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Effects of interventions for women and their partners to reduce or prevent stress and anxiety: A systematic review

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ABSTRACT

Background: The period from conception to two years postpartum (the first 1000 days) represents a normative transitional period, which can be potentially stressful for some parents. Parental stress and anxiety adversely impacts psychological and physical health for parents and children.
Aim: The aim of this review is to systematically examine effects of interventions for women and their partners to reduce or prevent stress and/or anxiety during the first 1000 days.
Methods: MEDLINE, Embase, CINAHL, PsychINFO, and Maternity and Infant Care were searched from inception to March 2019. Randomised controlled trials examining intervention effects on parental stress and/or anxiety during first 1000 days were eligible for inclusion. Data were independently extracted by two reviewers and narratively synthesised.
Findings: Fifteen interventions, reported in 16 studies, met inclusion criteria (n = 1911 participants). Overall, findings were inconsistent and the majority of trials demonstrated high risk of bias. Interventions were predominantly delivered to women during pregnancy and only two studies included fathers. There was some evidence that adapting interventions to the pre and postnatal periods provided benefits for stress and anxiety reduction, however there was limited evidence for individual intervention types or approaches.
Conclusions: There is currently inconsistent evidence of what interventions are most effective for women during the first 1000 days and there is insufficient evidence for any interventions for male partners during this period. There is a clear need for rigorous development and examination of interventions developed specifically to reduce or prevent stress and/or anxiety across the first 1000 days.

Statement of Significance

Problem

Stress and anxiety experienced by women and their partners during the period from conception to two years postpartum can have significant negative effects on parent and child health.

What is Already Known

Some interventions (e.g. psychotherapy) demonstrate reductions in stress and anxiety but the role of interventions for women and partners across perinatal period has not been systematically examined.

What the Paper Adds

There is currently insufficient evidence for effectiveness of stress and anxiety reduction interventions directed at parents during the first 1000 days.
There is a need to develop, implement and evaluate interventions to reduce or prevent parental stress and anxiety in the first 1000 days.

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Introduction

Stress and anxiety during the period from conception and up to two years postpartum ('the first 1000 days') are experienced by up to 84% of women [1] and 13–14% [2] of men, with prevalence rates varying across trimesters of pregnancy and the postpartum period [3]. Stress and anxiety are highly correlated though distinct constructs [4] characterised by emotional, cognitive, behavioural, and physiological components including responses such as cortisol reactivity [5]. Stress is defined as a person's perceived discrepancy between the demands of external events or stimuli, and perceived resources to meet those demands [6]. Anxiety is defined as a perception of external stimuli as threatening [7], and can be experienced as state anxiety or trait anxiety. Though perinatal stress and anxiety levels are lower in high-income countries than low to middle-income countries [3], there is evidence of association between stress and anxiety, and a range of adverse outcomes in countries such as Australia [8], Canada [9], Norway [10], and France [11]. Stress and anxiety in the first 1000 days have been associated with increased risk of depression [12], impaired relationship functioning [8,12] poor parent-child bonding and attachment [13], and poor health outcomes [14]. Adverse child outcomes include impaired neurodevelopment [15] and motor development [16], increased risk of internalising disorders [17], and emotional, self-regulation difficulties [18], and health difficulties [16].

Parental stress and anxiety have predominantly been examined among mothers, rather than fathers [19]. This may be due to the potential for intrauterine programming of child outcomes via maternal stress, and lower levels of reported stress and anxiety for men than women [20]; though adverse parental and child outcomes are associated with paternal stress [21,22]. The first 1000 days is recognised as a highly stressful transitional period for both men and women [23,24] due to changing roles, and responsibilities [8]. Though not experienced by all men and women during this period, parental stress can be associated with parental health and obstetric issues, [20], social support [25,26], perceived self-efficacy [27], sociodemographic factors [20], and stressful life events [26] including bereavement [28]. Antecedents may differ between men and women [2,20,23] and may vary at different time-points across the first 1000 days [29,30]. As such, focusing on the prenatal period only may limit our understanding of the complexity of parental stress.

Interventions for prenatal and postpartum stress and/or anxiety to date include, but are not limited to, cognitive behavioural therapy (CBT), mindfulness, music, and exercise [31]. While intervention effects are inconsistent [31], approaches including psychosocial [32], psychotherapeutic [19], CBT [33], and mind-body interventions [19,33,34] demonstrate greater positive effects for women at risk for mental health issues and/or experiencing elevated prenatal stress or anxiety, than for women who are not at risk. For men, a lack of support and tailored stress and anxiety treatment options during adjustment to the transition to fatherhood have been identified [35]. CBT and group work, digital support interventions, and clinic-based antenatal childbirth education demonstrate benefits for fathers' perinatal anxiety and depression [35,36] although evidence is limited [36].

While a range of interventions has been used to address stress and anxiety during the first 1000 days, the effects of interventions designed specifically to target stress and/or anxiety during this period have yet to be systematically examined. The aim of this review is to systematically review the effects of interventions, for women and their partners during the first 1000 days, to reduce or prevent stress and/or anxiety.

Methods

Searches

This review was registered in PROSPERO (CRD42019126057) and is conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement [37]. MEDLINE, Embase, and CINAHL, PsychINFO, and Maternity and Infant Care were searched from inception to March 2019. Reference lists of identified articles and of relevant reviews [31,34] were also searched.

Search terms

Search terms used were: (Pregnan* or antenatal or perinatal or maternal or prenatal or postpartum or antepartum or parenting or parent or parental or father or dad or mum or mother or mom or '1000 days' or paternal) AND (intervention* or strateg* or treatment or program or programme or policy or policies or education or prevention) AND (stress or distress or anxiety or mental health, psychological health) AND (RCT or randomised control* trial or randomized control* trial). See Supplementary file 1.

Eligibility criteria

Studies were eligible for inclusion if they were randomised controlled trials (RCTs) that: (1) included pregnant women, expectant fathers and/or partners during pregnancy, and/or parents in the first two years postpartum, from economically developed countries only (based on membership of the Organisation for Economic Co-operation and Development); (2) used a standard care or active control comparator group (e.g. included components and/or activities such as information provision or discussion of symptoms or concerns); (3) examined effects of non-pharmacological interventions developed to prevent or reduce stress and/or anxiety; (4) examined effects on parental stress and/or anxiety. Only studies published in English, Dutch or Portuguese were eligible for inclusion.

Screening and data extraction

Two reviewers (KMS & CF), independently screened titles and abstracts against eligibility criteria and, subsequently, full texts for eligibility (KMS & CF); disagreements were discussed with a third reviewer and resolved by consensus. Data were extracted using a standardised data extraction form (Supplementary File 2).

Quality assessment

Risk of bias for each study was assessed by two reviewers (KMS & CF) using standard Cochrane risk of bias criteria [38]. The GRADE approach was used to assess the quality of the body of evidence for stress and anxiety outcomes. As all included studies were RCTs, they were initially rated as high quality, with quality downgraded for serious (one level) or very serious (two levels) limitations related to risk of bias, indirectness of evidence, inconsistency, imprecise estimates of effects, or potential publication bias [39]. Study quality was not used as an exclusion criterion and so no studies were excluded on the basis of quality. This is because adopting a more stringent approach to study selection by including RCT designs only, is suggested to ensure higher quality as per the GRADE criteria; it was thus deemed more appropriate to examine quality within identified RCTs than to exclude on this basis.

Data synthesis

It was intended that a meta-analysis be conducted in Review Manager 5.3 software using studies reporting crude and/or adjusted estimates. Due to substantial heterogeneity between studies in terms of interventions and outcomes reported, a meta-analysis was not considered to be appropriate. A narrative synthesis of intervention effects, characteristics and theoretical underpinnings, was instead conducted. As interventions were conducted predominantly in either the prenatal or postnatal periods, with three interventions delivered in both periods, findings are presented for prenatal, postnatal, and both pre and postnatal periods.

Results

Full texts of 71 articles were assessed against eligibility criteria. Sixteen studies, representing 15 interventions, met inclusion criteria for the current review (Fig. 1).

Study quality

Only one study was rated as low risk of bias [49], six studies were rated as moderate risk of bias [40–44,50]; nine studies were rated as high risk of bias [38,39,41,42,47,48,51–53]. The most common sources of bias related to blinding; selective reporting bias in most studies was unclear as few studies were pre-registered or had published protocols. Though individual studies demonstrated varying quality, the quality of evidence for stress and anxiety outcomes overall was rated as low due to serious limitations regarding risk of bias, indirectness of evidence, inconsistency, imprecision of effect estimates and potential publication bias, as outlined by the GRADE criteria. See Supplementary file 3.

Study characteristics

Study populations

Characteristics of the included studies are summarised in Table 1. Seven studies [40,42,44–48] examined effects of prenatal interventions for women at risk of developing stress, anxiety and/or depression [45,48], or who already experienced elevated levels [40,42,44,46,47]. One study examined effects of an intervention for low-income pregnant women who were, for the most part, unmarried [41]. Postpartum interventions included women with anxiety and/or depression [43]; parents of preterm infants [49,50] or infants born with very low birth weight [51]. Four studies were conducted in populations who are not considered 'at-risk', herein referred to as 'general population' [52–55]. Two studies included fathers [49,50] and were conducted in the postnatal period; no study examined same sex partners (Table 1).

Intervention characteristics

Six interventions were CBT-based [40,42,43,45–47,55]; two were informed by CBT but were primarily mindfulness-based [48,52]. Two interventions targeted parent-infant interactions via triadic attachment [49], and reading and recognising own and infant's cues [51]. Two interventions focused solely on information provision and relaxation techniques [50,53]. One study involved nurse community health visits [41]; one intervention involved peer-mentoring [54]; one involved heart rate variability (HRV) biofeedback [44]. Thirteen of these interventions included some delivery in a medical setting, mostly hospitals providing maternity

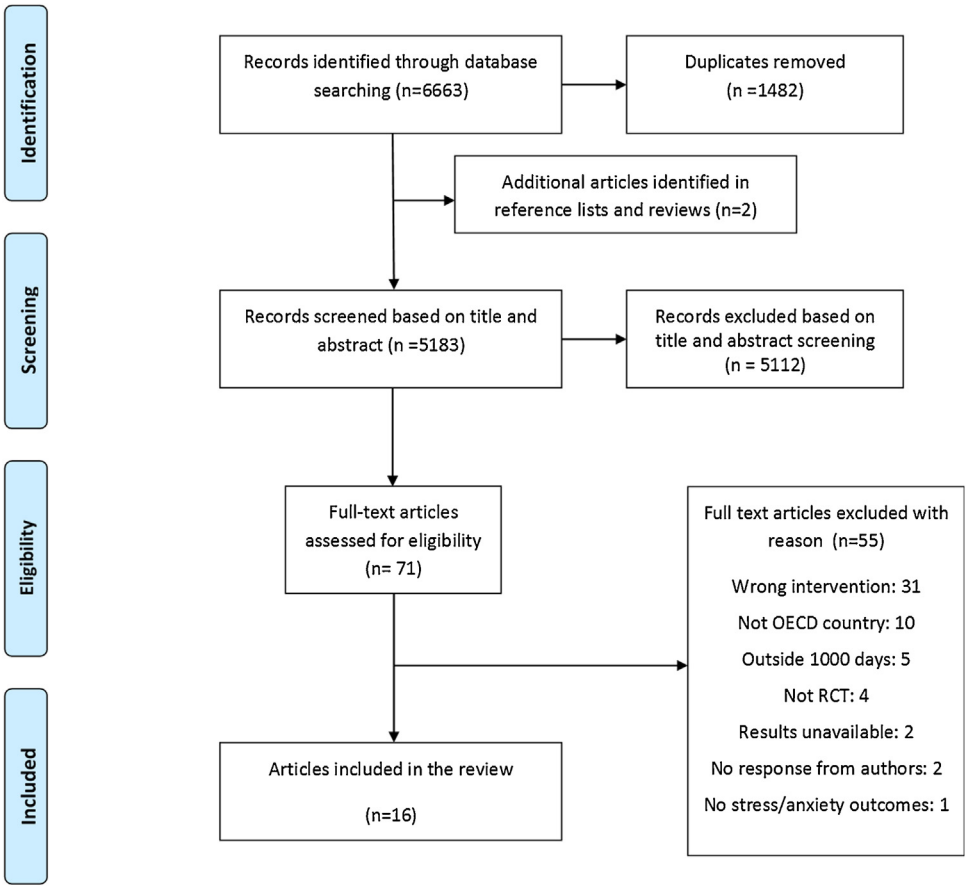

Fig. 1. Systematic Review Flow diagram.

Table 1
Study Characteristics.

Author (year)	Country	Participant characteristics	Parity	Design	Intervention	Control	Timing of delivery	Setting	Measurement	Additional outcomes	Results	Risk of Bias
Austin et al., 2008. [45]	Australia	Pregnant women at risk of developing perinatal depression or anxiety 97.3% partnered 88.1% English speaking background 90.3% combined family income > $40k Mean age (years) = 31.4 (SD = 3.5)	65.9% Primi-parous	RCT	N = 162 CBT	N = 171 Booklet and brief verbal delivery of components.	Prenatal Mean gestational age at commencement = 25.7 weeks (SD = 5.3)	Primary care	Self-report state trait anxiety (STAI)	Depression (EPDS)	At 4 months postpartum No significant difference in anxiety $p > .05$ Significant difference in depression over time up to 4 months postpartum: quadratic trend: ($F = 4.24$, $p < .05$) Difference not significant when baseline depression controlled: ($F = .23$, $p > .05$) No difference for high stress women over time ($F = .09$, $p > .05$)	High
Beattie et al., 2017 [52]	Australia	Low risk pregnant women All married Majority Australian Mean age (years): MiPP = 28.9 (SD = 5.7), PSP = 28.5 (SD = 6.4)	100% primi-parous	Pilot mixed-methods RCT	N = 9 Mindfulness in pregnancy (MiPP) intervention.	N = 11 Pregnancy support program control .	24–28 weeks gestation at intervention commencement	Tertiary care and maternity service provider	Perceived stress (PSS)	Depression (EPDS), mindfulness (MAAS), birth outcomes	At 6 weeks after intervention completion Non-significant reductions in stress for MIPP condition ($p = 0.822$, $d = .15$) No differences for depression ($p = 0.722$, $d = .06$), mindfulness ($p = .693$, $d = .417$) or any birth outcome: nset of labour ($p = 0.66$), mode of birth ($p = 0.15$), Apgar score at 1 min ($p = 0.21$) and at 5 min ($p = 0.42$), maternal complications ($p = 0.38$), baby complications ($p = 0.48$) and maternal analgesia ($p = 0.29$)	Moderate
Bittner et al.,	Germany	Pregnant women with elevated anxiety or	Majority nulli-parous:	RCT	N = 21 Adapted cognitive	N = 53 Usual care	Prenatally Approx. 16 weeks	[a]	Prenatal distress (PDQ)	Depression Mental disorders Fear of childbirth	At 3 months postpartum Anxiety from	High

2014 [46]		depression All married or in relationship Mean age = 29.5 years	Intervention = 76.2%, Control = 60.4%		behavioural group program		gestation at commencement			State trait anxiety (STAI; Anxiety sensitivity index)	Depresionogenic, negative cognitions and belief Social support Quality of marriage	baseline to post-intervention ($p = .246$, $n^2 = .019$); from baseline to 3months follow-up ($p = .529$, $n^2 = .006$) Anxiety sensitivity from baseline to post-intervention ($p = .406$, $n^2 = .010$); from baseline to 3months follow-up ($p = .139$, $n^2 = .031$) Fear of childbirth ($p > .05$) Depression ($p > .05$); women with elevated depression had greater decline over time than controls ($p = .05$, $d = .073$) Dysfunctional attitudes ($p > .05$) Social support ($p > .05$) Quality of relationship: significant improvement post-intervention $F(1, 67) = 4056$, p.048, n2 = .056; no effect at 3 months follow up	
Castel et al., 2016 [49]	France	Mothers (n = 53) and fathers (n = 42) of preterm infants Majority have bachelors degree or higher Mothers mean age: Intervention = 29.6 (SD = 5.2); Control = 31.2 (SD = 4.4) Fathers mean age: Intervention = 29.6 (SD = 5.2); Control = 31.4 (SD = 5.9) Children	Majority primi-parous, intervention (63.6%) control (62.5%)	Open prospective RCT	Mothers n = 29; Fathers n = 23 Triadic attachment intervention program	Mothers n = 24, Fathers n = 19 Usual care	Postpartum Corrected age 12 months		At home and neonatology ward	Parenting stress (PSI-SF)	Depression (EPDS); Perinatal Post-Traumatic Stress Disorder (PPTSD Scale);	<u>At 3 months</u> Overall stress Mothers = p > .05 Fathers = p > .05 <u>At 18 months</u> Global stress: Mothers = p < .001, Fathers p = .019; Parent Stress: Mothers = p = .0026, Fathers p = .068; Parent child stress: Mothers = p < .001, Fathers p = .0024 EPDS at 3 months: Mothers (p = .37), Fathers (p = .16); EPDS at 9 months: Mothers (p = .84),	High

Table 1 (*Continued*)

Author (year)	Country	Participant characteristics	Parity	Design	Intervention	Control	Timing of delivery	Setting	Measurement	Additional outcomes	Results	Risk of Bias
		% female: intervention = 62.5%, control = 47.1% 12 months corrected age									Fathers (p = .048); EPDS at 18 months: Mothers (p = .012), Fathers (p = .0024); PTSD at 18 months: Mothers (p < .001), Fathers (p = .0023);	
Fotiou et al., 2016 [50]	Greece	Parents of hospitalised premature infants Median age 34.5 (IQR = 32,5, 40.5) 91.5% married Majority moderately to highly satisfied with income (73.5%) Child born at median gestational age 34.5 (IQR = 2040); age at baseline = 10–15 days	64.5% Primi-parous	RCT	N = 31 Information provision and relaxation techniques including audio CD	N = 28 Information provision and audio CD for 3 months after discharge.	When infant was 10–15 days after delivery at intervention commencement	Neonatal intensive care unit of a tertiary maternity hospital	Perceived stress (PSS-14) Cortisol (Salivary cortisol collected at waking, +30 mins, and before sleeping at night) State trait anxiety (STAI)	None	At 3 months after discharge: Stress (p = .699) Higher baseline stress = higher stress after controlling for condition (p < .001) Higher education (p = .003) and lower income satisfaction (p = .003)= higher stress after controlling for condition Morning cortisol (p = .94), +30 min cortisol (p = .263), bedtime cortisol (p = .263) State anxiety (p = .515), Trait anxiety (p = .02)	High
Loughnan et al., 2019a [40]	Australia	Pregnant women with anxiety and/or depression Mean age = 31.61 (SD = 4.0) 77% married 79% University degree 82% Australian	65% Multi-parous	Randomised controlled superiority trial	N = 23 Brief unguided iCBT intervention	N = 36 Wait-list treatment as usual	Prenatal from mean gestational week 21.66 (M = 5.93)	Online	Generalised anxiety (GAD 7-item)	Depression (PHQ; EPDS) Non specific psychological distress (KPDS) Quality of Life (WHOQoL-BREF) Maternal antenatal attachment (MAAS[2])	Anxiety at 4 weeks after intervention F(254.67) = 6.48, p < .01, g = .76 Depression EPDS F(2, 54.99) = 0.18, p = .84, g = .35 PHQ F(2, 53.65) = 1.93, p = .16, g = .35 Distress F (253.93) = 7.07, p < .01, g = .52 Attachment F(2, 53.32) = 0.50, p = .61, g = .16 WHQoL all Fs (2, 47.05–55.04) = 0.07 - 0.14, all ps=>0.87	Moderate
	Australia		58% primiparous					Online				Moderate

Loughnan et al., 2019b [43]		Women within 12 months postpartum with anxiety and/or depression Mean maternal age = 32.56 (SD = 4.53) 88% married 78% Australian		Randomised controlled superiority trial	N = 37 Brief unguided iCBT intervention	N = 42 Wait-list treatment as usual	When infant was mean age = 4.55 months (SD = 3.05)		Generalised anxiety (GAD 7-item)	Depression (PHQ; EPDS) Non specific psychological distress (KPDS) Maternal Postnatal Attachment Scale (MPAS) Karitane Parenting Confidence Scale (KPCS) Quality of Life (WHOQoL-BREF) Treatment Credibility and Expectancy questionnaire (CEQ)	Four weeks post treatment Anxiety F(2, 94.04) = 9.13, p < 0.001 Depression EPDS F(2, 87.50) = 10.25, p < 0.001 PHQ F(2, 93.80) = 9.06, p < 0.001 Distress F (2216.22) = 30.80, p < .0001 Attachment F(2, 87.77) = 16.71, p<.0001 WHQoL Physical health F (2, 53.65) = 1.93, p < .001); Psychological F(2, 89.92) = 3.23, p < 0.05; environment F(2, 90.16) = 4.97, p < .0.01; social relationships F(2, 87.12) = 1.21, p = 0.30) Parenting confidence F(2, 88.81) = 2.10, p = 0.13	
Richter et al., 2012 [47]	Germany	Pregnant women with elevated stress, anxiety, and depression Mean age: Intervention = 29.19 (SD: 4.54) Control = 29.95 (SD: 4.29) 65.57 %= €1000 to 3000 net income per household All married or cohabiting All Caucasian German	Majority primi-parous 71.4 % Intervention, 62.5 % control	RCT	N = 21 Adapted cognitive behavioural group program	N = 40 Treatment as usual	Prenatal Approx. 16 weeks gestation at commencement	[a]	Salivary cortisol (5 samples at waking, +30 min, 11:00, 17:00, 22:00). Prenatal distress (PDQ) Perceived stress (PSS)	None reported	At 3 months postpartum Cortisol CAR: F(851) = 2.300 p = 0.047; AUC, F (258) = 0.188, p = 0.829. PDQ: F(1, 59) = 0.022, p = .883 PSS: F(2, 56) = 0.082 p = .922	High
Roman et al., 2009 [41]	United States	Low income pregnant women Age: 31%= <20years; 50% = 21-25years; 19% >25years, range = 16-42 years	55.84% had prior live birth	RCT	N = 266 Nurse-community health worker intervention	N = 264 State-sponsored, Medicaid	Prenatal and postnatal Intervention commenced when women approximately 11.9 weeks pregnant	Clinic and home visits	Perceived stress (PSS)	Depression (CES-D); Mastery(PSMS); Self-esteem (RSES); Social Support (MSPSS)	At 15 months postpartum Stress (p = .058) No effect based on high baseline stress (p = .336), significant difference if low	Moderate

Table 1 (*Continued*)

Author (year)	Country	Participant characteristics	Parity	Design	Intervention	Control	Timing of delivery	Setting	Measurement	Additional outcomes	Results	Risk of Bias
		82.6% unmarried 27% african american, 23% hispanic 41% white									psychosocial resources (p = .019), no effect if both low resources and high stress (p = .131) Depression (p = .036) Significant differences if high baseline stress (p = .019), low psychosocial resources (p = .016), or both (p = .022) Mastery (p = .057) Self Esteem (p = .79) Social Support (p = .63)	
Tragea et al., 2014 [53]	Greece	Pregnant women Median age = 32 years 73% completed higher education 85% married 96.6% live in Greece	All nulli-parous	RCT	N = 31 I nformational lecture and brochures	N = 29 Wait-list usual care	Median 17 weeks gestation at intervention commencement	[a]	Perceived stress (PSS) State trait anxiety (STAI)	Life, lifestyle and health (own questions) Health Locus of Control (HLCS)	At 6 weeks follow-up Stress: mean difference −3.23 (95% CI: −4.29 to −0.29) State anxiety: mean difference −1.5 (95% CI: −2.7 to 1.7) Trait anxiety: mean difference −2.29 (95% CI: −4.9 to 0.3) Health Locus of control mean change 1.99, (95% CI: 0.02—3.7) p < .05 Satisfied with sleep quality (p = .025) Smoking (p = .046) Repressed anger (p = .028) Sleep Disorders (p = .023) Complete control of things (p = .018) Lack of attention/ inability to concentrate (p = .093) Impaired memory	High

											capacity (p = .097) Tension headaches (p = .14)	
Urizar et al. 2011 [55]	United States	Women during pregnancy and postpartum Approx. 25 years (18–35 years) 87%= annual household income less than $30,000 77% married or living with partner 80% Spanish speaking Latina	60% Multi-parous	RCT	N = 24 Prenatal cognitive behavioural stress management (CBSM) intervention	N = 22 Usual care	Prenatal and postpartum Range 6–28 weeks gestation at intervention commencement Postpartum sessions at approx. 1, 3, 6, 12 months	Hospital where receiving prenatal services	Perceived stress (visual analogue scale) Cortisol (45 min after waking and 8 pm at night)	Depression risk (MMS; CES-D) Positive and negative affect (PANAS)	At 6 months Stress (p < .01) Morning, evening and average cortisol (p > .05) Cortisol slope (p > .05) No differences for depression or PANAS (ps>.05) At 18 months Stress (p > .05) Morning and evening cortisol (p > .05) Average cortisol (p < .05) Cortisol slope (p > .05) No differences for depression or PANAS (ps>.05)	High
Urizar et al., 2019 [42]	United States	Low-income pregnant women with low or high anxiety Approx. 27 years (SD = 6.26; range = 18–40 years) 71% Latina 76% annual income<$20 K 51% single	Multiparous: intervention = 61.8%, control = 64.4%	RCT	N = 55 Prenatal cognitive behavioural stress management (CBSM) intervention	N = 45 8 week active informational control	Prenatal 2–17 weeks pregnant at intervention commencement (M = 10, SD = 4.25)	Clinics where receiving prenatal care	Perceived stress (PSS) Salivary cortisol (waking, 30, 45 and 60 min.), 12 pm, 4 pm, 8 pm	n/a	At 3 months postpartum Perceived stress (p = .02, d= -0.60, CI.95= -0.89, -0.3) Cortisol AUC (p = .31) CAR (p = .07) Non-Latina intervention had greater decline from 2nd trimester to 3 months postpartum than control (p = .019, d = 0.90, CI.95 = 0.24, 1.37) Slope (p = .038, d = 0.68, CI.95 = 0.27, 1.10) High anxiety intervention had steeper decrease than high anxiety control (p = .015, d = 0.56, CI.95= −0.07, 1.20)	Moderate
van der Zwan et al., 2019 [44]	Netherlands	Pregnant women experiencing stress Non-pregnant women experiencing	Majority Nulliparous (65%)	Randomised controlled trial	N = 12 HRV Biofeedback	N = 8 Waitlist	Prenatal Mean gestation 19.33 weeks (SD = 5.2) at intervention commencement	? and at home exercises	Anxiety (DASS) Stress (DASS)	Depression (DASS) Sleep Quality (PSQI) Scales of	Immediately after intervention Anxiety : p = 0.001 Stress: p = 0.19 Depression: p = 0.55	Moderate

Table 1 (*Continued*)

Author (year)	Country	Participant characteristics	Parity	Design	Intervention	Control	Timing of delivery	Setting	Measurement	Additional outcomes	Results	Risk of Bias
		stress[b] Mean age = 33.14 (SD = 4.14) Majority had higher vocational school (45%) or University (40%) education								Psychological Well-being (SPW)	Well-being: p = 0.83 Sleep: p = 0.87	
Vieten & Astin 2008 [48]	United States	Pregnant women with history of mood concerns Mean age 33.9 (SD 3.8) years Mean household income = USD 89,677 (SD, USD 17,792) All married Majority (74%) white	[a]	Randomised wait list controlled trial	N = 13 Mindful motherhood programme	N = 18 Wait-list Care as usual	Prenatal Mean gestation 25 weeks (SD = 4, range = 18–31) at intervention commencement	Large urban hospital and synagogue	Perceived stress (PSS)	Depression (CES-D) State trait anxiety (STAI) Positive and negative affect (PANAS) Affect Regulation (ARM) Mindfulness (MAAS)	At 3 month follow up Stress: p = .35, d = .39 Anxiety : p = .04, d = .85 Depression: p = .06, d = .80 Positive affect: p = .08, d = .73 Negative affect: p = .03, d = .9 Affect regulation: p = .23, d = .5 Mindfulness: p = .11, d = .68	High
Weis et al., 2017 [57]	United States	Active duty women and wives of military service members Mean age = 28.72 years 42%= college education 98% married 60% white	38% Primi-parous	RCT	n = 125 Mentors Offering Maternal Support (MOMS) program	n = 121 Regular care	Prenatal 1st and 2nd trimesters Mean gestational age at baseline = 9 weeks (SD = 2.47)	Military setting	Pregnancy specific anxiety (LPSQ)	Self-esteem (RSES); Depression (EPDS); Resilience (BRS)	At approx. 30 weeks gestation Anxiety-wellbeing: p > .05; anxiety-acceptance p > .05; anxiety-identification with motherhood role p = .049; Anxiety-preparation for labour p = .017; anxiety-helplessness p > .05 Depression, self-esteem, resilience all p > .05	High
Zelkowitz et al., 2011 [51]	Canada	Mothers of very low birth weight infants Mean maternal age: Intervention = 31.1 (SD = 5.3) years, control = 30.8 (SD = 6.1) years Majority = junior college or higher (79.21%)	Majority Primi-parous (67.33%)	RCT	n = 50 Cues intervention to reduce anxiety and enhance maternal sensitivity	n = 48 Attention control, information provision by Care intervener	Postnatal Mean child age = 33 days (SD = 12)	NICU in two tertiary hospitals and at home	Parenting stress (PSS); Maternal perinatal post traumatic stress symptoms (PPTSD) State trait anxiety (STAI)	Depression (EPDS) Maternal behaviour (videoed observations coded using GRSMII Infant illness severity during NICU stay (RNNS)	At 6–8 weeks corrected age Stress- NICU infant behaviour/ appearance: mean difference= −.02 (95%CI: −0.1, 0.5) p = .14 Stress- parent role restriction: mean difference= −.00 (95%CI: -0.3, 0.3) p = .76	Low

					Mean child age at baseline = 33 (SD = 12) days Majority North American born (67.33%)	PTSD symptoms: Stress- NICU infant behaviour/ appearance: mean difference= −.3 (95%CI: −0.8, 1.5) p = .54 Anxiety: mean difference = .95 (95%CI: 0.88, 1.04) p = .28 Mother-infant interaction- mean difference= −.0 (95%CI: −0.5, 0.3) p = .71 Infant positive engagement: mean difference= −.1 (95%CI: −0.6, 0.3) p = .57 Infant liveliness mean difference= −.1 (95%CI: −0.4, 0.2) p = .53 Infant fretfulness: mean difference= −.1 (95%CI: −0.3, 0.2) p = .78 Length of NICU stay: mean difference= −.3 (95%CI: −14.7, 14.1) p = .97

ARM: Affect regulation measure; AUC: Area under the Curve; BRS: Brief Resilience Scale; CAR: Cortisol Awakening Response; CBSM: Cognitive Behavioural Stress Management; CBT: Cognitive Behavioural Therapy; CES-D: Centre for Epidemiological Studies Depression scale; CEQ: Treatment Credibility and Expectancy questionnaire; DASS: Depression Anxiety and Stress Scale; EDPS: Edinburgh Postnatal Depression Scale; GAD: Generalised Anxiety Disorder; GRSMII: Global rating scales of mother-infant interaction; HCP: Health Care Professional; iCBT: Internet Cognitive Behavioural Therapy; KPCS: Karitane Parenting Confidence Scale; KPDS: Kessler 10 item Psychological Distress scale; LPSQ: Lederman Prenatal Self-Evaluation Questionnaire–Short Form; MAAS: Mindfulness Awareness Attachment Scale; MAAS[2]: Maternal antenatal attachment Scale; MiPP: Mindfulness in Pregnancy intervention; MMS: Maternal Mood Screener; MOMS: Mentors Offering Maternal Support; MPAS: Maternal Postnatal Attachment Scale; MSPSS: Multidimensional Scale for Perceived Social Support; NBAS: Neonatal behaviour assessment scale; NICU: Neonatal Intensive Care Unit; PANAS: Positive and Negative Affect Scale; Prenatal Anxiety Scale: PAS; PDQ: Perinatal Distress Questionnaire; PHQ: Patient Health Questionnaire; PSMS: Pearlin Sense of Mastery Scale; PSQI: Pittsburgh Sleep Quality Index; PSS: Perceived Stress Scale; PPTSD: Perinatal Posttraumatic Stress Questionnaire; RCT: Randomised Controlled Trial; RSES: Rosenberg Self-esteem Scale; RNNS: Revised Nursery Neurobiological Score; STAI: State Trait Anxiety Inventory; SPW: Scales of Psychological Well-being; WHOQoL: World Health Organisation Quality of Life.

[a] Information not reported and not provided by original authors upon request.

[b] Non-pregnant population outcomes not included in the current review.

Table 2
Intervention and Control Characteristics.

	Intervention							Control		
Author (year)	Description	Components	Facilitator	Mode of delivery	Timing of delivery[a]	Duration and frequency	Theoretical basis	Description	Components & theoretical basis	Mode of delivery
Austin et al., 2015 [45]	Brief CBT group intervention Skills based	Behavioural strategies Weekly home task practice Education (perinatal anxiety and depression, and infant needs and behaviour) Pleasant event scheduling Relaxation training Goal setting Problem solving Cognitive strategies to address unhelpful attitudes Assertion skills Developing a broad social support network, including local postnatal support services	Clinical psychologist and trained midwife	Group sessions in primary care setting	Prenatal Late 1st trimester/ early second trimester at commencement	6 weekly 2-h sessions 1 later follow-up session	None stated	Active control Information based	Information (risk factors for postnatal anxiety and depression, triggers for postnatal distress) strategies to prevent and/or manage anxiety or depression List of local postnatal support services and how to access services Advice to contact GP if become symptomatic GP advised of above by letter No theoretical basis stated	Booklet Brief verbal delivery of booklet contents
Beattie et al., 2017 [52]	Mindfulness in pregnancy program (MiPP)	Mindfulness (of breath, eating, walking, movement, and listening) Body scan meditation tailored to pregnancy Ice meditation B.R.A.N.N. decision making model to work in partnership with HCPs during labour and birth Birthing suite visits Daily record of mindfulness practices	Trained midwife researcher/ investigator	Group sessions In maternity care setting	Prenatal 24–28 weeks gestation at intervention commencement	8 weekly 2-h sessions	Theoretical constructs of mindfulness and cognitive behavioural therapy adapted for a pregnant population. The co-emergence model of behaviour reinforcement, which is a mindfulness-based cognitive behavioural therapy model	Pregnancy Support Program (PSP) Generalised midwifery approach to intervention topics, without mindfulness	Information (communication, empathy, body image, pain relief, breastfeeding, newborn care, mental health and postnatal depression) Identification and discussion of stressors Listening Identifying own strengths, and wants versus needs Self-portrait highlighting physical changes, emotional response to birthing, and breastfeeding images; Envisaging support networks Brainstorming resources and childcare options. Birthing suite visits	8 weekly 2-h group sessions Delivered by midwife
Bittner et al., 2014 [46] Richter et al., 2012 [47]	Adapted cognitive behavioural group program	Psycho-education (stress, anxiety and depression) Cognitive behavioural strategies Exercise performance/ role playing Progressive muscle relaxation Homework exercises/role playing Progressive muscle relaxation between sessions	Trained clinical psychologist	Group sessions of 4 or 6 women	Prenatal Approx. 16 weeks gestation at commencement	8 weekly 90 min sessions	None stated	Usual care	n/a Monthly visits with an obstetrician (biweekly visits from 8th to 9th month of pregnancy) 3 ultrasound scans CTG during 3rd trimester Blood and urine tests	Individual in-person
Castel et al.,	Triadic attachment	Discussion of perceptions, emotions	Clinical psychologist	At-home individual visits	Post-partum Child was 12 months	First four months = twice	Attachment theory	Usual care	Monthly visits to a practitioner for the first 6	Individual in-person

2016 [49]	intervention program	and experiences Observation of parent-child interactions Identification of emotional states Promotion of parents-infant triadic relationships to foster infant's cognitive, motor, socio-emotional and behavioural development Promotion of parenting skills and attachment Supporting parents to understand child's cues and to respond Develop realistic expectations of child behaviour		Consultations in neonatology ward	corrected age at intervention commencement	monthly 1 h at-home visits Followed by monthly consultations in neonatology ward up to 22 sessions total over 14 months.	Parental reflective functioning theory Emotion theory Parenting and co-parenting concepts		months, and then every 3 months	
Fotiou et al., 2016 [50]	Interactive training courses including information and relaxation strategies	Information on prematurity, stress in NICU; breast-feeding; preparation for discharge; infant care at home; positive thinking; healthy lifestyle; and self-knowledge. Practice of breathing, progressive muscle relaxation, and guided imagery relaxation techniques in sessions (lasting 15-20 min) At-home twice-daily practice of relaxation techniques using audio cd encouraged Reminders sent by text messages, or respective weekly telephone calls, during 3-months post-discharge	Postgraduate researcher for NICU sessions	Group sessions in NICU Audio CD for at home	Post-partum Child was 10–15 days old at intervention commencement	Five 90 min sessions during NICU stay, At-home practice for 3 months after discharge	None stated	Active information control	Information on prematurity; stress in NICU; breast-feeding; preparation for discharge; infant care at home	Five 90 min sessions in NICU delivered by researcher on PowerPoint in NICU. At-home informative audio CD for 3 months after discharge.
Loughnan et al., 2019a [40]	MUMentum Pregnancy program Brief unguided prenatal iCBT intervention tailored to women with anxiety and depressive symptoms	Stand-alone, psychoeducational courses Introduction to CBT skills for anxiety and depression symptoms Cognitive restructuring Problem-solving Behavioural activation Relapse prevention Provision of general resources Participants were notified of new lessons and reminded to stay on schedule via email and SMS reminders. Technical assistance, but	n/a (online)	Lessons accessed sequentially via online Virtual Clinic Lesson content presented as short illustrated story of two fictional characters experiencing anxiety and depression during their pregnancy	Prenatal Mean gestational week 21.66 (M = 5.93) at intervention commencement	Three lessons over a 4 week period	None reported	Wait-list usual care from health services. Provided with MUMentum Pregnancy Program at intervention completion	Not stated	Not stated

Table 2 (*Continued*)

	Intervention							Control		
Author (year)	Description	Components	Facilitator	Mode of delivery	Timing of delivery[a]	Duration and frequency	Theoretical basis	Description	Components & theoretical basis	Mode of delivery
		no coaching or counselling provided.								
Loughnan et al., 2019b [43]	MUMentum postnatal program	Psychoeducation Problem solving Controlled breathing and muscle relaxation Activity planning Relapse prevention Assertive communication Provision of general resources Technical assistance, but no coaching or counselling provided.	n/a (online)	Lessons accessed sequentially via online Virtual Clinic system Lesson content presented as short illustrated story of two fictional characters experiencing postpartum anxiety and depression	Postpartum Within 12 months postpartum M = 4.55 months (SD = 3.05) postpartum	Three lessons, each completed every 2nd week, over 6 weeks in total	None reported	Wait-list treatment as usual, including any maternity or care services women wished to access	Not stated	Not stated
Roman et al., 2009 [41]	Nurse-community health worker intervention	Relationship-based support Activities to increase self-esteem Promotion of positive health behaviours Developing self awareness of stressors, causes of stressors Active problem solving Development of life goals Using community resources including specific focus on utilization of CHWs with nurses health.	Trained nurse and community health workers First assessment together followed by separate visits	Individual clinic and home visits	Prenatal and postnatal Intervention commenced when women approximately 11.9 weeks pregnant	Every other week during pregnancy Increased CHW visits for 1st month after birth if needed Two visits per month until six months post birth. At six months, visits could be reduced to once a month if needed. Average no. of contacts was 24.4	Ecological stress theoretical framework	State-sponsored, Medicaid provided by HCPS (primarily nurse). Up to 9 prenatal and 9 postnatal visits. Received an average of 8.5 face-to-face total contacts	Home visiting Multidisciplinary planning Transportation Psychosocial counselling Nutritional guidance Pregnancy and parenting education No theoretical basis	In-person
Tragea et al., 2014 [53]	Information and relaxation exercises	Elements of standard maternity practice including: Lecture on stress and management techniques Education brochure about stress antecedents and consequences Brochures about diet and exercise Relaxation exercises: Diaphragmatic breathing Progressive muscle relaxation 20 min long audio cd Diary to record and control the frequency of relaxation techniques Brochure about importance of a healthy lifestyle through and routine to reduce stress	Trainer-consultant	Individual Lecture Brochures Audio CD Telephone/in-person contact	Prenatally 2nd trimester Mean gestation = 17weeks at intervention commencement	6 weeks Single lecture Relaxation techniques twice per day	None stated	Wait-list control	Elements of standard maternity practice including: Lecture on stress and management techniques Education brochure about stress antecedents and consequences Brochures about diet and exercise Weekly telephone communication Provided audio CD at end of 6 weeks	Lecture Brochures Telephone contact

		and promote good health Weekly monitoring of relaxation techniques and effects via telephone or in-person meeting								
Urizar et al., 2011 [55]	Cognitive behavioural stress management intervention	Prenatal sessions Cognitive behavioural strategies: Recognizing and modifying maladaptive thoughts Increasing positively reinforcing activities Identifying and increasing positive social networks Parenting strategies Stress management strategies: Information on physical symptoms and effects of stress Diaphragmatic breathing Guided imagery Mindfulness-based training Progressive muscle relaxation Postpartum booster sessions Reviewed prenatal concepts Discussed challenges with new-born care	Faculty, postdoctoral fellows, and advanced doctoral graduate students in clinical psychology Facilitators supervised by clinical psychologist	Group sessions (3–8 people) in hospital where receiving maternity services	Prenatal and postpartum 2-28 weeks gestation at intervention commencement	Weekly sessions for 12 weeks prenatally Four booster sessions at 1, 3, 6, 12 months postpartum	Social learning theory Lewinsohn's behavioural approach to mood management	Usual care	Medical care from health care provider Information on locally available social services upon request, or if they developed clinical depression, throughout their participation in the study No theoretical basis	Individual in-person
Urizar et al., 2019 [42]	SMART Moms Cognitive behavioural stress management intervention	Interactive activities (e.g. role playing) Cognitive behavioural strategies Psychoeducation Diaphragmatic breathing Muscle relaxation Mindful thought awareness Coping strategies Supportive imagery Communication skills Information on using skills in postpartum	Clinically trained facilitators	Group sessions of 3–8 pregnant women in clinic where women receive prenatal services	Prenatal 2–17 weeks pregnant at intervention commencement (M = 10, SD = 4.25)	Weekly sessions for 8 weeks At home practice	Not stated	Active control group	8 week program Received printed materials weekly on prenatal health information Weekly contact by researcher to ensure receipt of materials and to answer any questions	None stated
van der Zwan et al., 2019 [44]	HRV Biofeedback	HRV biofeedback Abdominal breathing Psychoeducation Behavioural exercises (e.g. registering complaints, planning next weeks leisure and obligation activities).	Trained clinical psychologist and trained research assistants	Group sessions of 2–6 women At home practice	Prenatal Mean gestation 19.33 weeks (SD = 5.2) at intervention commencement	Weekly sessions (60–90 min.) for 5 weeks At home breathing practice of 10 min/day up to 2 × 20 min/day	Not stated	Waitlist treatment as usual	Not stated	Not stated
Vieten & Astin, 2008 [48]	Mindful Motherhood	Equal parts education, discussion, and experiential exercises Focus on thought sand	Clinical psychologist Certified yoga instructor	Group sessions of 12–20 women in large urban hospital and synagogue	Prenatal 18-31 weeks gestation, M = 25 (SD = 4) weeks at	Weekly sessions (2 hrs) for 8 weeks	MBSR MBCT Acceptance and	Wait list usual care	Not stated	Not stated

Table 2 (*Continued*)

Author (year)	Intervention							Control		
	Description	Components	Facilitator	Mode of delivery	Timing of delivery[a]	Duration and frequency	Theoretical basis	Description	Components & theoretical basis	Mode of delivery
		feelings via breath awareness and contemplative practices Guided body awareness meditation Mindful hatha yoga Presentation of psychological concepts that incorporate mindfulness, e.g. acceptance Weekly readings relevant to the material presented in class 20-min long audio CD disc of guided meditations for daily use		Audio CD Reading material	intervention commencement	20 min daily at home practice	Commitment Therapy			
Weis et al., 2017 [57]	Mentors Offering Maternal Support (MOMS) Mentoring support program	Educational sessions on: Pregnancy acceptance Identifying with motherhood Mother-daughter relationship Family-partner relationship Well-being of self and baby Fear of helplessness in labour Labour preparation	Trained mentors who were women married to military members or were active duty personnel and were mothers	Group sessions in military prenatal clinics	Prenatal 1st and 2nd trimesters Mean gestational age at baseline = 9 weeks (SD = 2.47)	1 h sessions bi-weekly for 16 weeks (8 sessions total)	None stated	Usual care	Note stated	Not stated
Zelkowitz et al., 2011 [51]	Cues intervention to reduce anxiety and enhance maternal sensitivity	Reading and recognising own anxiety/distress Muscle relaxation Guided imagery Cognitive reframing Reading and recognising infant cues and distress Information about thoughts, feelings and behaviours Information about VLBW infant behaviour Telephone follow-up call, to review the techniques and maintain contact Videotaped mother-infant interaction Videoed interaction reviewed with facilitator Booklet of session contents	Trained nurse, psychologist or graduate student in nursing or psychology	In-person individual sessions in private location in hospital Brochure	Postpartum	Six 60−90 min individual sessions: 5 in NICU, 1–2 sessions per week; 1 at home 2–4 weeks after discharge Total dose = 9–10 h	None stated	Attention control condition	6 contacts with a Care intervener at regular intervals Brochure Information on infant care, feeding and common health problems of preterm infants as well as general information about infant care and feeding readily available to all mothers of infants	Individual in = person contacts in private setting in NICU that parallel intervention group Brochure

B.R.A.N.N: Benefits, Risks, Alternatives, Needed, Now; CBT: Cognitive Behavioural Therapy; CHW: Community Health Worker; CTG: Cardiotocography; GP: General Practitioner; HCPs: Healthcare Professionals; HRV: Heart rate variability; iCBT: Internet Cognitive Behavioural Therapy; MBCT: Mindfulness Based Cognitive Therapy; MBSR: Mindfulness Based Stress Reduction; MiPP: Mindfulness in Pregnancy Intervention; MOMS: Mentors Offering Maternal Support; NICU: Neonatal Intensive Care Unit; VLBW: Very Low Birth Weight.

[a] Timing of intervention and control delivery the same unless otherwise stated.

and/or neonatal care [41,42,45,48–52,54,55]. Four interventions took in place in both medical settings and participants' homes [41,49,51,53]; one intervention took place at-home only [44]. Interventions were delivered by a range of facilitators (Table 2). All interventions included education or information provision, such as: psychoeducation related to stress and anxiety [40–47,49–51,53,55], aspects of pregnancy and parenting [42–45,48–52,54,55], and/or health behaviours [41,50,53]. Relaxation strategies were frequently included in interventions, including muscle relaxation [42,43,46,47,50,51,53,55], guided imagery [42,43,50,51,55], breathing exercises [43,44,48,50,53,55], and meditation [48,52]. One intervention included physical activity, namely yoga [48], though other interventions provided information about physical activity [50,53] (see Supplementary File 4). Intervention durations ranged from 4 weeks [40] to 14 months [56] and intervention delivery frequency was generally weekly [42,44–48,52] or bi-weekly [54]. Two interventions were initially delivered weekly or biweekly during pregnancy, with less frequent sessions occurring postpartum [41,55].

Intervention effectiveness

Effects of interventions were inconsistent across the reviewed studies; two interventions demonstrated reductions in stress or anxiety, eight studies demonstrated inconsistent effects, and five studies reported no effects for stress or anxiety. Only results for stress and anxiety are described in detail herein; findings for additional outcomes are summarised in Table 2.

Interventions demonstrating reductions in stress and/or anxiety

Two studies from the same research group examined effects of a brief unguided online cognitive behavioural intervention adapted for either pregnancy [40] or the postnatal period [43]. The intervention included women with or at risk of developing stress, anxiety and/or depression [40]. Intervention content was tailored to reflect symptoms and challenges in pregnancy [40] or postpartum [43] respectively. In the prenatal study, reductions were reported for generalised anxiety disorder, as measured by the Generalised Anxiety Disorder scale (GAD; $p < 0.01$, $g = .76$) and general psychological distress, measured by the Kessler-10 psychological distress scale (K-10; $p < 0.01$, $g = .52$). These reductions were observed in the third trimester relative to women receiving usual care. In the postnatal intervention there was a significant reduction in anxiety as measured by the GAD ($p < 0.001$), and distress, as measured by the K-10 at approximately 1–7 months postpartum.

Interventions demonstrating inconsistent effects for stress and/or anxiety

Prenatal interventions. Five studies conducted during the prenatal period reported inconsistent intervention effects for stress and/or anxiety outcomes. One study examined effects of an adapted cognitive behavioural intervention for women experiencing elevated levels of anxiety or depression at approximately 16 weeks gestation [46,47]. The control conditions included usual care for women with elevated anxiety or depression. This study reported a significant reduction in the cortisol awakening response (CAR; $p = 0.047$) at 3 months postpartum [47]. No effect was found for cortisol area under the curve (AUC; $p = 0.83$), self-reported prenatal stress measured using the prenatal distress questionnaire (PDQ; $p = 0.88$) or general stress measured using the Perceived Stress Scale (PSS; $p = 0.92$) [47]. Another study examined effects of a prenatal mindfulness intervention on perceived stress and anxiety at a 3-month follow-up in a group of women with a history of mood concerns [48]. Timing of follow-up measurement ranged from approximately 7.5 months gestation to 1.5 months postpartum. The intervention demonstrated a reduction in anxiety, measured using the State Trait Anxiety Inventory (STAI) ($p = 0.04$, $d = .85$) but no effect for stress using the PSS ($p = 0.35$, $d = .39$) [48].

A third intervention included information provision on stress and stress management techniques, including breathing and muscle relaxation for a general pregnant population [53]. The intervention was delivered for 6 weeks from approximately 17 weeks gestation and was examined relative to a wait-list usual care control condition. At an average of 23 weeks gestation, a reduction in perceived stress measured with the PSS (mean difference −3.23 (95% CI: −4.29 to −0.29)). There was no change in state anxiety (mean difference −1.5 (95% CI: −2.7 to 1.7)) or trait anxiety (mean difference −2.29 (95% CI: −4.9 to 0.3)) as measured by the STAI. A fourth study included HRV biofeedback, which aims to increase HRV through paced breathing exercises using a small handheld heart rate measurement device [44]. The intervention took place as five weekly sessions and daily at home practice of progressively increasing duration per week with a sample of pregnant women experiencing stress. The control group comprised a wait-list condition of pregnant women experiencing stress. Relative to the control group, the intervention demonstrated reductions in anxiety ($p = 0.001$) but not stress ($p = 0.19$), both measured using the Depression Anxiety and Stress Scale (DASS). Outcomes were assessed at roughly 24 weeks gestation. The fifth prenatal study involved peer-mentoring, and was delivered in the 1st and 2nd trimesters to a sample of active duty women and wives or military service members [54]. The control condition comprised active duty women and wives of military service members receiving usual care. At approximately 30 weeks gestation the intervention demonstrated reductions in anxiety related to identification with motherhood ($p = .049$) and preparation for labour ($p < 0.005$). No effects were reported for anxiety related to acceptance or helplessness ($p > 0.05$), or for depression, self-esteem or resilience ($p > 0.05$); all outcomes were measured using The Lederman Prenatal Self-Evaluation Questionnaire–Short Form [56].

Postpartum interventions. One of the two postpartum interventions intervention [50] which demonstrated inconsistent effects was for parents of children in the neonatal intensive care unit (NICU) 10–15 days after delivery. The intervention included information provision and relaxation techniques, delivered as five 90-min sessions during the infant's NICU stay and an audio CD for at home use. The intervention was examined in comparison to an active control involving information provision regarding preterm infant care. Three months following infant discharge from the NICU, there was no effect on perceived stress overall, as measured by the PSS ($p = 0.70$); an increase in stress was reported for participants with high baseline stress levels ($p < 0.001$), higher education ($p < 0.005$) and lower income satisfaction ($p < 0.005$). No effects were reported for morning cortisol ($p = 0.94$), +30 min cortisol ($p = 0.26$) or bedtime cortisol ($p = 0.26$). There was also no effect for state anxiety ($p = 0.52$) but a significant reduction was reported for trait anxiety ($p < 0.005$), as measured by the STAI. Results in this study were not examined separately for mothers and fathers [50].

The second study examined effects of a mother-father-infant (triadic) attachment intervention program for parents of preterm infants [49]. The intervention focused on parent-infant interactions and parental understanding of infant development, to reduce stress and improve parent-infant relationships to enhance infant developmental outcomes. Using the Parenting Stress Index-Short Form (PSI-SF) to evaluate stress, there was no effect on parenting stress for mothers or fathers when the infant was approximately 3 months old. At 18 months, the intervention demonstrated reductions in global stress for mothers ($p < 0.001$)

and fathers ($p < 0.005$); reduced parenting stress for mothers ($p < 0.005$) but not fathers ($p = 0.07$); and reduced parent-child stress for mothers ($p < 0.001$) and fathers ($p < 0.005$), relative to a usual care control condition of parents of preterm infants.

Prenatal and postpartum interventions. One study examined effects of a nurse community health worker home-visiting intervention with a group of low-income pregnant women, the majority of whom were unmarried [41]. At 15 months postpartum there was no effect for perceived stress, measured using the PSS, in comparison to Medicaid care as usual ($p = 0.058$). For women with low psychosocial resources, the intervention significantly reduced stress ($p < 0.005$); there was no effect based on baseline stress differences ($p = 0.34$) or when baseline stress and psychosocial resources were combined ($p = 0.13$). Another study examined the effects of a CBSM intervention in a general pregnant population [55]. At 6 months postpartum the intervention reduced stress, measured using a visual analogue scale, relative to usual care among a general pregnant population ($p < 0.01$); no differences were reported for morning, evening or average cortisol, or cortisol slope (all $p > 0.05$). At 18 months, there was no effect on stress, morning or evening cortisol, or cortisol slope (all $p > 0.05$). A significant reduction in average cortisol, based on samples collected 45 min after waking and at 8 pm at night, was reported ($p < 0.05$).

Interventions demonstrating no effects for stress and/or anxiety

Five studies reported no effects for stress and/or anxiety. These interventions may have demonstrated beneficial effects for other outcomes (Table 1) but as stress and anxiety are the outcomes of interest in the current review, these interventions are categorised as having no effect here. No studies reported negative effects of the interventions however. Four of these interventions were delivered in the prenatal period and one was delivered in the postpartum period.

One study examined the effects of a CBT intervention for pregnant women at risk for developing stress, anxiety and/or depression, on state and trait anxiety up to 4 months postpartum [45]. The intervention was delivered in the late 1st and early 2nd trimester. At 4 months postpartum there was no effect for anxiety ($p > 0.05$), as measured by the STAI, in comparison to a control group who were provided with verbal and written information on perinatal mental health [45]. A second study examined effects of an adapted cognitive behavioural intervention for women experiencing elevated levels of anxiety or depression at approximately 16 weeks gestation [46,47]. This study reported no effect for anxiety, measured using the STAI, at approximately 24 weeks gestation ($p = 0.25$) or up to 3 months postpartum ($p = 0.53$) in comparison to usual care received by women with elevated anxiety or depression [46]. There was no effect for anxiety sensitivity, using the anxiety sensitivity scale, at approximately 24 weeks gestation ($p = 0.41$) or up to 3 months postpartum ($p = 0.14$). A third CBT-focused study examined effects of a cognitive behavioural stress management (CBSM) intervention for low-income women up to 3 months postpartum, in comparison to a control condition involving care as usual and Information on locally available social services. A significant effect was observed for perceived stress, using the PSS, ($p < 0.05$) and diurnal cortisol slope ($p < 0.05$). Intervention condition participants with high baseline anxiety demonstrated steeper decreases than low anxiety participants ($p < 0.05$). There was no effect for area under the curve (AUC; $p = 0.31$) or the CAR ($p = 0.07$) but non-Latina intervention participants demonstrated greater CAR decline than non-Latina controls ($p < 0.05$). The final prenatal study examined effects of a mindfulness-based intervention in a general population of pregnant women, compared to a control condition involving activities such as identification of stressors and strengths (see Table 2) [52]. Six weeks following intervention cessation, at 30–36 weeks gestation, there was a non-significant effect for stress measured using the PSS ($p = 0.82$ $d = 0.15$) [52].

The postpartum study examined an intervention for mothers of very low birth weight infants in comparison to a control condition involving information provision and contacts with a 'care convener' [51]. The intervention was delivered when the child was a mean age of 33 days, and provided information on recognising and utilising strategies for managing one's own anxiety and information on recognising and responding to the infant's cues. At 6–8 weeks corrected infant age, there were no effects of the intervention for stress related to infant behaviour or appearance ($p = 0.14$) or parent role restriction ($p = 0.76$); these were assessed using the Parental Stressor Scale: Neonatal Intensive Care Unit [57]. There was also no effect for anxiety measured by the STAI ($p = 0.28$) or post-traumatic stress disorder (PTSD) measured by the Perinatal PTSD Questionnaire ($p = 0.54$).

Theory use in interventions

Nine studies explicitly reported using theory to inform the intervention. Of the seven studies [40,45–47,50,51,53] not explicitly reporting using theory, interventions such as those based on CBT [40,45–47] and HRV biofeedback [44], are derived from theory based approaches. Reported theories and models varied between interventions and no theories or models were used in multiple interventions; all reported theories and models were used in one intervention only (See Table 2). Reported theories included the co-emergence model of behaviour reinforcement [58]; mindfulness-based cognitive behavioural model; the Ecological Stress Theoretical Framework [59,60]; Social Learning Theory [61], Lewinsohn's approach to mood management [62]; and attachment theory [63].

Discussion

This review identified 15 interventions, in 16 studies, developed to reduce or prevent stress and/or anxiety during the first 1000 days. Three main findings emerged from the current review. Firstly, findings were inconsistent, with most studies at high risk of bias and just one intervention reducing stress and anxiety in both periods. Secondly, interventions were highly heterogeneous with variation in intervention type, timing of delivery, target populations, and outcome measures. Thirdly, the majority of interventions were delivered prenatally and/or to vulnerable populations, with few delivered postnatally or to male partners, and none for same sex partners.

Intervention effects

Intervention outcomes were inconsistent overall, with effects differing for different intervention types. The most commonly used intervention approach in reviewed studies was CBT. While the current review found insufficient support for CBT interventions to reduce parental stress or anxiety overall, one online cognitive behavioural intervention that was adapted for use in the prenatal and postpartum periods demonstrated reductions in anxiety and distress. This highlights some potential usefulness for online CBT tailored for use across the first 1000 days and previous reviews have identified CBT-based interventions as effective treatments for perinatal distress [34,35]. Recent reviews have also highlighted some beneficial effects of mindfulness during the perinatal period [64] but the current review does not provide support for effects on stress and anxiety in the first 1000 days. This discrepancy may be due to a broader range of interventions (i.e. those not explicitly

designed for stress and/or anxiety) and time-periods (i.e. prenatal or postpartum only) included in previous reviews. This review included only those interventions specifically developed to reduce or prevent stress and/or anxiety and so additional components included in broader mindfulness or CBT interventions may have contributed to previously observed effects. Psychoeducation was included in all reviewed interventions, which is unsurprising as there is consistent evidence that parents want clear, consistent information about aspects of their pregnancy and early parenting [65–67]. The importance of psychoeducation for stress and anxiety prevention/reduction has previously also been noted [31,36,68]. Findings of the current review further support the importance of psychoeducation in that studies utilising active control conditions, particularly those based on information provision, were more likely to report no effect [45,51,52].

Methodological considerations of reviewed studies

A number of methodological issues may influence observed findings of the current review. For instance, use of appropriate theory is essential to guide development of appropriate and effective interventions [68] but few interventions in the current review explicitly reported being based on theory; some interventions were based on theoretical approaches such as CBT. Social-ecological approaches to stress, as included in one reviewed study [41], provide useful approaches to understand and target stress and anxiety at multiple levels across the first 1000 days. Greater consideration and inclusion of appropriate theoretical underpinnings for future interventions is needed. High risk of bias in the majority of reviewed studies, and low quality of examined outcomes across trials, is also problematic in the current review. For instance, the use of small sample sizes, lack of trial protocols or pre-registration, and poor reporting of confidence intervals and effect sizes limit confidence in observed findings. Further, variability across studies in conceptualisations and definitions of stress and anxiety potentially impacts intervention development and outcome measurement.

Timing of outcome measurement is also problematic in some studies because varying times of outcome assessment can introduce variability in intervention outcomes [3]. In addition, few studies examined effects of interventions on potential mediators or mechanisms of change. While this may be due to small sample sizes limiting statistical power, it limits conclusions that can be made about direct or indirect effects of interventions. Similarly, timing of intervention delivery is an important consideration in evaluation and interpretation of intervention effects. The majority of interventions included in the current review were delivered in the prenatal period. Considerably fewer interventions were delivered in the post-partum period, or across the first 1000 days. Prenatal and post-partum stress and anxiety can differ in terms of antecedents and potential outcomes [69]. As the expected mechanisms underlying treatment effects are likely to differ between pregnancy and postpartum, it is logical that separate interventions are developed for each period. However, as the first 1000 days represents a potentially stressful transitional period with stress and anxiety during pregnancy influencing experiences in the postpartum [70], provision of supports across this period is appropriate and necessary. In the current review, the only intervention adapted for both the prenatal and postnatal periods [40,43] demonstrated reductions in anxiety and distress in both periods. This represents a beneficial tailored approach across the first 1000 days that should be considered in future research.

Study populations included in reviewed studies

The study populations included in the reviewed studies can also influence likelihood of effects and the majority of women and their partners in the current review were at increased risk of adverse mental health outcomes. Previous reviews have reported greater benefits for treatment than preventive interventions [34]. Inclusion of participants experiencing, or at risk for, psychological distress may increase the likelihood of detecting intervention effects; particularly as large sample sizes are needed to detect changes in stress and anxiety symptoms in general populations for which baseline levels are not elevated. In line with this, interventions conducted with general pregnant populations in the current review demonstrated inconsistent findings [53–55]. As such the findings of the current review are more applicable to women at high-risk of mental health issues, limiting generalizability to women at low risk. It is important to note however that general populations may include individuals with stress and anxiety symptoms that could become exacerbated as pregnancy progresses and/or in early parenthood due to the stressful transitional nature of this period [23,24]. Robust longitudinal examinations of interventions that provide skills to manage stress and anxiety across the first 1000 days are needed to better determine effects of preventive, in addition to reduction-focused, interventions.

Inclusion of partners in future stress and/or anxiety reduction interventions in the first 1000 days should also be considered. Though fathers tend to report lower stress and anxiety than mothers [20], paternal stress is associated with maternal stress [27], perceived social support [24], and child development [71]. Only two reviewed interventions included fathers, and these were delivered postpartum to fathers of preterm infants with inconsistent effects [49,50]. This review cannot therefore provide support for interventions for fathers in the first 1000 days. Future interventions including fathers are needed to investigate potential direct and indirect effects via mechanisms, such as social support, for parents and children.

Limitations of the review

The inclusion criteria used in the current review was designed to identify interventions developed specifically to reduce or prevent stress and/or anxiety. Therefore, not all interventions that have been *used* to reduce or prevent stress and/or depression have been included. However, the findings highlight the limited number of interventions that are explicitly stress and/or anxiety focused. A range of diverse intervention types and populations were included in the identified papers, which limited evidence synthesis. However, it appears that evidence for effective interventions that are appropriate for use with both men and women across the first 1000 days is scant.

Conclusion

The findings of the current review highlight insufficient evidence for the effectiveness of stress and anxiety interventions for women and their partners from conception to two years postpartum. Future interventions should include psychoeducation and may benefit from inclusion of partners, though evidence from this review is limited. Further research on preventive interventions may also be useful as this review provides more evidence for intervention effects in vulnerable populations. While stress and anxiety prevention and reduction should not be a 'one-size fits-all' approach, the prevalence of stress and anxiety for mothers and fathers across the first 1000 days warrants a reappraisal of for whom stress and anxiety interventions and approaches are developed and implemented. Evidence from this review indicates that interventions in both prenatal and postpartum periods may result in reductions in stress and anxiety; with evidence from one study highlighting benefits of tailoring interventions across these periods [40,43]. Development and methodologically robust

examination of interventions specifically targeting stress and anxiety for use across, or tailored to, the prenatal and postnatal periods is essential.

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Ethical statement

This manuscript reports a systematic review of previously published studies. As such, an ethical statement is not applicable.

Conflicts of interest

Karen Matvienko-Sikar, Caragh Flannery, Sarah Redsell, Catherine Hayes, Anja Huizink and Patricia M Kearney declare that they have no

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.wombi.2020.02.010.

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