Effectiveness of eHealth Interventions to Reduce Perinatal Anxiety: A Systematic Review and Meta-Analysis

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ABSTRACT

Objective: eHealth interventions have been shown to be effective in improving anxiety among the general population. Despite the effectiveness of eHealth interventions for perinatal depression, a recent review reported mixed results for perinatal anxiety. The review, however, was not focused on anxiety, and studies with various designs were included. The aim of this systematic review is to summarize the evidence specific to anxiety and to conduct a meta-analysis to examine the effectiveness of eHealth interventions in reducing perinatal anxiety.

Data Sources: MEDLINE, CINAHL, EMBASE, and PsycINFO were searched beginning with the date that the databases were available through March 2018 using keywords such as *perinatal period*, *web-based interventions*, and *anxiety*.

Study Selection: Randomized controlled trials that were conducted during the perinatal period, examined the effectiveness of an eHealth mental health intervention, measured anxiety symptoms or disorders as a primary or secondary outcome, provided data on anxiety levels both pre-intervention and post-intervention, had a comparison group, and were published in English were included. A total of 770 articles were retrieved, and the full texts of 64 articles were reviewed. Five studies met the inclusion criteria, 4 of which fulfilled the quality criteria and were included in the meta-analysis.

Data Extraction: Data were extracted using a data extraction form developed for this study. The Cochrane Collaboration's Review Manager software was used to conduct the meta-analysis.

Results: The test for heterogeneity ($I^2 = 0\%$; $P = .80$) suggested a homogeneous sample. The meta-analysis for the total effect size showed that at post-intervention, the eHealth group had significantly lower anxiety scores than the control group, with a standardized mean difference of −0.41 (95% CI, −0.71 to −0.11; $P = .007$).

Conclusions: eHealth interventions are promising in improving perinatal anxiety. The content of these interventions should account for common comorbid mental health conditions during the perinatal period and provide opportunities to tailor further treatment if necessary.

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Anxiety is a prevalent mental health problem during the perinatal period. The rates of anxiety disorders and symptoms, respectively, are 15% and 23% during pregnancy and 9% and 15% during the postpartum period.[1,2] Perinatal anxiety has been linked to various adverse maternal and child outcomes, including antenatal alcohol consumption[3] and smoking,[4,5] low birth weight and preterm birth,[6–8] postpartum depression,[9–11] and poor cognitive, behavioral, and psychomotor development and mental health problems in children.[6,12–16] Per health economic evaluations, perinatal mental health problems carry immense cost to the health care system and society, of which 72% is related to adverse child outcomes.[17]

Nonpharmacologic interventions such as cognitive-behavioral therapy (CBT) have been shown to be effective in managing perinatal anxiety[18,19] and are recommended for pregnant and breastfeeding women with mild to moderate conditions.[20–22] However, perinatal mental health issues in practice often remain underdiagnosed and untreated for various reasons. In particular, the lack of care pathways and accessible treatment following a positive screening has been reported as a critical barrier hindering care providers' engagement in the screening process and contributing to their skepticism toward the usefulness of screening.[23–26] Women also report a number of barriers in seeking treatment, including time constraints, childcare issues, stigma, and uncertainty regarding the availability of support.[26–29]

eHealth interventions, defined as digital applications to facilitate the delivery of health care,[30] can address a number of these barriers by providing accessible and timely treatment, being cost-effective and convenient, reaching a wider population in need, and providing options for those who prefer less anonymous approaches for mental health treatment.[31,32] eHealth interventions can also reduce the burden on traditional clinics and optimize the utilization of health care resources.[32]

The effectiveness of eHealth interventions has been reported for the treatment of a variety of mental health conditions among various populations,[33,34] and eHealth interventions have been shown to be as effective as face-to-face therapy.[32,33,35] Evidence of the effectiveness of eHealth interventions during the perinatal period is emerging. Two recently published reviews[36,37] showed that eHealth interventions might be promising for the management of perinatal mental health issues, particularly depression and grief. While both reviews were mainly focused on depression, Ashford et al[36]

Clinical Points

- eHealth interventions have been shown to be effective in improving anxiety among the general population; however, mixed results were reported for perinatal anxiety.
- This meta-analysis showed that eHealth interventions are promising in improving perinatal anxiety.
- Strictly focused eHealth program content on a specific mental health condition might disregard comorbid conditions. Given the prevalence and comorbidity of depression and anxiety, the content of eHealth mental health programs should cover both conditions.

reported a brief synthesis on the effectiveness of eHealth interventions for perinatal anxiety. They reported that despite the effectiveness of eHealth interventions for perinatal depression, the evidence for anxiety is mixed, and, predominantly, no significant impact is evident. This finding contrasts with the findings of meta-analyses among general populations[34,35,38] that have shown medium to large effect sizes of eHealth interventions for the treatment of anxiety. This inconsistency between findings for the general population and findings for the perinatal population might be partly due to the review methods and selection of studies based on criteria nonspecific to anxiety and to the inclusion of studies with various designs. Despite comorbidity, anxiety is a concept that is distinct from depression. In this systematic review focused on anxiety, we aimed to summarize the evidence on this topic, conduct a meta-analysis to determine the pooled effect of eHealth interventions on improving perinatal anxiety, and provide insights to aid in understanding the reported discrepancies in the literature.

METHODS

Search Strategy

To identify relevant studies, the following electronic databases were searched, beginning with the date that each database was available through March 2018: MEDLINE, CINAHL, EMBASE, and PsycINFO. Table 1 depicts the details of the search strategies for each database. The reference lists of the included studies were also searched for additional relevant articles. We did not attempt to retrieve gray literature. This was a systematic review; thus, an institutional ethics board approval was not required.

Criteria for Study Inclusion

We included randomized controlled trials (RCTs) with the following characteristics: (1) were conducted during the perinatal period; (2) examined the effectiveness of an eHealth mental health intervention delivered via computer software, online websites, or mobile applications; (3) measured anxiety symptoms or disorders as a primary or secondary outcome; (4) provided data on anxiety levels both pre-intervention and post-intervention; (5) had a comparison group; and (6) were published in English.

Data Extraction and Analysis

Data were extracted using a data extraction form that included information about the study aim, location, publication year, sample size, participant characteristics, eHealth intervention, main and secondary mental health outcomes, and user experience (when available). We used the Cochrane Collaboration's Review Manager software version 5.3[39] to summarize the data and conduct the meta-analysis. Heterogeneity was assessed using the reported I^2 values in the Cochrane Collaboration Review Manager software. We compared postintervention anxiety levels between the intervention and control groups and calculated standardized mean differences (SMDs) and 95% confidence intervals (CIs).

Quality Appraisal

The quality of the included studies was evaluated independently by 2 reviewers using the Scottish Intercollegiate Guidelines Network (SIGN) methodology checklist for RCTs.[40] Disagreements were resolved through discussion. The risk of bias was assessed using the Cochrane Risk of Bias Tool in Review Manager. In the assessment of the risk of bias, the nature of the intervention made the blinding of participants nearly impossible; thus, we evaluated this item based on the blinding of the personnel.

RESULTS

A total of 770 articles were initially identified through the literature searches. After removal of duplicates, the titles and abstracts of potential articles were screened for eligibility by 2 reviewers independently. The full texts of 64 articles were retrieved for further assessment, of which 5 studies met the inclusion criteria and were included in the review. The search process and reasons for exclusions at each stage are reported in Figure 1. Among the included studies, 3 interventions were based on CBT[41–43] and 2 were based on behavioral activation treatment (BAT).[44,45] Depression was the primary outcome in 4 studies, and 1 study identified various outcomes as the main outcome, including stress, anxiety and program satisfaction. Two studies included pregnant participants, and 3 studies included postpartum participants (Table 2).

Quality Appraisal

Overall, 4 of the 5 included studies had high or acceptable quality based on the criteria listed in the SIGN methodology checklist for RCTs[40] and had a low risk of bias in most criteria defined in the Cochrane Risk of Bias Tool. The main risk of bias included the blinding of outcome assessment (detection bias). The report by Scherer et al[43] did not provide sufficient information to determine the risk of bias in several areas, specifically for the randomization process, allocation concealment, and blinding of personnel and outcome measures. The risk of attrition bias was also high because of high dropout numbers. Another weakness included not having a "real" control group. The control group in this study

Table 1. Details of Search Strategy for Each Database

Database	Search Terms
MEDLINE	(online or computer* or m?health or web?based or mobile app* or mobile?health or tele?health).mp. [mp = title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms] (self?help or self?care or self?management or e?health or intervention* or web*).mp.[mp = title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms] software/ or mobile applications/ or software design/ or software validation/ or user-computer interface/ or video games/ or web browser/ Therapy, Computer-Assisted/ Online Systems/ internet/ or blogging/ or social media/ or computers/ Telemedicine/ AND self care/ or self administration/ or self medication/ Self-Help Groups/ exp Psychotherapy/ exp behavior therapy/ or cognitive therapy/ or "acceptance and commitment therapy"/ or mindfulness/ or relaxation therapy/ AND ("generalized anxiety disorder*" or "GAD" or "PTSD").mp. [mp = title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms] "trauma and stressor related disorders"/ or adjustment disorders/ or stress disorders, traumatic/ or psychological trauma/ or stress disorders, post-traumatic/ or stress disorders, traumatic, acute/ fear/ or panic/ exp anxiety disorders/ or panic disorder/ or phobic disorders/ or phobia, social/ exp Anxiety/ AND peripartum period/ or postpartum period/ perinatal care/ or postnatal care/ or prenatal care/ Obstetrics/ exp Pregnancy Complications/ exp pregnancy/ or exp pregnancy outcome/
EMBASE	(postpartum or post-partum or antenatal or prenatal).mp. [mp = title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word] puerperium/ or exp postnatal care/ exp prenatal care/ or prenatal diagnosis/ or prenatal screening/ or prenatal development/ exp perinatal period/ or exp perinatal stress/ exp named groups by pregnancy/ or multigravida/ or multipara/ or nulligravida/ or nullipara/ or pregnant woman/ or primigravida/ or primipara/ exp pregnancy/ or exp adolescent pregnancy/ or exp first trimester pregnancy/ or exp mother fetus relationship/ or exp multiple pregnancy/ or exp second trimester pregnancy/ or exp third trimester pregnancy/ or exp unplanned pregnancy/ or exp unwanted pregnancy/ AND GAD.mp. exp generalized anxiety disorder/ exp panic/ exp phobia/ or exp neophobia/ or exp social phobia/ exp fear/ exp anxiety/ or exp anxiety assessment/ or exp anxiety disorder/ or exp anxiety neurosis/ or exp anxiety sensitivity index/ AND exp psychotherapy/ cognitive behavioral therapy/ cognitive therapy/ or "acceptance and commitment therapy"/ or cognitive remediation therapy/ behavior therapy/ self-care/ or self-care agency/ or self-medication/ self-help/ or self-help device/ AND mobile application/ or mobile phone/ or smartphone/ (e?health or computer?based or web?based or intervention* or web*).mp. [mp = title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word] exp telediagnosis/ or exp telehealth/ or exp telemedicine/ computer/ or human computer interaction/ or computer assisted drug therapy/ or computer assisted therapy/ or computer assisted diagnosis/ Internet/ or online system/
CINAHL	(MH "Self-Care+") (MH "Psychotherapy+") OR (MH "Psychotherapy, Brief") OR (MH "Psychotherapy, Group+") (MH "Behavior Therapy+") OR (MH "Behavior Modification+") (MH "Cognitive Therapy+") OR (MH "Cognitive Therapy (Iowa NIC)+") (MH "User-Computer Interface+") OR (MH "Software+") (MH "Website Development") OR (MH "World Wide Web Applications+") OR (MH "World Wide Web+") "postpartum" OR "postpartum" OR "antenatal" OR "prenatal" (MH "Postpartum Psychosis") OR (MH "Postnatal Period+") OR (MH "Pregnancy Complications, Psychiatric+") (MH "Obstetrics") OR (MH "Delivery, Obstetric+") OR (MH "Obstetric Patients") OR (MH "Obstetric Care+") OR (MH "Obstetric Service") OR (MH "Pregnancy Outcomes") OR (MH "Perinatology") OR (MH "Postnatal Care+") OR (MH "Prenatal Care") OR (MH "Perinatal Care") (MH "Pregnancy+") OR (MH "Childbirth+") OR (MH "Labor+") OR (MH "Pregnancy, Multiple+") OR (MH "Pregnancy Trimesters+") OR (MH "Pregnancy, High Risk") OR (MH "Pregnancy, Unplanned") OR (MH "Pregnancy, Unwanted") (MH "Expectant Mothers") OR "pregnant" (MH "Panic Disorder") OR ("panic attack*") (MH "Anxiety Disorders+") OR (MH "Generalized Anxiety Disorder") OR (MH "Phobic Disorders+") OR ("phobia*") OR ("GAD") (MH "Anxiety+") OR (MH "Fear+") (MH "Support Groups+") OR "self-help" OR "self-help" (MH "Mobile Applications") (MH "Therapy, Computer Assisted+") OR "computer" (MH "Internet+") OR (MH "Social Media") OR (MH "Social Networking") (MH "Videoconferencing+") OR (MH "Wireless Communications") OR (MH "Telemedicine+") OR (MH "Telenursing") OR (MH "Telepsychiatry") OR

(continued)

Table 1 (continued).

Database	Search Terms
	(MH "Cellular Phone+") OR (MH "Telecommunications+") OR (MH "Electronic Bulletin Boards") OR (MH "Electronic Mail")
	(MH "Online Services") OR (MH "Informatics+") OR (MH "Health Informatics+") OR (MH "Telecommunications+") OR (MH "Telehealth+") OR (MH "Wireless Communications")
PsycINFO	DE "Relaxation Therapy" DE "Psychotherapy"
	DE "Cognitive Behavior Therapy" OR DE "Cognitive Therapy" OR DE "Behavior Therapy"
	DE "Self-Care Skills"
	DE "Self-Help Techniques" OR DE "Support Groups" OR DE "Self-Management" OR DE "Self- Regulated Learning"
	"GAD" OR "PTSD"
	DE "Phobias" OR DE "Fear" OR DE "Panic Disorder" OR DE "Panic" OR DE "Panic Attack"
	DE "Anxiety Disorders" OR DE "Generalized Anxiety Disorder" OR DE
	"Panic Disorder" OR DE "Phobias" OR DE "Posttraumatic Stress Disorder" OR DE "Anxiety" OR DE "Anxiety Management"
	DE "Childbirth Training" OR DE "Prenatal Care" OR DE "Prenatal Development" OR DE "Prenatal Developmental Stages" OR DE "Prenatal Diagnosis"
	DE "Perinatal Period" OR DE "Neonatal Period" OR DE "Antepartum Period" OR DE "Postnatal Period"
	DE "Adolescent Pregnancy" OR DE "Pregnancy Outcomes" OR DE "Caesarean Birth" OR DE "Natural Childbirth" OR DE "Premature Birth" OR DE "Birth Injuries" OR DE "Birth Trauma" OR DE "Labor (Childbirth)" OR DE "Birth" OR DE "Pregnancy" OR DE "Obstetrics" "ehealth" OR "computer-based" OR "web-based"
	DE "Cellular Phones" OR DE "Computer Applications" OR DE "Computers"
	DE "Information Dissemination" OR DE "Electronic Communication" OR DE "Internet" OR DE "Websites" OR DE "Computer Mediated Communication" OR "Web*"
	DE "Computer Applications" OR DE "Computer Assisted Diagnosis" OR DE "Computer Assisted Testing" OR DE "Computer Assisted Therapy"
	DE "Online Social Networks" OR DE "Social Media" OR DE "Network Therapy" OR DE "Social Networks" OR DE "Online Community"
	DE "Online Therapy" OR DE "Online Experiments"
	DE "Telemedicine"

also received an intervention that included internet-based exercises (6 modules) such as sudoku, riddles, and writing stories. As the authors noted, the inclusion of a wait-list control group in the study design rather than a control group with the intervention would have provided more robust information about the effectiveness of the intervention. Given these limitations, we did not include this study in the meta-analysis (Figure 2).

Meta-Analysis

Four studies[41,42,44,45] were included in the meta-analysis. Various scales were used to measure anxiety, including the Generalized Anxiety Disorder Scale with 7 items (GAD-7)[42,44] and the Depression Anxiety Stress Scales with 21 items.[41,45] Given variations in the measurement of anxiety (Table 3), random effects models were computed using Review Manager.[39,46] A test for heterogeneity was conducted to determine the suitability of performing a meta-analysis and calculating a pooled estimate of effect size. The test for heterogeneity ($I^2 = 0\%$; $P = .80$) suggested a homogeneous sample. The meta-analysis for the overall effect size showed that the intervention group had significantly lower anxiety scores than the control group post-intervention, with an SMD of −0.41 (95% CI, −0.71 to −0.11; $P = .007$) (Figure 3).

Depression

Forsell et al[42] reported that the intervention group had significantly lower depression scores postintervention than the control group, as measured with the Montgomery-Asberg Depression Rating Scale Self-Report Version, and that compared with the control group, more women in the intervention group no longer met the diagnostic criteria for depression (63% vs 12%). Milgrom et al[41] also reported that, compared to the control group, fewer women in the intervention group met the clinical diagnostic criteria for depression at the 12-week assessment (79% vs 18%, $P = .001$). Similarly, in the study by Pugh et al,[45] more women in the intervention group compared to those in the control group were classified as recovered on the Edinburgh Postnatal Depression Scale (62% vs 38%, $P = .08$). O'Mahen et al[44] also reported a large effect size for BAT in reducing depression for the women who received intervention.

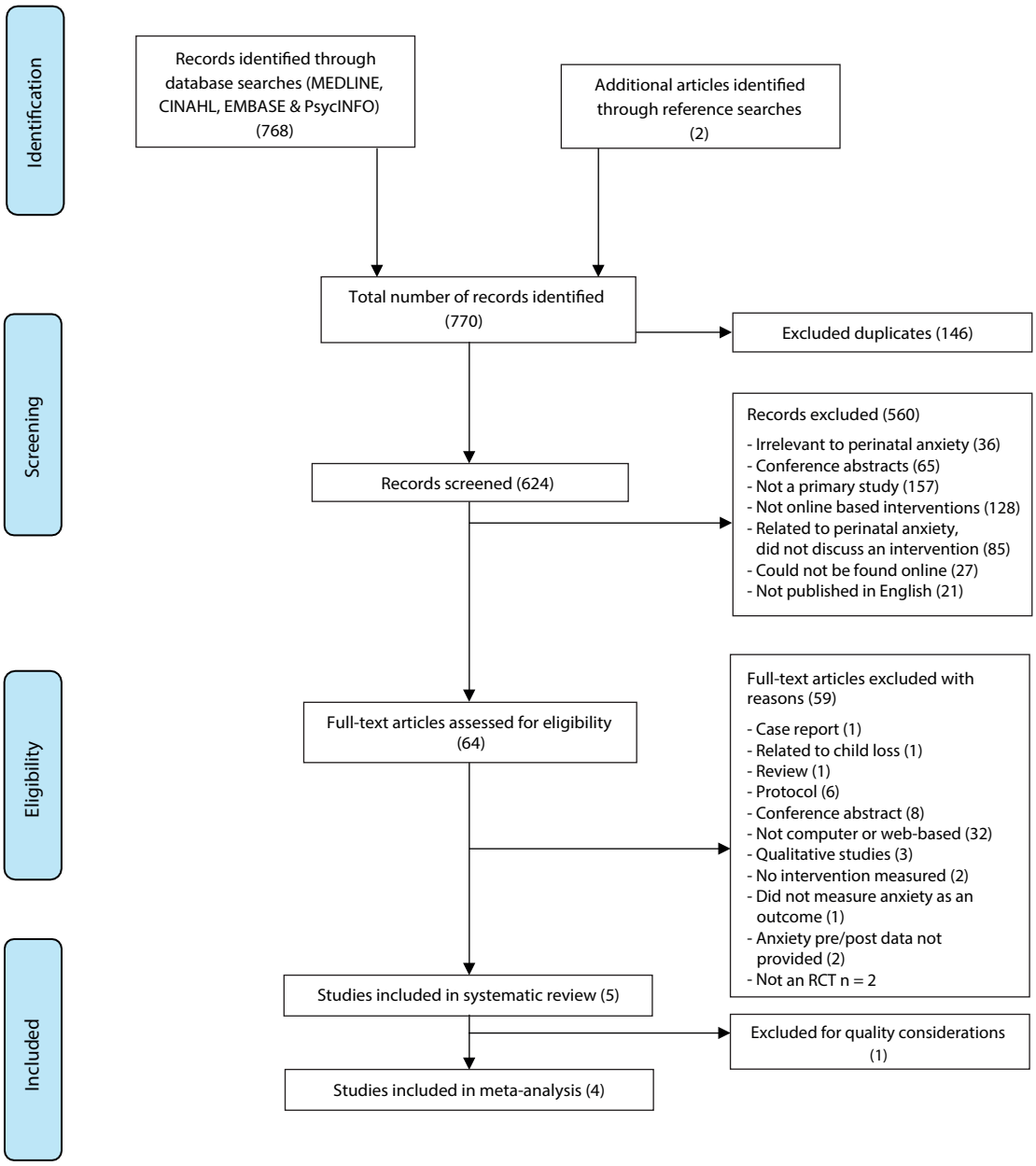
User Experience

The included studies evaluated several aspects of user experience, including program satisfaction, perception of the program, and utilization and adherence. Overall, program satisfaction was high, and perceptions of the program were positive.[41,42] Pugh et al[45] found that 80% of their participants reported enjoying the program and communicating with their coach. Utilization and adherence to the program varied among studies. Some participants in the study by Forsell et al[42] reported feeling stressed about not keeping up with the treatment modules.[42] Table 2 depicts the assessment of user experience in each included study.

DISCUSSION

This review of the available literature on the effectiveness of eHealth mental health interventions for perinatal anxiety showed significant improvements following these interventions. A recent synthesis[36] showed mixed results for the effectiveness of eHealth interventions in which anxiety symptom reduction was greater in the intervention group in half of the studies and symptom reduction was greater in the control group in half of the studies. In this meta-analysis of RCTs, we found a significant reduction in anxiety scores following an eHealth intervention, with a medium effect size (SMD = −0.41; 95% CI, −0.71 to −0.11; $P = .007$). The SMD is widely used, and its values of 0.2, 0.5, and 0.8 correspond

Figure 1. Flow Diagram of Article Collection Throughout the Systematic Review



Abbreviation: RCT = randomized controlled trial.

to small, medium, and large effects, respectively.[47] This medium effect size is considerable given that the content of interventions in the included studies focused little on anxiety. For example, in the study by Forsell et al,[42] treatment modules mainly covered depression. Several modules, including the module specific to anxiety and worry, were identified as "extra" by the developer, and only 9% of patients completed the module specific to anxiety and worry.[42] In the study by O'Mahen et al,[44] eHealth treatment included a core module and 6 optional modules. The module on anxiety was optional, and women were expected to choose 2 optional modules from a list of 6.[44] The content of interventions was mainly focused on depression, and all studies reported a large effect size for eHealth in reducing depression. It is possible that interventions with content more specific to anxiety may result in larger effect sizes. Studies are needed to examine this possibility.

A trend of within-group anxiety reduction was evident for both the intervention and control groups over the course of treatment. For example, decreases in both depression and anxiety scores were reported for both groups in the study by Forsell et al.[42] Given this parallel reduction, despite significant within-group reductions in the GAD-7 score in the intervention group, between-group comparisons with the control group showed no significant changes. There are several possible explanations for the anxiety reduction among the control group participants. First, anxiety often diminishes as pregnancy progresses.[48] Similar reductions

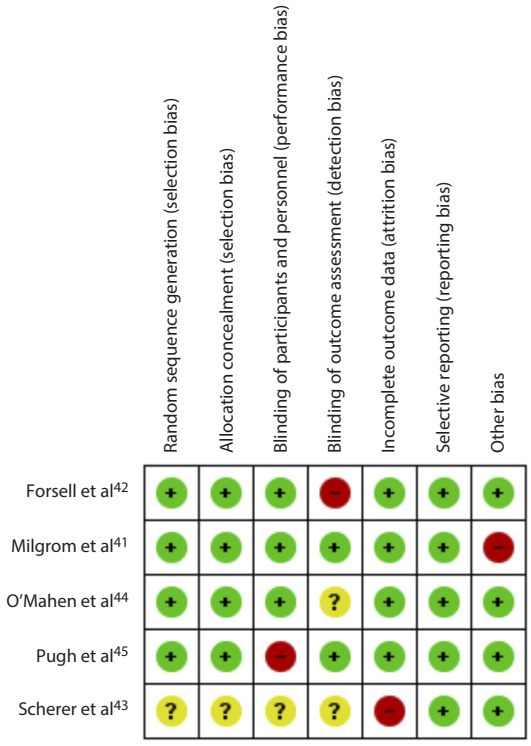
Table 2. Characteristics of Studies Meeting Inclusion Criteria[a]

Study, Location	Sample Size and Inclusion Criteria	Control	Intervention Type and Timing	Therapist Support	Satisfaction	Perception About Program	Adherence and Utilization	Study Quality
Forsell et al (2017),[42] Sweden	N = 37 ≥ 18 age, 10–28 weeks pregnant, has major depression (SCID-I), score 15–35 on MADRS-S, at no/low risk of suicide, on no/stable antidepressant dose for last 3 weeks	TAU	CBT, 10 sessions 12–28 weeks' gestation	CBT-trained therapist provided online feedback to submitted module activities	CSQ-8	Treatment Credibility Scale	Time spent, number of logins, messages sent to the therapist, the number of modules accessed and completed, and time spent by therapists	Acceptable
Milgrom et al (2016),[41] Australia	N = 43 ≥ 18 age, EPDS score 11–23, no current depression treatment, no thoughts of self-harm, has major/minor depression (SCID-IV)	TAU	CBT, 6 sessions Postpartum	Trained coaches not provided clinical guidance	4-point Likert scale (1 = not at all satisfied, 4 = very satisfied)	…	Number and duration of visits to the website and number of program sessions attended	High
O'Mahen et al (2014),[44] United Kingdom	N = 59 > 18 age, EPDS score > 12, no previous substance abuse or psychosis, has major depressive disorder	TAU	BAT, 12 sessions Postpartum	Trained mental health workers provided 20–30 minutes/wk telephone support	…	…	Numbers of modules viewed, modules completed, and telephone support sessions	High
Pugh et al (2016),[45] Canada	N = 39 ≥ 18 age, EPDS score ≥ 10 on the EPDS, no current psychotherapy treatment, on no/stable medication for past month, no past or present psychotic mental illness or bipolar disorder, no current suicide intent, has subclinical and clinical PPD	Waitlist	BAT, 6 sessions Postpartum	Clinical psychology doctoral students provided weekly e-mails/telephone calls if the participants were inactive	Two questions, adapted from the Treatment Satisfaction Questionnaire-Modified	The Credibility/Expectancy Questionnaire and TAQ	…	Acceptable
Scherer et al (2016),[43] Switzerland	N = 58 Has preterm labor without a high-risk pregnancy, psychosis, suicidal tendencies, or substance abuse disorders (other than nicotine)	Online distraction exercises	Cognitive behavioral stress management therapy, 6 sessions 18–32 weeks' gestation	Regular online exchanges with a psychologist or psychologist-in-training	CSQ-8	…	WAI-SR	Low

[a]Although all 5 studies described in this table met inclusion criteria and were included in the systematic review, the study by Scherer et al[43] rated "low" on the quality appraisal and thus was not included in the meta-analysis.

Abbreviations: BAT = behavioral activation therapy, CBT = cognitive-behavioral therapy, CSQ-8 = 8-item Client Satisfaction Questionnaire, EPDS = Edinburgh Postnatal Depression Scale, MADRS-S = Montgomery-Asberg Depression Rating Scale-Self-Report Version, PPD = postpartum depression, SCID-I = Structured Clinical Interview for *DSM* Axis I Disorders, SCID-IV = Structured Clinical Interview for *DSM-IV*, TAQ = Therapy Alliance Questionnaire, TAU = treatment as usual, WAI-SR = Working Alliance Inventory–Short Revised.

Figure 2. Assessment of Risk of Bias in Included Studies



Symbols: + = low risk, − = high risk, ? = unclear risk.

Table 3. Assessment of Anxiety in Studies Meeting Inclusion Criteria[a]

Measure	Study	Mean (SD) Pre-Score; n	Mean (SD) Post-Score; n
GAD-7	Forsell et al, 2017[42]	I: 11.6 (4.5); n = 21 C: 13.1 (5.7); n = 18	I: 7.2 (4.1); n = 20 C: 10.1 (5.3); n = 17
	O'Mahen et al, 2014[44]	I: 13.9 (3.82); n = 41 C: 14.12 (4.78); n = 42	I: 8.71 (4.61); n = 31 C: 11.29 (5.29); n = 28
DASS-21	Milgrom et al, 201[641]	I: 9 (7); n = 21 C: 6.7 (5.3); n = 22	I: 4.2 (5.5); n = 21 C: 5.4 (3); n = 22
	Pugh et al, 2016[45]	I: 13.04 (8.49); n = 23 C: 9.04 (8.22); n = 22	I: 6.1 (6.16); n = 19 C: 7.62 (6.74); n = 20
STAI-S	Scherer et al, 2016[43]	I: 48.32 (10.22); n = 31 C: 48.59 (11.93); n = 27	I: 38.62 (9.44); n = 31 C: 39.52 (8.61); n = 27
STAI-T	Scherer et al, 2016[43]	I: 43.48 (10.34); n = 31 C: 41.37 (11.41); n = 27	I: 37.1 (8.81); n = 31 C: 37.91 (7.95); n = 27

[a]Although all 5 studies described in this table met inclusion criteria and were included in the systematic review, the study by Scherer et al[43] rated "low" on the quality appraisal and thus was not included in the meta-analysis.
Abbreviations: C = control group, DASS-21 = Depression Anxiety Stress Scales with 21 items, GAD-7 = Generalized Anxiety Disorder Scale with 7 items, I = intervention group, STAI = State-Trait Anxiety Inventory.

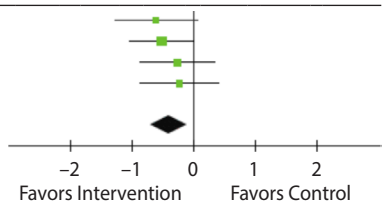
in worries about the baby's health from early pregnancy to the postpartum period have also been reported.[49] Forsell et al[42] suggested that the regular maternity care in their study might have positively influenced mental health and anxiety reduction in the control group. A decrease in anxiety scores can also be attributed to help-seeking among members of the control groups after they underwent initial screening and realized that they had mental health problems. Forsell et al[42] reported that 40% of women in the treatment-as-usual (TAU) group initiated some form of counseling over the course of the intervention. Similarly, Milgrom et al[41] reported that 81% of the TAU group reached out to obtain various types of support, including seeking advice from a general practitioner or nurse and taking medications. Despite reductions in anxiety scores among both the control and intervention groups, the meta-analysis showed significant differences in anxiety scores post-intervention, with greater reductions in the eHealth intervention group.

One of the strengths of eHealth interventions is being highly structured, which can increase treatment fidelity and decrease therapist drift (deviation from the treatment manual) compared to traditional treatments.[42] However, this fixed approach may also be a limitation, as it does not offer treatment adaptation based on interactions between the therapist and patient and on the ongoing needs of a patient. O'Mahen et al[44] reported that while the eHealth intervention reduced depression, they observed only a trend toward improvement in maternal perceived support. In their study, changes in maternal self-reported bonding with the infant also remained nonsignificant after the intervention.[44] Similarly, Milgrom et al[41] reported a 4-fold improvement in the rates of depression remission, but no improvements were observed in anxiety or in the quality of partner relationships. This finding highlights the significance of program content and suggests that close attention should be devoted particularly to comorbid conditions when the intervention is focused on a certain mental health condition. O'Mahen et al[44] reported that in their study, some women struggled with posttraumatic stress disorder and grief in addition to depression, and some initiated new treatments outside of the eHealth intervention to treat their comorbid conditions. As these authors noted, eHealth treatments can be a "starting point" for further treatment. eHealth treatments focused on specific conditions should offer tools/venues to facilitate addressing common comorbid conditions.[44] Strictly focused eHealth program content on a specific mental health condition might disregard comorbid conditions. Given the prevalence and comorbidity of depression and anxiety,[50] the content of eHealth interventions for perinatal mental health should cover both depression and anxiety.

eHealth interventions were deemed to be acceptable,[41,42] and program satisfaction was good and similar to that reported in the general population treated with eHealth.[32] Adherence to eHealth treatment was affected by socioeconomic status (SES). For example, O'Mahen et al[44] found that women were more likely to complete more modules if they had a higher income, were on maternity leave or not working, had higher perceived social support, and had better social and

Figure 3. Forest Plot of Standardized Mean Differences Between Intervention and Control Groups

Study or Subgroup	Intervention Mean	Intervention SD	Intervention Total	Control Mean	Control SD	Control Total	Weight	Standard Mean Difference IV, Random, 95% CI
Forsell et al[42]	7.2	4.1	20	10.1	5.3	17	20.2%	−0.61 [−1.27 to 0.06]
O'Mahen et al[44]	8.71	4.61	31	11.29	5.29	28	32.8%	−0.51 [−1.03 to 0.00]
Milgrom et al[41]	4.2	5.5	21	5.4	3	22	24.6%	−0.27 [−0.87 to 0.33]
Pugh et al[45]	6.1	6.16	19	7.62	6.74	20	22.4%	−0.23 [−0.86 to 0.40]
Total (95% CI)			**91**			**87**	**100.0%**	**−0.41 [−0.71 to −0.11]**



Heterogeneity: $\tau^2 = 0.00$; $\chi^2_3 = 1.02$ ($P = .80$); $I^2 = 0\%$
Test for overall effect: $Z = 2.69$ ($P = .007$)

Abbreviation: IV = inverse variation.

occupational functioning at baseline. Women with lower SES and less social support required more time and support to work through the materials and treatment content.[44] Other research[43] noted that patients' reports of the quality of their working alliance with their therapist predicted program satisfaction. In general, guided support through supplemented telephone and/or e-mail communication improves the overall adherence retention rate[51,52]; however, participants with lower SES and social support may benefit the most from guided interactions to increase treatment adherence. On the other hand, some individuals may not require guidance to continue with treatment.[53] While eHealth interventions may potentially decrease barriers related to cost and access to treatment, social disparities appear to remain important in the utilization of these types of interventions. These findings suggest that women with more complicated life circumstances may benefit from closer follow-ups or additional personal interactions or from a combined approach of eHealth and traditional treatment. Therapist support can add to women's sense of social support more broadly, whereas the lack thereof has been found to be a risk factor for poor mental health.[28,29] A better understanding of the characteristics of the population that requires guided support can inform the targeting of resources toward in-need populations and improve the effectiveness of the intervention. Studies are also needed to determine what components of a multilayered online therapy contribute to its treatment efficacy—the online modules, the therapist support, or a combination of the two.[41,44] Economic evaluations are also needed to compare the cost of online therapies to the cost of traditional in-person therapies to confirm the rationale that the former is a cost-effective alternative to the latter.[44,45]

To our knowledge, this systematic review is the first specifically focused on anxiety to determine the effectiveness of eHealth interventions. The inclusion of high-quality RCTs in the meta-analysis is a strength of this review. A limitation of this review is the small sample sizes of the included studies, which may have resulted in inflated effect sizes. None of the included studies reported statistically significant reductions in anxiety scores; however, a pooled total effect showed significant reductions in anxiety scores. The small sample sizes of the original studies, in conjunction with the slim content of the intervention focused on anxiety, may have resulted in less power to detect small changes. Hence, future larger studies with interventions focused on anxiety as a primary outcome may provide more accurate effect size estimations.

CONCLUSION

Globally, the treatment gap for mental problems is large.[54] During pregnancy and lactation, most affected women are reluctant to use medications.[55] Psychotherapy treatments for mild and moderate mental health conditions offered through eHealth interventions have several benefits, including convenient access, particularly in rural/remote areas; private therapy for those who prefer anonymous approaches; and a reduced burden on clinics. This review confirms that, similar to in the general population, eHealth mental health treatment can be effective for the treatment of anxiety among the perinatal population. eHealth interventions for perinatal mental health conditions are emerging, and the content of these interventions should account for common comorbid conditions during the perinatal period and provide opportunities to tailor further treatment if necessary.

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REFERENCES

1. Bayrampour H, McDonald S, Tough S. Risk factors of transient and persistent anxiety during pregnancy. *Midwifery*. 2015;31(6):582–589.
2. Dennis C-L, Falah-Hassani K, Shiri R. Prevalence of antenatal and postnatal anxiety: systematic review and meta-analysis. *Br J Psychiatry*. 2017;210(5):315–323.
3. Arch JJ. Pregnancy-specific anxiety: which women are highest and what are the alcohol-related risks? *Compr Psychiatry*. 2013;54(3):217–228.
4. Meshberg-Cohen S, Svikis D. Panic disorder, trait anxiety, and alcohol use in pregnant and nonpregnant women. *Compr Psychiatry*. 2007;48(6):504–510.
5. Newport DJ, Ji S, Long Q, et al. Maternal depression and anxiety differentially impact fetal exposures during pregnancy. *J Clin Psychiatry*. 2012;73(2):247–251.
6. Field T. Prenatal anxiety effects: A review. *Infant Behav Dev*. 2017;49:120–128.
7. Kramer MS, Lydon J, Séguin L, et al. Stress pathways to spontaneous preterm birth: the role of stressors, psychological distress, and stress hormones. *Am J Epidemiol*. 2009;169(11):1319–1326.
8. Liou SR, Wang P, Cheng CY. Effects of prenatal maternal mental distress on birth outcomes. *Women Birth*. 2016;29(4):376–380.
9. Heron J, O'Connor TG, Evans J, et al; ALSPAC Study Team. The course of anxiety and depression through pregnancy and the postpartum in a community sample. *J Affect*

Disord. 2004;80(1):65–73.
10. Skouteris H, Wertheim EH, Rallis S, et al. Depression and anxiety through pregnancy and the early postpartum: an examination of prospective relationships. *J Affect Disord*. 2009;113(3):303–308.
11. Ahluwalia IB, Mack KA, Mokdad A. Mental and physical distress and high-risk behaviors among reproductive-age women. *Obstet Gynecol*. 2004;104(3):477–483.
12. Davis EP, Sandman CA. Prenatal psychobiological predictors of anxiety risk in preadolescent children. *Psychoneuroendocrinology*. 2012;37(8):1224–1233.
13. Loomans EM, van der Stelt O, van Eijsden M, et al. High levels of antenatal maternal anxiety are associated with altered cognitive control in five-year-old children. *Dev Psychobiol*. 2012;54(4):441–450.
14. Buss C, Davis EP, Hobel CJ, et al. Maternal pregnancy-specific anxiety is associated with child executive function at 6–9 years age. *Stress*. 2011;14(6):665–676.
15. Blair MM, Glynn LM, Sandman CA, et al. Prenatal maternal anxiety and early childhood temperament. *Stress*. 2011;14(6):644–651.
16. O'Donnell KJ, Glover V, Barker ED, et al. The persisting effect of maternal mood in pregnancy on childhood psychopathology. *Dev Psychopathol*. 2014;26(2):393–403.
17. Bauer A, Parsonage M, Knapp M, et al. *The Costs of Perinatal Mental Health Problems*. London, UK; Centre for Mental Health: 2014.
18. Weisberg RB, Paquette JA. Screening and treatment of anxiety disorders in pregnant and lactating women. *Womens Health Issues*. 2002;12(1):32–36.
19. Green SM, Haber E, Frey BN, et al. Cognitive-behavioral group treatment for perinatal anxiety: a pilot study. *Arch Women Ment Health*. 2015;18(4):631–638.
20. Misri S, Abizadeh J, Sanders S, et al. Perinatal generalized anxiety disorder: assessment and treatment. *J Womens Health (Larchmt)*. 2015;24(9):762–770.
21. NICE. Anxiety disorders. NICE Quality Standard (QS53). London, UK; National Institute for Health and Care Excellence: 2014.
22. Goodman JH, Guarino A, Chenausky K, et al. CALM Pregnancy: results of a pilot study of mindfulness-based cognitive therapy for perinatal anxiety. *Arch Women Ment Health*. 2014;17(5):373–387.
23. Fisher J, Chatham E, Haseler S, et al. Uneven implementation of the National Perinatal Depression Initiative: findings from a survey of Australian women's hospitals. *Aust N Z J Obstet Gynaecol*. 2012;52(6):559–564.
24. Psaros C, Geller PA, Sciscione AC, et al. Screening practices for postpartum depression among various health care providers. *J Reprod Med*. 2010;55(11–12):477–484.
25. Edge D. Falling through the net—black and minority ethnic women and perinatal mental healthcare: health professionals' views. *Gen Hosp Psychiatry*. 2010;32(1):17–25.
26. Bayrampour H, McNeil DA, Benzies K, et al. A qualitative inquiry on pregnant women's preferences for mental health screening. *BMC Pregnancy Childbirth*. 2017;17(1):339.
27. Dennis C-L, Chung-Lee L. Postpartum depression help-seeking barriers and maternal treatment preferences: a qualitative systematic review. *Birth*. 2006;33(4):323–331.
28. Goodman JH. Women's attitudes, preferences, and perceived barriers to treatment for perinatal depression. *Birth*. 2009;36(1):60–69.
29. Xie R-H, He G, Koszycki D, et al. Prenatal social support, postnatal social support, and postpartum depression. *Ann Epidemiol*. 2009;19(9):637–643.
30. Pagliari C, Sloan D, Gregor P, et al. What is eHealth (4): a scoping exercise to map the field. *J Med Internet Res*. 2005;7(1):e9.
31. Andersson G, Titov N. Advantages and limitations of Internet-based interventions for common mental disorders. *World Psychiatry*. 2014;13(1):4–11.
32. Hedman E, Ljótsson B, Lindefors N. Cognitive behavior therapy via the Internet: a systematic review of applications, clinical efficacy and cost-effectiveness. *Expert Rev Pharmacoecon Outcomes Res*. 2012;12(6):745–764.
33. Andersson G, Cuijpers P, Carlbring P, et al. Guided Internet-based vs face-to-face cognitive behavior therapy for psychiatric and somatic disorders: a systematic review and meta-analysis. *World Psychiatry*. 2014;13(3):288–295.
34. Andrews G, Cuijpers P, Craske MG, et al. Computer therapy for the anxiety and depressive disorders is effective, acceptable and practical health care: a meta-analysis. *PLoS One*. 2010;5(10):e13196.
35. Barak A, Hen L, Boniel-Nissim M, et al. A comprehensive review and a meta-analysis of the effectiveness of internet-based psychotherapeutic interventions. *J Technol Hum Serv*. 2008;26(2–4):109–160.
36. Ashford MT, Olander EK, Ayers S. Computer- or web-based interventions for perinatal mental health: a systematic review. *J Affect Disord*. 2016;197:134–146.
37. Lee EW, Denison FC, Hor K, et al. Web-based interventions for prevention and treatment of perinatal mood disorders: a systematic review. *BMC Pregnancy Childbirth*. 2016;16(1):38.
38. Spek V, Cuijpers P, Nyklícek I, et al. Internet-based cognitive behaviour therapy for symptoms of depression and anxiety: a meta-analysis. *Psychol Med*. 2007;37(3):319–328.
39. *Review Manager (RevMan) Version 5.3 for Windows* [computer program]. Copenhagen, Denmark; 2014.
40. Scottish Intercollegiate Guidelines Network. Methodology Checklist 2: Controlled Trials. SIGN website. http://www.sign.ac.uk/checklists-and-notes.html. 2017.
41. Milgrom J, Danaher BG, Gemmill AW, et al. Internet cognitive behavioral therapy for women with postnatal depression: a randomized controlled trial of MumMoodBooster. *J Med Internet Res*. 2016;18(3):e54.
42. Forsell E, Bendix M, Holländare F, et al. Internet delivered cognitive behavior therapy for antenatal depression: a randomised controlled trial. *J Affect Disord*. 2017;221:56–64.
43. Scherer S, Alder J, Gaab J, et al. Patient satisfaction and psychological well-being after internet-based cognitive behavioral stress management (IB-CBSM) for women with preterm labor: a randomized controlled trial. *J Psychosom Res*. 2016;80:37–43.
44. O'Mahen HA, Richards DA, Woodford J, et al. Netmums: a phase II randomized controlled trial of a guided Internet behavioural activation treatment for postpartum depression. *Psychol Med*. 2014;44(8):1675–1689.
45. Pugh NE, Hadjistavropoulos HD, Dirkse D. A randomised controlled trial of therapist-assisted, internet-delivered cognitive behavior therapy for women with maternal depression. *PLoS One*. 2016;11(3):e0149186.
46. Borenstein M, Hedges LV, Higgins JP, et al. A basic introduction to fixed-effect and random-effects models for meta-analysis. *Res Synth Methods*. 2010;1(2):97–111.
47. Cohen J. *Statistical Power Analysis for the Behavioral Sciences*, 2nd ed. Hillsdale, NJ: Erlbaum Associates; 1988.
48. Buist A, Gotman N, Yonkers KA. Generalized anxiety disorder: course and risk factors in pregnancy. *J Affect Disord*. 2011;131(1–3):277–283.
49. Georgsson Ohman S, Grunewald C, Waldenström U. Perception of risk in relation to ultrasound screening for Down's syndrome during pregnancy. *Midwifery*. 2009;25(3):264–276.
50. Bayrampour H, Tomfohr L, Tough S. Trajectories of perinatal depressive and anxiety symptoms in a community cohort. *J Clin Psychiatry*. 2016;77(11):e1467–e1473.
51. Cuijpers P, Donker T, van Straten A, et al. Is guided self-help as effective as face-to-face psychotherapy for depression and anxiety disorders? a systematic review and meta-analysis of comparative outcome studies. *Psychol Med*. 2010;40(12):1943–1957.
52. Carroll KM, Ball SA, Martino S, et al. Enduring effects of a computer-assisted training program for cognitive behavioral therapy: a 6-month follow-up of CBT4CBT. *Drug Alcohol Depend*. 2009;100(1–2):178–181.
53. O'Mahen HA, Woodford J, McGinley J, et al. Internet-based behavioral activation–treatment for postnatal depression (Netmums): a randomized controlled trial. *J Affect Disord*. 2013;150(3):814–822.
54. Kohn R, Saxena S, Levav I, et al. The treatment gap in mental health care. *Bull World Health Organ*. 2004;82(11):858–866.
55. Vigod SN, Wilson CA, Howard LM. Depression in pregnancy. *BMJ*. 2016;352:i1547.

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