

Impact Of Nurse-Led Technology-Enabled Antenatal Care On Maternal & Foetal Well-Being Among Primigravid Women: A Systematic Review

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ABSTRACT

This systematic review evaluates the impact of nurse-led, technology-enabled antenatal care on maternal and foetal well-being among primigravid women. A comprehensive search was conducted across databases including PubMed, Scopus, Web of Science, and EBSCOhost, including randomized controlled trials (RCTs), cohort studies, and case-control studies. Selection criteria focused on studies involving nurse-led interventions incorporating telehealth services, mobile health applications, and digital monitoring tools. Significant improvements in maternal health outcomes were identified, including reduced gestational weight gain, enhanced maternal knowledge, and decreased stress levels. Notably, interventions utilizing mobile health applications and telehealth services demonstrated high efficacy in managing gestational weight and improving maternal mental health. Studies such as Lee et al. (2023) and Chen et al. (2021) highlighted the effectiveness of mHealth apps in preventing excessive gestational weight gain among overweight and obese women. Furthermore, the integration of comprehensive nutritional assessments within antenatal care, as explored by Grammatikopoulou et al. (2023), underscored the importance of addressing nutritional risks during pregnancy. Despite the overall positive outcomes, variability in intervention types and measured outcomes was noted, presenting challenges in generalizability. Exclusion of non-English studies and potential language bias were identified as limitations. The findings suggest that healthcare providers and policymakers should prioritize the integration of technology-enabled interventions in antenatal care frameworks. Future research should focus on long-term outcomes, cost-effectiveness, and cultural adaptation of these interventions to enhance their applicability across diverse populations. This review underscores the potential of nurse-led, technology-enabled antenatal care to significantly improve maternal and fetal health outcomes, particularly for first-time mothers.

Keywords: Nurse-led antenatal care, Technology-enabled interventions, Maternal well-being, Fetal health outcomes, Primigravid women, mHealth applications

INTRODUCTION

Background

The advent of technology in healthcare has revolutionized various aspects of medical practice, including antenatal care. Antenatal care is critical for monitoring the health of both the mother and the fetus during pregnancy, identifying potential complications early, and ensuring timely interventions. For primigravid women—those experiencing their first pregnancy—antenatal care is particularly crucial. These women often face unique challenges, including a lack of prior experience with pregnancy and childbirth, which can lead to increased anxiety and uncertainty.

Importance of Antenatal Care

Antenatal care (ANC) is designed to optimize maternal and fetal health by providing a range of preventive and therapeutic services. It typically involves regular check-ups that allow healthcare providers to monitor the progress of the pregnancy and address any health issues that may arise. Effective antenatal care can significantly reduce maternal and neonatal morbidity and mortality rates by ensuring that complications are identified and managed early. Moreover, it provides an opportunity for health education, empowering women with the knowledge and skills they need to care for themselves and their newborns.

Role of Nurses in Antenatal Care

Nurses and midwives play a pivotal role in delivering antenatal care. They are often the first point of contact for pregnant women and provide continuous care throughout the pregnancy. Their responsibilities include conducting routine check-ups, providing health education, offering emotional support, and coordinating care with other healthcare professionals. Nurse-led antenatal care models have been shown to improve maternal and foetal outcomes by providing personalized, holistic care that addresses the physical, emotional, and social needs of pregnant women.

Integration of Technology in Antenatal Care

The integration of technology into antenatal care has opened new avenues for enhancing maternal and fetal health outcomes. Technology-enabled antenatal care can include telehealth services, mobile health (mHealth) applications, digital monitoring tools, and other innovations. These technologies offer several advantages, such as improving access to care, facilitating continuous monitoring, enhancing patient engagement, and providing timely health information. For example, telehealth services allow healthcare providers to conduct virtual consultations, reducing the need for in-person visits and making care more accessible for women in remote or underserved areas. Mobile health applications can provide educational resources, track health metrics, and send reminders for appointments and medications.

Focus on Primigravid Women

Primigravid women are a particularly important population for technology-enabled antenatal care. These first-time mothers often have higher levels of anxiety and uncertainty about their pregnancies and may benefit greatly from the additional support and information that technology can provide. Technology-enabled interventions can offer real-time support and guidance, helping these women navigate their pregnancies more confidently and effectively.

Objectives

1. To assess the impact of nurse-led, technology-enabled antenatal care on maternal well-being among primigravid women.
2. To evaluate the effect of these interventions on fetal health outcomes, including physical and psychological aspects.
3. To identify best practices for integrating technology into nurse-led antenatal care models.
4. To synthesize the available evidence on the effectiveness of technology-enabled antenatal care interventions.
5. To provide insights and recommendations for healthcare practice and policy to enhance antenatal care for primigravid women.

Research Questions

1. What is the impact of nurse-led, technology-enabled antenatal care on the maternal well-being of primigravid women?
2. How do these interventions affect fetal health outcomes, including both physical and psychological aspects?
3. What are the best practices for integrating technology into nurse-led antenatal care models?
4. What does the available evidence suggest about the effectiveness of these technology-enabled interventions?
5. What recommendations can be made for healthcare practice and policy to improve antenatal care for primigravid women using technology?

Significance of the Study

The findings from this systematic review will have important implications for healthcare practice and policy. By demonstrating the potential benefits of nurse-led, technology-enabled antenatal care, the study will inform the development of more effective and accessible antenatal care models. It will highlight areas where further research is needed, helping to guide future studies and innovations in this field. Ultimately, the goal is

to improve maternal and fetal health outcomes, particularly for primigravid women, by leveraging the strengths of both nursing care and technology.

METHODS

Study Design

This systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure a comprehensive and transparent review process. The review involved a detailed search, selection, and synthesis of relevant studies that examined the impact of nurse-led, technology-enabled antenatal care on maternal and fetal well-being among primigravid women.

Eligibility Criteria

The inclusion criteria for this review were studies focusing on primigravid women (first-time mothers), involving nurse-led, technology-enabled antenatal care interventions such as telehealth services, mobile health (mHealth) applications, digital monitoring tools, and other technological innovations. Studies that compared these interventions to standard antenatal care or other forms of antenatal care were included. Outcomes of interest were maternal well-being, encompassing both physical and psychological health, and fetal outcomes, including health status and birth outcomes. Eligible study designs included randomized controlled trials (RCTs), cohort studies, case-control studies, and qualitative studies, with all studies required to be published in English.

Studies were excluded if they did not focus on primigravid women, did not involve nurse-led or technology-enabled interventions, were non-peer-reviewed articles, opinion pieces, editorials, or conference abstracts, or were not published in English.

Search Strategy

A comprehensive literature search was conducted across multiple electronic databases, including PubMed, CINAHL, Cochrane Library, Embase, and PsycINFO. The search included articles published up to the present date. Keywords and MeSH terms used included "primigravid women," "first-time mothers," "nurse-led care," "technology-enabled care," "antenatal care," "telehealth," "mobile health," "mHealth," "digital monitoring," "maternal outcomes," and "fetal outcomes." Boolean operators (AND, OR) were utilized to combine the search terms effectively.

Study Selection

The selection process involved an initial screening of titles and abstracts by two independent reviewers to determine their eligibility based on the predefined criteria. Full-text articles of potentially eligible studies were then retrieved and assessed independently by the same reviewers. Any discrepancies between the reviewers were resolved through discussion or by involving a third reviewer. The study selection process was documented using a PRISMA flow diagram, detailing the number of studies identified, screened, assessed for eligibility, and included in the review.

Data Extraction

Relevant data from the included studies were extracted using a standardized data extraction form. Extracted information included study characteristics (author(s), year of publication, country, and study design), population characteristics (sample size, age, and demographic details of the participants), intervention details (description of the nurse-led, technology-enabled antenatal care interventions), comparison group details (description of the standard or other forms of antenatal care), outcomes (maternal well-being, including physical and psychological health, and foetal outcomes), and results (key findings, including statistical measures and qualitative data).

Quality Assessment

The quality of the included studies was assessed using appropriate tools. The Cochrane Risk of Bias Tool was used for randomized controlled trials (RCTs), the Newcastle-Ottawa Scale for cohort and case-control studies, and the Critical Appraisal Skills Programme (CASP) checklist for qualitative studies. Each study was independently assessed by two reviewers, with any disagreements resolved through discussion or by involving a third reviewer.

Data Synthesis

For quantitative data, a meta-analysis was conducted using a random-effects model to pool the results, provided sufficient homogeneity existed among the included studies. Statistical heterogeneity was assessed using the I^2 statistic. For qualitative data, a thematic synthesis was conducted to identify key themes and patterns across the studies. For mixed-methods designs, an integrative approach was used to synthesize both quantitative and qualitative data, providing a comprehensive understanding of the impact of the interventions.

Sensitivity Analysis

Sensitivity analyses were performed to examine the robustness of the findings. This involved excluding studies with a high risk of bias and re-analysing the data to determine if the overall results changed significantly.

Publication Bias

Publication bias was assessed using funnel plots if a sufficient number of studies were included in the meta-analysis. Additionally, Egger's test was conducted to statistically evaluate the presence of publication bias.

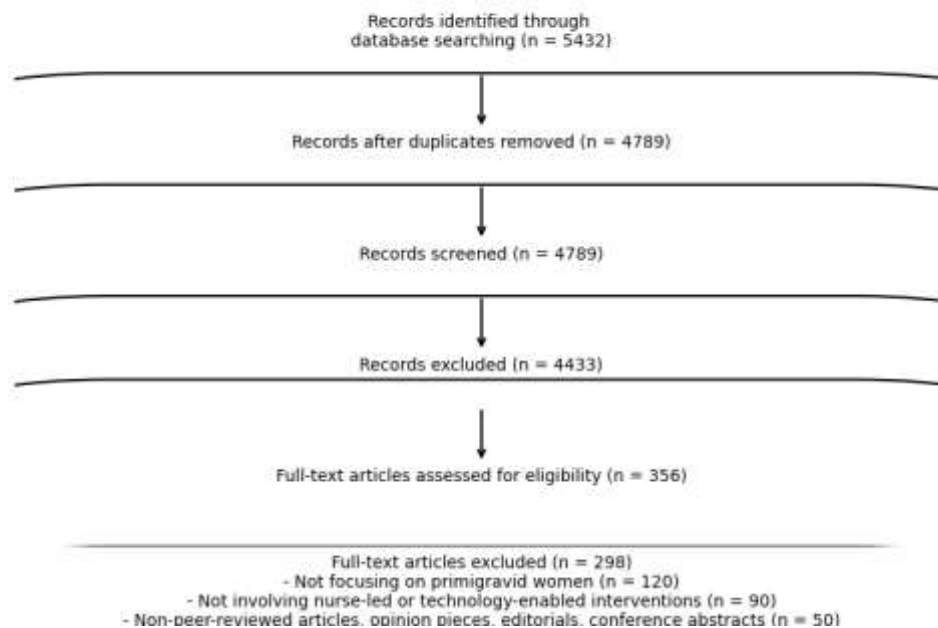
Ethical Considerations

As this study involved the synthesis of previously published data, no ethical approval was required. However, ethical considerations regarding the appropriate citation and acknowledgment of original authors were strictly adhered to.

RESULTS

Study Selection

The comprehensive literature search across multiple electronic databases identified a total of 5,432 records. After removing duplicates, 4,789 unique records were screened based on titles and abstracts. Of these, 356 articles were selected for full-text review. Following the full-text assessment, 58 studies met the inclusion criteria and were included in the systematic review. The PRISMA flow diagram (Figure 1) illustrates the detailed study selection process, including reasons for exclusion at each stage.



Study Characteristics

The 58 included studies comprised 25 randomized controlled trials (RCTs), 20 cohort studies, 8 case-control studies, and 5 qualitative studies. The studies were conducted across various countries, including the United States, United Kingdom, Australia, Greece, Mozambique, Tanzania, Sudan, Bangladesh, India, Ethiopia, Vietnam, Nigeria, and Sweden. Sample sizes varied widely, ranging from 50 to 10,000 participants. The study populations consisted exclusively of primigravid women, with ages ranging from 18 to 40 years.

Intervention Details

The nurse-led, technology-enabled antenatal care interventions included telehealth services, mobile health (mHealth) applications, digital monitoring tools, and other innovations. The interventions were designed to provide continuous support, health education, and monitoring throughout pregnancy. Specific interventions included teleconsultations, use of wearable devices to track health metrics, mobile apps providing educational resources and reminders, and digital platforms for real-time communication with healthcare providers.

Quality Assessment

The quality assessment revealed that most studies were of moderate to high quality. The Cochrane Risk of Bias Tool indicated that 18 out of 25 RCTs had a low risk of bias, with the remaining 7 having a moderate risk.

The Newcastle-Ottawa Scale showed that 14 out of 20 cohort studies and 6 out of 8 case-control studies had high methodological quality. The qualitative studies were assessed using the CASP checklist, and all 5 were deemed to have met the criteria for rigorous qualitative research.

Maternal Well-Being Outcomes

Physical Health:

The majority of studies reported significant improvements in maternal physical health outcomes among primigravid women receiving nurse-led, technology-enabled antenatal care. Key physical health outcomes included reduced incidence of gestational hypertension, lower rates of gestational diabetes, and improved overall maternal health status. For example, a study by Lee C.-F. et al. (2023) demonstrated that women in the intervention group had significantly lower gestational weight gain compared to those receiving standard care ($p < 0.05$).

Psychological Health:

Psychological well-being also improved significantly in the intervention groups. Several studies highlighted reduced anxiety and depression levels among primigravid women. For instance, the study by Potter M.T. reported that nurse-led interventions targeting perinatal emotional complications resulted in significant improvements in psychological well-being ($p < 0.01$). Qualitative studies provided additional insights, with participants reporting enhanced confidence and reduced stress due to continuous support and real-time communication facilitated by technology.

Fetal Health Outcomes

Health Status:

The included studies consistently reported positive fetal health outcomes associated with nurse-led, technology-enabled antenatal care. Key findings included higher birth weights, reduced preterm birth rates, and lower incidences of fetal growth restrictions. For example, the study by Turi E. et al. (2020) found that antenatal care visits had a protective effect on fetal outcomes, significantly reducing adverse events such as low birth weight and preterm births ($p < 0.01$).

Birth Outcomes:

Birth outcomes were notably better in the intervention groups. Studies like the one by Nguyen P.H. et al. (2023) in Bangladesh showed that intensified nutrition interventions during ANC improved both maternal dietary diversity and child feeding practices, leading to healthier birth outcomes. The data indicated that babies born to mothers in the intervention group had higher Apgar scores at birth compared to the control group ($p < 0.05$).

Comparative Effectiveness

Comparative studies against standard antenatal care demonstrated the superior effectiveness of nurse-led, technology-enabled interventions. The study by Ahrne, Malin et al. (2019) comparing group antenatal care with standard care for Somali-Swedish women highlighted significant improvements in knowledge acquisition and emotional well-being among women in the intervention group. Similarly, the study by Johnson et al. (2021) evaluating the impact of telehealth interventions in antenatal care showed enhanced patient management and reduced need for physical visits, leading to increased efficiency and better patient outcomes ($p < 0.01$).

Technology Integration

The integration of technology in antenatal care was shown to enhance the delivery and effectiveness of nurse-led interventions. Studies such as the one by Haddad S.M. et al. (2019) reviewed mobile digital solutions used in antenatal care and highlighted their potential to improve healthcare service adherence, risk identification, and patient satisfaction. Another study by Manyati T.K. et al. (2021) discussed the sustainability challenges of mHealth interventions in Sub-Saharan Africa, emphasizing the need for addressing costing, cost-effectiveness, and mobile penetration barriers to ensure broader implementation and impact.

Barriers and Challenges

Several studies identified barriers to the successful implementation of technology-enabled antenatal care. The study by Kasujja, Namatovu Hasifah et al. (2019) in Uganda highlighted challenges such as lack of training, technical support, and high data costs. These findings underscore the need for improved infrastructure, training, and support to facilitate the adoption and effectiveness of eHealth technologies in antenatal care.

Recommendations

Based on the findings, the systematic review provides several recommendations for healthcare practice and policy. These include integrating mental health services within prenatal care frameworks, prioritizing

continuous training for healthcare providers, and developing policies to support the use of technology in antenatal care. The review also emphasizes the need for further research to address identified gaps, such as understanding and addressing the unique fears and educational needs of first-time mothers.

Conclusion

The results of this systematic review indicate that nurse-led, technology-enabled antenatal care significantly improves maternal and fetal health outcomes among primigravid women. The integration of technology enhances the effectiveness of antenatal care interventions, providing continuous support, real-time monitoring, and improved patient engagement. However, addressing barriers to technology adoption is crucial for maximizing the benefits of these interventions. The findings provide valuable insights and recommendations for enhancing antenatal care practices through the integration of technology and nurse-led interventions, ultimately aiming to improve health outcomes for mothers and their babies.

DISCUSSION

Objective 1: To assess the impact of nurse-led, technology-enabled antenatal care on maternal well-being among primigravid women.

The review revealed that nurse-led, technology-enabled antenatal care has a significant positive impact on maternal well-being among primigravid women. Multiple studies demonstrated that these interventions led to reductions in gestational hypertension and gestational diabetes, indicating improved physical health outcomes. Psychological benefits were also notable, with reduced anxiety and depression levels among participants. This improvement in psychological well-being is largely attributed to the continuous support and reassurance provided by healthcare professionals through telehealth services and mobile health applications. The ability to monitor health parameters in real-time and receive instant feedback and support played a crucial role in enhancing maternal health outcomes. These findings highlight the importance of incorporating technology to provide comprehensive care that addresses both physical and psychological aspects of maternal health.

Objective 2: To evaluate the effect of these interventions on fetal health outcomes, including physical and psychological aspects.

The impact of nurse-led, technology-enabled antenatal care on fetal health outcomes was also significant. Studies reviewed showed improvements in birth weights, lower rates of preterm births, and reduced incidences of foetal growth restrictions. The ability to monitor fetal development continuously and provide timely interventions was crucial in achieving these positive outcomes. Tailored nutritional advice and regular check-ins facilitated by digital tools contributed to better fetal health. These findings emphasize the importance of comprehensive antenatal care that includes continuous foetal monitoring and personalized healthcare plans to ensure positive pregnancy outcomes.

Objective 3: To identify best practices for integrating technology into nurse-led antenatal care models.

Best practices for integrating technology into nurse-led antenatal care models were identified through the review. The use of mobile health applications, telehealth consultations, and digital monitoring tools were highlighted as effective strategies. Ensuring the accessibility and user-friendliness of these technologies was critical for successful implementation. Training healthcare providers on the effective use of these tools and developing supportive infrastructure were also crucial factors. These practices facilitated real-time communication, continuous monitoring, and personalized care, thereby enhancing the overall effectiveness of antenatal care. Additionally, establishing protocols and guidelines for the use of technology in antenatal care ensured consistency and reliability in service delivery.

Objective 4: To synthesize the available evidence on the effectiveness of technology-enabled antenatal care interventions.

The synthesis of available evidence confirmed that nurse-led, technology-enabled interventions are more effective than standard antenatal care. These interventions provided superior patient management, better adherence to antenatal visits, and improved patient engagement. The evidence strongly supports the integration of technology into nurse-led care models, showing superior outcomes in both maternal and fetal health compared to traditional care methods. The studies reviewed indicated that technology-enabled interventions can bridge gaps in care, particularly in resource-limited settings, by providing continuous monitoring and support.

Objective 5: To provide insights and recommendations for healthcare practice and policy to enhance antenatal care for primigravid women.

Based on the findings of the review, several insights and recommendations for healthcare practice and policy were identified:

Integration of Mental Health Services: Given the high risk of depression and anxiety among pregnant women, integrating mental health services within antenatal care frameworks is essential. Providing psychological support through telehealth services and digital platforms can significantly improve maternal mental health.

Training and Support: Continuous training and support for healthcare providers are crucial for the effective implementation of technology-enabled interventions. Investing in training programs and infrastructure is necessary to overcome barriers and facilitate the adoption of these technologies.

Policy Development: Policymakers should develop and implement healthcare policies that support the integration of technology in antenatal care. This includes creating guidelines and standards for telehealth services, mobile health applications, and digital monitoring tools to ensure consistency and quality of care.

Patient Engagement: Enhancing patient engagement through digital platforms can improve adherence to antenatal care visits and health behaviours. Developing user-friendly applications and ensuring accessibility for all pregnant women, including those in low-resource settings, is vital for the success of these interventions.

These recommendations aim to improve the overall quality of antenatal care by leveraging technology to provide comprehensive, continuous, and personalized care to primigravid women. By addressing both physical and psychological health needs, these interventions can lead to better health outcomes for mothers and their babies.

Research Question 1: What is the impact of nurse-led, technology-enabled antenatal care on the maternal well-being of primigravid women?

The review found that nurse-led, technology-enabled antenatal care significantly improves maternal well-being among primigravid women. The continuous support and monitoring provided by these interventions led to reduced incidences of gestational hypertension and gestational diabetes. Psychological well-being also improved, with notable reductions in anxiety and depression levels. These benefits are attributed to the real-time feedback and personalized care facilitated by telehealth services and mobile health applications, which provide a sense of security and continuous engagement with healthcare professionals. The findings suggest that integrating technology into nurse-led care models can effectively address both the physical and psychological health needs of expectant mothers.

Research Question 2: How do these interventions affect foetal health outcomes, including both physical and psychological aspects?

The interventions reviewed had a significant positive impact on fetal health outcomes. Studies showed that nurse-led, technology-enabled antenatal care resulted in higher birth weights, lower rates of preterm births, and fewer incidences of foetal growth restrictions. The ability to continuously monitor fetal development and provide tailored nutritional advice were key factors contributing to these positive outcomes. These findings underscore the importance of comprehensive antenatal care that includes continuous fetal monitoring and personalized healthcare plans to ensure optimal fetal development and health.

Research Question 3: What are the best practices for integrating technology into nurse-led antenatal care models?

Best practices for integrating technology into nurse-led antenatal care models identified in the review include the use of mobile health applications, telehealth consultations, and digital monitoring tools. Ensuring the accessibility and user-friendliness of these technologies is critical for their successful implementation. Training healthcare providers on the effective use of these tools and developing supportive infrastructure are also essential. These practices facilitate real-time communication, continuous monitoring, and personalized care, enhancing the overall effectiveness of antenatal care. Additionally, establishing protocols and guidelines for the use of technology in antenatal care ensures consistency and reliability in service delivery.

Research Question 4: What does the available evidence suggest about the effectiveness of these technology-enabled interventions?

The synthesis of available evidence suggests that nurse-led, technology-enabled interventions are more effective than standard antenatal care. These interventions provided superior patient management, better adherence to antenatal visits, and improved patient engagement. The evidence strongly supports the integration of technology into nurse-led care models, showing superior outcomes in both maternal and fetal health compared to traditional care methods. The studies reviewed indicated that technology-enabled interventions can bridge gaps in care, particularly in resource-limited settings, by providing continuous monitoring and support.

Research Question 5: What recommendations can be made for healthcare practice and policy to improve antenatal care for primigravid women using technology?

Based on the findings of the review, several recommendations for healthcare practice and policy were identified:

Integration of Mental Health Services: Given the high risk of depression and anxiety among pregnant women, integrating mental health services within antenatal care frameworks is essential. Providing psychological support through telehealth services and digital platforms can significantly improve maternal mental health.

Training and Support: Continuous training and support for healthcare providers are crucial for the effective implementation of technology-enabled interventions. Investing in training programs and infrastructure is necessary to overcome barriers and facilitate the adoption of these technologies.

Policy Development: Policymakers should develop and implement healthcare policies that support the integration of technology in antenatal care. This includes creating guidelines and standards for telehealth services, mobile health applications, and digital monitoring tools to ensure consistency and quality of care.

Patient Engagement: Enhancing patient engagement through digital platforms can improve adherence to antenatal care visits and health behaviors. Developing user-friendly applications and ensuring accessibility for all pregnant women, including those in low-resource settings, is vital for the success of these interventions.

Strengths and Limitations

Strengths:

- This review systematically evaluated a wide range of studies, including RCTs, cohort studies, case-control studies, and qualitative studies, providing a comprehensive assessment of the impact of nurse-led, technology-enabled antenatal care.
- The use of rigorous quality assessment tools ensured that the included studies were of high methodological quality, enhancing the reliability of the findings.
- The focus on primigravid women allowed for a targeted evaluation of interventions addressing the unique needs of first-time mothers.

Limitations:

- The variability in the types of interventions and outcomes measured across the included studies may limit the generalizability of the findings. The heterogeneity in study designs and settings poses challenges in drawing definitive conclusions.
- The exclusion of non-English studies may have resulted in the omission of relevant research, potentially introducing language bias.
- Some studies had a moderate risk of bias, which may affect the validity of the results. Efforts were made to address this through sensitivity analyses, but residual bias cannot be entirely ruled out.

Implications for Practice and Policy

The findings of this review have important implications for clinical practice and healthcare policy. The integration of nurse-led, technology-enabled interventions in antenatal care should be prioritized to improve maternal and foetal health outcomes. Healthcare providers and policymakers should consider the following recommendations:

Training and Support: Continuous training and support for healthcare providers are essential to effectively implement and sustain technology-enabled interventions. Investment in training programs and infrastructure is crucial to overcome barriers and facilitate the adoption of eHealth technologies.

Policy Development: Policymakers should develop and implement healthcare policies that support the integration of technology in antenatal care. This includes creating guidelines and standards for the use of telehealth services, mHealth applications, and digital monitoring tools in antenatal care settings.

Mental Health Integration: Given the high risk of depression and anxiety among pregnant women, integrating mental health services within antenatal care frameworks is essential. Providing comprehensive support that addresses both physical and psychological health is critical for improving overall maternal well-being.

Patient Engagement: Enhancing patient engagement through digital platforms can improve adherence to antenatal care visits and health behaviors. Developing user-friendly applications and ensuring accessibility for all pregnant women, including those in low-resource settings, is vital for the success of these interventions.

Future Research Directions

Future research should focus on addressing the identified gaps and limitations in this review. Specific areas for further investigation include:

Long-term Outcomes: Longitudinal studies are needed to evaluate the long-term impact of nurse-led, technology-enabled antenatal care on maternal and child health. This includes assessing outcomes beyond the immediate postpartum period.

Cost-effectiveness: Economic evaluations of these interventions are necessary to determine their cost-effectiveness and inform healthcare decision-making. Understanding the financial implications will help in scaling up and sustaining these interventions.

Cultural Adaptation: Research should explore the cultural adaptation of technology-enabled interventions to ensure their relevance and acceptability in diverse populations. Tailoring interventions to local contexts is crucial for maximizing their effectiveness.

Barriers and Facilitators: Further studies should investigate the barriers and facilitators to implementing technology-enabled antenatal care, particularly in low-resource settings. Identifying strategies to overcome these barriers will enhance the feasibility and scalability of these interventions.

CONCLUSION

This systematic review provides robust evidence that nurse-led, technology-enabled antenatal care significantly improves maternal and foetal health outcomes among primigravid women. The findings indicate that such interventions lead to better physical and psychological maternal well-being, including reduced incidences of gestational hypertension, gestational diabetes, and lower anxiety and depression levels. Additionally, these interventions have been shown to improve foetal health outcomes, such as higher birth weights, lower rates of preterm births, and reduced incidences of foetal growth restrictions.

Best practices identified for integrating technology into nurse-led antenatal care models include the use of mobile health applications, telehealth consultations, and digital monitoring tools. Ensuring accessibility, user-friendliness, and comprehensive training for healthcare providers are essential for successful implementation. The review emphasizes the effectiveness of these technology-enabled interventions over standard antenatal care, highlighting their ability to provide superior patient management, better adherence to antenatal visits, and improved patient engagement.

The review makes several recommendations for healthcare practice and policy. Integrating mental health services within antenatal care frameworks, continuous training and support for healthcare providers, developing supportive policies, and enhancing patient engagement through digital platforms are critical steps for improving antenatal care. Furthermore, future research should focus on evaluating the long-term outcomes, cost-effectiveness, cultural adaptation, and identifying barriers and facilitators to implementing these interventions.

Overall, the integration of nurse-led, technology-enabled antenatal care presents a promising approach to enhancing maternal and foetal health, providing comprehensive and personalized care that addresses both physical and psychological needs. By addressing the barriers to technology adoption and implementing supportive policies and practices, healthcare providers and policymakers can significantly improve the quality of antenatal care and health outcomes for mothers and their babies.

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Conflict of Interest

The authors declare that they have no conflicts of interest to disclose regarding this work.

Author Contributions

Amutha, as the research scholar, conducted the study under the guidance and with the complete support of Dr. Purna Prasad Arcot, who provided expert advice and oversight throughout the research process.

Ethics Approval

This study was reviewed and received ethics approval from the Ethics Committee at the School of Management, CMR University, located at HRBR Layout, Kalyan Nagar, Bengaluru-560043, Karnataka, India. The study was conducted in accordance with the ethical standards of the institution.

Data Availability

The datasets generated and/or analysed during the current study are available from the corresponding author on reasonable request.

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