



# Systematic Review of Online Interventions to Reduce Perinatal Mood and Anxiety Disorders in Underserved Populations

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## ABSTRACT

**Background:** Online health interventions increase access to care, are acceptable to end users and effective for treating mental and physical health disorders. However, less is known about interventions to prevent and treat perinatal mood and anxiety disorders (PMADs). This review synthesizes existing research on PMAD prevention and treatment by exploring the treatment modalities and efficacy of online interventions and examining the inclusion of underserved populations in PMAD research. **Methods:** Using PRISMA guidelines, authors conducted a systematic review of peer-reviewed literature published between 2008 and 2018 on online interventions aimed to prevent or treat PMADs. The authors also assessed quality. Eligible articles included perinatal women participating in preventive studies or those aimed to reduce symptoms of PMADs and utilized a Web-based, Internet, or smartphone technology requiring an online component. This study excluded telephone-based interventions that required one-on-one conversations or individualized, text-based responses without a Web-based

aspect. **Results:** The initial search yielded 511 articles, and the final analysis included 23 articles reporting on 22 interventions. Most studies used an experimental design. However, no study achieved an excellent or good quality rating. Psychoeducation and cognitive-behavioral therapies (CBTs) were most common. Several interventions using CBT strategies significantly decreased depression or anxiety. Four studies recruited and enrolled mainly people identifying as low-income or of a racial or ethnic minority group. Attrition was generally high across studies.

**Discussion:** More research using rigorous study designs to test PMAD interventions across all perinatal times is needed. Future research needs to engage diverse populations purposefully.

**Key Words:** cognitive-behavioral therapy, health disparities, online intervention, perinatal mental health, psychoeducation, systematic review

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Maternal and infant health outcomes in the United States are on par with many developing countries despite the high average per capita spending on health and social services.<sup>1</sup> Chronically low prenatal healthcare usage and education rates, poor health outcomes across perinatal periods, and challenges connecting women and infants to care resources are present in both rural and urban geographies.<sup>2–4</sup> Once believed to be protective, the reproductive period can increase the risk of poor mental health outcomes for generations.<sup>5–7</sup> Antenatal depression occurs in 16% of women, and the prevalence of anxiety ranges from 13% to 21%. Comorbid anxiety and depression occur in 10% of women antenatally.<sup>8,9</sup> In the postpartum period (ie, from birth through 1 year), 11% to 17% of women experience anxiety and 13% experience depression.<sup>8,10</sup>

While anxiety- and depression-related disorders are the most prevalent perinatal mood and anxiety disorders (PMADs), phobias, panic disorder, social anxiety disorder, obsessive-compulsive disorder, posttraumatic stress disorder (PTSD), and postpartum psychosis also occur.<sup>7,10</sup>

There are numerous risk factors for PMADs, signaling the need for effective and accessible interventions. Risk factors of PMADs include a history of mental health disorders or postpartum depression, past medical complications or loss in pregnancy, unintended pregnancy, intimate partner violence, poor relationship quality, perceived lack of social support, and maladaptive coping.<sup>11–17</sup> Although women are generally at an increased risk for poor mental health outcomes during the perinatal period, variation in the prevalence is partly attributable to social determinants of health.<sup>5,18</sup> Disproportionally high rates of PMADs and associated poor health outcomes exist for traditionally underserved groups, including women from racial and ethnic minority groups and people living in or near poverty.<sup>10,15,18–20</sup>

The short- and long-term consequences of PMADs are a public health issue requiring change at micro, mezzo, and macro levels. Inadequate prenatal care, inability to conduct activities of daily living, difficulty caring for current children, thoughts of self-harm, and maternal suicide are associated with poor perinatal mental health.<sup>21–24</sup> Complications in pregnancy and childbirth, premature birth, decreased breastfeeding initiation, and reduced maternal sensitivity (ie, timely, contingent, and appropriate responding to infants' cues) are significantly associated with PMADs.<sup>19,20,25,26</sup> PMADs are associated with child maltreatment and are detrimental to children's cognitive and emotional development, relationship quality, attachment, and mental health. The risk for poor mental health outcomes follows children throughout their life course.<sup>27–29</sup>

Best practices for identifying and treating PMADs include screening people at risk for mood or anxiety disorders during primary care visits,<sup>30–33</sup> counseling therapies,<sup>32–38</sup> and pharmacological interventions.<sup>32,33,39</sup> Interventions that include mindfulness activities,<sup>37,40</sup> strategies for increasing sleep,<sup>41</sup> exercise,<sup>42–44</sup> breastfeeding support,<sup>45</sup> perinatal education,<sup>46</sup> and improving social supports<sup>38,47–49</sup> are successful in reducing PMADs. Although promising, these interventions are not universally available and may not benefit all populations. Populations that experience barriers to care—including underserved populations and people who distrust the healthcare system—in particular need additional options for treatment outside of the typical in-seat office visits. Underserved populations are open to receiving intervention virtually, although connectivity challenges

exist.<sup>50–53</sup> Research on online interventions outside of PMAD treatment does show various health-related needs such as chronic disease management,<sup>52,53</sup> behavioral health,<sup>54,55</sup> health education,<sup>56,57</sup> and social connectivity<sup>58,59</sup> can be achieved virtually.

The use of online interventions for perinatal mental health increases each year and can contribute to accessible and equitable treatment options. Practitioners, policy makers, and researchers benefit from a timely and frequent review of interventions to understand innovations and their effectiveness.<sup>60,61</sup> This systematic review aims to synthesize existing research on PMAD prevention and treatments by exploring online treatment modalities and intervention efficacy and the extent to which underserved populations—including racial and ethnic minorities and people living in or near poverty—are included in PMAD prevention and treatment research.

## METHODS

This systematic review of the literature conforms to Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines.<sup>62</sup> The authors used the Population, Intervention, Comparison, Outcome (PICO) model to describe inclusion and exclusion criteria for this study.<sup>63</sup> The Downs and Black<sup>64</sup> checklist, used routinely in systematic reviews of multidisciplinary studies,<sup>65</sup> was applied to assess selected studies' quality.

### Identification and screening

The authors searched online libraries and databases for studies published in peer-reviewed journal articles for the 10 years preceding October 2018. Elton B. Stephens Company databases, including Psychological Information and Cumulative Index to Nursing and Allied Health Literature (CINAHL) and Ovid MEDLINE—including 6 Evidence-Based Medicine review databases—were searched. In addition to database searching, the research team reviewed reference lists from published articles.

This review utilized MeSH terms, subject headings, and other search terms per this study's PICO inclusion criteria. Target population search terms included “perinatal periods,” “online,” “web-based,” “mobile application,” and “eHealth preventative interventions.” Mental health outcome terms included a spectrum of maternal disorders (ie, anxiety, depression, bipolar disorder, obsessive-compulsive disorder, PTSD, and psychosis). Table 1 outlines the specific MeSH syntax utilized for Ovid MEDLINE databases; searches within other databases used equivalent terms.

Table 1. Ovid MEDLINE search terms according to PICO criteria

	MeSH	Key words
Population	postpartum period/ or pregnancy trimesters/ or pregnancy/ or parturition/ or pregnancy/	(pre-natal or prenatal or (antenatal or ante natal) or (postpartum or post partum) or perinatal or new mother* or pregnan*).mp.
Intervention (prevention)	perinatal care/ or prenatal care/ or mental health services/ or counseling/ or social work, psychiatric/ or psychotherapy/ or behavior therapy/ or cognitive therapy/ or relaxation therapy/ or meditation/ or psychotherapy/ or self care/ or self-management/ or attitude to health/ or health knowledge, attitudes, practice/ or "treatment adherence and compliance"/ or health education/ or health promotion/ or postnatal care/ or home care services/ or home health nursing/ or maternal health services/ or maternal-child health services/ or community mental health services/ or self help groups/	support groups or behavior modification or self care or self management or behaviour therap* or behavioural therapy or self help).mp.
Intervention (platform)	social networking/ or telecommunications/ or electronic mail/ or telemedicine/ or telephone/ or cell phone/ or text messaging/ or internet/ or blogging/ or social media/ or mobile applications/ or user-computer interface/ or video games/	(mobile application* or mobile app* or smartphone or online or internet or browser or user-computer interface or video game* or software design or e-health or ehealth or telemedicine or internet or web*).mp.
Outcome	anxiety disorders/ or anxiety/ or depressive disorders/ or depression/ or depressive disorder, major/ or bipolar disorder/ or stress, psychological/ or stress disorders, post-traumatic/ or stress disorders, post-traumatic/ or stress, psychological/ or obsessive-compulsive disorder/ or mental disorders/ or psychotic disorders/ or mental health/ or depression, postpartum/ or perinatal mood disorder/	(well being or wellbeing or trauma or emotional trauma or obsessive compulsive disorder or OCD or psychosis or mental health or bipolar or anxiety or PTSD or depress* or (posttraumatic or posttraumatic) or wellbeing or stress).mp.

### Eligibility and inclusion

In addition to the PICO parameters detailed later, included studies were published in the time frame noted earlier, peer-reviewed, and published in English. PICO parameters for inclusion and exclusion include the following:

**Population:** Articles of interest were limited to women during the perinatal period (ie, conception through 1 year postpartum; delivering a live baby).

**Intervention:** The interventions included studies that were preventive or aimed to reduce symptoms of PMADs and utilized a Web-based, Internet, or smartphone technology requiring an online component. This study excluded telephone-based interventions that required one-on-one conversations or individualized, text-based responses without a Web-based component. There was no requirement that the tool was already evidence-based or used with a specific clinical treatment protocol.

**Comparison:** Studies with any experimental or quasi-experimental design with treatment-as-usual (TAU)

or a control group, alternative treatment groups, wait-listed groups, or pre/posttest measures.

**Outcomes:** Interventions addressing 1 or more PMADs (ie, depression, anxiety, PTSD, obsessive-compulsive disorder, bipolar mood disorders, and postpartum psychosis) were included.

The authors removed duplicate studies, independently screened titles, and reviewed abstracts for inclusion criteria. Next, the first author reviewed the remaining full-text articles and selected the final candidates for the second author to review. At any point in the screening process where there was disagreement on articles that were included or excluded, the authors would discuss points of disagreement until reaching a consensus. After the full-text review, studies not meeting inclusion criteria were removed, and reasons for exclusion were recorded.

### Coding of intervention characteristics

An online abstraction form was created using RED-Cap software and included the following information: country, study design, treatment modality, intervention

description, recruitment strategy, inclusion and exclusion criteria, sample size, perinatal period, PMAD outcomes and associated measures, attrition, and dosage.<sup>66</sup> Demographic variables, education, socioeconomic status (SES) indicator, insurance type, married/partnered status, pregnancy intention, and gravidity or parity were abstracted. The authors recorded statistically significant PMAD outcomes and effect sizes.

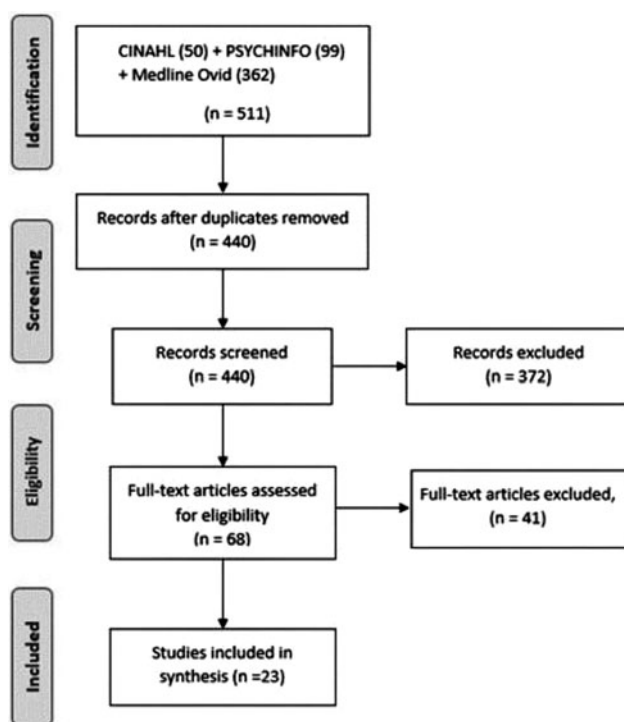
### Quality assessment

The authors assessed methodological quality using a checklist developed by Downs and Black<sup>64</sup> for randomized and nonrandomized studies. Scoring of studies includes 5 domains: (1) reporting, (2) external validity, (3) internal validity—bias, (4) internal validity—confounding, and (5) power. The authors modified item 27—assessment of study power—by rating it as 0 or 1 rather than a rank of 0 through 5. The authors independently reviewed articles. The first author compiled and analyzed results, with validation of the analysis performed by the second author. Quality scores could range from 0 to 28, with 28 indicating the highest quality. Scores indicate the following quality levels: excellent (26–28), good (20–25), fair (15–19), and poor ( $\leq 14$ ).

Interrater agreement on the overall quality assessment checklist in this study was good, with an average score of 0.84. The authors compared their independent assessments and discussed discrepancies by reviewing the agreement of items comprising each domain; 0 indicated disagreement and 1, agreement. The authors' average agreement scores were obtained by summing the agreement scores for each domain and dividing them by the total number of studies. Averages for each domain varied from 1 (ie, strong agreement) to 0.65 (ie, moderate agreement).

## RESULTS

Initial search results generated 511 articles from CINAHL ( $n = 50$ ), PsycINFO ( $n = 92$ ), and Ovid MEDLINE ( $n = 362$ ) databases. After removing duplicates, 440 titles and abstracts were reviewed, yielding 68 articles for full-text review. The final analysis included 23 articles reporting on 22 intervention studies and 1 secondary analysis. Figure 1 outlines the PRISMA-P flow diagram of included studies.<sup>62</sup> The primary reason for exclusion was that the study did not meet the inclusion criteria, as indicated in the study protocol. Other reasons for exclusion were that the study was not published or available in English, and the trial was not yet published. Most participants were outside of the 12-month postpartum inclusion criteria in 1 case.



**Figure 1.** PRISMA-P flow diagram.

### Demographics

Table 2 illustrates participant characteristics across studies. Sixty-one percent of the participants in these studies had a mean age of 29 to 35 years. In 43% of the studies, there were no reports of demographic variables for race or ethnicity. When reported, 77% of studies identified most participants as “White” or “White and Other.” Three studies targeted underserved populations.<sup>67–69</sup> One study reported participants’ health insurance type. The most common SES measures were total household income or employment status; 26% of the studies did not report any measure of SES. Eighty-seven percent of the participants reported college/trade school or a college degree when educational attainment was reported.

In 82% of studies, participants reported being married or partnered; 4% of studies mainly included unmarried or nonpartnered participants, and 23% did not report a relationship status. Across studies, most participants reported already having a child at home or more than 1 pregnancy; 23% of the studies did not report this information.

The majority of studies included participants from high-income countries, where 40% of studies were in the United States, 22% in the United Kingdom, and 13% in Australia. Canada, Ireland, Sweden, and Switzerland had one study each. Low- and middle-income countries included participants from India and Thailand. Barrera et al<sup>70</sup> included participants from 23 countries

Table 2. Participant demographics

First author (Year)	Location	Study, N	Age range or mean, y	Largest % reported for each variable			Partnered or married	First pregnancy or child at home
				Race/Ethnicity	Education	SES Indicator		
Barber (2013) <sup>76</sup>	UK and New Zealand	9	...	...	...	...	...	Child at home
Dennis-Tiway (2017) <sup>87</sup>	US	33	29-35	46% White	College	≥\$80 000	...	Child at home
Barrera (2015) <sup>70</sup>	Worldwide	289	29-35	53% White 71% Latinx	College	Working	Yes	...
Felder (2017) <sup>85</sup>	US	37	29-35	86% White 11% Latinx	College graduate	\$50 000-\$80 000	Yes	Not first
Forsell (2017) <sup>77</sup>	Sweden	42	29-35	...	College	> 75% working	Yes	First
Jareethum (2008) <sup>86</sup>	Thailand	68	26	...	High school or less	...	...	Not first
Kelman (2018) <sup>78</sup>	US and India	123	25-35	54% White 6% Latinx	College	\$50 000-80 000	...	...
Kim (2014) <sup>79</sup>	US	123	29-35	White	...	≤\$25 000	No	...
Loughnan (2019) <sup>80</sup>	Australia	73	29-35	...	College graduate	Working	Yes	First
Matvienko-Sikar (2017) <sup>89</sup>	Ireland	46	29-35	...	College graduate	86.1% private insurance	Yes	...
Scherer (2016) <sup>71</sup>	Switzerland	93	29-35	...	College graduate	...	Yes	First
Song (2013) <sup>69</sup>	US	23	21	80% African American 15% Latinx	...	185% poverty guideline	No	...

(continues)

Table 2. Participant demographics (*Continued*)

First author (Year)	Location	Study, N	Age range or mean, y	Largest % reported for each variable			First pregnancy or child at home
				Race/Ethnicity	Education	SES Indicator	Partnered or married
Ahmed (2016) <sup>83</sup>	US	106	29-35	68% White 4% Latinx	College	\$50 000-\$80 000	...
Ayers (2015) <sup>75</sup>	England	80	...	90% White 50% college	50% high school College	...	Yes
Baumei (2018) <sup>67</sup>	US	20	29-35	40% African American 15% Latinx	College	Working	Yes
Danaher (2013) <sup>84</sup>	US and Australia	53	29-35	...	College	≥\$80 000	Yes
Horsch (2017) <sup>88</sup>	Switzerland	56	29-35	...	College	...	Yes
Hudson (2012) <sup>68</sup>	US	41	18	100% African American	High school or less	≤\$25 000	...
Milgrom (2016) <sup>81</sup>	Australia and New Zealand	43	29-35	...	High school or less	≥\$80 000	Yes
O'Mahen (2013) <sup>74</sup>	UK	910	29-35	...	College	Working	Yes
O'Mahen (2014) <sup>73</sup>	UK	83	...	93% White	College	\$25 000-\$50 000	Yes
O'Mahen (2017) <sup>72</sup>	UK	...	...	93% White	College	\$25 000-\$50 000	Yes
Pugh (2016) <sup>82</sup>	Canada	50	...	90% White	College	...	No

Abbreviations: ..., not reported; SES, socioeconomic status; UK, the United Kingdom; US, the United States.

worldwide. Studies had a wide variation of attrition (ie, study-wide participation calculated by numbers at enrollment through study follow-up) ranging from 0% to 62%; 5 antenatal studies and 1 postpartum study exceeded 30%. One study conducted a dropout analysis of demographic characteristics and reported no significant findings.<sup>71</sup>

## Study designs and treatment modalities

### Study designs

Seventy percent of the studies in this review were randomized trials ( $n = 16$ ). Thirteen randomized control trials included intervention and TAU or a control condition. There were 6 quasi-experimental studies. Five used a pre/posttest design, and one was a matched-control study. There was a single secondary data analysis of an intervention (see O'Mahen et al<sup>72</sup>); this study utilized data from O'Mahen et al<sup>73</sup> also included in this review.

Nearly half of all studies (48%) required participants to have a history of or current depression or anxiety-related symptoms. Forty-eight percent of studies excluded participants based on having other mental health disorders. Forty-three percent of studies excluded people who started treatment such as medication or therapy in a specified time (eg, within the month before enrollment). Supplemental Digital Content Table 3 (available at: <http://links.lww.com/JPNN/A24>) illustrates study designs, treatment modalities, and PMAD outcomes.

### Quality assessment

No studies received an "excellent" or "good" quality rating in this review. Eleven studies scored as "fair." The 12 remaining studies received a poor rating.

### Treatment modality

The most common intervention used was self-directed psychoeducation delivered via online modules. Across studies, psychoeducational content included thought reframing, strategies to increase coping, reflective journaling, and behavior monitoring.<sup>67,70,71,74–82</sup> Fifty-seven percent of studies had support services available via formal (ie, professional services including therapist, trained coaches, students in a counseling program) or informal sources (ie, personal relationships including partners, family members, peers, or community members).<sup>67,68,71,73,74,77,79,81–85</sup> Beyond technical troubleshooting, interventions during the postpartum period compared with the antenatal period were more likely to include additional support services (75% and 27%, respectively). No study included perinatal partners as the primary participant or pregnant woman-partner

dyads. Some studies included personal or peer support forums, and 2 had content for partners.<sup>81,84</sup>

Nonmodular interventions included automated smartphone text applications; one study was a one-way text system sending educational messages about pregnancy topics to the participant. The other was a 2-way text system where participants asked pregnancy-related questions and returned an automated response.<sup>69,86</sup> Two studies used gaming applications for attention modification or cognitive restructuring after potentially traumatic births.<sup>87,88</sup> One study monitored breastfeeding behaviors,<sup>83</sup> another used a Web-based format to deliver educational resources over participants' televisions, and one gave mindfulness listening activities via Web-based recordings.<sup>89</sup> Finally, a secondary analysis of data assessing factors related to sudden gains (ie, a depression score measured for a specified period during treatment) examined upward or downward mood shifts associated with the therapeutic process.<sup>72</sup> In total, 83% of studies measured intervention usability or satisfaction outcomes, and all had positive participant reports.

Nearly half of the studies included interventions informed by cognitive-behavioral therapy (CBT).<sup>70,71,77–80,85</sup> Other therapeutic approaches had mindfulness approaches,<sup>76</sup> compassionate mind training,<sup>78</sup> cognitive science of emotional memory,<sup>88</sup> attention bias modification,<sup>87</sup> cognitive-behavioral stress management,<sup>71</sup> social cognitive therapy,<sup>83</sup> acceptance and commitment therapy,<sup>67</sup> and social support theory.<sup>68</sup> Some studies did not cite a specific approach or theory that informed the tested intervention. For example, *Bundle of Joy*,<sup>89</sup> described a multifaceted approach using mindfulness, gratitude, and stress-reduction intervention. Neither text-based studies, *TuTalk*<sup>69</sup> nor *1-way text*,<sup>86</sup> referenced a specific evidence-based practice or theoretical framework informing the treatment modality nor did the *New Mother's Network*.<sup>68</sup>

## Treatment modality and outcomes by perinatal period

Several studies tested interventions during the antenatal period. *TuTalk*,<sup>69</sup> *Internet Cognitive Behavior Therapy*,<sup>77</sup> and *Good Days Ahead*<sup>79</sup> reduced PMAD symptoms. Half of the antenatal studies used CBT, 2 of which had significant reductions in anxiety or depression in favor of the intervention. Both studies included the option to follow up with a therapist in addition to the online intervention.<sup>77,79</sup> The smart text-based intervention, *TuTalk*,<sup>67</sup> also produced significant decreases in PMAD symptoms. The *Bundle of Joy*,<sup>89</sup> *Internet-based Cognitive-Behavioral Stress Management*,<sup>71</sup> *MUMentum*,<sup>80</sup> and *Mindful Mood*

*Balance*<sup>85</sup> studies did not significantly reduce PMAD symptoms.

Four studies examined interventions beginning in the antenatal period and ending in the postpartum period. Jareethum et al<sup>86</sup> found a significant reduction in anxiety and depression scores antenatally and with depression at follow-up in the postpartum period with the *1-way text* intervention. The *Mindful Motherhood* intervention significantly reduced depression scores from pretest to posttest.<sup>76</sup> Kelman et al<sup>78</sup> compared compassionate mind training to a cognitive-behavioral intervention and found no significant differences between groups. *Mothers and Babies Internet Course/Curso Internet de Mamás y Bebés (e-MB)* failed to reach significance between groups but found depression scores trending lower in the intervention group.<sup>70</sup>

Postpartum interventions with a significant reduction between groups or at the posttest include *Brief Online Self-help Postnatal Intervention for Mood*,<sup>75</sup> *Visuospatial Cognitive Task—Tetris*,<sup>88</sup> *MomMoodBooster*,<sup>84</sup> *MumMoodBooster*,<sup>81</sup> *Netmums* and *Netmums Helping With Depression*.<sup>73,74</sup> Treatments with significant findings in favor of the intervention utilized CBT delivered with psychoeducation via modules,<sup>72–75,81,84</sup> and cognitive science of emotional memory to inform the intervention.<sup>88</sup> The *Visuospatial Cognitive Task—Tetris* postpartum intervention using cognitive science of emotional memory did not rely upon additional formal or informal support beyond the gaming program. The intervention was introduced to participants immediately following an emergency cesarean section. The *Tetris* intervention was the sole study that aimed to reduce a PMAD other than anxiety or depression. This study found a significant reduction in PTSD<sup>88</sup> with the protocol analysis but not with an intention-to-treat analysis.

One of the CBT-based interventions delivered in the postpartum, the *Therapist-assisted, Internet-delivered CBT* intervention, did not significantly reduce depression.<sup>82</sup> Ayers et al<sup>75</sup> conducted the sole unassisted CBT-based intervention, which significantly improved the treatment group symptoms. The other 5 postpartum CBT-based interventions had significant findings between groups or at the posttest. Two studies included formal support paired with online components,<sup>81,84</sup> and 3 studies<sup>72–74</sup> included informal support in online peer groups.

In sum, all studies found a reduction of PMAD symptoms or no increase in symptoms over time. The between-group or pre/posttest measures interventions significantly reduced anxiety or depression symptoms in 52% of studies. Sample-wide, 52% of studies utilized CBT-based interventions, 8 (67%) of which had a significant reduction in a PMAD in favor of the

intervention<sup>72–75,77,79,81,84</sup> and 4 (33%) did not.<sup>70,80,82,85</sup> Interventions not informed by CBT, with significant findings, include mindfulness,<sup>72</sup> cognitive science of emotional memory,<sup>87</sup> and 2 studies that did not specify a guiding theory.<sup>69,86</sup> Interventions that found a significant reduction in PMADs in favor of the treatment group included formal or informal sources of support 30% of the time.<sup>72–74,77,79,81,84</sup>

## Representation of underserved populations

Four articles recruited and enrolled participants from primarily underserved populations (ie, low-income households or people identifying racial or ethnic minorities). The Barrera et al<sup>70</sup> perinatal study *Mothers and Babies Internet Course/Curso Internet de Mamás y Bebés (e-MB)* included participants from 23 countries; 71% of participants identified as Latinx. Programming was made available in English and Spanish. The study utilized 8 CBT-based psychoeducational lessons, including text, videos, and downloadable worksheets. Participants worked on learning modules at their own pace and were sent automated monthly follow-ups after sessions to prompt engagement.

*TuTalk* recruited African American participants eligible to receive WIC (Special Supplemental Nutrition for Women, Infants, and Children; ie, meeting 185% US poverty level) and ranged in age from 14 to 28 years ( $M = 21.05$ ,  $SD = 4.43$ ).<sup>69</sup> The study aimed to explore the usability, acceptability, and real-life benefits of using the intervention, including whether participants gained pregnancy-related knowledge, increased communication with their healthcare provider, and reduced stress. The 2-way text messaging with automated responses intervention did find a significant reduction in depression scores at posttest.

Hudson et al<sup>68</sup> tested *New Mothers Network* and targeted African American women who were low income and ranged in age from 16 and 21 years. The intervention aimed to deliver perinatal-related informational resources to their Internet-enabled television and social support through peer chats and conversations with advanced practice nurses. This trial did not find a significant difference in depression scores between groups.

Kim et al<sup>79</sup> tested *Good Days Ahead* and included participants reporting a household income of US \$25 000 or less; 50% of study participants reported an unintended pregnancy. Although most participants had poverty-level incomes, this was not an inclusion requirement for the study. This study was one of 2 to ask participants about pregnancy intention but the only study to analyze it as a factor.<sup>89</sup> The study compared participants with unintended versus intended pregnancy and found no significant differences in treatment response.



## DISCUSSION

This review included studies examining online interventions aimed at reducing PMADs. Given the popularity of online interventions for various health-related interventions, this review provides new and updated information on efficacy and treatment modalities and describes recruitment and enrollment of underserved populations.<sup>60,61</sup> Notably, studies primarily focused on treating or reducing symptoms of PMADs. There was a lack of prevention-focused interventions. Future studies are needed to explore effective strategies for preventing PMADs with online programming.

This review reveals that more focus is needed on the full spectrum of PMADs across various pregnancy periods. Given the high rates of perinatal anxiety and depression, the focus on these outcomes, in particular, is essential and the literature documents numerous consequences when symptoms are left untreated.<sup>9,15,20</sup> However, prevention and treatment of perinatal phobias, panic disorder, social anxiety disorder, obsessive-compulsive disorder, and postpartum psychosis are less studied and understood.<sup>90-92</sup> The high burden of these conditions contributes to societal costs and increases the risk of developing additional mood or anxiety disorders perinatally and across the life span.<sup>20,22</sup> Furthermore, a PMAD occurring in the antenatal period increases the risk of complications at birth and poor physical and mental health in the postpartum.<sup>15,93</sup>

There were numerous findings in this review that found significant results in favor of the intervention, adding to the body of evidence that online intervention is a strategy for treating PMADs in need of further study. However, despite the literature supporting online mental health interventions,<sup>33,55,57</sup> most studies in this review achieved a fair or poor quality rating, with none obtaining an excellent or good score. There was a wide variation in inclusion and exclusion criteria across studies, limiting significant findings' generalizability. Finally, there was a high rate of attrition across studies included in this review. Except for one study, there was no report of dropout analyses, insights into why participants drop out, and understanding characteristics of who stays in the intervention versus who does not contribute to designing interventions for different populations. Given what we have learned about the barriers and facilitators of access and the popularity of online intervention needed during the COVID-19 pandemic, rigorous studies in various contexts with more diverse populations are needed.<sup>51,94,95</sup>

Educational modules were common intervention components across this review. Similarly, studies using self-directed learning with a combination of text or video instruction, online quizzes, homework, and

downloadable worksheets were described often. In general, participants from these studies found the programming satisfactory and usable. Evaluation of long-term behavioral change resulting from online programming may provide further insights to increase the long-term impacts of online interventions.<sup>96</sup>

This review shows promise for using self-directed online interventions and highlights the importance of formal or informal support to complement online programming.<sup>97,98</sup> Many of the significant outcomes for studies resulted from a hybrid intervention model, an online component with follow-up by a perinatal professional. In some cases, programming engaged participants with perinatal peers or community support groups. Future studies would benefit from continued exploration of a hybrid approach. The global pandemic provides insights useful for future adaption of PMAD interventions. Lessons learned from COVID-19 suggest increased access to broadband and telehealth services and incorporating online programming to systems that users are familiar with, such as electronic medical records or hybrid birth classes, or *doula* services as suitable for PMAD interventions.<sup>99-101</sup>

Findings from this review indicate a further need for purposeful engagement of underserved populations. Less than 20% of studies included participants primarily from underserved populations; most studies included participants who identified as White, educated, middle-class women. Studies with strategies and intentional design to increase participation of underserved populations are needed as are studies exploring participant satisfaction.<sup>53,102</sup> Furthermore, fully exploring reasons for dropouts and implementing fidelity checks would answer questions about intervention strengths and weaknesses associated with participation.

Generally, women are at risk for developing mood or anxiety disorders in the perinatal period. There is clear evidence that age, race, ethnicity, educational attainment, SES, place of residence, and pregnancy intention are important risk factors for PMADs.<sup>5,10,15,18-20</sup> Many studies did not report participant characteristics that would indicate engagement with underserved populations. Studies designed to capture and examine demographic and risk factors for participants using online interventions to prevent and treat PMADs can guide uptake and meaningful engagement with interventions.<sup>53</sup>

## CONCLUSION

Connecting people to mental healthcare interventions is complex, and the perinatal period increases the risk of developing a PMAD. Online health interventions are a known and effective way to overcome barriers to care,

and findings from this review support this approach for treating PMADs. Most treatment modalities used in the interventions were informed by a theoretical framework, with CBT commonly used and producing positive results. However, studies that utilize mindfulness, social support, and cognitive reframing strategies are promising and worthy of more research. Future researchers may consider a hybrid in-person plus online approach when developing interventions.

Online health interventions are increasingly popular and necessary, as we have learned during the COVID-19 pandemic. This review provides ways that future research can improve online interventions for PMADs and highlights the need to target and meaningfully engage underserved populations. Nurses are the front-line workers who encounter women with PMADs most often. Having a clear understanding of the warning signs, using evidence-based tools for assessment, and knowing the interventions available for effectively treating PMADs are essential to reducing the number of women and children impacted. As identified in this review, there are myriad options for intervention. Nurses and other allied health professionals can utilize these options to find the best fit for patients needing to manage their PMADs. In addition to those in nursing and allied health professions, policy makers, health practitioners, helping-professions, educators, public health professionals, and researchers can use this information to inform practice and develop future innovations to improve perinatal outcomes.

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