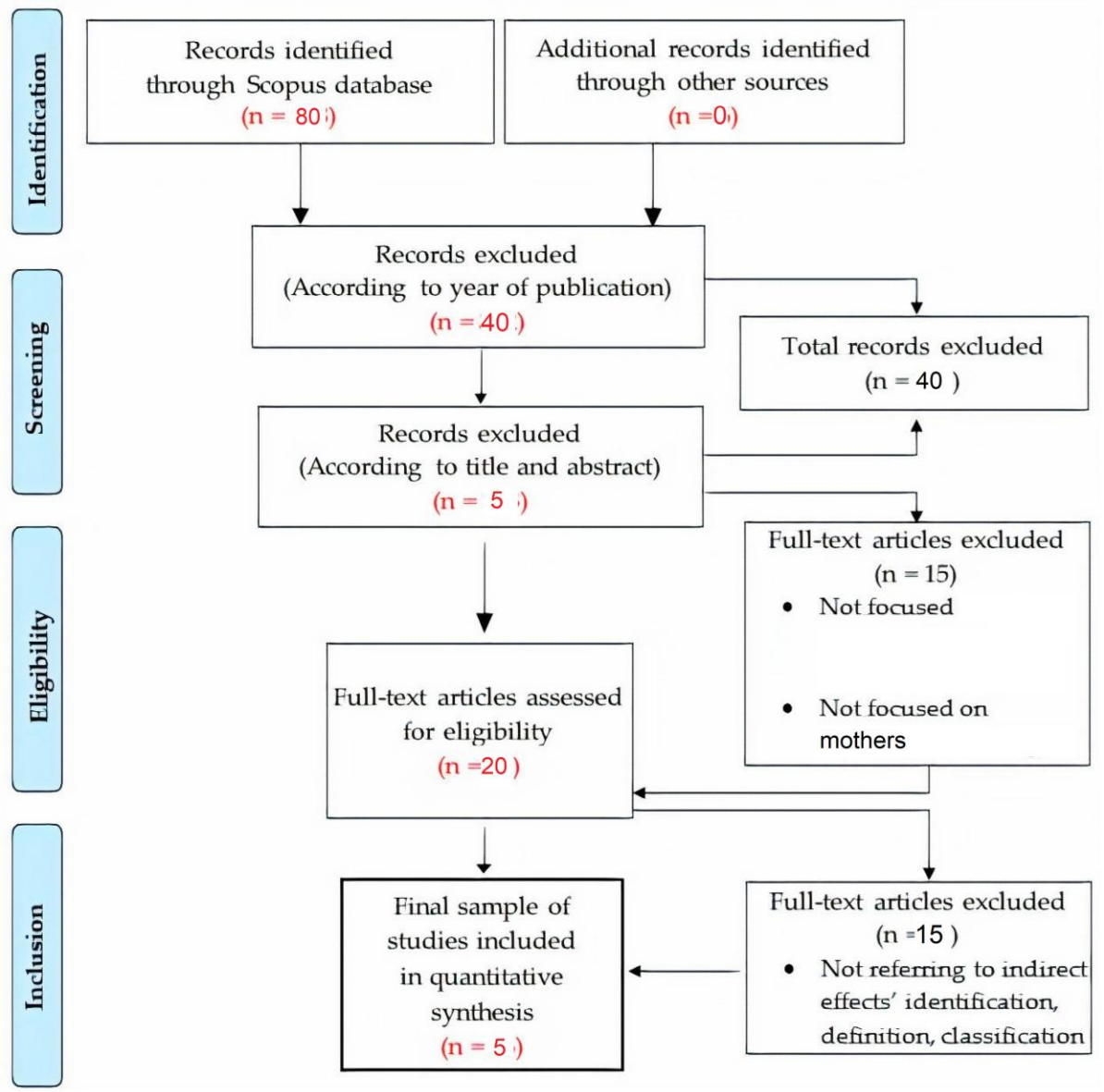

Figure 1. PRISMA guideline

Upon retrieving the initial set of articles, a meticulous removal of duplicates was undertaken to ensure the uniqueness of each study (Patel et al., 2022). Subsequently, the titles and abstracts of the remaining articles underwent scrutiny to eliminate studies that were evidently irrelevant or misaligned with the research question. The primary inclusion criterion was the consideration of studies explicitly discussing the impact of Android-based education on early preeclampsia detection, prompt treatment, antenatal care adherence, and complication prevention.

Following the initial screening, the full texts of the chosen articles underwent comprehensive evaluation to determine their eligibility for inclusion, adhering to rigorous criteria (Page, McKenzie, et al., 2021). Any discrepancies or disagreements were resolved through discussion and consultation, leading to the final selection of five articles in collaboration with other reviewers. The studies meeting all inclusion criteria were then included in the conclusive analysis (Gray & Grove, 2020).

To ascertain the quality of the selected studies, a thorough assessment of each study's methodological rigor was conducted using standardized tools such as the Newcastle-Ottawa Scale for observational studies (Norris et al., 2021) and the Cochrane Risk of Bias tool for randomized controlled trials (Andersen et al., 2020). Studies demonstrating low methodological quality underwent careful scrutiny for potential bias and their potential impact on the overall findings of the systematic review was considered (Page et al., 2021).

A thematic review was done and the 5 themes were based on detection (theme 1), prompt treatment (theme 2), antenatal care (theme 3), antenatal adherence (theme 4), and complication prevention (theme 5).

The systematic screening process ensured the inclusion of only high-quality, pertinent, and reliable studies in the analysis (table 1), thereby fortifying the credibility and validity of the review's findings.

Results and Findings

Of the 80 articles selected from databases, only five were used in this systematic review to address the 5 themes as a method of data analysis.

Theme 1: Detection

According to Feroz et al., (2023), limited knowledge exists regarding caregivers' perspectives on the utilization of telemonitoring (TM) interventions in low-middle-income countries. Recognizing the interconnectedness of caregiving activities with the social, emotional, and clinical outcomes of pregnant women underscores the importance of understanding caregivers' viewpoints on TM interventions. This research aims to investigate caregivers' perspectives and their perceived acceptability of a mobile phone-based TM program designed to

support pregnant women at high risk for preeclampsia. Employing a qualitative description design, 28 semi-structured interviews were conducted and analyzed with a diverse group of caregivers at the Jinnah Post Graduate Medical Center in Karachi, Pakistan. Caregivers were purposefully sampled, and additional interviews were conducted until data saturation was achieved. Utilizing the conventional content analysis technique, digital audio recordings of caregiver interviews were thoroughly examined. The findings according to Feroz et al., (2023) revealed unanimous support among caregivers for the proposed mobile phone-based TM program, attributing numerous benefits, including reduced caregiver anxiety and workload, enhanced convenience, and cost-effectiveness. However, caregivers highlighted potential challenges for the future implementation of the TM program, such as the limited capacity of some women and caregivers to use the TM system and the reluctance of less educated and non-tech-savvy families to embrace the TM system. The study recommends the development of a TM program to alleviate caregiver stress and workload, the design of a context-specific TM program using a user-centric approach, comprehensive training for caregivers in TM program usage, awareness campaigns to enlighten caregivers about the benefits of the TM program, and the creation of a cost-effective TM program to ensure widespread accessibility.

Theme 2: Prompt treatment

According to Krishnamurti et al., (2021) a patient cohort comprising 2,563 participants (79% white; mean age, 30 years [SD 5.2]) with a total of 2,567 pregnancies. Of these pregnancies, 73.3% were among women with private or employer-based insurance, and 48.5% were among nulliparous patients. Approximately 12.3% of pregnancies reported at least one factor associated with a high risk for preeclampsia, while 40.9% reported two or more factors associated with moderate risk. Out of 1015 pregnancies where patients voluntarily provided information about aspirin use, 12.2% met at least one criterion for the highest risk of preeclampsia. Among these pregnancies, 46.0% reported receiving a low-dose aspirin (LDASA) recommendation from their practitioner, but upon examination of medical records, 72.6% had evidence of an LDASA recommendation, and 27.4% did not. Among the pregnancies with a documented LDASA recommendation, 36.7% of patients were unaware of it. Previous preeclampsia (28 weeks' gestation: odds ratio, 20.1; 95% CI, 11.0-36.9) and chronic hypertension (28 weeks' gestation: odds ratio, 17.4; 95% CI, 6.3-48.2) were identified as the

primary high-risk factors associated with LDASA recommendation. This cohort study reveals that only 46.0% of prenatal care app users at the highest risk of preeclampsia reported receiving an LDASA recommendation, suggesting potential miscommunication between patients and practitioners. The findings highlight the potential role of digital tools like the MyHealthyPregnancy app in improving the identification of patients at risk for preeclampsia and facilitating communication about aspirin use.

Theme 3: Antenatal care

According to Parsa et al., (2019), after the development of a mobile application focusing on pre-eclampsia, a controlled before-and-after study was conducted over a three-month period in 2018. The study targeted pregnant women attending obstetrician clinics and offices in Kerman, Iran, with a total of 110 participants divided into intervention and control groups. At baseline and a 1-month follow-up, participants completed a pre-eclampsia knowledge questionnaire. The study involved 108 pregnant women, averaging 28 years of age. No significant difference was observed between the scores of the two groups before the intervention ($p=0.94$). However, there was a highly significant difference after the intervention ($p<0.001$). The knowledge improvement within both groups was significant ($p<0.05$). The results indicated a significant association between the participants' knowledge scores after the intervention, their group assignment, and their assessment scores before the intervention ($p<0.001$). This study underscores the potential impact of an Android-based education application on enhancing pre-eclampsia knowledge among pregnant women attending antenatal care in Kerman, Iran.

Theme 4: Antenatal adherence

According to Choudhury et al., (2023) In light of the National Family Health Survey of 2021, which reveals a notable increase in anemia prevalence among women aged 15-49 in India from 53% in 2016 to 57%, and a separate study indicating a 32.60% prevalence of preeclampsia in southern India, this research investigates the potential of mobile health (mHealth) interventions to address these public health challenges. Despite various community-based initiatives, achieving desired outcomes has proven challenging. This study aims to explore whether technological advancements can overcome the hurdles faced by traditional healthcare

interventions. Specifically, it assesses pregnant mothers' perceptions of mHealth interventions in managing anemia and preeclampsia, along with their health awareness and knowledge levels. A survey involving 131 pregnant mothers in three underserved villages in Jharkhand, India, was conducted to gather insights. Statistical analysis, utilizing the non-parametric partial least squares-structural equation modeling through the SEMinR package in R (Version 2023.06.0), was employed. Notably, each household owned at least one smartphone, with the respondents primarily utilizing these devices for calling, messaging, and social media. A significant 61% of respondents expressed interest in a nutrition and pregnancy app, while 23.66% remained uncertain. In terms of nutritional knowledge during pregnancy, 68.7% reported having some knowledge, yet only 11.45% claimed comprehensive knowledge. A notable knowledge gap was identified regarding critical nutrients required during pregnancy and the recommended foods for a healthy pregnancy diet. Furthermore, awareness of pregnancy-related conditions, such as anemia and preeclampsia, was low. Most respondents were uncertain about the primary causes, impacts, and symptoms of these conditions. This study represents a crucial step toward harnessing technology to improve public health outcomes in low-resource settings. With widespread access to mobile devices and a demonstrated willingness to use mHealth apps, coupled with the urgent need for enhanced maternal health, the imperative for action is clear. Seizing this opportunity is vital, ensuring that technology's potential is fully realized and not wasted, thereby avoiding the risk of a widening digital divide.

Theme 5: Complication prevention

According to Kókai et al., (2022) 35 patients from the Follow-Up PreEClampsia Outpatient Clinic (FUPEC) at Erasmus MC in the Netherlands had women's needs for health behavior promotion and their preferences for intervention delivery to prevent preeclampsia. The primary focus of women's health behavior promotion needs included fat and sugar intake, physical activity, mental health practices, fruit and vegetable intake, salt intake, water intake, and, for a minority, alcohol and tobacco use. The majority expressed a preference for app-based interventions, with a hierarchy of features in descending order: tracking health-related metrics, an interactive platform, utilization of behavior change strategies, provision of information, and personalization. Ensuring the relevance of cardiovascular health promotion for women with prior severe preeclampsia is crucial. App-based interventions are likely to be well-received when

addressing fat and sugar intake and physical activity, incorporating features such as health metric tracking, interactivity, behavior change strategies, informative content, and personalization. Integrating these insights into intervention design holds the potential to enhance uptake, promote behavior change, and sustain these changes within this specific population.

Table 1. Results and findings

Authors & year	Design	Aim	Theme	Findings
Feroz et al., (2023)	Qualitative conventional content analysis	To investigate caregivers' perspectives and their perceived acceptability of a mobile phone-based TM program	Detection	Mobile phone-based TM program for high-risk pregnant women, indicating potential benefits for early preeclampsia detection.
Krishnamurti et al., (2021)	Cohort study	To determine the potential role of digital tools like the MyHealthyPregnancy app in improving the identification of patients at risk for preeclampsia	Prompt treatment	MyHealthyPregnancy app improved the treatment of patients at risk for preeclampsia
Parsa et al., (2019)	Cross sectional	To identify the impact of an Android-based education application on enhancing pre-eclampsia knowledge among pregnant women attending antenatal care	Antenatal care	Android-based education application enhanced pre-eclampsia knowledge
Choudhury et al., (2023)	Cross sectional survey	To evaluate mHealth apps, coupled with the urgent need for enhanced maternal health	Antenatal adherence	Adherence to treatment of pregnancy-related conditions, such as preeclampsia, was achieved
Kókai et al., (2022)	Qualitative focus group	To explore preference for app-based interventions in order to prevent pre-eclampsia complications	Complication prevention	App-based interventions are likely to prevent complications of pre-eclampsia on fat and sugar intake and

				physical activity, incorporating features such as health metric tracking, interactivity, behavior change strategies, informative content, and personalization.

Acquiring the results found on table1 requires a rigorous discussion in order to synthesize new knowledge.

Discussion

In the pursuit of advancing antenatal maternal health outcomes, a synthesis of new knowledge emerges from the exploration of five key themes: detection, prompt treatment, antenatal care, antenatal adherence, and complication prevention.

Detection (Theme 1):

The investigation into caregivers' perspectives on a mobile phone-based TM program reveals a promising avenue for early detection of pre-eclampsia risks. By understanding the acceptability of such digital tools among caregivers, the study sheds light on a potential strategy to identify and address pre-eclampsia risks in pregnant women (Munda et al., 2023; Püschl et al., 2023).

Prompt Treatment (Theme 2):

The study examining the potential role of the MyHealthyPregnancy app in improving the identification of patients at risk for preeclampsia emphasizes the importance of prompt treatment. By leveraging digital tools, this research suggests that timely interventions can be facilitated, ensuring that pregnant women at risk receive the necessary care and treatments promptly, thereby mitigating the severity of pre-eclampsia (Tamrat et al., 2023; Yew et al., 2021).

Antenatal Care (Theme 3):

The impact of an Android-based education application on enhancing pre-eclampsia knowledge among pregnant women attending antenatal care underscores the pivotal role of educational interventions in antenatal care settings. Integrating technology into antenatal care can empower pregnant women with knowledge, fostering informed decision-making and proactive engagement in their healthcare (Feng et al., 2023; Vandenberk et al., 2019).

Antenatal Adherence (Theme 4):

The evaluation of mHealth apps and their alignment with the urgent need for enhanced maternal health emphasizes the significance of antenatal adherence. By utilizing mobile health applications, there is a potential to enhance adherence to antenatal care recommendations, ensuring that pregnant women follow prescribed interventions, leading to improved health outcomes (Charanthimath et al., 2021; Chen et al., 2018).

Complication Prevention (Theme 5):

Exploring the preference for app-based interventions to prevent pre-eclampsia complications reflects a forward-looking approach to maternal healthcare. By understanding and catering to the preferences of pregnant women for digital interventions, there is an opportunity to design targeted strategies that effectively prevent and mitigate complications associated with pre-eclampsia (Hasan et al., 2020; Nuruddin et al., 2021).

In essence, these five themes collectively contribute to a holistic understanding of how digital tools, caregiver perspectives, education applications, and can synergistically enhance the detection, prompt treatment, antenatal care, adherence, and prevention of complications related to pre-eclampsia. The synthesis of this knowledge not only informs the current state of maternal healthcare but also paves the way for future interventions that leverage technology to optimize outcomes for pregnant women at risk of pre-eclampsia (Villar et al., 2021).

The use of Android-based education for early preeclampsia detection becomes significant in light of the ubiquity of smartphones and the increasing penetration of mobile technologies,

particularly in resource-constrained settings (Krishnamurti et al., 2021). Android applications have the potential to deliver tailored and accessible educational content to pregnant women, empowering them with knowledge about the signs and symptoms of preeclampsia (Miller & Hill, 2018). Moreover, these applications can facilitate regular monitoring of vital signs, such as blood pressure, allowing for early detection and timely intervention (Shantharam et al., 2022).

The focus on prompt treatment is integral to mitigating the progression of preeclampsia and preventing severe complications (Jung et al., 2022). Android-based platforms offer a dynamic medium for delivering real-time information on treatment options, medication adherence, and lifestyle modifications (Ma'ayeh & Costantine, 2020). Through interactive features and push notifications, these applications can serve as personalized health companions, guiding pregnant women through their treatment plans and fostering a sense of agency in managing their health (Overton et al., 2022; Venkatesan et al., 2023).

Conclusion

Evaluating the impact of Android-based education on early preeclampsia detection, and the mhealth prompt treatment, antenatal care adherence on mobile phone-based TM programs, and complication prevention on app-based software reveal a nuanced and multifaceted antenatal maternal healthcare. The exploration of this study's perspectives elucidates the potential for early detection, highlighting the crucial role technology can play in identifying pre-eclampsia risks. This theme underscores the importance of incorporating digital tools into the maternal healthcare framework to proactively address complications and enhance overall detection capabilities. In tandem, the examination of the MyHealthyPregnancy app's potential in improving the identification of high-risk patients emphasizes the significance of prompt treatment. By leveraging mobile applications, healthcare providers can streamline the identification process, allowing for timely interventions and mitigating the severity of pre-eclampsia. This theme underscores the transformative power of digital tools in facilitating prompt and targeted treatments, ultimately contributing to improved maternal health outcomes. The seamless integration of technology into early detection and prompt treatment aligns with the broader objective of advancing maternal care in an era where accessibility and efficiency are paramount.

In conclusion, the systematic review will synthesize existing evidence to provide insights into the effectiveness of Android-based education in the realm of preeclampsia management. By

evaluating its impact on early detection, prompt treatment, ANC adherence, and complication prevention, this review aims to contribute valuable knowledge for healthcare providers, researchers, and policymakers working towards improving maternal and fetal health outcomes. The integration of mobile health solutions has the potential to revolutionize antenatal care and contribute to a comprehensive approach in addressing the challenges posed by preeclampsia.

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