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Review Article

Telehealth for healthy gestational weight gain among overweight pregnant women: A systematic review

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ABSTRACT

Introduction: Excessive Gestational Weight Gain (GWG) is associated with various complications during pregnancy and childbirth. In contrast, digital interventions like telehealth offer cost-effective solutions with broader accessibility. Therefore, our outcomes are to analyze the effectiveness of telehealth interventions for healthy GWG among overweight and obese pregnant women and to know which features are needed in telehealth for healthier GWG.
Methods: We undertook a systematic review to address the objectives mentioned above. Initially, we employed the keywords telehealth, pregnant women, and overweight, which were subsequently refined using Medical Subject Headings provided by the National Center for Biotechnology Information. To identify relevant articles, we searched six databases—Scopus, SAGE Journals, Web of Science, PubMed, ScienceDirect, and ProQuest.
Results: We included 15 articles in this review according to the criteria. Eleven papers show a positive effect of telehealth in promoting healthy GWG. Telehealth encompasses various functionalities, such as providing information, push notifications, self-monitoring, and feedback features related to gestational weight gain (GWG), maintaining a healthy diet, engaging in physical activity, receiving reminders, managing stress, and setting goals. On the other hand, four papers show no significant difference between telehealth and regular interventions.
Conclusions: Telehealth is alternatively effective to use as an additional intervention to promote healthier GWG in overweight pregnant women.
Keywords: gestational weight gain; overweight; pregnant women; telemedicine

INTRODUCTION

Overweight and obesity have severe consequences in pregnancy. Pregnant women who are classified as overweight or obese based on their pre-pregnancy body mass index face a notably higher chance of experiencing excessive Gestational Weight Gain (GWG) if they follow an unhealthy diet during the later stages of pregnancy (Yang et al., 2022). It is crucial to prevent excessive GWG since it contributes to various adverse outcomes in pregnancy, including preeclampsia, gestational diabetes, cesarean delivery, and macrosomia (Henriksson et al., 2022) and postpartum weight retention (Ribeiro et al., 2022).

The worldwide prevalence of obesity has risen dramatically in recent years, leading the World Health Organization (WHO) to label it a "global epidemic." According to Kim and Ayabe (2022), the number of overweight and obese individuals nearly tripled between 1975 and 2016. Data from the Basic Health Research Survey (Riskesdas) in 2018 revealed that, among the adult population in Indonesia, 13.6% were overweight, 21.8% were obese, and 31% had central obesity (Kemenkes, 2018). Regarding this high number of overweight and obese, there is an alternative intervention to reduce excessive GWG for pregnant women.

Research findings indicate that technology-based interventions have demonstrated similar effectiveness in achieving weight loss compared to face-to-face interventions while also offering the advantage of lower cost per unit of weight lost (Kozak et al., 2017; Krukowski et al., 2011; Rumbo-Rodríguez et al., 2020). Additionally, smartphone applications are gaining popularity in the healthcare field as an additional and valuable source of information (Dodd et al., 2018). Moreover, our primary outcome in this review is to analyze the effectiveness of telehealth interventions for healthy GWG among overweight and obese pregnant women. At the same time, our secondary goal is to know which feature is needed in telehealth for a healthier GWG.

METHODS

Design

In this study, a systematic review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines, using the PICOS framework.

Search Strategy

In this review, the literature search was conducted in April

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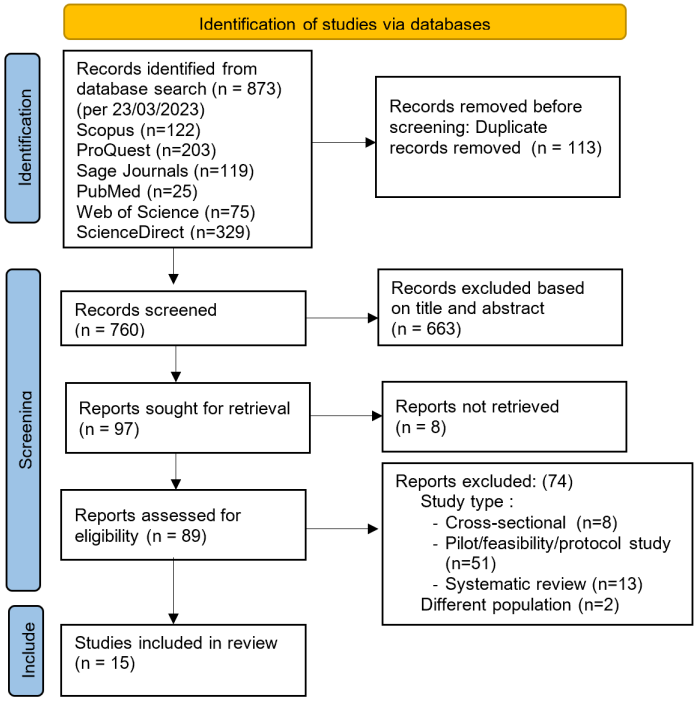

Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA)

Table 1. PICOS Criteria

Criteria	Inclusion	Exclusion
Population	Pregnant women	Child, adolescent, woman, elderly
Intervention	Telehealth/Telemedicine	In-person delivered intervention
Comparison	Overweight/obese pregnant women	N/A
Outcome	Healthy gestational weight gain	N/A
Study Design & Publication Type	RCT, quasi-experiment, cohort study, qualitative study, mixed methods,	Article review, cross-sectional, pilot/feasibility/ protocol study
Publication Year	2018-2023	Before 2018
Language	English	Language other than English

2023. Original studies published in scientific journals with full-text availability were considered for inclusion. Specifically, articles focusing on telehealth or telemedicine interventions and providing details about their intervention strategies were included in this study. The literature was obtained from the Scopus, SAGE Journals, Web of Science, PubMed, ScienceDirect, and ProQuest database. The specific keywords utilized for article retrieval were: (telemedicine OR "virtual medicine" OR "mobile health" OR telehealth OR eHealth OR mHealth) AND ("pregnant women" OR "pregnant woman" OR pregnancy) AND (overweight OR obesity).

Study Selection

In this stage, reviewers adhered to a method of article selection guided by predefined keywords. Previously, reviewers employed the PICOS format as a guideline for evaluating the relevance of each article. The PICOS criteria established for article selection are outlined in Table 1.

Data Extraction

A total of 873 articles matching the specified keywords was obtained from multiple databases: Scopus (n=122), ProQuest (n=203), Sage Journals (n=119), PubMed (n=25), Web of Science (n=75), and ScienceDirect (n=329). After removing 113 duplicate articles, 760 unique articles remained. Following a screening process based on title and abstract, 89 articles were deemed relevant to the study's theme. Further evaluation based on inclusion and exclusion criteria resulted in the selection of 15 articles suitable for inclusion in the review. The article selection process and outcomes are visually represented in PRISMA Figure 1.

Quality Appraisal

Table 2 comprehensively evaluates the methodological rigor of the studies included in the review. The assessment uses the JBI critical appraisal checklist, where scores for the studies range from 7/13 to 11/13.

Table 2. Critical appraisal results for included studies using the JBI Critical Appraisal Checklists

Authors (year)	Study design	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Total
Ferrara et al. (2020)	RCT	Y	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y	8/13
Gonzalez-Plaza et al. (2022)	RCT	Y	Y	Y	N	U	N	U	Y	Y	N	Y	N	Y	7/13
Ainscough et al. (2020)	RCT	Y	Y	Y	N	N	U	U	Y	Y	N	U	Y	Y	7/13
Van Horn et al. (2018)	RCT	Y	Y	Y	N	Y	N	Y	N	Y	U	N	Y	Y	8/13
Zhou et al. (2020)	RCT	Y	N	Y	N	N	N	N	Y	Y	N	Y	Y	Y	7/13
Sandborg, Söderström, et al. (2021)	RCT	Y	Y	Y	N	N	N	U	Y	Y	N	Y	U	Y	7/13
Henriksson et al. (2022)	RCT	U	N	Y	N	U	Y	U	Y	Y	N	Y	Y	Y	7/13
Sandborg, Henriksson, et al. (2021)	Qualitative Study	N	Y	Y	Y	Y	U	Y	Y	Y	U	N/A	N/A	N/A	7/10
Wilkinson et al. (2023)	Cohort design	Y	Y	Y	U	U	Y	Y	Y	U	U	Y	N/A	N/A	7/11
Tinius et al. (2021)	Qualitative Study	Y	Y	Y	Y	Y	U	U	Y	Y	Y	N/A	N/A	N/A	8/10
Lee et al. (2023)	Qualitative Study	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N/A	N/A	N/A	9/10
Mackeen et al. (2022)	RCT	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	10/13
Olson et al. (2018)	RCT	U	Y	Y	Y	Y	N	Y	Y	Y	U	Y	Y	Y	10/13
Holmes et al. (2020)	RCT	Y	Y	Y	N	Y	Y	Y	Y	Y	U	Y	Y	Y	11/13
Dodd et al. (2018)	RCT	Y	Y	Y	U	N	Y	U	Y	N	U	Y	Y	Y	8/13

Legend: Q# question number, Y yes, N no, U unclear, N/A not applicable

Table 3. Papers included in the systematic review

Authors (year)	Location of research	Intervention	Key findings
Ferrara et al. (2020)	California, USA	The core lifestyle intervention consisted of two in-person and 11 telephone sessions on behavioral strategies to improve weight, diet, physical activity, and stress management.	The GLOW intervention, primarily delivered through telehealth and designed to be implemented in healthcare delivery settings, has demonstrated effectiveness in significantly reducing excessive gestational weight gain (GWG).
Gonzalez-Plaza et al. (2022)	Barcelona, Spain	The intervention utilized a smart band, specifically the Mi Band 2, connected to the Mi Fit app to monitor physical activity. In addition, the Hangouts app was used to facilitate communication between participants and the midwife, allowing for the exchange of personal health information.	Implementing a comprehensive mobile health intervention was linked to achieving adequate gestational weight gain (GWG), with the intervention group exhibiting lower GWG than the control group.
Ainscough et al. (2020)	Dublin, Ireland	Participants received guidance on nutrition, specifically focusing on low glycemic index and healthy eating. They also received exercise advice. Additionally, participants were provided with a smartphone app and received fortnightly e-mails as part of the intervention.	Implementing a behavioral lifestyle intervention during pregnancy, supported by a smartphone app, improved dietary intake, physical activity levels, and motivation to exercise.

Authors (year)	Location of research	Intervention	Key findings
Van Horn et al. (2018)	Chicago, USA	At the gestational age of 16 weeks, the intervention group received coaching from dietitians, focusing on the Dietary Approaches to Stop Hypertension (DASH) diet and physical activity. This coaching was conducted through phone and webinars. The intervention group utilized a commercially available smartphone application to self-monitor their diet and physical activity. Adherence to the intervention was encouraged through telephone, text messages, and e-mail reminders, as well as by promoting website engagement. In contrast, the usual-care group, called "web-watchers," received biweekly newsletters via e-mail and had access to publicly available maternity website links.	Implementing a technology-enhanced Dietary Approaches to Stop Hypertension (DASH) diet and lifestyle intervention significantly reduced total gestational weight gain over 35 weeks. Importantly, this reduction in weight gain did not result in any adverse outcomes for the infants—furthermore, the intervention improved nutrient quality without negatively affecting the prematurity rate.
Zhou et al. (2020)	China	All the mothers participating in the study were categorized into four different groups. The first group served as the control group, which received only a limited number of "Basic" messages. The second group received messages focused on Care-Seeking (CS), the third group received messages promoting Good Household Prenatal Practices (GHPP), and the fourth group received all 148 text messages available in the intervention.	The group that received all text messages demonstrated significantly lower odds of inappropriate weight for gestational age (IWGA) compared to the control group. Additionally, the care Seeking message group and the All Texts group showed significantly lower odds of delivering macrosomic newborns than the control group.
Sandborg, Söderström, et al. (2021)	Sweden	The intervention group received the HealthyMoms smartphone app for six months, which offered a range of features. These features included access to information related to pregnancy, push notifications to provide reminders and updates, self-monitoring tools, and feedback features specifically designed to track and manage GWG, dietary habits, and physical activity. The app was provided in conjunction with standard care practices.	The findings indicate that the utilization of the HealthyMoms smartphone app has the potential to promote healthy dietary behaviors and effectively reduce weight gain in women who are overweight and obese during pregnancy. The app shows promise as a valuable tool in supporting and encouraging positive health outcomes in this population.
Henriksson et al. (2022)	Sweden	The study investigates how user engagement with the HealthyMoms app correlates with gestational weight gain, diet quality, and physical activity during pregnancy within a 6-month mHealth intervention. The HealthyMoms app encourages healthy weight gain, dietary habits, and physical activity during pregnancy. Participants in the intervention group received both standard antenatal care and access to the HealthyMoms app.	Higher engagement, as indicated by greater registrations for weight, diet, and physical activity within the HealthyMoms app, was linked to lower gestational weight gain and enhanced diet quality. This suggests that active participation and utilization of the app's features played a role in achieving healthier weight management and dietary practices during pregnancy.
Sandborg, Henriksson, et al. (2021)	Sweden	Experience in 6-month usage of the HealthyMoms app.	The HealthyMoms app was highly regarded as a valuable and reliable tool for managing excessive GWG. It was perceived to be beneficial due to its valuable features and provision of relevant information that facilitated the establishment and maintenance of healthy habits throughout pregnancy.

Authors (year)	Location of research	Intervention	Key findings
Wilkinson et al. (2023)	Australia	The primary focus of the intervention was to promote healthy nutrition, physical activity, and appropriate gestational weight gain (GWG) through the txt4two intervention. Various modalities were employed in the intervention, including bi-directional text messages (SMS) that encouraged positive health behaviors, goal setting and self-monitoring, video messages, and an informative website.	- The txt4two intervention cohort exhibited notable disparities compared to the control cohort concerning vegetable intake, fiber-diet quality index, and total diet quality index. However, no significant differences in physical activity or gestational weight gain were observed. - A substantial proportion of participants (85.7%) rated the txt4two intervention as highly or moderately useful, with 92.9% indicating they would recommend it. - The feasible program yielded favorable outcomes regarding physical activity and gestational weight gain.
Tinius et al. (2021)	Kentucky, USA.	N/A	The research pinpointed various essential functionalities for a mobile health application. These include goal-setting and progress tracking, evidence-backed exercise advice customized for various pregnancy and postpartum phases, a community-based forum for social support, symptom monitoring, efficient workout choices, and push notifications for timely reminders and updates. By integrating these sought-after attributes, a thoughtfully crafted mobile app could effectively cater to the distinct requirements of women in rural locales, elevate their overall user experience, and ultimately foster better clinical results.
Lee et al. (2023)	Taiwan	N/A	- The primary concern of overweight and obese pregnant women was ensuring the safe delivery of a healthy baby. - Feedback from participants using the mHealth app for gestational weight gain (GWG) management was generally positive. The app appeared to support healthy eating and physical activity, potentially boosting participants' confidence in managing their weight gain. Moreover, participants showed satisfactory adherence to the app, which could help prevent excessive weight gain among obese women. - The extent to which existing apps can effectively facilitate gestational weight gain (GWG) management remains uncertain, underscoring the ongoing necessity to investigate the experiences of overweight and obese pregnant women with mHealth apps designed for GWG management.

Authors (year)	Location of research	Intervention	Key findings
Mackeen et al. (2022)	Pennsylvania, USA	The paper's intervention involves a lifestyle modification program delivered by registered dietitians/nutritionists (RDNs) to decrease excessive gestational weight gain in gravida with obesity. The intervention includes personalized letters detailing appropriate GWG, exposure to a personalized GWG chart in the electronic health record (EHR) via the patient portal, and ongoing counseling with RDNs. Telehealth consults were added as an enhancement to enrich the focus on weight management and increase compliance with study visit attendance.	A physician's letter providing guidelines on appropriate gestational weight gain (GWG) and consultation with a registered dietitian/nutritionist (RDN) using a personalized GWG chart were found to be effective in promoting GWG within the guidelines set by the Institute of Medicine (IOM) for women with class III obesity. However, these interventions did not show significant benefits for women with class I or II obesity. - No significant differences in GWG outcomes between the groups (UC and EC arms) were observed, and the intervention did not result in significant differences in GWG, pregnancy, or neonatal outcomes when analyzed in aggregate.
Olson et al. (2018)	Northeastern, USA	Participants in the intervention group were provided access to a website that offered various behavior change tools. These tools included a weight gain tracker to monitor gestational weight, a goal-setting and self-monitoring tool for diet and physical activity, and a range of health information such as tips, articles, and frequently asked pregnancy-related questions. The website also provided information on local community resources relevant to pregnancy and parenting. Additionally, participants had access to a blogging tool to share their experiences and an event and appointment reminder feature.	The study found that adding behavior change tools to an informational placebo control did not result in a difference in the proportion of women with excessive total gestational weight gain compared to the placebo control. The integrated online and mobile phone intervention had no significant effect beyond the informational placebo control on primary or secondary gestational weight gain outcomes.
Holmes et al. (2020)	O'ahu, Hawai'i	The intervention group received weekly SMS messages targeting nutrition and physical activity throughout pregnancy. These messages aimed to assist participants in adhering to the recommended guidelines for gestational weight gain (GWG) and exercise set forth by the Institute of Medicine (IOM) and the American College of Obstetricians and Gynecologists. In contrast, the control group received general health-related SMS messages throughout pregnancy without specific nutrition and physical activity guidance. Both groups received one text message per week for eighteen weeks.	- The gestational weight gain (GWG) between the intervention and control groups did not significantly differ. - To achieve notable improvements, more extended intervention periods, different message frequencies, and the inclusion of personalized or interactive messages might be necessary. - The disparity in the number of participants exceeding GWG recommendations did not demonstrate significance among treatment groups or BMI categories.
Dodd et al. (2018)	Adelaide, South Australia	The study assesses how a smartphone application influences dietary and physical activity changes in pregnant women when used alongside in-person consultations. The main focus is on the Healthy Eating Index (HEI), measured at the beginning of the trial, at 28 weeks, and 36 weeks of gestation. The application provided various features, including providing information, setting goals, offering feedback, and enabling self-monitoring.	Including the smartphone application alongside lifestyle advice did not result in notable improvements in the Healthy Eating Index (HEI) score compared to solely providing lifestyle advice. Additionally, no significant differences were observed in maternal dietary intake or physical activity patterns between the group using the smartphone application and the group receiving only lifestyle advice. In summary, integrating the smartphone application into the overall lifestyle intervention did not significantly enhance maternal dietary intake or physical activity patterns.

These scores indicate how each study has addressed potential biases in its design, implementation, and analysis (Hadisuyatmana et al., 2023). Studies with lower scores were not included in this review. Each study's contribution to the overall knowledge base was carefully considered in gathering information for this review.

Each article underwent appraisal using the relevant critical appraisal checklist the Joanna Briggs Institute provided. Randomized controlled trials were assessed using the JBI critical appraisal tool for assessing the risk of bias in randomized controlled trials. At the same time, qualitative studies were evaluated using the appraisal checklist for qualitative research. Cohort studies were appraised using a critical appraisal checklist designed for cohort studies.

RESULTS

This systematic review identified 15 articles, all obtained from the past five years. The articles included in this review encompass studies conducted across four geographical regions: North America, Europe, Asia, and Australia. The majority of the studies originated from North America (n=6; 40%), followed by European countries (n=5; 33.3%), Asia (n=2; 13.3%), and Australia (n=2; 13.3%).

Only three of the 15 included articles were qualitative studies (Sandborg, Henriksson et al., 2021; Tinius et al., 2021). Among the quantitative papers, 11 were RCTs (Ainscough et al., 2020; Dodd et al., 2018; Ferrara et al., 2020; Gonzalez-Plaza et al., 2022; Henriksson et al., 2022; Holmes et al., 2020; Mackeen et al., 2022; Olson et al., 2018; Sandborg, Söderström et al., 2021; Van Horn et al., 2018; Zhou et al., 2020). Our review revealed a cohort study assessing an intervention promoting healthy nutrition, physical activity, and gestational weight gain (GWG). The intervention incorporated multiple components, including SMS messages promoting positive health behaviors, goal-setting and self-monitoring strategies, video messages, and an informational website (Wilkinson et al., 2023). Additional details regarding the characteristics of the included studies can be found in Table 3.

The forms of intervention used in this review are varied. Most of the articles used mobile applications on smartphones to deliver their intervention. It is followed by SMS, telephone, device tracker, e-mail, video messages, and website. The intervention features are diet/nutrition, physical activity, and GWG information. However, the main features in telehealth which are most used are nutrition and physical activity. Other than that, there are stress management, reminders, notifications, a calendar, a weight tracker, and a self-monitoring feature.

Eleven out of 15 articles show beneficial outcomes in reducing excessive GWG using telehealth. Meanwhile, four articles did not show significant results in reducing excessive GWG or promoting healthy GWG.

DISCUSSION

This review highlights the efficacy of telehealth interventions in promoting healthier gestational weight gain (GWG), improving pregnancy diet, and increasing physical activity. These findings are consistent with prior research demonstrating that complex digital interventions can reduce GWG and increase physical activity among obese pregnant women (Gonzalez-Plaza et al., 2022). Similarly, a randomized controlled trial in Sweden found that women who were overweight or obese before pregnancy experienced less weight gain when using a comprehensive intervention delivered exclusively through a mobile app (Sandborg, Söderström et al., 2021). In addition to their effectiveness, telehealth interventions are user-friendly and convenient, as evidenced by a telehealth-based lifestyle intervention significantly reducing excessive GWG in pregnant women who were overweight or obese (Slomski, 2020).

On the other hand, Intensive interventions involving in-person counseling and multiple clinic visits may not be feasible or practical for many women, potentially reducing treatment efficacy and posing implementation challenges in healthcare settings (Ferrara et al., 2020). Therefore, telehealth interventions can be an alternative or additional approach to in-person interventions. Incorporating telehealth technologies into prenatal care holds promise for improving the overall experience for women while potentially reducing healthcare costs. This integration can potentially maintain or even enhance health outcomes for both mothers and babies without compromising the quality of care (Atkinson et al., 2023).

The main features of telehealth that are very well used and effective are diet and physical activity information. Previous studies have emphasized the importance of diet-quality interventions during pregnancy to reduce the risk of abnormal GWG (Yang et al., 2022). A higher-quality diet in the middle and late stages of pregnancy has been shown to help prevent excessive weight gain (Yang et al., 2022). Likewise, participating in physical exercise during pregnancy has been linked to a reduced likelihood of excessive gestational weight gain, gestational diabetes mellitus, and complications related to obesity (Vargas-Terrones et al., 2019). A review study also demonstrated that exercise interventions effectively controlled weight gain (Ribeiro et al., 2022). Therefore, promoting a healthy diet and physical activity within telehealth interventions is crucial. By integrating these components into telehealth features, interventions can effectively support pregnant women in achieving healthier GWG and reducing the risk of complications associated with excessive weight gain.

CONCLUSION

In short, our review shows that telehealth is effective in promoting healthier GWG among overweight and obese women. Some key features, including diet and physical activity, support it. In addition, a comprehensive feature is needed to develop the application. Further research is recommended regarding barriers to accessing telehealth for pregnant women.

Declaration of Interest

The authors assert that they have no conflicts of interest.

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Data Availability

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

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