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TELEHEALTH IN PREGNANCY CARE: OPPORTUNITIES, CHALLENGES, AND FUTURE DIRECTIONS THROUGH BIBLIOMETRIC ANALYSIS

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ABSTRACT

This study aims to evaluate telehealth's role in pregnancy care, focusing on remote monitoring and diagnostic innovations. A bibliometric analysis of 943 articles from the Scopus database (2019-2024) was conducted using VOSviewer software. Citation, co-citation, and co-word analyses were employed to identify influential articles, explore intellectual relationships, and uncover recurring themes. The results show that telehealth reduces face-to-face visits and improves patient satisfaction through remote monitoring. Key themes include telehealth's efficacy in antenatal care, remote monitoring technologies, and continuous glucose monitoring for pregnant women with diabetes. Telehealth is a critical tool for antenatal care, with numerous opportunities for future research.

Keywords: *Telehealth; Pregnancy Care; Remote Monitoring; Antenatal Care.*

INTRODUCTION

The World Health Organization (WHO) estimates that in 2020, a woman dies every two minutes due to preventable pregnancy and childbirth-related causes (WHO et al., 2023). Key factors contributing to maternal mortality

include deficiencies in healthcare systems and socio-economic conditions (Simoncic et al., 2022; WHO et al., 2023). Digital technologies, particularly telehealth, offer a solution (WHO et al., 2017). Telehealth uses telecommunication devices to provide healthcare services remotely, particularly benefiting those in underserved areas.

Telehealth has revolutionized antenatal care by improving access to personalized health education, real-time monitoring, and maternal-fetal consultations (Cheung et al., 2023; Craig et al., 2021). In the Netherlands, 38% of hospitals have adopted telemonitoring, reducing hospital admissions (van den Heuvel et al., 2020). Telehealth's integration into routine care has shown improved patient satisfaction, cost reductions, and reduced antenatal stress (Kruse et al., 2017). This study examines the evolution of telehealth in pregnancy care, identifying key trends and future directions through bibliometric analysis.

METHODS

A bibliometric analysis was conducted to explore telehealth in pregnancy care. The study analyzed peer-reviewed articles from 2019 to 2024, sourced from the Scopus database. An initial search returned 9449 documents, refined to 943 articles based on relevance and inclusion criteria (English language and telehealth-related content). VOSviewer software was used to construct and visualize bibliometric networks. Three techniques were employed: Citation Analysis: To identify influential articles and their contributions. Co-citation Analysis: To explore intellectual relationships through frequently co-cited articles. Co-word Analysis: To analyze recurring keywords and identify trends in telehealth research (Donthu et al., 2021; Eck & Waltman, 2017; Fauzi et al., 2023).

RESULTS AND DISCUSSION

Citation Analysis

Based on the top publications, three key themes in telehealth for pregnancy care were identified: AI-Driven Wearables, Remote Monitoring and Management, and Patient Preferences and Care Delivery. Telehealth in pregnancy care has rapidly developed, integrating AI, remote monitoring, and patient-centered care models to improve outcomes.

Theme 1 focuses on telehealth in pregnancy care, showing its effectiveness in reducing in-person visits during the COVID-19 pandemic,

especially for high-risk pregnancies (Aziz et al., 2020). (Fryer, 2020) emphasizes its role in overcoming prenatal care barriers, while (Palmer et al., 2021) stress its continued relevance post-pandemic. Telehealth mitigates risks, enhances care, and presents future research opportunities across healthcare fields.

Theme 2 focuses on remote monitoring technologies like home blood pressure monitoring and electrohysterogram (EHG) signals, which have proven effective in managing pregnancies and predicting labor (Mas-Cabo et al., 2019; Xydopoulos et al., 2019). These technologies offer personalized care, improve outcomes, and reduce costs. Large-scale studies confirm telehealth enhances patient satisfaction and healthcare efficiency in antenatal care without compromising results.

Theme 3 emphasizes patient-centered care models, like remote monitoring, which increase satisfaction and ease healthcare burdens. (Peahl et al., 2020) found postpartum women preferred fewer antenatal visits, while (Zizzo et al., 2022) highlighted home monitoring as a safe alternative for high-risk pregnancies. Telehealth improves care experience, reduces costs, and maintains positive outcomes, enhancing both patient satisfaction and healthcare efficiency in antenatal care.

Co-citation Analysis

Co-citation analysis identifies key publications shaping the research on diabetes and pregnancy outcomes. Out of 50,285 cited references, 333 met the threshold. The most co-cited works include Battelino et al. (2019), Feig et al. (2017), and Kristensen et al. (2019).

Cluster 1 highlights the persistent challenges in managing diabetes and obesity during pregnancy, even with interventions like preconception care. Abell et al. (2017) found that women with type 2 diabetes still faced elevated risks of preterm birth and neonatal complications despite glycemic control. These findings emphasize the need for more targeted strategies and further research to better address these complex maternal health issues.

Cluster 2 stresses the importance of tight glycemic control in pregnant women with type 1 diabetes. Cyganek et al. (2017) suggest revising therapeutic targets to reduce complications like macrosomia, which remains a risk despite current strategies. This highlights the need for more individualized glycemic management, continuous monitoring, and treatment adjustments to better control blood sugar and improve maternal and fetal outcomes.

Cluster 3 emphasizes the crucial role of continuous glucose monitoring (CGM) in managing diabetic pregnancies. Studies show that CGM reduces maternal hyperglycemia and improves neonatal outcomes, while minimizing

glucose variability lowers the risk of large-for-gestational-age infants. These findings highlight CGM's importance in optimizing blood sugar control, reducing complications, and enhancing care quality and safety in diabetic pregnancies (Feig et al., 2017; Kristensen et al., 2019).

Co-word Analysis

Co-word analysis identified recurring themes in the Scopus database using pregnancy-related keywords. Of 9242 keywords, 212 met the 22-keyword threshold, resulting in four distinct clusters based on keyword groupings that reflect key research areas in telehealth, pregnancy, and fetal monitoring.

Cluster 1 highlights recent advancements in fetal ECG analysis and cardiotocography (CTG) technologies. Innovations like attention mechanisms and sinus activation functions have improved signal processing, allowing for more precise mapping of maternal to fetal ECG. These improvements enhance diagnostic accuracy, enabling earlier detection of fetal distress and contributing to better maternal and fetal health outcomes (Mohebbian et al., 2022).

Cluster 2 examines the impact of metformin on improving pregnancy outcomes in gestational diabetes (GDM) and explores how maternal height and twin pregnancies affect preterm birth and low birth weight. The findings emphasize the importance of tailored interventions, such as metformin use, to mitigate risks and improve maternal and neonatal health, particularly in high-risk pregnancies (Simões et al., 2024).

Cluster 3 highlights the effectiveness of home-based telemonitoring (HBTM) in managing high-risk pregnancies, particularly for postnatal blood pressure control and continuous maternal-fetal monitoring. The approach improves health outcomes and patient satisfaction, reducing the need for frequent in-person visits while ensuring comprehensive care. These findings support the efficacy of remote monitoring in enhancing maternal health management (Forna et al., 2024).

Cluster 4 underscores the importance of glycemic control during pregnancy, particularly using continuous glucose monitoring (CGM) for women with diabetes. CGM has been shown to reduce the risks of large-for-gestational-age infants and neonatal complications. However, further research is needed to refine CGM parameters and optimize its use, improving outcomes for diabetic mothers and their infants (McLean et al., 2023).

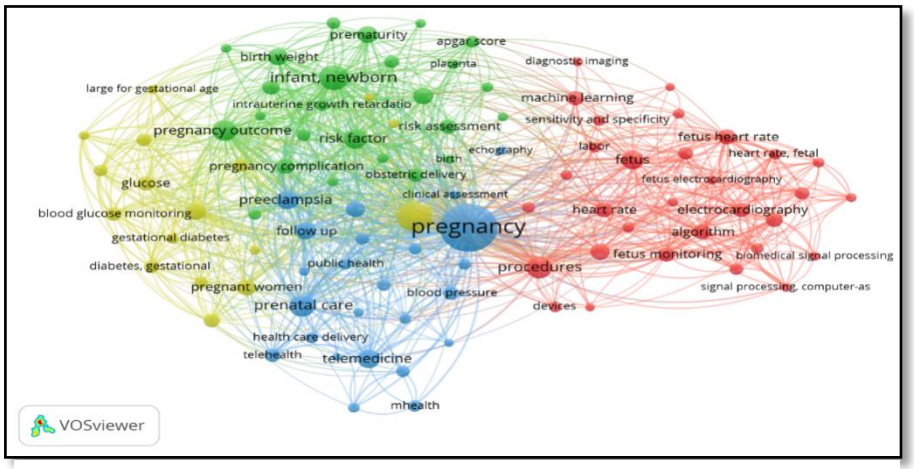

Figure 1: Co-word analysis of telehealth, pregnancies and fetal monitoring

The analysis identifies key future research areas in telehealth for pregnancy care. Long-term studies are needed to assess its sustained effectiveness in high-risk pregnancies. Advancements in remote monitoring technologies and the development of standardized protocols are crucial for improving accuracy, reliability, and integration into prenatal care. These efforts aim to optimize maternal and fetal health outcomes.

CONCLUSION

This bibliometric analysis offers a comprehensive look at telehealth's evolving role in pregnancy care. Telehealth reduces the need for face-to-face visits, improves patient satisfaction, and supports remote monitoring. Key research themes identified include telehealth's effectiveness, remote monitoring technologies, and patient-centered care models. Future research should focus on optimizing telehealth technologies, exploring long-term outcomes, and developing standardized protocols to ensure effective and accessible care.

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