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Digital Therapy Versus Traditional Care for Maternal Mental Health: Meta-Analysis of Psychotherapy RCTs

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Abstract

Perinatal mental health issues, particularly depression and anxiety, pose critical challenges to maternal and children's well-being. It has been reported that psychological distress affects approximately 20.7% of prenatal and 17% of postnatal mothers, attributed to multifaceted emotional, physiological, social, and interpersonal transitions during the perinatal period. Accessibility of digital technologies has increased, prompting innovative approaches to prevention and treatment. This study aims to evaluate the effectiveness of digital psychotherapy interventions compared to traditional care in addressing perinatal mental health outcomes. A comprehensive literature search conducted between September and October 2023 across Scopus, PubMed, and Web of Science databases yielded eleven eligible randomized controlled trials (2017-2023). Meta-analytic findings using Review Manager 5.4 demonstrated significant reductions in anxiety (SMD: -0.41; 95% CI: -0.67 to -0.15; $p = 0.002$) and depressive symptoms (SMD: -0.41; 95% CI: -0.54 to -0.27; $p < 0.00001$) through digital interventions compared to traditional care. Future research directions should prioritize developing engaging interventions, possibly incorporating animation and virtual environments, while considering population-specific factors and optimal intervention duration.

Introduction

Maternal mental health disorders, particularly depression and anxiety, pose significant challenges during pregnancy and up to one year postpartum. These conditions affect maternal well-being and have profound implications for child development and family dynamics (Cimino, 2023). In developing countries, the prevalence of maternal mental health problems is high, with approximately 15.6% of cases occurring during childbirth and 19.8% postpartum (WHO, 2016). According to Mahajan, prevalence rates vary between 10-15% in different countries, depending on assessment techniques and regional factors (Mahajan., 2019). Meta-analyses have revealed that the incidence of depression during pregnancy is approximately 20.7% and 17% of cases occur in the postnatal period (Shorey *et al.*, 2018; Yin *et al.*, 2021). These statistics underline the magnitude of perinatal mental health problems and their potential to affect the well-being of both mother and child significantly.

Prenatal depression is associated with severe perinatal complications, including intrauterine growth retardation, preterm birth, low birth weight, and increased risk of infectious diseases in infants (Gelaye *et al.*, 2016; Roy *et al.*, 2022). In addition, untreated maternal depression can lead to dire consequences, including the risk of suicide and infanticide (Cimino, 2023). Despite the

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severity of these problems, the prevention and treatment of perinatal depression is often delayed or inaccessible. This gap in care is due to a variety of factors, including insufficient ability to recognize and analyze symptoms of perinatal mental health problems, lack of interest or capacity to seek professional help, and prevailing stigma and mistrust among perinatal women and within communities (Daehn *et al.*, 2022). In addition, prenatal stress may be exacerbated by cultural and linguistic background, weak partner support, and a history of childhood abuse (Khanlari *et al.*, 2019).

Traditionally, primary health care has been the main approach to maternal mental health. This approach includes regular check-ups, counseling, and pharmacological interventions. However, these traditional approaches often face challenges related to accessibility and affordability (Webb *et al.*, 2023). In light of these challenges, digital technologies have emerged as a promising medium for mental health interventions, offering potential benefits such as increased accessibility, flexibility, and cost-effectiveness. Digital interventions, particularly those incorporating psychological components such as cognitive behavioral therapy (CBT), are effective in treating a range of mental health problems, including depression, anxiety, substance abuse, and personality disorders (Sarkhel, Singh and Arora, 2020).

Recent studies have demonstrated the effectiveness of web- or app-based therapy interventions in managing postpartum depression (Sun *et al.*, 2019; Qin *et al.*, 2022). Meta-analyses have also assessed the efficacy of digital therapy interventions based on specific objectives, intervention type(Siobhan A. Loughnan *et al.*, 2019), and study quality (Bright *et al.*, 2019; Siobhan A. Loughnan *et al.*, 2019; Miura *et al.*, 2023). Despite the growing body of research on both traditional care and digital therapy interventions for maternal mental health, a comprehensive comparison of these approaches is lacking. To date, no meta-analyses have systematically compared the effectiveness of digital therapy interventions with traditional primary care for maternal mental health, focusing specifically on psychotherapeutic approaches. Therefore, this meta-analysis aimed to compare the effectiveness of digital therapy interventions with traditional primary care in improving maternal mental health outcomes and to identify potential moderating factors that influence the effectiveness of these treatment approaches.

Method

This meta-analysis adhered to the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines, conducting a comprehensive search across Scopus, PubMed, and Web of Science databases from September to October 2023. The study focused on randomized controlled trials (RCTs) evaluating digital-based psychotherapy interventions for perinatal maternal mental health, specifically examining Generalized Anxiety Disorder-7 (GAD-7) scores for anxiety symptoms and Edinburgh Postnatal Depression Scale (EPDS) scores for depression symptoms. Data search utilizing the PICOS framework (Participants, Interventions, Comparisons, Outcomes, and Study design framework) (Page *et al.*, 2021).

The search strategy incorporated keywords related to perinatal, prenatal, and postnatal mothers exhibiting anxiety or depression symptoms. Intervention keywords encompassed various digital psychotherapy approaches, including Cognitive Behavioral Therapy and mindfulness applications. The comparison keyword "treatment as usual" represented standard maternal primary health care, while outcome keywords focused on GAD-7 and EPDS scores. The Study design keyword used is Randomized Controlled Trials (RCT). The combination of keywords used in this study were "Mother perinatal" OR "Mother prenatal" OR "Mother Postpartum" AND "Digital psychotherapy intervention" OR "Cognitive Behavioral Therapy" OR "Cognitive Therapy" OR "Behavior Therapy" OR "mindfulness application" AND "Treatment as usual" AND "GAD-7 score" OR "EPDS score" AND "Randomized Controlled Trials". Details of the search strategy are shown in Appendix 1.

Eligibility criteria included full-text, English-language publications published in the last ten years, and targeting perinatal women

aged over 18 years, from early pregnancy to one year postpartum. The analysis focused on perinatal psychotherapeutic interventions delivered via websites and mobile applications compared to standard perinatal care. Studies were excluded from the analysis if the study design was not an RCT, did not present outcome data in the form of Me±SD, did not analyze symptoms of maternal perinatal stress and anxiety, or the form of intervention was not digital, either via a website or a mobile application. The description of the eligibility criteria is shown in Figure 1.

Data extraction was performed independently and included characteristics such as study location, design, objectives, population details, intervention specifics, and outcomes (mean±SD). The results of the data extraction are presented in Appendix 2. The quality assessment used the Revised Cochrane risk-of-bias tool for randomized trials (RoB 2), evaluating six domains of potential bias (Sterne *et al.*, 2019). The quality assessment of the trials is provided in Appendix 3. The meta-analysis used a random effects model to assess clinical heterogeneity. Data were processed as continuous variables using standard mean differences (SMDs) and 95% confidence intervals, presented in visual inspection of forest plots. Review Manager version 5.4 facilitated data analysis and provided a robust review of the effectiveness of digital psychotherapy for perinatal maternal mental health.

Result and Discussion

The literature search identified 433 studies potentially relevant to the effectiveness of digital education and removed 25 duplicates. Screening of titles and abstracts resulted in 223 studies being included in the full-text review. After evaluation based on eligibility criteria, 11 studies were identified for this meta-analysis. Table 1 shows RCT studies conducted between 2017 and 2023 in Singapore, Sweden, Australia, China, Taiwan, Norway, the United States, Portugal, and the Netherlands. The studies included 6555 perinatal women aged ≥18 years, including 3121 prenatal women and 3434 postnatal women. The sample sizes ranged from 42 to 1342, and the duration of intervention ranged from 28 days to 12 months. The attrition rate of the study ranged from 1.9% to 32.4%.

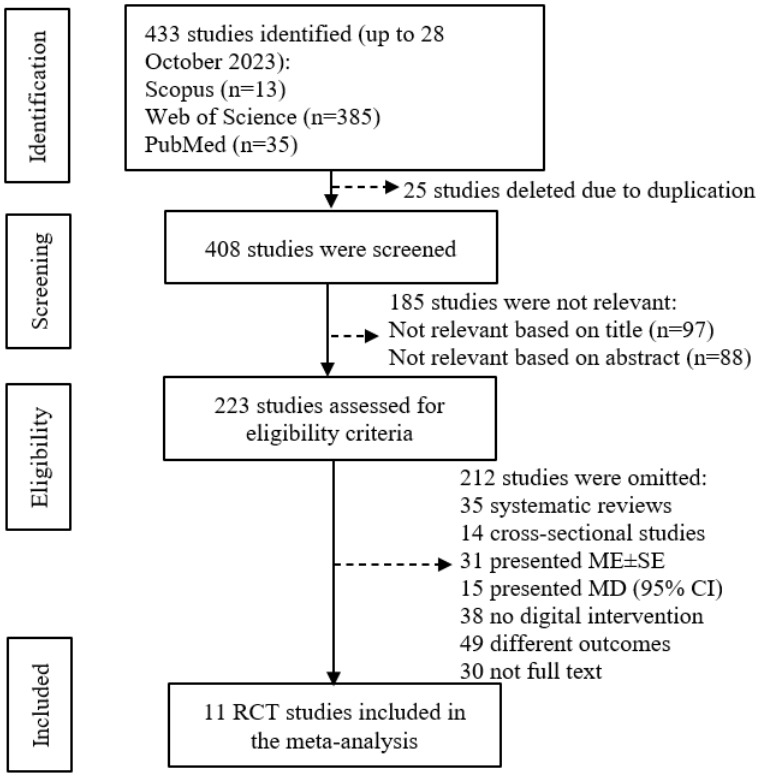

FIGURE 1. Flow Chart of Study Selection

Table 1. Study Characteristics

Author	Country	Years of Study	Population	Age (Mean ±SD)	Intervention	Comparator	Size Sample	Intervention Time	Attrition
(Forsell *et al.*, 2017)	Sweden	2017	Prenatal (10-28 weeks), 95 participants	≥18 years	ICBT	TAU	I: 22; K: 20	Maternity treatment by ICBT for 10 weeks	7.1%
(Haga *et al.*, 2019)	Norwegia	December 2013-February 2015	Prenatal (21-25 weeks), 1590 participants	≥18 years	Mamma Mia	TAU	I: 678; K: 664	Intervention was 44 sessions for 11.5 months	16.8%
(Siobhan A Loughnan *et al.*, 2019)	Australia	2019	Postnatal (<12 months postpartum), 383 participants	≥18 years	MUMentum Pregnancy	TAU	I: 43; K: 44	Intervention during 6 weeks	5.2%
(Heller *et al.*, 2020)	Belanda	March 2014 to January 2017	Prenatal (≤ 30 weeks), 349 participants	≥18 years	MamaKits online	TAU	I: 79; K: 80	Intervention during 5 weeks (1 module/ week)	17.6%
(Liu *et al.*, 2022)	Taiwan	2022	Prenatal (36–38 weeks), 130 participants	20-40 years	We'll App	TAU	I: 65; K:65	Application intervention 3 times a week for 8 weeks	26.6%
(Qin *et al.*, 2022)	China	2022	Postnatal (0-3 postnatal), 112 participants	31.9 ±3.6 years	Application of the CareMom program	TAU	I: 57; K: 55	Intervention during 28 days	6.3%
(Carona *et al.*, 2023)	Portugal	25 January 2019-30 January 2021	Postnatal (≤ 3 months), 1980 participants	18-45 years	Be a Mom	TAU	I: 542;	Intervention 8 weeks	32.4%

(Shorey *et al.*, 2023)	Singapura	February 2020 until July 2022	Prenatal (> 24 weeks), 349 participants	≥21 years	Supportive Parenting App (SPA)	TAU	I: 100;	Interventions during pregnancy and follow-up were extended to 12 months	27.5%
(Suharwardy *et al.*, 2023)	United States	January-May 2019	Postnatal (≤ 12 bulan), 467 participants	≥18 years	Woebot application and TAU	TAU	I: 96; K:96	Intervention for 2 weeks and 4 weeks of follow-up	20.8%
(X. Zhang *et al.*, 2023)	Australia	December 2020 until April 2021	Prenatal (12-20 weeks), 608 participants	≥18 years	Application-based ISP and TAU	TAU	I: 80; K: 80	Interventions 6 weeks and follow-up to 6 months	1.9%
(Y. Zhang *et al.*, 2023)	China	May 2020 until March 2021	Postnatal (≤ 6 months), 492 participants	≥18 years	Application-based ISP and TAU	TAU	I: 118;	Intervention 3 months and follow-up 3 months	3.4%

ICBT: Internet-Delivered Cognitive Behavioural Therapy; ISP: Internet-Based Support Program; PST: Problem-Solving Treatment; TAU: Treatment as Usual

Sumber: (Forsell *et al.*, 2017; Haga *et al.*, 2019; Siobhan A Loughnan *et al.*, 2019; Heller *et al.*, 2020; Liu *et al.*, 2022; Qin *et al.*, 2022; Carona *et al.*, 2023; Y. Zhang *et al.*, 2023; Shorey *et al.*, 2023; Suharwardy *et al.*, 2023; X. Zhang *et al.*, 2023)getting treatment is of the utmost importance. A guided internet self-help intervention may help to provide more women with appropriate treatment. Objective: This study aimed to examine the effectiveness of a guided internet intervention (MamaKits online

Figure 2 presents the intervention studies analyzed were generally of high quality, with the randomized sequences generated from 11 studies rated as low risk of bias for, the randomization process (n= 9), departures from the intended interventions (n= 9), missing outcome data (n= 9), measurement of the outcome (n= 9), selection of the reported outcome (n= 7), and overall bias (n= 6). The risk of bias was unclear in 11 studies for allocation concealment, randomization process (n= 2), deviations from the intended interventions (n= 2), measurement of the outcome (n= 1), selection of the reported outcome (n= 2), and overall bias (n= 2).

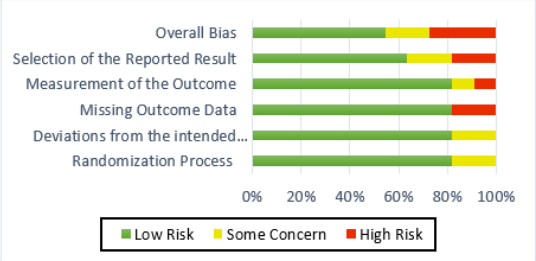

FIGURE 2. Analysis of Risk of Bias in Included Studies
Sumber: (Forsell *et al.*, 2017; Haga *et al.*, 2019; Siobhan A Loughnan *et al.*, 2019; Heller *et al.*, 2020; Liu *et al.*, 2022; Qin *et al.*, 2022; Carona *et al.*, 2023; Y. Zhang *et al.*, 2023; Shorey *et al.*, 2023; Suharwardy *et al.*, 2023; X. Zhang *et al.*, 2023

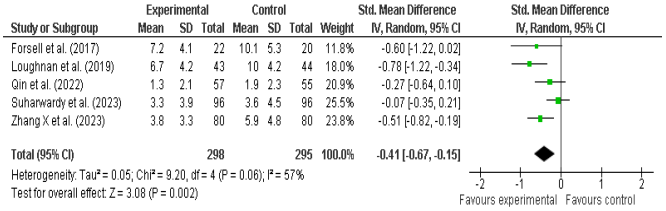

FIGURE 3. Forest Plot Effectiveness of Digital Psychotherapy Intervention on Perinatal Anxiety Symptoms
Source: Revman's analysis from the study (Forsell et al., 2017; Siobhan A Loughnan et al., 2019; Qin et al., 2022; Suharwardy et al., 2023; X. Zhang et al., 2023)

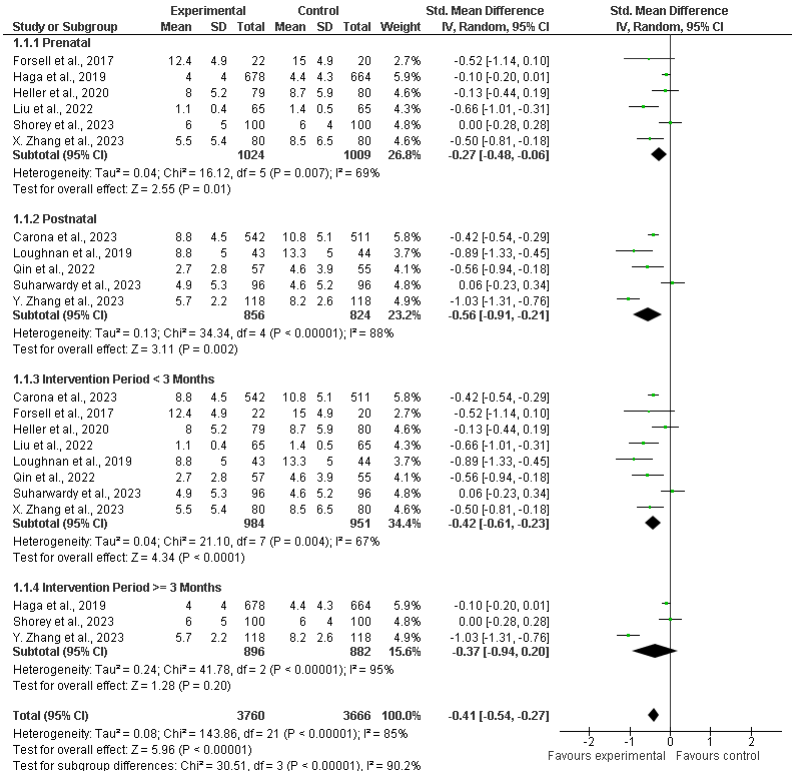

FIGURE 4. Forest Plot of Comparison Effectiveness of Digital Psychotherapy Interventions on Perinatal Depression Symptoms Based on Research Population and Period Intervention
Source: Revman's analysis from the study (Forsell et al., 2017; Haga et al., 2019; Siobhan A Loughnan et al., 2019; Heller et al., 2020; Liu et al., 2022; Qin et al., 2022; Carona et al., 2023; Y. Zhang et al., 2023; Shorey et al., 2023; Suharwardy et al., 2023; X. Zhang et al., 2023)a

Figure 3 shows the statistically significant effect (p = 0.002, from five studies) of digital psychotherapy interventions on reducing perinatal maternal anxiety symptoms. The analysis reveals a small to moderate effect size (SMD: -0.41; 95% CI: -0.67 to -0.15), with consistency across studies despite moderate heterogeneity (I^2 = 57%, Chi^2 = 9.20, p = 0.06). This heterogeneity suggests variability in intervention efficacy across different contexts or populations. Based on the study analysis indicates that two studies had medium to large effect sizes. Loughnan *et al.* (SMD: -0.78; 95% CI: -1.22 to -0.34) and Forsell *et al.* (SMD: -0.60; 95% CI: -1.22 to 0.02) reported the highest values. Interestingly, both Forsell and Loughnan's studies employed Internet-delivered cognitive behavioral therapy (ICBT) as their intervention paradigm, albeit with distinct target populations (Forsell *et al.*, 2017; Siobhan A. Loughnan *et al.*, 2019). Forsell *et al.* focused on pregnant women (n = 42) over a 10-week intervention period, whereas Loughnan *et al.* targeted postpartum women (n = 131) with six-week programs. It is worth noting the differential completion rates: 85.7% in Forsell *et al.*'s study compared to 68.1% in Loughnan *et al.*'s investigation (Forsell *et al.*, 2017; Siobhan A. Loughnan *et al.*, 2019). These differences in population characteristics, intervention duration, and adherence may contribute to the observed heterogeneity and warrant future research to optimize digital psychotherapy interventions for perinatal anxiety.

The analysis forest plot in Figures 4 and 5 shows digital psychotherapy interventions'

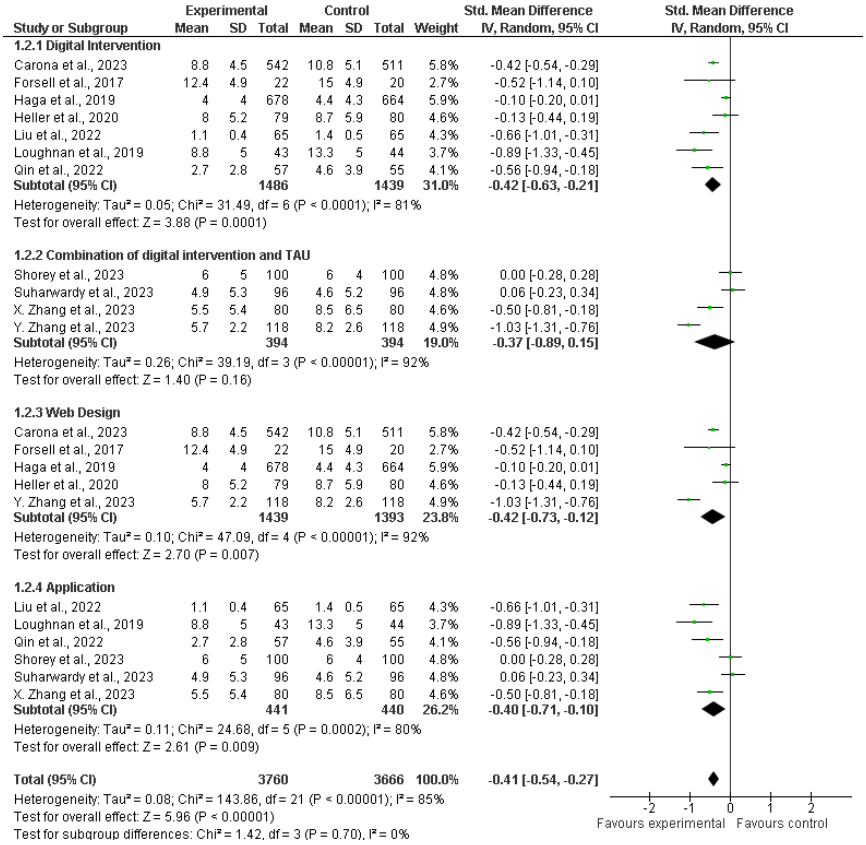

FIGURE 5. Forest Plot of Comparison Effectiveness of Digital Psychotherapy Interventions on Perinatal Depression Symptoms Based on Intervention Type and Digital Media

Sumber: (Forsell et al., 2017; Haga et al., 2019; Siobhan A Loughnan et al., 2019; Heller et al., 2020; Liu et al., 2022; Qin et al., 2022; Carona et al., 2023; Y. Zhang et al., 2023; Shorey et al., 2023; Suharwardy et al., 2023; X. Zhang et al., 2023)

a new app-based cognitive behavioral therapy program, on reducing the depressive symptoms of mothers during the very early postpartum period via a pilot randomized controlled study. The participants were recruited during birth hospitalization (within 3 days after giving birth

effectiveness in improving perinatal depression symptoms ($p < 0.0001$ from 11 studies). The analysis reveals a small to moderate effect size (SMD: -0.41; 95% CI: -0.54 to -0.27). However, the heterogeneity observed was very high ($I^2 = 85\%$, $Chi^2 = 143.86$, $p < 0.00001$). This indicates substantial variability in intervention effects across studies, potentially attributable to differences in populations, intervention types, use of digital media, and intervention periods.

Based on the analysis shown in Figure 4, the timing of intervention implementation (prenatal or postnatal) and intervention duration (long-term or short-term) may affect the effectiveness of perinatal depression treatment. Meta-analysis results indicate that interventions in prenatal populations (SMD: -0.27; 95% CI: -0.48 to -0.06), postnatal populations (SMD: -0.56; 95% CI: -0.91 to -0.21), and short-term interventions (<3 months) (SMD: -0.56; 95% CI: -0.91 to -0.21) significantly reduced depressive symptoms. Meanwhile, the long-term intervention (≥3 months) showed no significant differences between experimental and control groups (three studies, p=0.2). This study suggests the highest intervention effectiveness was observed in the postnatal population. This finding aligns with Finlayson *et al*. research regarding the effectiveness of postnatal interventions in reducing depressive symptoms (Finlayson *et al.*, 2020). This may be influenced by the complexities of adapting to parenthood roles and changing family dynamics during the perinatal phase. However, postnatal maternal care often receives insufficient attention regarding service standardization and individualization (Beňová *et al.*, 2023), given that maternal health systems prioritize antenatal and intrapartum care. This emphasizes that the specific needs of both populations need to be considered when optimizing perinatal mental health services.

In the short-term intervention, Loughnan et al.'s study demonstrated the highest intervention effect (SMD: -0.89; 95% CI: -1.33 to -0.45), involving 131 postnatal mothers for six weeks of intervention and four weeks of follow-up, with a low attrition rate of 3.4% (Siobhan A Loughnan *et al.*, 2019). Conversely, although not reaching statistical significance, the long-term intervention by Zhang *et al*. resulted in the highest measure of effectiveness in the subgroup (SMD: -1.03; 95% CI: -1.31 to -0.76). The study involved 236 three-month postnatal mothers and a three-month follow-up, with an attrition rate of 5.2% (Y. Zhang *et al.*, 2023). The duration of both the intervention and follow-up periods appears to be a crucial determinant of application use dropout rates. Linardon's research suggests that a significant decline in app usage correlates with the duration of use, whether measured in minutes, days, or hours (Linardon, 2023). This observation highlights the importance of considering engagement strategies and optimal intervention duration when designing and implementing digital psychotherapy interventions for perinatal depression. These findings emphasize the importance of considering the optimal duration of interventions in perinatal depression intervention management. Although postnatal and short-term interventions tend to provide more consistent and significant results, long-term interventions also deserve further exploration, considering the potential unidentified in current studies.

The forest plot in Figure 5 shows the variation in effectiveness by intervention type (digital intervention and combination of digital intervention with TAU) and delivery platform (web modification and app) in perinatal depression management. Meta-analytic findings revealed statistically significant intervention effectiveness in depression symptom reduction across digital interventions (SMD: -0.42; 95% CI: -0.63 to -0.21), web-based modifications (SMD: -0.42; 95% CI: -0.73 to -0.12), and mobile applications (SMD: -0.40; 95% CI: -0.71 to -0.10). Although the combination of digital intervention with TAU showed a positive trend, it was not statistically significant (SMD: -0.37; 95% CI: -0.89 to 0.14, $p = 0.16$). The substantial heterogeneity observed in this subgroup analysis ($I^2 = 92\%$) indicates considerable inter-study variability in intervention efficacy. In a subgroup analysis of digital interventions, the MUMentum Pregnancy application, evaluated by Loughnan *et al*., demonstrated the highest effectiveness. This application adapted Internet-based Cognitive Behavioural Therapy (ICBT) with content condensed through comic-style illustrated narratives, achieving a 60.3%

completion rate over a 4-week follow-up period (Siobhan A Loughnan *et al.*, 2019). Protocol adherence was monitored through sequential lesson access, regulated by an automated five-day interval restriction mechanism. These findings align with Chua and Shorey's systematic review, which showed the promising potential of mobile application-based interventions in enhancing overall perinatal well-being (Chua and Shorey, 2022). Their research also recommended incorporating animation and virtual reality technologies to provide experiential learning opportunities for parents.

Regarding web-based platforms, Zhang Y *et al.*'s evaluation of an integrated digital intervention and TAU approach utilizing an Internet-based Support Programme (ISP) scored the highest, although the overall analysis of studies in this subgroup was not significant. This may have been influenced by the limited number of studies analyzed. Participants achieved 96.6% compliance over a three-month follow-up period, as measured by login frequency and duration (Y. Zhang *et al.*, 2023). Variability in attrition and completion rates may have affected the intervention outcomes (Sterne *et al.*, 2019), with enhanced protocol adherence correlating with stronger treatment-seeking intentions. Multiple factors influence the implementation and success of these interventions, particularly in combined approaches. Barriers to traditional mental health services include stigma, lack of awareness, and limited access (Atif *et al.*, 2023), which are particularly prevalent in low- and middle-income countries (Sun *et al.*, 2021). Furthermore, delays in accessing mental health services are often due to a lack of qualified professionals to facilitate psychological interventions and financial constraints (Mitchell *et al.*, 2023). Improving the effectiveness of interventions depends on the full integration of user preferences, accessibility, and context-specific perinatal healthcare systems.

Conclusion

This meta-analysis investigates the effectiveness of digital therapies versus traditional treatments for maternal mental health, focusing on randomized controlled trials (RCTs) of psychotherapy. The study provides important insights into technology-based interventions to address maternal mental health issues, particularly depression and anxiety. Findings indicate that digital interventions are most effective for the postnatal population when implemented for less than three months. The analyzed studies were generally of high methodological quality and predominantly conducted in high-income countries, which limits the generalizability of results to low- and middle-income settings. A notable limitation is that fewer studies measured anxiety symptoms, which limits our understanding of the effectiveness of interventions for antenatal and postnatal anxiety. While the analyzed study's strength lies in its sample size and attrition rate, results should be interpreted cautiously. Further research is needed to validate these findings and explore the role of digital technologies in improving the accessibility and effectiveness of psychological interventions in different clinical and cultural contexts.

Acknowledgment

We sincerely thank the researchers whose randomized controlled trials (RCTs) were included as supplementary data in this meta-analysis. Their rigorous studies contributed significantly to the depth and validity of our findings, enabling a comprehensive synthesis of evidence on digital therapies for maternal mental health.

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