# RESEARCH



# Association between postpartum anxiety and depression and exclusive and continued breastfeeding practices: a cross-sectional study in Nevada, USA



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# Abstract

**Background** Exclusive (EBF) and continued breastfeeding (CBF) as defined by the World Health Organization are the optimal feeding practices. Perinatal Mental Health Conditions (PMHCs) such as anxiety and depression may influence breastfeeding practices. We aimed to examine if maternal postpartum anxiety and depression symptoms, individually and combined (comorbid), influence EBF and CBF practices.

**Methods** A cross-sectional survey was conducted between November 2022 and March 2023 with 326 mothers of children 0–23 months old, all residing in Clark County, Nevada, USA. Descriptive, bivariate, and multivariable logistic regression analyses were conducted to examine the association between self-reported postpartum anxiety and depression symptoms and EBF and CBF in the 24 h prior to the survey.

**Results** The prevalence of EBF among infants under 6 months old and CBF among children 6–23 months old was 36.3% (n=41) and 52.1% (n=111), respectively. After adjusting for maternal socio-demographic, perinatal, and infant/ child characteristics, decreased odds of EBF were associated with the presence of postpartum depressive symptoms (AOR 0.13; 95% CI 0.03,0.55) and the comorbid presence of postpartum anxiety and depression symptoms (AOR 0.16; 95% CI 0.04,0.66). Similarly, decreased odds of CBF were associated with the presence of postpartum anxiety symptoms (AOR 0.36; 95% CI 0.16,0.82).

**Conclusion** Postpartum anxiety and depression symptoms decreased the odds of breastfeeding practices among mothers of children under two years old in Clark County, Nevada. However, the relationship may be bidirectional or inverse, requiring further research to clarify. Culturally appropriate interventions to reduce postpartum anxiety and depression are essential to improve breastfeeding practices.

**Keywords** Exclusive breastfeeding, Continued breastfeeding, Breastfeeding, Maternal mental health, Postpartum anxiety, Postpartum depression, Mothers

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#### Background

The World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) suggest exclusive and continued breastfeeding as key indicators for measuring infant and young child feeding practices [1]. Exclusive breastfeeding (EBF) is defined as the practice of feeding a child with breast milk without giving any other food or beverages, including water, until the child reaches six months of age. After exclusively breastfeeding for the first six months, the WHO recommends continued breastfeeding (CBF) for up to two years or beyond, alongside complementary foods [1]. Despite the well-documented short-term and long-term benefits of breastfeeding for maternal-child health and nutrition [2], only 27.2% of infants are exclusively breastfed through 6 months (0-6 months), and 39.5% continue breastfeeding at one year of age (12 months) in the United States of America (USA) **[3]**.

Postpartum is a delicate and complex phase in an individual's life, which entails several changes and adjustments for the birthing parent, including the potential onset of perinatal mental health conditions (PMHCs). The exact rates of PMHCs are unknown, but evidence shows that seventy to eighty% (70-80%) of new parents are overwhelmed both physically and emotionally after childbirth [4]. The common perinatal mental health symptoms are postpartum anxiety and depression and are caused by a combination of psychological, biological, and social stressors, including environmental and genetic factors [5]. Postpartum anxiety is described as feeling excessive worry, panic, nervousness, and irrational fears for the baby most of the time [6]. Postpartum depression is described as feeling sadness, exhaustion, and despair that hinder the ability of a mother to perform their daily responsibilities [7]. Ten to fifteen% (10-15%) of mothers develop major symptoms of postpartum anxiety and depression, with a 75% (75%) rate of co-occurrence across both conditions [8, 9]. Both postpartum anxiety and depression may contribute to diminished breastfeeding initiation and duration, as well as less exclusive breastfeeding [10, 11].

The relationship between breastfeeding and postpartum anxiety and depression can be bidirectional and is not fully understood [12, 13]. On one hand, breastfeeding may offer a protective effect. It may induce feelings of joy, calmness, and emotional equilibrium and provide several psychological benefits for mothers, such as enhancing the mother-child bond, improving emotional well-being, boosting maternal self-esteem and confidence, fostering a sense of empowerment and accomplishment, and reducing the risk of anxiety and depression [14, 15].

On the other hand, the development of any difficulties with breastfeeding may lead to higher levels of postpartum anxiety and depression [11, 16–18]. Postpartum anxiety and depression can negatively impact breastfeeding outcomes, such as lowering breastfeeding duration [10, 13, 19]. Factors such as past experiences with breastfeeding, low breastfeeding self-efficacy, poor self-esteem, latching problems, and lack of adequate social support can create worries for mothers about their ability to feed

can create worries for mothers about their ability to feed their infants properly. These concerns lead to feelings of anxiety and depression [13]. Consequently, these feelings may directly or indirectly interfere with milk supply, intensifying breastfeeding struggles and ultimately influencing breastfeeding outcomes [13]. Other evidence also indicates that mothers grappling with postpartum anxiety and depression result in early discontinuation of breastfeeding, increased reliance on formula feeding, and earlier weaning by several months [13, 20, 21].

Understanding the associations between postpartum anxiety and depression and breastfeeding is important to inform public health programs and policies and ultimately to develop supportive and equitable interventions for promoting breastfeeding and improving maternalchild health outcomes [13, 22]. In our study, we hypothesized that the frequency of breastfeeding practices (EBF and CBF) is lower among mothers with postpartum anxiety and depression symptoms. We use data from a cross-sectional study involving mothers with children under two years old (0-23 months) to examine if maternal postpartum anxiety and depression symptoms-both individually and combined (comorbid)-influence EBF and CBF practices. While previous research has looked at these relationships [10, 11, 13, 19, 20], it often has not considered the comorbid effects of postpartum anxiety and depression on breastfeeding outcomes. Thus, our study aims to address this gap by conducting a comprehensive analysis of both individual and comorbid effects of postpartum anxiety and depression symptoms on breastfeeding practices. By doing so, we hope to provide a clearer understanding of whether these perinatal mental health conditions influence breastfeeding practices and offer valuable insights to boost support strategies for new mothers.

## Methods

#### Study design

A cross-sectional study was conducted among mothers of children ages 0–23 months old residing in Clark County, Nevada, USA. This study investigated maternal sociodemographic characteristics, perinatal characteristics, infant/child characteristics, maternal mental health, and breastfeeding outcomes.

#### Study setting

The study was conducted in Clark County, Nevada, USA. Clark County is the 14th largest county in the USA and the largest county in Nevada, which occupies 8,102

square miles and is home to 70% of Nevada's population. As of 2024, the population of Clark County was 2,368,484, with the majority of residents identifying as White (42.1%), Black (13.3%), Asian (10.9%), and 31.6% identified as belonging to other races or more than two races (15.5%) [23]. Among them, Hispanics or Latinos represented 32.50% of the population [23]. In Nevada, anxiety and depression are the top two mental healthrelated diagnoses [24]. Approximately 38.4% of adults in the state reported symptoms of these conditions, compared to a national average of 32.3% [25]. On top of that, females have notably higher rates of hospital visits for anxiety (65%) and depression (61%) compared to males [24]. Furthermore, Nevada is designated as a Mental Health Professional Shortage Areas (HPSA) [26]. Buccini et al. documented the lack of perinatal mental health resources in zip codes within Clark County, Nevada which highlights the urgent need to improve mental health and well-being, particularly among women and maternal populations [27]. Similarly, data from Nevada reveal a shortage of lactation professionals, with just 4.14 Certified Lactation Consultants (CLC) [28] and 2.4 International Board-Certified Lactation Consultants (IBCLCs) [29] per 1,000 live births in 2014 and 2021, respectively. This is below the national average of 3.7 IBCLCs per 1,000 live births and the USA Surgeon General's recommendation of 8.6 IBCLCs per 1,000 live births as outlined in the call to action to support breastfeeding [30]. The low ratio of CLCs and IBCLCs to births in Nevada highlights a critical shortage of lactation workforce, contributing to challenges such as limited access to lactation services, including individual counseling, support groups, education, and culturally tailored lactation counseling. This shortage is further escalated by low diversity and representation in the lactation profession. In Clark County, breastfeeding support and resources are scarce, with breastfeeding education primarily provided by the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), a USA federal assistance program that provides nutrition education, breastfeeding support services, supplemental nutritious foods, and referrals for pregnant women and new mothers, as well as infants and children under five years old [31].

#### Sample

Eligible mothers were 18 years old or older, had a child from 0 to 23 months old, and resided in Clark County, Nevada. Children who had specific illnesses or needs such as Down syndrome, cleft lip and/or palate, congenital heart disease, neurological conditions, or cardiac problems that prevented or made breastfeeding practices difficult were excluded. A power analysis using G Power 3.1.9.2 was used to determine the sample size at a small effect size of 0.2 with 80% power, Cohen's d = 0.2 [32]. The estimated minimum sample size for each outcome was 71 mother-child dyads.

Out of 358 eligible mothers who started the survey, 83.5% (n = 299) completed 100% of it, while 16.5% (n = 59) completed 74–99%. Mothers who did not respond to either the infant feeding questions (EBF and CBF) or the maternal mental health questions (postpartum anxiety and depression symptoms) (n = 32) were excluded from the analysis presented in this study. Thus, the analytical sample for this study consisted of 326 mothers, including 113 mothers with children under six months, and 213 mothers with children aged 6–23 months.

#### **Data collection**

Data collection occurred from November 2022 to March 2023. A convenience sampling technique was employed to recruit eligible mothers from the general maternalchild population in Clark County, Nevada, USA. Flyers detailing the research on the experiences of mothers/ caregivers of children under two years old were distributed at healthcare facilities, including WIC centers, birth, lactation, and pediatric care centers in Clark County. The flyers were also shared on social media platforms like Facebook and Instagram. The flyer included a QR code that directed participants to the survey in their preferred language (English or Spanish). Eligible mothers were able to respond to the online survey consisting of close-ended questions on maternal socio-demographic characteristics, perinatal characteristics, infant/child characteristics, maternal mental health, and breastfeeding outcomes.

#### Measurements

**Outcomes** Exclusive (EBF) and continued (CBF) breastfeeding practices were the key dependent variables of interest. EBF was measured for children under six months old (0–5 months) and defined as the percentage of infants under six months old who were exclusively fed breast milk during the previous day (without any other drinks or food, including water). According to WHO, CBF refers to the percentage of children aged 12–23 months who were fed breast milk the previous day. In this study, CBF was defined as the percentage of children 6–23 months old who were breastfed during the previous day, with or without complementary foods [1].

Following the WHO guidelines for assessing infant and young child feeding practices, the use of current breastfeeding status was adopted to minimize possible recall biases resulting from the informant's memory [1]. EBF and CBF were determined from the question, "From yesterday morning until this morning, what has your child eaten? Check all that apply." The liquid/food choices were: breastmilk; formula; dairy products, soy milk, another milk substitute; water; juice, tea, sweetened beverages; processed meat, meat, organic meat; fried and ultra-processed proteins, fried foods and side dishes; poultry; fish (tuna, salmon, etc.), shellfish (shrimp, crab, lobster, oysters, clams, etc.); tofu; eggs; vegetables, beans, peas, lentils, leafy vegetables; fruits (e.g. banana, applesauce, grapes, raisins); grains and starches, nuts; salty crackers, pretzels, popcorn, etc.; baked goods, candy, chocolates, honey, other sweets; and others. The response options were "yes" or "no" for all these liquid or food choices. If the child (belonging to age 0–5 months) received only breastmilk and no other liquid or food in the previous 24 h, it was considered EBF. On the other hand, if the child (belonging to age 6–23 months) received breastmilk in the previous 24 h with other liquid or food items, that was considered CBF.

**Independent variables** The three independent variables used to characterize maternal mental health status were: postpartum anxiety symptoms, postpartum depression symptoms, and comorbid postpartum anxiety and depression symptoms.

Postpartum anxiety symptoms The Generalized Anxiety Disorder 7-Item Scale (GAD-7) was used to detect mothers at risk for postpartum anxiety [33]. GAD-7 is a seven-item instrument that assesses the severity of anxiety symptoms. Each item was asked to rate the severity of symptoms over the last two weeks. The options for responses included "not at all," "several days," "more than half the days," and "nearly every day" and were scored as 0, 1, 2, and 3, respectively, based on the seriousness of the symptom. The total score for these seven items ranged from 0 to 21, and the scores were classified as 0-4 for minimal anxiety, 5-9 for mild anxiety, 10-14 for moderate anxiety, and 15-21 for severe anxiety. For statistical analysis, mild, moderate, and severe anxiety symptoms were re-categorized as 'presence' of postpartum anxiety symptoms, and minimal anxiety symptoms were re-categorized as 'absence' of postpartum anxiety symptoms.

*Postpartum depression symptoms* The Edinburgh Postnatal Depression Scale (EPDS) was used to detect mothers at risk of postpartum depression [34]. EPDS is a ten-item instrument that assesses the severity of depression symptoms [35]. Each item asked how the mother had been feeling during the previous seven days. The responses were scored as 0, 1, or 2 based on the seriousness of the symptoms. The total score for these ten items ranged from 0 to 30. The cut-off points for the EPDS in clinical and community settings vary in the literature. In clinical settings, an EPDS cut-off value of 11 or higher maximizes combined sensitivity and specificity; while a cut-off value of 13 or higher is less sensitive but more specific [36]. In community settings, using severity cut-off scores for the EPDS is recommended due to the wide range of depression symptoms experienced by postpartum women. In this study, the following severity ranges were used: none or minimal depression (0–6), mild depression (7–13), moderate depression (14–19), and severe depression (19–30) [34]. For statistical analysis, severity levels of postpartum depression symptoms were combined into a binary variable, where mild, moderate, and severe depression symptoms were re-categorized as the 'Presence' of postpartum depression symptoms and none or minimal depression symptoms were re-categorized as the 'Absence' of postpartum depression symptoms.

*Comorbid postpartum anxiety and depression symptoms* An interaction term was created to group individuals as having the 'presence' of both anxiety and depression symptoms in order to test the hypothesis that having symptoms of both would lead to worse breastfeeding outcomes compared to those without both symptoms, either anxiety symptoms alone or depression symptoms alone. For statistical analysis, a binary variable was used, comparing those with the 'Presence' of comorbid anxiety and depression symptoms to those with 'Absence' of comorbid conditions.

**Covariables** The selection of covariables was guided by the conceptual hierarchical framework [37] and empirical evidence supporting associations with maternal mental health and breastfeeding outcomes [17, 18, 20, 21]. Variables were grouped and organized across three categories according to their influence on the outcomes: maternal socio-demographic characteristics, perinatal characteristics, and infant/child characteristics.

Maternal socio-demographic characteristics included household income (up to \$74,999; more than \$75,000), age of mother (18-24 years; 25-34 years; 35-44 years), education (Master's degree and above; Bachelor's degree and below), mother's race/ethnicity (non-Hispanic White; others), mother's employment (working; not working), had maternity leave (yes; no), and food insecurity (food secure; food insecure). Perinatal characteristics included WIC enrollment (yes; no), current diagnosis of depression/anxiety by a health professional (yes; no), using psychotropic medications (yes; no), planned pregnancy (yes; no), parity (primiparous; multiparous), type of delivery (vaginal; c-section), and mothers' pumping breast milk (yes; no). Infant/child characteristics included preterm/term birth (yes; no), low birth weight (yes; no), baby put on the breast within the first hour after birth (yes; no), pacifier use (yes; no), a child attending daycare/ pre-K (yes; no), and co-sleeping (child sleeping in the same room with the parents) (yes; no).

#### Statistical analysis

The data was collected in Qualtrics and was exported to the Statistical Package for Social Sciences (SPSS) Version 28 for statistical analysis. For statistical significance, a p-value of < 0.05 was used as the criterion.

**Descriptive and bivariate** A descriptive analysis was done to explore the outcome, independent variables, and covariables. Initially, outcomes were explored across the three groups of independent variables. Bivariate analyses were conducted to estimate unadjusted odds ratios (UORs) for the association between each independent variable and the breastfeeding outcomes. Covariables with a  $p \le 0.20$  in the bivariate analysis were included to adjust the multivariable logistic regression models.

**Multivariable logistic regression** Considering that this study has two outcomes (i.e., EBF and CBF), the steps for data analysis were reproduced for each outcome.

Logistic regression for the EBF outcome included three independent modeling approaches. Each independent multivariable logistic regression model was adjusted by covariables selected in the bivariate analysis. Model 1 estimated the associations between maternal postpartum anxiety symptoms with EBF. Model 2 estimated the associations between maternal postpartum depression symptoms with EBF. Model 3 estimated the associations between the comorbid presence of postpartum anxiety and depression symptoms with EBF.

Similarly, logistic regression for the CBF outcome included three independent modeling approaches. Each independent multivariable logistic regression model was adjusted by covariables selected in the bivariate analysis. Model 4 estimated the associations between maternal postpartum anxiety symptoms with CBF. Model 5 estimated the associations between maternal postpartum depression symptoms with CBF. Model 6 estimated the associations between the comorbid presence of postpartum anxiety and depression symptoms with CBF. Logistic regression results were expressed as adjusted odds ratios (AORs) with 95% confidence intervals (CI).

### Results

Of the 326 mothers, 113 had children under six months old, with more than a third (36.3%) exclusively breastfeeding (EBF) and 70.8% engaging in any breastfeeding. Among the 213 mothers with children aged 6–23 months, approximately half (52.1%) were continuing breastfeeding (CBF). Of these, 70.9% of the 79 mothers with children aged 6–11 months were involved in any breastfeeding, while 41.0% of the 134 mothers with children aged 12–23 months were doing the same. Regarding maternal mental health, 66.9% of all mothers had symptoms of postpartum anxiety (minimal anxiety: 33.1%; mild anxiety: 41.7%; moderate anxiety: 15.3%; severe anxiety: 9.8%), and 59.5% had symptoms of postpartum depression (minimal depression: 40.5%; mild depression: 36.2%; moderate depression: 18.4%; severe depression: 4.9%) (Table 1).

Among all mothers, 56.5% had incomes greater than \$75,000, and more than 65.9% of mothers were aged 25–34 years. The risk for food insecurity was reported by 31.9% of the mothers. Most of the mothers had a planned pregnancy (68.4%), were multiparous (51.2%), and had a vaginal delivery (59.2%). In addition, 70.2% of mothers placed their babies on the breast within the first hour of birth (Table 1).

Among mothers who were EBF (n = 41), 61% reported symptoms of postpartum anxiety, 44% had depression symptoms, 39% dealt with comorbid anxiety and depression symptoms, and 34% had neither. Conversely, among mothers who were continuing to breastfeed children aged 6–23 months of age, (n = 111), 59% experienced symptoms of postpartum anxiety, 58% reported depression symptoms, 49% faced comorbid postpartum anxiety and depression symptoms, and 32% had neither (Fig. 1).

In the multivariable analysis, mothers with postpartum depression symptoms were 87% less likely to exclusively breastfeed compared to those without postpartum depression symptoms (AOR 0.13; 95% CI 0.03, 0.55) (Table 2). Likewise, mothers experiencing comorbid postpartum anxiety and depression symptoms were 84% less likely to be exclusively breastfeed than those without comorbid conditions (AOR 0.16; 95% CI 0.04, 0.66) (Table 2).

Alternatively, mothers with postpartum anxiety symptoms were 64% less likely to continue breastfeeding compared to those without postpartum anxiety symptoms (AOR 0.36; 95% CI 0.16, 0.82) (Table 3). The comorbid presence of postpartum anxiety and depression symptoms did not affect continued breastfeeding (Table 3).

#### Discussion

Our findings confirmed maternal postpartum anxiety and depression symptoms as factors associated with lower breastfeeding practices among children under two years (0–23 months) old. The presence of depression as well as the comorbid presence of postpartum anxiety and depression symptoms was associated with lower EBF. In addition, postpartum anxiety symptoms were associated with lower CBF. To our knowledge, this study is one of the first studies to investigate the association between maternal postpartum anxiety and depression symptoms with both EBF and CBF practices in Clark County, Nevada, United States. The state of Nevada has a diverse population, both culturally and economically, which can affect mental health and breastfeeding in various ways. Furthermore, the state of Nevada in the United States

#### Table 1 Sample characteristics and breastfeeding outcomes

Variables	All (0–23 months) (n=326)	<6 months (n = 113)	6–23 months (n=213)
	<u>())</u> n (%)	n (%)	n (%)
Outcomes			
Exclusive breastfeeding (EBF), Yes	-	41 (36.3)	-
Continued breastfeeding (CBF), Yes	-	-	111 (52.1)
Independent variables			
Postpartum anxiety, Yes	218 (66.9)	76 (67.3)	142 (66.7)
Postpartum depression, Yes	194 (59.5)	65 (57.5)	129 (60.6)
Comorbid postpartum anxiety + depression, Yes	178 (54.6)	61 (54.0)	117 (54.9)
Maternal socio-demographic characteristic			
Household income, <i>Up to \$74,999</i>	141 (43.5)	50 (44.6)	91 (42.7)
Maternal age in years, 18–24	38 (11.6)	17 (15.0)	21 (9.9)
Maternal age in years, 25–34	215 (65.9)	75 (66.4)	140 (65.7)
Maternal age in years, 35–44	73 (22.5)	21 (18.6)	52 (24.4)
Maternal education, Bachelor's degree and below	238 (73.0)	82 (72.6)	156 (73.2)
Maternal race/ethnicity, Non-Hispanic White	162 (49.7)	56 (49.6)	106 (49.8)
Maternal employment, Employed	-	-	132 (62.0)
Had maternity leave, Yes	-	86 (76.1)	-
Food insecurity, Yes	104 (31.9)	32 (28.3)	72 (33.8)
Perinatal characteristics			
WIC enrollment, Yes	66 (20.5)	23 (20.4)	43 (20.2)
Current diagnosis of depression/ anxiety, Yes	98 (30.5)	37 (33.3)	61 (29.0)
Using psychotropic medications, Yes	50 (15.3)	19 (16.8)	31 (14.6)
Planned pregnancy, Yes	223 (68.4)	79 (69.9)	144 (67.6)
Parity, Primiparous	159 (48.8)	47 (41.6)	112 (52.6)
Type of delivery, Vaginal	193 (59.2)	64 (56.6)	129 (60.6)
Mothers' pumping breast milk, Yes	122 (38.1)	64 (58.2)	58 (27.6)
Infant/child characteristics			
Preterm birth, Yes	61 (18.7)	28 (24.8)	33 (15.5)
Low birth weight, Yes	25 (7.7)	15 (13.4)	10 (4.7)
Baby put on the breast within the first hour after birth, Yes	229 (70.2)	81 (71.7)	148 (69.5)
Pacifier use in the last 24 h, Yes	134 (42.1)	71 (64.0)	63 (30.3)
Child attending day care/Pre-K, Yes	53 (16.3)	9 (8.0)	44 (20.8)
Co-sleeping, Yes	228 (71.5)	103 (92.8)	125 (60.1)

has lower breastfeeding rates compared to the national average (EBF at 6 months: 26.1% vs. 27.2% and CBF at 12 months: 30.0% vs. 39.5%) [3]; thus, understanding how perinatal mental health conditions impact breastfeeding in these settings is critical to design interventions to support breastfeeding practices. Our study highlights the crucial role of maternal mental health for EBF and CBF among maternal-child dyads living in urban areas of the United States.

EBF was 36.3% for infants aged 0–5 months old in the present study, which is higher than the national average (27.2%) for the same age group, but lower than what was observed in a recent study for Clark County, Nevada (53.6%) [3, 38]. This later study only included infants under 6 months, which may explain the difference in prevalence [38]. For CBF, the CDC reports a prevalence of 39.5% at one year of age (but does not report data for

two years) [3]. In our study, we estimated CBF at two years of age and found it to be higher, at 52.1%. One possible explanation for this discrepancy might be due to the fact that most of our participants reported having a higher education and income. Well-educated and high-income mothers tend to have better accessibility to breastfeeding resources enabling them to breastfeed longer [39].

More than half of the participants in our study reported symptoms of postpartum depression symptoms. The only data on maternal perinatal mental health available in Nevada comes from a 2021 maternal-child survey conducted in Clark County with mothers of infants under 6 months, where postpartum depressive symptoms were reported for 9.2% of the caregivers [11], which is lower than the frequency of only postpartum depression symptoms found in our study (3.5-6%) for women with



Fig. 1 Prevalence of postpartum anxiety and depression symptoms according to exclusive and continued breastfeeding

Table 2	Unadj	usted and	adjusted	d odds ra	atio for (	exclusive	breastfeeding	) (EBF	) and intera	ction o	f maternal	mental	health
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Independent variables	Dependent variable: Exclusive breastfeeding (EBF) (<6 months)						
	n (%)	Unadjusted		Adjusted			
		UOR (95% CI)	p-value	AOR (95% CI) <sup>a</sup>	p-value		
Model 1:	25 (32.9%)	0.64	0.284	0.80	0.709		
Postpartum anxiety symptoms		(0.29, 1.44)		(0.25, 2.58)			
Model 2:	18 (27.7%)	0.42	0.029*	0.13	0.006*		
Postpartum depression symptoms		(0.19, 0.91)		(0.03, 0.55)			
Model 3:	16 (26.2%)	0.38	0.017*	0.16	0.011*		
Comorbid postpartum anxiety + depression symptoms		(0.17, 0.85)		(0.04, 0.66)			

Abbreviations: EBF, Exclusive Breastfeeding; UOR, Unadjusted Odds Ratio; AOR, Adjusted Odds Ratio; CI, Confidence Interval; \* p < 0.05

Model 1, 2, and 3 are independent analysis

<sup>a</sup>Odds ratio adjusted by household income, age of mother, education, race/ethnicity, maternity leave, food insecurity, WIC enrollment, current diagnosis of depression/ anxiety by a health professional, using psychotropic medications, planned pregnancy, type of delivery, mothers' pumping breast milk, child's age, preterm/term birth, low birth weight, and baby put on the breast within the first hour after birth, pacifier use (last 24 h), and co-sleeping

children aged 0–23 months old. Globally, the prevalence of postpartum depression among women with children up to 12 months is 17.2% [40]. A systematic review found that the prevalence of postpartum depression ranges from 4 to 63.9%, with Japan reporting the lowest rates [41]. Prevalence of postpartum anxiety symptoms was also found among two thirds of our sample. A prospective study reported postpartum anxiety symptoms ranging from 17 to 20% after childbirth [9]. In Italy, a study showed prevalence of postpartum anxiety symptoms of 34.2% [42]. A meta-analysis found the prevalence of postpartum anxiety to be 15.0% at six months postpartum and 14.8% at more than six months postpartum, with higher rates in low-income countries compared to highincome ones [43]. The high rates of symptoms of postpartum anxiety and depression observed in the current study may be exacerbated by socio-ecological factors such as the limited access to perinatal mental health resources in Clark County, Nevada documented in a prior study [27]. Surprisingly, comorbid postpartum anxiety and depression symptoms occur for more than half of our sample. A population-based survey conducted with 4,451

#### Table 3 Unadjusted and adjusted odds ratio for continued breastfeeding (CBF) and interaction of maternal mental health

	Dependent variable: Continued breastfeeding (CBF) (6–23 months)						
Independent variables	n (%)	Unadjusted		Adjusted			
		UOR (95% CI) p-value		AOR (95% CI) <sup>a</sup> p-value			
Model 1:							
Postpartum anxiety symptoms	66 (46.5%)	0.50 (0.28, 0.90)	0.021*	0.36 (0.16, 0.82)	0.015*		
Model 2							
Postpartum depression symptoms	64 (49.6%)	0.77 (0.45, 1.35)	0.366	0.76 (0.36, 1.63)	0.486		
Model 3							
Comorbid postpartum anxiety + depression symptoms	55 (47.0%)	0.63 (0.37, 1.09)	0.100	0.50 (0.23, 1.09)	0.083		

Abbreviations: CBF, Continued Breastfeeding; UOR, Unadjusted Odds Ratio; AOR, Adjusted Odds Ratio; CI, Confidence Interval; \*p < 0.05

Model 4, 5, and 6 are independent analysis

<sup>a</sup>Odds ratio adjusted by household income, age of mother, education, race/ethnicity, mother's employment, food insecurity, WIC enrollment, parity, type of delivery, mothers' pumping breast milk, child's age, preterm/term birth, low birth weight, baby put on the breast within the first hour after birth, pacifier use (last 24 h), child attending day care/Pre-K, and co-sleeping

postpartum women in the United States, including both urban and rural areas, found that 35% of those reporting postpartum anxiety symptoms also had comorbid depression symptoms [44]. Additionally, among women with postpartum depression symptoms, 64% reported comorbid anxiety symptoms [44]. These findings corroborate similar trends observed in our study.

We found that comorbid postpartum anxiety and depression symptoms among mothers negatively influenced EBF. Although the comorbid symptoms of postpartum anxiety and depression symptoms have been previously studied [44], to our knowledge, no studies have investigated the combined influence of both on EBF. Therefore, our study highlighted an important area of research that provided insight into the challenges faced by mothers who are facing the compounding burden of postpartum anxiety and depression and its negative influence on breastfeeding practices. This might be because the first six months postpartum are a particularly vulnerable time for the onset or escalation of anxiety and depression symptoms due to physical and emotional fatigue, challenging parenting, social isolation and poor support, sleep deprivation, and negative self-perception about breastfeeding adequacy [45]. Our study also indicated that mothers with the symptoms of postpartum depression had significantly lower odds of EBF. Our results are in line with previous literature that showed a link between maternal postpartum depression and breastfeeding difficulties, as well as shorter breastfeeding duration [10, 13, 18, 19]. A recent study in Greece also showed that the presence of postpartum depression decreased the likelihood of EBF [46]. The study showed that mentally stressed mothers have trouble with breastfeeding and thus choose to interrupt it early [46].

In our study, mothers reporting postpartum anxiety symptoms had significantly lower odds of CBF after 6 months postpartum. Our results are consistent with existing evidence that postnatal anxiety is a predictor of breastfeeding interruption [10, 19]. A longitudinal study in Canada showed that postpartum anxiety in the postpartum period is associated with lower CBF [47]. Postpartum anxiety may possibly influence breastfeeding practices through two pathways. First, maternal postpartum anxiety affects the mother's self-esteem, which can harm mother-child bonding and interactions, declining the mother's self-efficacy related to breastfeeding [10, 19, 48]. Second, maternal postpartum anxiety is linked to maternal stress, interfering with the production of oxytocin, affecting the milk ejection reflex, and adversely impacting breastfeeding physiologically [10, 48]. Our findings on the relationship between maternal postpartum anxiety and breastfeeding highlight the importance of diagnosing and treating postpartum anxiety in a timely manner. Prior literature emphasizes that poor mental health undermines breastfeeding; it is crucial to address barriers to care when mental health issues are present [18]. Therefore, a mental health continuum of care is crucial during the perinatal period to promote both breastfeeding and maternal well-being. It should include culturally appropriate interventions, universal mental health screenings and counselling, as well as referrals to both individual and group therapies. Structural policy changes, such as expanding insurance coverage, are needed to improve accessibility and provide better support for mothers and families in need.

Our study had several strengths. First, we adopted the 24-hour diet recall method to measure breastfeeding practices, as recommended by the WHO, to reduce recall bias. Second, we employed validated perinatal mental health assessment tools, including the GAD-7 and the EPDS, to assess postpartum anxiety and depression symptoms respectively. These psychometric tools are widely used in epidemiological studies, making it easier to compare our findings with those from other populations. Third, our study findings are generalizable to mothers living in urban areas, who are often racially and ethnically diverse. There are also some limitations to consider when interpreting the results. First, convenience sampling techniques were employed to recruit mothers with children ages 0-23 months old in Clark County. Most participants were recruited through social media, despite the efforts to collect data across birth, pediatric, lactation, and other healthcare centers, which might have limited the diversity of mothers in terms of race/ethnicity, education, and income. To investigate selection bias, we compared the characteristics of our sample with data from Clark County, Nevada, and found that the respondents' characteristics were similar (with no statistical difference) to those of Clark County residents in terms of education and income. Therefore, the high prevalence of maternal mental health symptoms found in our study may be explained by selection bias or might suggest this is an underdiagnosed issue during postpartum. Second, this study surveyed mothers about their perinatal and infant/child characteristics, which may have resulted in recall bias due to varying accuracy in recalling past experiences. The 24-hour diet recall method recommended by WHO might lead to outcome misclassification bias, as an infant/child might be incorrectly classified as not being breastfed at present if the breastfeeding did not occur within the last 24 h, even if it happened frequently. Any such misclassification bias would likely be nondifferential and would tend to bias the findings toward the null.

Third, response bias is a concern as we used selfreported assessment tools to assess anxiety (GAD-7) and depression (EPDS) symptoms. While there could be exposure misclassification due to response bias, there is no evidence to suggest that it is more prevalent among certain mothers based on breastfeeding status or sociodemographic factors. Fourth, we chose to describe the severity cut-off scores for the EPDS. In community settings, it is particularly important to document the severity levels of postpartum depressive symptoms as this helps determine community needs for referrals and services. Additionally, findings from a meta-analysis suggested that lower cut-off values for mild postpartum symptoms, like the one applied in this study, could reduce false negatives and identify most mothers who meet diagnostic criteria [36]. However, this approach might have overestimated the prevalence of postpartum depression symptoms in our sample. Fifth, the severity levels of both postpartum anxiety and depression symptoms were combined into binary variables, which limited our ability to distinguish between groups that might have been meaningful. This parsimonious data analysis approach was used to maximize sample power, improve model stability, and strengthen our ability to draw meaningful conclusions. Sixth, this study did not include mothers living in rural regions, thus the findings may not be generalized to rural populations in the USA. Lastly, given the study's cross-sectional design, temporality cannot be established and therefore, reverse causality cannot be ruled out. It is uncertain whether the association between postpartum anxiety and depression symptoms with breastfeeding outcomes identified in this study are true or an artifact of the relationship between breastfeeding and mental health. However, given the complexity of the relationship, it is likely that a bidirectional pathway exists, with postpartum anxiety and depression symptoms influencing

#### Conclusion

Postpartum anxiety and depression symptoms decreased the odds of breastfeeding practices among mothers of children under two years old in Clark County, Nevada. Early identification of maternal postpartum anxiety and depression symptoms, including the promotion and protection of breastfeeding practices, can foster the optimal health and well-being of infants and mothers. Considering the importance of breastfeeding-both exclusive (EBF) and continued breastfeeding (CBF) for both mother and child—as well as the mutual association between breastfeeding and maternal mental health, this kind of research is significant to public health outcomes and would eventually have implications for future interventions. However, more extensive research is required to clarify the bidirectional relationship between maternal mental health and breastfeeding.

#### Abbreviations

- AOR Adjusted Odds Ratio
- CDC Centers for Disease Control and Prevention

breastfeeding outcomes and vice versa.

- CI Confidence Interval
- CLC Certified Lactation Consultant
- EPDS Edinburgh Postnatal depression Scale
- GAD Generalized Anxiety Disorder
- HPSA Health Professional Shortage Area
- IBCLC International Board-Certified Lactation Consultant
- PMHC Perinatal Mental Health Condition
- SPSS Statistical Package for Social Sciences
- UOR Unadjusted Odds Ratio
- USA United States of America
- WHO World Health Organization

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#### Author contributions

SN and GB conceptualized the study, designed the study, developed the survey, planned the methods, and a statistical analysis. AMV and AHD contributed to the research design and statistical analysis. KM contributed to the discussion of the clinical impacts of perinatal mental health conditions on

breastfeeding practices. SN and GB prepared the first draft of the manuscript. All authors contributed to critically reviewing the manuscript draft. All authors approved the final version of the manuscript.

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#### Data availability

Data is provided within the manuscript file.

#### Declarations

#### Ethical approval and consent to participate

Ethical approval was granted by the Institutional Review Board (Protocol UNLV-2022-372) of the University of Nevada, Las Vegas. Informed consent was received prior to the beginning of the survey.

#### **Consent for publication**

Not applicable.

#### **Competing interests**

The authors declare no competing interests.

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