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Prenatal Anxiety and Infant Feeding Outcomes: A Systematic Review

Victoria Fallon, BSc[1], Kate Mary Bennett, PhD[1], and Joanne Alison Harrold, PhD[1]

Abstract

Prenatal anxiety may negatively affect infant health in multiple domains, including infant feeding. However, the relationship between prenatal anxiety and infant feeding is not well understood. Given the benefits of recommended infant feeding practices, clarifying this relationship is important. This review was conducted to examine the relationship between prenatal anxiety and infant feeding outcomes. Electronic searches were performed in relevant databases. A hand search of selected journals and reference lists of included articles was then conducted. All studies were considered that provided information related to infant feeding outcomes and anxiety during pregnancy. Quality assessment and data extraction were conducted by 2 reviewers; 99 studies were identified, of which 6 were eligible. No associations were found between prenatal anxiety and breastfeeding initiation or breastfeeding in any quantity. However, relationships between high levels of prenatal anxiety and a reduction in both breastfeeding intention and breastfeeding exclusivity were identified. The review was limited by the small number of studies included. Sample sizes lacking power and heterogeneous measures and definitions all significantly affected the comparability of findings. It is concluded that there is insufficient evidence to clarify the relationship between prenatal anxiety and infant feeding outcomes.

Keywords

breastfeeding, formula feeding, infant feeding, pregnancy, prenatal anxiety

Background

Pregnancy has frequently been described as a time of emotional well-being for prospective mothers,[1] but for some women, the prenatal period can lead to elevated levels of distress and an impaired quality of life.[2] Novel concerns arise during this period, primarily surrounding the health of the individual and her unborn child.[3,4] Changes in lifestyle, relationships, and appearance may also elicit unwelcome apprehension in this population.[5,6] Although many women are able to manage these additional stressors effectively, some are susceptible to heightened levels of anxiety.

Since the pregnant woman is the sole environment for the developing fetus, psychological alterations during pregnancy may uniquely affect infant outcomes.[6] A 2005 review of the literature presents evidence spanning 2 decades that consistently reports associations between prenatal anxiety and adverse pregnancy outcomes.[7] More recent, a number of prospective studies have observed a relationship between prenatal anxiety and more distal cognitive, behavioral, and emotional problems in the infant or child after controlling for established confounders.[8-15] These include a difficult infant temperament,[10] negative behavioral reactivity,[9] and irregular sleeping patterns[15]—all particularly pertinent factors given their relationship with breastfeeding.[16-18] There is increasingly robust evidence to support the enduring effects of prenatal anxiety on aspects of infant development, although the notion of anxiogenic fetal programming within the context of infant feeding remains unclear.

To highlight the biologically plausible relationship between prenatal anxiety and infant feeding,[19,20] the multifaceted nature of anxiety must first be taken into account. As defined by Spielberger et al,[21] anxiety refers to an unpleasant emotional state or condition. Spielberger and others have further described different components of anxiety, which include an individual's dispositional proneness to anxiety or *trait anxiety*, and a more acute emotional arousal in response to a perceived stressful, dangerous, or threatening situation—*state anxiety*.[22] Prenatal anxiety is highly correlated with anxiety symptoms in the postpartum period.[23] The enduring nature of trait anxiety may interfere with the release of oxytocin; a hormone that

[1]University of Liverpool, Liverpool, UK

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Corresponding Author:
Victoria Fallon, BSc, Institute of Psychology, Health and Society, University of Liverpool, Eleanor Rathbone Building, Bedford Street South, Liverpool, L69 7ZA, UK.
Email: vfallon@liverpool.ac.uk

stimulates the milk-ejection reflex.[20] Repeated inhibition of this reflex renders women physiologically less capable of producing breast milk.[19] Furthermore, acute emotional stress (ie, state anxiety) is known to produce elevated levels of cortisol and glucose, which have been implicated in delaying breast fullness and decreasing milk volume in the immediate postpartum.[24] More recently, a body of literature has identified a third component of anxiety that is embedded in concerns among pregnant women in the context of their pregnancies.[25] Pregnancy-specific anxiety is akin to state anxiety and may undermine breastfeeding via similar physiological mechanisms. However, psychometric studies have revealed that this type of anxiety predicts perinatal outcomes more effectively than general measures of anxiety and therefore may be a more useful method of measurement within the context of infant feeding.[4,26]

Despite these associations, methodological limitations have delayed a clear understanding of the relationship between prenatal anxiety and infant feeding. Inconsistencies in definitions of anxiety plague the literature, and high comorbidity with prenatal depression generates further uncertainty.[2] These ambiguities are mirrored in prevalence studies of prenatal anxiety with incongruent frequencies ranging between 6% and 54%.[2,27-30] However, the Cochrane Pregnancy and Childbirth Group maintains that prenatal anxiety remains under-researched irrespective of evidence suggesting that its subclinical form is highly prevalent and more frequent than depression in all trimesters of pregnancy.[30] Given the widely researched and well-established benefits of recommended infant feeding practices, clarifying this relationship is necessary for all those working toward improving maternal and child health outcomes.

To date, research interest has focused instead on the apparent changes in mental health following delivery, rather than on psychological states during pregnancy.[6] Comparably, the majority of research on the relationship between maternal mental health and infant feeding has been driven by postpartum depression. Prenatal anxiety is known to be a robust predictor of postpartum depression,[2,7] which was systematically reviewed by Dennis and McQueen[31] as an established indicator of infant feeding outcomes. Their narrative synthesis found that women with depressive symptoms may be at increased risk of negative infant feeding outcomes, with heightened susceptibility to decreased breastfeeding initiation, duration, and self-efficacy. However, no such summary of the literature concerning prenatal anxiety and infant feeding outcomes has been completed. Current UK policies recommend exclusive breastfeeding for the first 6 months of life, yet less than 1% of mothers adhere to these guidelines.[32] A better understanding of potentially modifiable psychological factors and their effect on infant feeding could lead to clinical and policy changes, which may help to improve this statistic. This review will draw on similar techniques used effectively by Dennis and McQueen to provide a comprehensive overview of the literature while acknowledging the existing heterogeneity in methodologies, measures, and analyses.

Methods

Eligibility Criteria

Published and unpublished studies were considered provided they detailed information specifically related to intended or actual infant feeding practices and examined anxiety during pregnancy. The operational definition of prenatal anxiety used in this review was any subclinical, self-reported symptoms of anxiety or clinical diagnosis of an anxiety disorder occurring at any point during the gestational period. This definition allowed identification of studies that assessed anxiety in pregnancy using both general and pregnancy-specific measures. Studies that focused on women with anxiety symptoms (subclinical or clinical) that were identified prepregnancy were not deemed eligible. Other mental health conditions occurring during and/or after pregnancy (ie, postnatal anxiety, prenatal or postnatal depression, postpartum blues, and puerperal psychosis) were also ineligible. However, due to well-established high comorbidity rates with depression and a lack of studies focusing solely on prenatal anxiety, studies that focused on prenatal depression were examined if the measures used contain an anxiety subscale with analyses reported separately. Studies that incorporated measures of postpartum anxiety were examined if prenatal anxiety was also assessed. However, studies that focused on anxiety experienced during labor or delivery were excluded due to the unique situational anxieties experienced by women when giving birth.[33] Studies that assessed labor anxiety during pregnancy were, however, eligible for inclusion as this is a previously validated dimension of pregnancy-specific anxiety.[34] Samples that included both primiparous and multiparous participants and failed to adjust their analyses for parity were not deemed eligible for inclusion. Between-group differences in anxiety levels[35-39] and lactation[40-43] are prevalent in the literature and parity was consequently expected to confound results. Table 1 provides a summary of inclusion/exclusion criteria. It is recognized that there are other sociocultural confounders that have been shown to affect prenatal anxiety and infant feeding. However, these do not appear to be as closely associated with both variables of interest. Furthermore, the exclusion of all potential determinants is deemed overly rigorous and may limit findings within an already sparse research area. Instead, a discussion of those relevant to the review will be provided. For the purpose of this review, breastfeeding was defined as any intended, current, or previous breastfeeding behavior at any intensity (ie, exclusive, partial, any). No language restrictions were placed on eligibility of studies. A full copy of the review protocol can be accessed by emailing the authors.

Table 1. Inclusion and Exclusion Criteria.

Inclusion Criteria
• Published or unpublished literature
• Subclinical, self-reported symptoms or clinical diagnosis of anxiety occurring during pregnancy
• General (state-trait) and pregnancy-specific measures of anxiety
• Studies examining prenatal depression that use an anxiety subscale and report analyses for anxiety separately
• Postpartum anxiety if prenatal anxiety was also assessed
• Anxieties about labor or delivery during pregnancy
Exclusion Criteria
• Historical literature
• Subclinical or clinical diagnosis of anxiety occurring prepregnancy
• Other mental health conditions occurring during/after pregnancy
• Anxiety experienced during labor or delivery
• Primiparous and multiparous women with no statistical adjustment for parity

Information Sources

The research team sought to systematically review both published and unpublished articles, reviews, and doctoral theses targeting academic research, conference proceedings, and local and central government studies. The information sources were broad to ensure that as many studies as possible were assessed for their relevance. The initial search strategy was limited to the inception year of each database to March 2014. Databases searched were MEDLINE (1966-2014), Global Health (1910-2014), Cumulative Index to Nursing and Allied Health Literature (CINAHL) (1982-2014), PsycInfo (1887-2014), PsycArticles (varies by title), ProQuest (varies by database), AMED (1985-2014), Cochrane Library (varies by database), Scopus (1823-current), and Google Scholar (varies by title). Keywords used in various combinations included *prenatal anxiety*, *antenatal anxiety*, *maternal anxiety*, *pregnancy specific anxiety*, *breastfeeding*, *infant feeding*, *formula feeding*, and *bottle feeding*. Boolean operators were used to combine the keywords and truncation was applied to retrieve variants of the search terms. Controlled vocabulary (MeSH) was used to search the MEDLINE database. An example of a full electronic search strategy can be found in Appendix 1, available online. Tables of contents for key journals were hand searched from 2011 to 2014. A manual search of reference lists of included articles was then conducted followed by correspondence with experts in the field to identify data sources not yet found through previous methods. No limits were applied to sources identified through manual searching.

Study Selection

A 3-stage screening process was used. Titles were initially assessed and any articles that were evidently unsuitable were excluded at this early stage. The remaining abstracts were then screened and excluded where appropriate. The full text of each eligible article was then read by 2 authors (V.F. and J.A.H.) in its entirety to determine inclusion in the systematic review.

Data Extraction

For eligible studies, 2 review authors (V.F. and J.A.H.) independently extracted data. Discrepancies were resolved by discussion or, if required, K.M.B. was consulted. For each included study, information collected included study design, participants (sample size and characteristics), measures taken, and results. Correspondence with relevant authors was then conducted to identify/confirm any necessary data. The Newcastle-Ottawa Quality Assessment Scale was then completed independently for each included study by V.F. and J.A.H. to aid methodological discussion. This is a risk of bias assessment tool that is recommended by the Cochrane Collaboration to assess the quality of observational studies in a systematic review.[44] The scale has established content validity and inter-rater reliability based on previous applications in women's health studies.[45]

Results

The search strategy identified 99 studies, of which 6 presented information specifically related to prenatal anxiety and infant feeding outcomes (Table 2).[20,46-50] Studies included were published between 1989 and 2014 with sample sizes ranging from 88 to 1436 (N = 3185) from the United Kingdom, United States, and Canada. Due to the heterogeneity of both outcome variables and methodologies in the studies included, a meta-analysis was not deemed appropriate. Instead, data were narratively synthesized according to infant feeding outcome: breastfeeding intention, breastfeeding initiation, exclusive breastfeeding, and any breastfeeding activity.

Table 2. Studies Included That Examined the Relationship between Prenatal Anxiety and Infant Feeding Outcomes.

Principal Outcome	Authors	Study Design	Sample	PA Outcome	Infant Feeding Outcome	Summary of Results	Methodological Comment
PA and breastfeeding intention							
	Fairlee et al (2009)[49]	Prospective cohort study using an anxiety questionnaire in early pregnancy and a written infant feeding question in the second trimester of pregnancy	2670 pregnant US women recruited from 8 obstetric offices in Eastern Massachusetts as part of a larger prospective study; 1436 women analyzed	7 questions from the 10-item PSAS were used in the first trimester of pregnancy—mean gestational age of administration 10.4 weeks; high pregnancy-related anxiety was defined as "very much" responses to 3 or more questions	Intention to breastfeed ascertained via written question between 26 and 28 weeks gestation; asked if intention was to feed infant "breast milk only, mostly breast milk, some breast milk, formula only, or uncertain"; only or mostly breast milk categorized as "planned to breastfeed," and those who indicated mostly or exclusively formula categorized as "planned to formula feed"	Women with high pregnancy-related anxiety were more likely to plan to formula feed prenatally than those with low-moderate anxiety	Health care setting highly supportive of breastfeeding; mainly Caucasian, well-educated sample—more likely to intend to breastfeed; high attrition rate (33% lost to follow up); range of confounders accounted for; anxiety measure did not use full scale; study relied on cross-sectional data to examine anxiety and feeding intention in the second trimester of pregnancy so unable to assess if this changed throughout the remainder of the pregnancy; imprecise definition of breastfeeding and formula feeding
	Insaf et al (2011)[50]	Prospective cohort study using anxiety questionnaires administered at 2 time points in pregnancy and infant feeding medical record abstraction at delivery	424 Hispanic women from statewide obstetric practices in Western Massachusetts as part of a larger ongoing prospective study	STAI used to assess trait anxiety at baseline (mean 13.6 weeks gestation) and re-administered in mid-pregnancy to assess state anxiety (taken at either 24 weeks gestation or 28 weeks gestation, if women attended both times; mean scores were used so all women had 1 mid-pregnancy score)	Prenatal breastfeeding intention was abstracted from medical records before or immediately after delivery; categorized as intending to breastfeed if they reported exclusive or mixed feeding intentions; categorized as formula feeding only if intending to exclusively formula feed	Women in the highest quartile of both trait and state anxiety were less likely to intend to breastfeed compared to women in the lowest quartile	Comparable anxiety and breastfeeding intention levels to other studies; examined anxiety at 2 pregnancy time points; comprehensive range of confounders accounted for; imprecise definition of breastfeeding; self-report measures of anxiety; minority women of low SES susceptible to social desirability; sole outcome was prenatal intention; unable to predict whether women with breastfeeding intent will initiate and continue breastfeeding after delivery

(continued)

Table 2. (continued)

Principal Outcome	Authors	Study Design	Sample	PA Outcome	Infant Feeding Outcome	Summary of Results	Methodological Comment
PA and breastfeeding initiation							
	Adedinsewo et al (2014)[20]	Prospective cohort study using anxiety questionnaires at 2 time points in pregnancy and self-report breastfeeding questions at 3, 6, or 12 months postpartum	306 pregnant Canadian women recruited from maternity hospitals in Hamilton; 255 women analyzed	STAI and HAM-A; data collection occurred twice during pregnancy; 18-23 weeks gestation and 24-26 weeks gestation for HAM-A and once at 18-23 weeks for STAI; analyzed as continuous variables	Self-report question administered at 3 months postpartum; women provided with the option of responding that they never breastfed or provided breast milk for their baby	94.2% of women initiated breastfeeding, meaning there was insufficient variance in initiation of breastfeeding to assess differences across anxiety measures	Included women from sociodemographically disadvantaged populations and women who screened positively for antenatal anxiety; procedures in place to minimize recall and reporting errors; small sample with potentially insufficient power; 51 women lost to follow up; imprecise definition of breastfeeding; did not use clinical cutoffs for anxiety measures
	Fairlee et al (2009)[49]	Prospective cohort study using an anxiety questionnaire in early pregnancy and an infant feeding postdelivery interview	2670 pregnant US women recruited from 8 obstetric offices in Eastern Massachusetts as part of a larger prospective study; 1436 women analyzed	7 questions from the 10-item PSAS were used in the first trimester of pregnancy—mean gestational age of administration 10.4 weeks; high pregnancy-related anxiety was defined as "very much" responses to 3 or more questions	Postdelivery interviews asked, "Have you breastfed your baby? By breastfeeding, we mean that you have put your baby to the breast whether or not your baby actually received breast milk, or that you have fed your baby your breast milk." Failure to initiate was defined as a response of "no."	Women with high pregnancy-related anxiety were no more likely to initiate breastfeeding than women with low to moderate pregnancy-related anxiety	Unusually high prevalence of breastfeeding initiation; imprecise definition of breastfeeding; outcome measure does not provide proof of actual transfer of milk from mother to infant; high attrition rate (33% lost to follow up); range of confounders accounted for; self-report anxiety measure although bias precautions were taken; anxiety measure did not use full scale

(continued)

Table 2. (continued)

Principal Outcome	Authors	Study Design	Sample	PA Outcome	Infant Feeding Outcome	Summary of Results	Methodological Comment
	Mehta et al (2011)[47]	Prospective cohort study using anxiety questionnaires at 2 time points in pregnancy and infant feeding interview at 3 months postpartum	688 pregnant US women recruited from University of North Carolina hospitals as part of a larger ongoing prospective study; 1169 women originally recruited, 480 excluded or refused; analyzed 546 due to missing data	State dimension of STAI taken at 15-20 weeks gestation and 24-29 weeks gestation; analyzed as categorical variable with 3 levels	Breastfeeding initiation was assessed at 3 months postpartum with the question, "Did you ever breastfeed this baby?"	State anxiety was not related to breastfeeding initiation at either of the measured time points	One component of a wider mediation analysis assessing pregravid BMI and psychological factors on infant feeding behaviors; the 480 women lost to follow up had significantly higher levels of anxiety; anxiety measures used could not clinically diagnose and therefore may not be sensitive enough; range of confounders accounted for.
	Sherr (1989), doctoral thesis[46]	Prospective cohort study using an anxiety questionnaire at 38 weeks gestation and infant feeding hospital follow-up interview 48 hours after delivery	88 primiparous UK women of at least 38 weeks gestation from 2 hospitals (N = 44 from each hospital)	STAI at 38 weeks gestation; analyzed as a linear variable	Whether mothers chose to initiate breast or formula feeding; ascertained via single question in hospital interview within 48 hours of delivery	Neither state or trait anxiety was significantly different in breastfeeding and formula-feeding mothers	Small sample size; no definition of breastfeeding; unequal feeding groups; anxiety grouping method did not use full sample; no confounders or effect modifiers accounted for; potentially inadequate follow-up period; no depression measure taken
PA and exclusive breastfeeding							
	Adedinsewo et al (2014)[20]	Prospective cohort study using anxiety questionnaires at 2 time points in pregnancy and self-report breastfeeding questions at 3 and 6 months postpartum	306 pregnant Canadian women recruited from maternity hospitals in Hamilton; 255 women analyzed	STAI and HAM-A; data collection occurred twice during pregnancy; 18-23 weeks gestation and 24-26 weeks gestation for HAM-A and once at 18-23 weeks for STAI; analyzed as continuous variables	Self-report question at 3 and 6 months postpartum asking the age of the baby (in weeks) when she or he was fed for the first time with something other than breast milk; variable dichotomized at each time point	STAI and HAM-A anxiety scores were not associated with exclusive breastfeeding at either time point	Included women from sociodemographically disadvantaged populations and women who screened positively for antenatal anxiety; procedures in place to minimize recall and reporting errors; small sample with potentially insufficient power; 51 women lost to follow up; imprecise definition of breastfeeding; did not use clinical cutoffs for anxiety measures

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Table 2. (continued)

Principal Outcome	Authors	Study Design	Sample	PA Outcome	Infant Feeding Outcome	Summary of Results	Methodological Comment
	Mehta et al (2012)[48]	Prospective cohort study using anxiety questionnaire in mid-pregnancy and infant feeding interview at 3 and 12 months postpartum	688 pregnant US women recruited from University of North Carolina hospitals as part of a larger ongoing prospective study; 1169 women originally recruited, 480 excluded or refused; analyzed 436 due to missing data	State dimension of STAI at 24-29 weeks gestation; analyzed as categorical variable with 3 levels	Exclusive breastfeeding duration was collected at infant feeding interviews at 3 and 12 months postpartum; calculated by comparing duration with the age of introduction of formula and complementary foods; for each postpartum month, women reported breast milk, breast milk substitutes, and other foods; analyzed as categorical variable with 3 levels	High anxiety during pregnancy was associated with exclusive breastfeeding duration of < 1 month but not 1 to < 4 months	One component of a wider mediation analysis assessing pregravid BMI and psychological factors on infant feeding behaviors; World Health Organization definition of breastfeeding applied; women who did not initiate included in analysis; study population different from the US population as breastfeeding initiation and exclusive duration rates were much higher; the 480 women lost to follow up had significantly higher levels of anxiety and possessed other factors predictive of breastfeeding; inability to examine potential effect measure modification by race due to small sample size; anxiety measures used could not clinically diagnose and therefore may not be sensitive enough
PA and any breastfeeding							
	Adedinsewo et al (2014)[20]	Prospective cohort study using anxiety questionnaires at 2 time points in pregnancy and self-report breastfeeding questions at 3, 6, and 12 months postpartum	306 pregnant Canadian women recruited from maternity hospitals in Hamilton; 255 women analyzed	STAI and HAM-A; data collection occurred twice during pregnancy; 18-23 weeks gestation and 24-26 weeks gestation for HAM-A and once at 18-23 weeks for STAI; analyzed as continuous variables	Self-report question at 3, 6, and 12 months postpartum; asked the age of the baby (in weeks) when mothers stopped giving breast milk	No associations were found between STAI and HAM-A scores and any breastfeeding at 3, 6, or 12 months	Included women from sociodemographically disadvantaged populations and women who screened positively for antenatal anxiety; procedures in place to minimize recall and reporting errors; small sample with potentially insufficient power; 51 women lost to follow up; imprecise definition of breastfeeding; did not use clinical cutoffs for anxiety measures

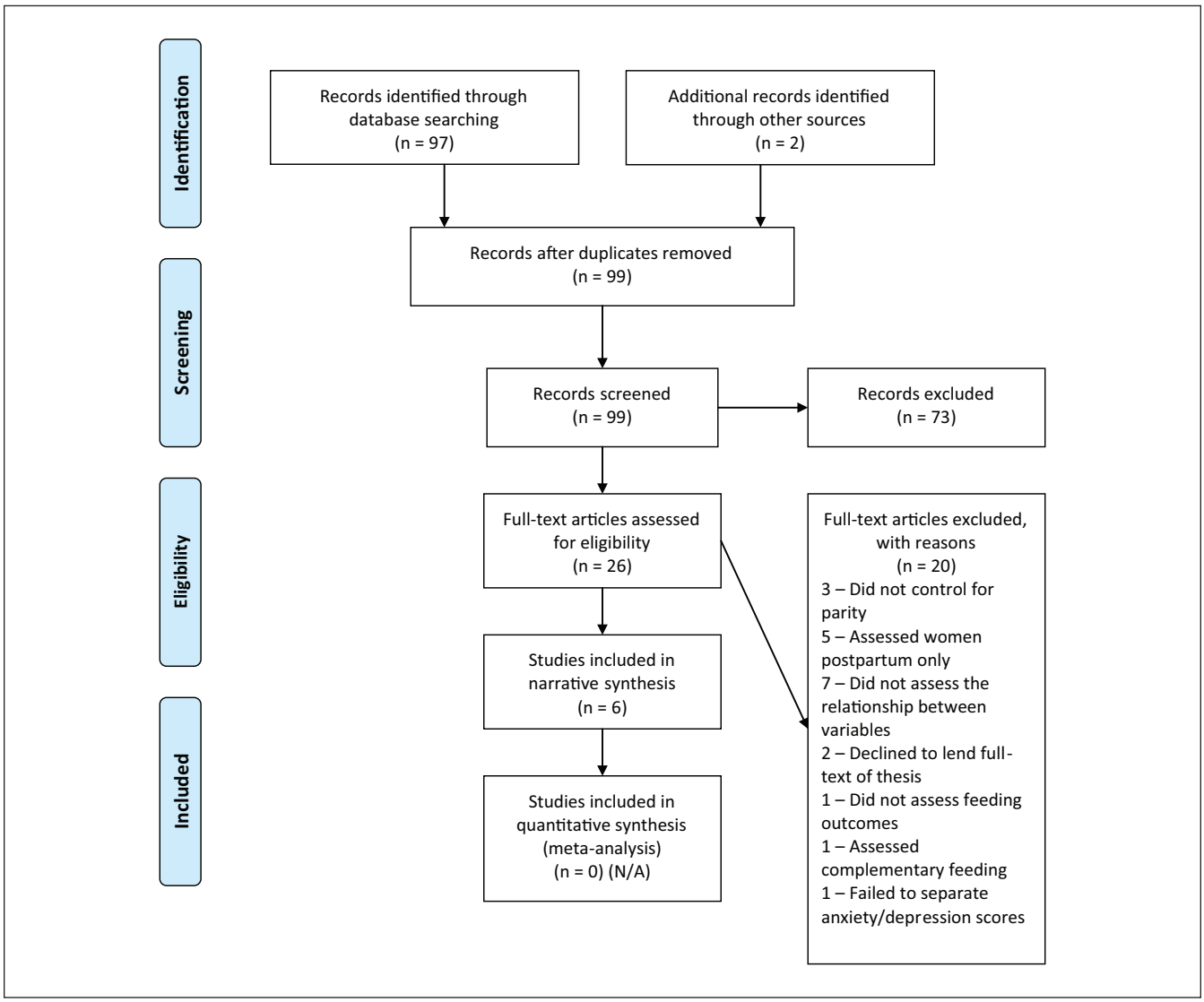
(continued)

Table 2. (continued)

Principal Outcome	Authors	Study Design	Sample	PA Outcome	Infant Feeding Outcome	Summary of Results	Methodological Comment
	Mehta et al (2012)[48]	Prospective cohort study using anxiety questionnaire in mid-pregnancy and infant feeding interview at 3 and 12 months postpartum	688 pregnant US women recruited from University of North Carolina hospitals as part of a larger ongoing prospective study; 1169 women originally recruited, 480 excluded or refused; analyzed 470 due to missing data	State dimension of STAI at 24-29 weeks gestation; analyzed as categorical variable with 3 levels	Any breastfeeding duration was collected at 3, 12, and 36 month infant feeding interviews; if women reported having stopped breastfeeding at any interview, they were asked how old the infant was when they stopped (reported in days/weeks/months); categorized as < 4 months, 4-7 months, 7-12 months, and < 12 months; included exclusive breastfeeding as well as mixed feeding with formula or complementary foods	STAI scores were not associated with any breastfeeding duration at any of the categorized time periods (< 4 months, 4-6 months, and 7-12 months)	One component of a wider mediation analysis assessing pregravid BMI and psychological factors on infant feeding behaviors; imprecise definition of breastfeeding; women who did not initiate included in analysis; study population different from the US population as breastfeeding initiation rates were much higher

Abbreviations: BMI, body mass index; HAM-A, Hamilton Anxiety Scale; PA, prenatal anxiety; PSAS, Pregnancy Specific Anxiety Scale; SES, socioeconomic status; STAI, State Trait Anxiety Inventory.

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



Prenatal Anxiety and Breastfeeding Intention

Two US studies[49,50] with samples drawn from highly dissimilar populations examined the relationship between levels of prenatal anxiety and prospective mothers' intention to breastfeed their baby in pregnancy. Insaf et al[50] used the State Trait Anxiety Inventory (STAI) to assess trait anxiety at 13 weeks gestation and state anxiety in mid-pregnancy (24-28 weeks) in a subgroup of 424 Hispanic women identified as high risk for perinatal mood and anxiety disorders. Breastfeeding intention was extracted from medical records before or immediately after delivery. A complete case method was used to extract prevalence risk ratios (PRRs) and 95% confidence intervals (CIs). In age adjusted analyses, women in the highest quartile of trait anxiety in early pregnancy were 34% less likely to breastfeed than women in the lowest quartile (PRR, 0.66; 95% CI, 0.54-0.80; $P < .001$). Findings were marginally significant for high levels of state anxiety in mid-pregnancy (PRR, 0.81; 95% CI, 0.65-1.00; $P = .05$). In final adjusted models, these findings were virtually unchanged. This study benefited from examination of self-report anxiety levels at 2 separate time points in pregnancy, although susceptibility to social desirability is increased within vulnerable populations.[51]

In a US study, Fairlee and colleagues[49] administered the Pregnancy Specific Anxiety Scale (PSAS) to 1436 women (mainly Caucasian, high socioeconomic status) in the first trimester of pregnancy. In the second trimester, mothers were then asked to report whether they intended to use all or mostly formula or breast milk in the first week postpartum. In unadjusted analyses, women with high pregnancy-related anxiety were no more likely to plan to formula feed

prenatally than those with low to moderate anxiety (odds ratio [OR], 1.40; 95% CI, 0.84-2.33). However, adjustment for education, household income, and prepregnancy body mass index (BMI) significantly increased the effect estimate (OR, 1.99; 95% CI, 1.12-3.54). Further adjustment for prenatal depression lowered this slightly (OR, 1.87; 95% CI, 1.04-3.34). Reliance on cross-sectional data in early pregnancy for the variables considered resulted in inability to assess if feeding intention changed throughout the course of pregnancy. In summary, both of these studies found that women with high levels of prenatal anxiety in early pregnancy were more likely to express intentions to formula feed after accounting for a range of established confounders. Significant results were observed in highly heterogeneous populations using both general[50] and pregnancy-specific anxiety measures.[49]

Prenatal Anxiety and Breastfeeding Initiation

Four studies[20,46,47,49] examined the relationship between prenatal anxiety and breastfeeding initiation. Fairlee et al[49] used the PSAS in the first trimester of pregnancy to prospectively follow 1436 women. The study had a low follow-up rate of 67% due to ineligibility or withdrawal. The outcome measure "failure to initiate breastfeeding" was ascertained in postdelivery interviews. After adjustment for multiple covariates, women with high prenatal anxiety were no more likely to initiate formula feeding than women with low-moderate anxiety (OR, 1.28; 95% CI, 0.74-2.20). These findings were paradoxical in relation to their formula-feeding intention results[49] and could be explained via a change in mood or intention that occurred since the single measurement taken in early pregnancy.

A small UK study[46] administered the STAI to 88 mothers at 38 weeks of pregnancy and found that there was no significant difference in state or trait anxiety between mothers who initiated breastfeeding and mothers who initiated formula feeding (State: $t = 0.70$, $P > .05$; Trait: $t = 0.18$, $P > .05$). The researcher's intended outcome of interest was infant feeding method; however, this was inappropriately measured via a single question assessing breastfeeding initiation within 48 hours of delivery. The small sample size coupled with unequal feeding groups (62 breastfeeders, 21 formula feeders) may have limited the parametric analysis, with insufficient power to detect an association. Furthermore, no confounders or effect modifiers were accounted for in the analysis. Mehta et al[47] also assessed the association between prenatal anxiety and breastfeeding initiation. Their regression analyses were part of a wider study assessing the effect of BMI in pregnancy on breastfeeding behaviors with anxiety, among other mental health indicators, as a potential mediator. The state dimension of the STAI was administered to 688 women at both 15-20 weeks gestation and 24-29 weeks gestation. Breastfeeding initiation was assessed at 3 months postpartum with the question, "Did you ever breastfeed this baby?" State anxiety did not predict breastfeeding initiation at either of the measured time points.

Finally, a Canadian-based research team assessed prenatal anxiety in 255 women, as measured by the Hamilton Anxiety Scale (HAM-A) and the STAI in mid-pregnancy.[20] Breastfeeding initiation data were established at 3 months postpartum with a single self-report question; 94.2% of women initiated breastfeeding, leaving insufficient variance to assess differences across anxiety indicators. This is a surprisingly high initiation rate given that oversampling for low-income women and women undergoing treatment for anxiety or depression was factored into their recruitment protocol.

In conclusion, 3 of the 4 studies found no relationship between prenatal anxiety and breastfeeding initiation.[46,47,49] The fourth study was unable to perform the proposed analysis due to disproportionate breastfeeding initiation data.[20] An unusually high breastfeeding initiation rate was observed in 2 of the studies.[20,49] Finally, the majority of studies used the STAI, yet the timing of anxiety measurements varied widely across samples.[20,46,47]

Prenatal Anxiety and Exclusive Breastfeeding

Two studies[20,48] assessed the association between prenatal anxiety and exclusive breastfeeding. Adedinsewo et al[20] compared HAM-A scores obtained twice in mid-pregnancy and a single STAI score taken at 18-23 weeks between mothers who were exclusively breastfeeding at both 3 and 6 months postnatally and mothers who were not. In crude analyses, mothers who were not exclusively breastfeeding their infants at 3 months had significantly higher HAM-A scores, indicating higher anxiety at both time points in pregnancy compared with those providing only breast milk (18-23 weeks: 7 vs 4, $P = .02$; 24-26 weeks: 7 vs 5, $P = .02$). However, exclusive breastfeeding at 3 months was not related to state or trait anxiety scores taken at 18-23 weeks prenatally. In adjusted multivariate models, no associations remained significant. Furthermore, neither crude nor adjusted analyses showed an association between prenatal anxiety scores and exclusive breastfeeding at 6 months postpartum. However, the small sample size (N = 255) may have had insufficient power to detect associations where they may have existed. Moreover, it may have contributed to the researchers using continuous anxiety scores with diagnostic measures, which limits clinical relevance, rather than categorizing them based on preferred clinical thresholds.

In Mehta et al's[48] study, 436 women completed STAI state anxiety scores at 27-30 weeks gestation. Exclusive breastfeeding status at < 1 month and 1 to < 4 months was ascertained via self-report at 3, 6, and 12 months postpartum. High state anxiety was predictive of an exclusive breastfeeding duration of < 1 month (OR, 1.90; 95% CI, 1.03-3.53) but not 1 to < 4 months (OR, 1.65; 95% CI, 0.91-2.96). This analysis was unique in that it included those who did not

initiate breastfeeding, therefore minimizing selection bias. However, the researchers were unable to examine potential effect measure modification by ethnicity due to their small and mainly Caucasian sample. The sample recruited also had much higher rates of exclusive breastfeeding duration (50% at 4 months and longer) than the US population (30.2% at 3 months) it was drawn from.

In summary, only 1 study found a relationship between high levels of prenatal anxiety and a reduction in exclusive breastfeeding in the early postpartum.[48] Both studies provided clear definitions of exclusive breastfeeding since birth and accounted for a range of confounders. Both studies used the STAI to examine anxiety, yet timings of measurements varied.[20,48] Similarly, timings of measurements for breastfeeding exclusivity varied, although both studies benefited from multiple postnatal assessments. Both studies were subject to high attrition rates and predominately Caucasian samples.

Prenatal Anxiety and Any Breastfeeding

Both studies examining prenatal anxiety in relation to exclusive breastfeeding also assessed the relationship between prenatal anxiety and breastfeeding in any quantity in the postnatal period. Adedinsewo et al[20] collected HAM-A scores and STAI scores from 255 women (as described above) in mid-pregnancy and collected breastfeeding data at 3, 6, and 12 months postpartum. A self-report question was used at each time point, querying the age of the baby (in weeks) when mothers stopped providing breast milk. In unadjusted analyses, no associations were found at 3 or 6 months; however, mothers who were not breastfeeding at 12 months postpartum had significantly higher levels of anxiety on both scales (HAM-A: 6 vs 4, $P = .02$; STAI State: 35 vs 28, $P = .03$; STAI Trait: 43 vs 38, $P = .01$) when compared to women who were still providing breast milk. In multivariate models, no associations remained significant. Again, the small sample size (N = 255) may have attenuated associations, especially when accounting for multiple covariates in adjusted models.

In Mehta et al's[48] study, state anxiety data collected in mid-pregnancy from a larger sample of 470 women were assessed against breastfeeding duration data collected at 3, 12, and 36 months postpartum. Duration of any breastfeeding ranged from 0 to 38.6 months with a median duration of 7.9 months. Any breastfeeding included exclusive breastfeeding as well as combination feeding with formula or complementary foods. State Trait Anxiety Inventory scores were not predictive of breastfeeding duration at any of the categorized time periods (< 4 months, 4-6 months, and 7-12 months). Again, this analysis included those who chose not to initiate breastfeeding, although a higher prevalence of breastfeeding when compared to national rates somewhat limits generalizability.

In conclusion, neither study found an association between prenatal anxiety and breastfeeding in any quantity.[20,48] Similarities and differences between studies were synonymous with those discussed in the previous section.

Discussion

Although anxiety during pregnancy may impair postnatal maternal and child outcomes in multiple domains, the relationship between prenatal anxiety and infant feeding outcomes is not well understood. The primary objective of this review was to evaluate the evidence relating to these variables. To date, 6 studies with 3185 participants are available for review.[20,46-50] Among these studies, 3 examined multiple infant feeding outcomes (Table 2), resulting in 10 overall analyses examining the relationship between prenatal anxiety and infant feeding.[20,48,49]

Of the 10 reported analyses, 7 found no relationship between prenatal anxiety and infant feeding outcomes, namely, breastfeeding initiation and any breastfeeding activity. Of the 4 studies assessing breastfeeding initiation,[20,46,47,49] 1 was conducted in the 1980s with various methodological and analytical weaknesses, meaning that results should be approached with caution.[46] Another 2 studies were subject to an unusually high prevalence of initiation, which limits the generalizability of results.[20,49]

Both studies assessing how women intend to feed their baby reported a significant relationship between high levels of prenatal anxiety and formula-feeding intentions.[49,50] This suggests that women who experience high levels of anxiety in pregnancy are more likely to choose not to breastfeed prenatally. These effects were observed within 2 diverse samples and remained after controlling for a range of confounders and effect modifiers. Previous research has found that breastfeeding intention is a strong and potentially modifiable predictor of breastfeeding behavior, showing significant associations with both exclusive breastfeeding and prolonged breastfeeding duration.[52,53] However, Insaf and colleagues'[50] sole outcome was feeding intention and Fairlee's[49] findings did not translate into reduced breastfeeding initiation.

One study also found that state anxiety was predictive of reduced exclusive breastfeeding duration.[48] Given the recognized benefits of exclusive breastfeeding to 6 months, it is evident that future studies are warranted in this area before assumptions are made.[54] However, it could be argued that women with state anxiety in pregnancy who choose to breastfeed may also be more likely to provide a formula supplement in the early postpartum. This may be explained via the inverse relationship between state anxiety and breast milk volume noted in the introduction.[24] This argument is further supported by 2 related studies that also found that prenatal anxiety was related to early breastfeeding cessation.[55,56] These studies were not included in this review as 1 failed to explore anxiety independently from depression[55] and 1 failed to control for the effects of parity.[56] Various measurement issues hindered the comparability of findings between studies. There was

limited agreement on exposure and outcome measures with only 2 studies from the same author providing recognized definitions of breastfeeding[47,48] and 1 study using an anxiety measure specific to pregnancy.[49] Although the majority of studies administered the STAI, none used clinical thresholds for anxiety, despite using a diagnostic measure.[20,46-48,50] Some studies benefited from multiple prenatal anxiety assessments; however, inconsistent timing of data collection across studies coupled with natural fluctuations in anxiety over the course of pregnancy make comparisons between these studies problematic.[20,47,50] Some studies also used retrospective, self-report methods to assess feeding outcomes, which may have led to recall or reporting bias.[20,47,48] Similar limitations were prevalent in a review assessing postpartum depression and infant feeding outcomes[31] and suggest a need for researchers in this area to standardize methods of measurement to aid comparability.

Sampling limitations were also prevalent. Three of the studies included were restricted by self-admitted small sample sizes, despite using multivariate models that may necessitate larger numbers for sufficient power.[20,47,48] Furthermore, none of the studies included reported a power calculation, which may further limit the interpretation of study results. Attrition-related bias was also a concern, with 4 studies reporting rates of more than 20%.[20,47-49] Finally, the homogeneous nature of some samples limited the generalizability of findings.[47-50]

Five of the 6 studies included in the review used analyses that accounted for a range of potential confounders.[20,47-50] Maternal educational attainment was observed as a significant confounder and adjusted for in all 5 of these studies. Level of education is established as a strong influence on breastfeeding status and is robust to influence from other sociodemographic and psychosocial characteristics.[57] It is therefore essential to take this into consideration in future research. Prepregnancy BMI was also found to be a key variable affecting exposure and outcome variables in 3 studies.[47-49] This adds to a growing body of research linking prepregnancy weight status to breastfeeding outcomes,[58,59] strongly supporting consideration of this variable in future research. The decision to exclude studies that failed to control for parity was warranted, with 4 studies making adjustments based on the number of previous pregnancies.[47-50] The only study that did not find parity to be associated with either exposure or outcome variables was subject to a small sample size, which "may have had insufficient power to detect associations where they may have existed."[20(p107)] Ultimately, it is recognized that both anxiety during pregnancy and breastfeeding behavior are multifaceted phenomena that perhaps cannot be fully explicated with quantitative methodologies such as those reviewed. Future research may benefit from more creative, qualitative, or mixed methodology approaches providing a rich and complex understanding of factors affecting infant feeding outcomes.

Conclusion

In contrast to Dennis and McQueen's[31] review assessing postpartum depression and infant feeding outcomes, there is insufficient evidence to make firm conclusions regarding the effect of prenatal anxiety on infant feeding outcomes. This is concerning given the acknowledged correlations between prenatal anxiety and other indices of maternal mental health, the growing body of literature concerning the effect of anxiety in other areas of infant development, and the well-established benefits of breastfeeding. Future studies that take into consideration the limitations of the existing evidence base are urgently needed so policy makers can reliably identify what is needed to support those experiencing anxiety during pregnancy and further promote recommended feeding practices.

Authors' Note

Victoria Fallon is a psychology PhD student at the University of Liverpool. Her research on maternal anxiety and infant feeding is supervised by Dr Jo Harrold, Prof Jason Halford, and Dr Kate Bennett.

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Supplementary Material

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