December 2023

Does Maternal Mental Health (Anxiety and Depression) Negatively Impact Exclusive and Continued Breastfeeding Practices?

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DOES MATERNAL MENTAL HEALTH (ANXIETY AND DEPRESSION) NEGATIVELY IMPACT EXCLUSIVE AND CONTINUED BREASTFEEDING PRACTICES?

By

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Bachelor of Public Health
Pokhara University
2018

A thesis submitted in partial fulfillment
of the requirements for the

Master of Public Health

Social and Behavioral Health
School of Public Health
The Graduate College

University of Nevada, Las Vegas
December 2023

UNLV | GRADUATE COLLEGE

Thesis Approval

The Graduate College
The University of Nevada, Las Vegas

November 8, 2023

This thesis prepared by

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entitled

Does Maternal Mental Health (Anxiety and Depression) Negatively Impact Exclusive and Continued Breastfeeding Practices?

is approved in partial fulfillment of the requirements for the degree of

Master of Public Health
Social and Behavioral Health

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Abstract

Exclusive and continued breastfeeding practices are the optimal source of nutrition for an infant's well-being, cognitive growth, and development and have positive health outcomes for the mother too. Anxiety and depression are common perinatal mental health conditions associated with early breastfeeding interruption. However, Nevada lacks data on perinatal mental health and its influence on breastfeeding practices. The objective of this study was to assess whether maternal mental health (anxiety and depression) impacts exclusive and continued breastfeeding practices in Clark County, Nevada. A cross-sectional survey was conducted with 358 mothers having children 0-23 months old and residing in Clark County, Nevada. A descriptive, bivariate, and multivariate logistic regression analysis between breastfeeding outcomes and self-reported anxiety and depression symptoms adjusted by co-variables was performed. The prevalence of exclusive breastfeeding for infants under 6 months old was 35.0% (n=123), and the continued breastfeeding rate for children 7-23 months old was 50.9% (n=224). Decreased exclusive breastfeeding was independently associated with depressive symptoms (AOR = 0.13, 95% CI: 0.03- 0.51) and the interaction between both anxiety and depression symptoms (AOR= 0.15, 95% CI: 0.04-0.57). Decreased continued breastfeeding was significantly associated with anxiety symptoms (AOR=0.41, 95% CI: 0.18-0.91). We found that maternal anxiety and depression are independent risk factors for decreasing the frequency of breastfeeding practices among mothers of children under two years old in Clark County, Nevada. Hence, evidence-based interventions should be implemented to reduce maternal anxiety and depression, as they are linked to breastfeeding success and the well-being of mothers and children.

Acknowledgements

I would like to acknowledge and express my sincere gratitude to my Advisory Committee Chair (Supervisor/Advisor), Dr. Gabriela Buccini, for her constant support and guidance. She is the one who made this work possible. Her insightful critiques, constructive feedback, and scientific advice carried me through all the stages of doing this thesis. I would also like to give my warmest thanks to my thesis Advisory Committee Members, Dr. Amanda Haboush-Deloye and Dr. Ann Vuong, and Graduate College Representative, Dr. Alyssa Crittenden, for their support and feedbacks during prospectus preparation and defense, data analysis, and final report writing. Also, a special thanks to the Institutional Review Board of the University of Nevada, Las Vegas, for granting ethical approval to conduct the study in Clark County, Nevada. Most importantly, my sincere gratitude goes to all the mothers who gave consent and participated in this study.

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Chapter 1: Introduction

1.1 Breastfeeding

Breastfeeding enhances the health, survival, and development of children (Rollins et al., 2016). It is the optimal source of nutrition for the physical, neurological, and cognitive growth of infants (Assarian et al., 2014). Breast milk is clean, safe, healthy, and accessible. Breastfed children have reduced infectious mortality and morbidity, higher intelligence, and fewer dental malocclusions (Assarian et al., 2014; Victoria et al., 2016). Similarly, positive health outcomes for breastfeeding mothers include decreased blood pressure and risk of breast cancer, ovarian cancer, and diabetes, attenuated stress responses, and enhanced sleep (Victoria et al., 2016). Every year, almost 823,000 child deaths and 20,000 breast cancer deaths can be prevented if breastfeeding is scaled up to a universal level (Victoria et al., 2016). Due to enormous direct and indirect benefits, breastfeeding is considered as one of the most realistic and cost-effective interventions to improve maternal and child health (Carroll et al., 2018).

Breastfeeding is also a core element of the 2030 Agenda for Sustainable Development. Eight out of seventeen goals of the Sustainable Development Goals (SDGs) are linked to breastfeeding, including goals for reducing hunger, poverty, and promoting gender equality, along with goals for health and education (UNICEF, 2017). If a nation aims to achieve the SDGs, they should develop budget and action plans in such a way that prioritizes breastfeeding (UNICEF, 2017). In addition to helping to achieve many SDGs, breastfeeding is essential to the Global Strategy for Women's, Children's, and Adolescents' Health (UNICEF, 2017). Despite the plethora of benefits of breastfeeding, many mothers in both developing and developed countries do not achieve their breastfeeding goals.

The World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) recommend six breastfeeding indicators, which are very important to report for any population. The indicators are ever breastfeeding, early initiation of breastfeeding, exclusive breastfeeding for the first two days after birth, exclusive breastfeeding under six months, mixed milk feeding under six months, and continued breastfeeding for 12–23 months. In this study, exclusive breastfeeding and continued breastfeeding were considered.

1.2 Exclusive Breastfeeding

Having only breast milk as your infant's source of nutrition—not even water—is referred to as exclusive breastfeeding (WHO, 2021). It is recommended for the first six months of an infant's life, and this safeguards the best health outcome for both child and mother. Prescribed medications, vitamins, minerals, and oral rehydration solutions are not considered foods or fluids. However, those children who consume herbal fluids or any traditional medicines are counted as fluids and, therefore, are not considered exclusively breastfed (WHO, 2021). Exclusive breastfeeding diminishes the risk of diarrhea, lower respiratory infections, acute otitis media, and childhood overweight or obesity among infants. Around 41% of babies worldwide are exclusively breastfed for six months (La Leche League International, 2021), while only 24.9 percent were exclusively breastfed in 2019 in the United States (CDC, 2022). In this context, the World Health Assembly (WHA) has set a global goal of increasing exclusive breastfeeding to 50% by 2025 and to 70% by 2030 (WHO, 2012; WHO, 2018).

1.3 Continued Breastfeeding

After exclusive breastfeeding for six months, breastfeeding should be continued for at least two years and beyond, while also introducing complementary solid foods (WHO, 2021). Continued

breastfeeding is defined as the percentage of 12- to 23-month-old children who are still receiving breast milk (WHO, 2021). Continued breastfeeding prevents almost half of all deaths caused by infectious diseases among children between 6 and 23 months of age (Sankar et al., 2015). When children are sick, they have very little appetite for solid food, and thus continued breastfeeding plays a crucial role during illness, thereby preventing dehydration and providing the vital nutrients that would be required for recovery (Brown et al., 1990). Those children who have been breastfed for more than 12 months benefit the most from higher performance on IQ tests (Victoria et al., 2015). In addition, a child has a reduced risk of becoming overweight or obese if he or she is breastfed for a longer period (Victoria et al., 2016). Mothers who continue breastfeeding for more than a year also have a reduced risk of developing ovarian cancer, breast cancer, and type 2 diabetes (Chowdhury et al., 2015). However, only 45 percent of mothers worldwide continue to breastfeed for up to two years (WHO, 2021). Similarly, the breastfeeding prevalence at 12 months in the US was 35.9 percent in 2019 (CDC, 2022).

1.4 Maternal Mental Health: Anxiety and Depression

Maternal mental health (MMH) disorders comprise a range of symptoms and illnesses, such as anxiety and depression. These conditions can occur in a woman during pregnancy and after childbirth (also referred as postpartum period) (2020 Mom, 2022). Such disorders can cause disastrous consequences for the mother, child, family, and community if left undiagnosed and untreated. These conditions/illnesses are caused by a combination of psychological, biological, and social stressors, which include lack of support, a family history, or an experience with these conditions or disorders (2020 Mom, 2022).

Anxiety is an emotion that is characterized by fear, tension, dread, uneasiness, and worried thoughts. It is one of the very common mental illnesses that affects 40 million adults aged 18 and older in the US which is 19.1 percent of the population (ADAAa, 2022). However, it is easily treatable; only 39.9% of them are receiving proper treatment (ADAAa, 2022). Also, 15% of women develop anxiety symptoms during pregnancy or after the birth of a child (Fairbrother et al., 2016). Anxiety after childbirth is associated with exclusive breastfeeding. Mothers with anxiety have difficulties while breastfeeding, and they terminate breastfeeding early (Fukui et al., 2021). Moreover, mothers with higher anxiety were also found to be both formula-feeding and breast-feeding (Fukui et al., 2021).

Depression is an illness that influences how we feel, act, and think. The symptoms of depression are feeling sad, anxious, irritated, worrying too much, having sleep problems, losing interest in daily activities, and having trouble making decisions (Pope and Mazmanian, 2016). Children of mothers suffering from depression show developmental abnormalities, cognitive defects, behavioral disorders, and anxiety disorders (Baran et al., 2021). About 264 million people around the world are living with depression. In the context of the US, 17.3 million adults aged 18 and over have experienced major depressive episodes at least once. Depression is more prevalent among women than men and one out of seven women suffers from depression after the birth of a child (ADAAb, 2022).

1.5 Significance for the Field

Maternal mental health has an impact on both mother and child health. Someone who is suffering from anxiety can also suffer from depression, and vice versa. Almost one-half of depressed people are also diagnosed with anxiety (ADAAa, 2022). There are a lot of reasons that cause depression

and anxiety to develop among mothers, including huge physical changes and hormonal changes after childbirth; including the need to adapt to the new environment; childcare; fatigue; and lack of sleep (Baran et al., 2021). These maternal mental health issues can further impact the bond between mother and child.

Mothers' mental health has a significant impact on breastfeeding and the growth and development of a healthy baby (Assarian et al., 2014). A mother’s breastfeeding decision is influenced by multiple factors including but not limited to biological aspects, individual self-efficacy, education, prior experience with breastfeeding, historical trauma, lack of social support, and their mental health state (Lauret de Mola et al., 2016; 2020 Mom, 2022). Mental health states like anxiety and depression play a crucial role in declining breastfeeding. Breastfeeding also reduces the odds of suffering from severe depression symptoms (Loret de Mola et al., 2016). Moreover, the probability of breastfeeding cessation increases with an increase in the level of anxiety and depression (Sharifi et al., 2016). Thus, the screening of anxiety and depression among mothers after childbirth and during pregnancy is highly recommended and necessary (Sharifi et al., 2016).

In the US, mental illnesses are common and affect nearly one in five adults (DHHS, 2022). The prevalence of any kind of mental health issues is higher in females (25.8%) as compared to males (15.8%) (DHHS, 2022). Also, anxiety and depression have increased by 37% in teen girls, which will lead to an increase in the number of women suffering from postpartum depression in the near future (ACOG, 2015). Thus, mothers' mental health is in crisis, and this harms the health of the whole family. Also, identifying and treating maternal mental health is crucial to helping them recover and improving exclusive and continued breastfeeding rates. If such conditions go undiagnosed and untreated, they can cause maternal and infant morbidity and mortality, as well as

injuries, substance abuse complications, poor cognitive development in children, and an enormous health-cost burden on families and society (Howard et al., 2020).

Also, very little research and evidence exists that determines the association between maternal mental health (anxiety and depression) and breastfeeding behaviors in the US. Therefore, this research filled an important public health gap by assessing maternal mental health and its influence on breastfeeding outcomes in Clark County, Nevada. This study has the potential to provide information for formulating prevention strategies to alleviate maternal mental health problems and ultimately increase breastfeeding rates. Overall, it will promote the health of the mother, child, community, and nation as a whole.

1.6 Objectives

The objectives of this study were:

General Objective

- To assess whether maternal mental health (anxiety and depression) impacts exclusive and continued breastfeeding practices.

Specific Objectives:

- To identify whether maternal mental health (anxiety and depression) impacts exclusive breastfeeding.
- To analyze whether maternal mental health (anxiety and depression) impacts continued breastfeeding.

Chapter 2: Background and Significance

2.1 Physiological Mechanisms Linking Breastfeeding and Maternal Mental Health

There are hormonal changes in a woman during pregnancy and after childbirth. These hormonal changes after childbirth can cause mood disorders, anxiety, and depression among mothers. Specifically, two hormones, *prolactin,* and *oxytocin,* are directly linked to breast milk production and breastmilk release respectively (Lawrence and Lawrence, 2005; Uvnäs Moberg et al., 2020). Increased levels of *oxytocin,* which enhances bonding between a mother and child, activates *prolactin* (Levine et al., 2007; Uvnäs Moberg et al., 2020). A positive correlation is also observed between the level of *prolactin* and the duration of breastfeeding. On the other hand, low *oxytocin* levels have been linked to symptoms of anxiety and depression, including postpartum depression. *Oxytocin* levels can be naturally boosted with music, exercise, simple massage or touch, cuddles, or giving someone a hug, which leads to an increase in the levels of this hormone and a greater sense of well-being among mothers (Uvnäs Moberg et al., 2020).

Mothers who breastfeed have lower blood pressure and do not react more to physical and emotional stress than non-breastfeeding women (Gribble, 2006). During breastfeeding, mothers convey a relaxation response in their brains. Less stressed mothers are more likely to be responsive to their children. Furthermore, some studies have discovered that women who breastfeed are more socially interactive and care for their children more than mothers who do not breastfeed (Gribble, 2006). A systematic review by Groer et al. (2006) also noted that breastfeeding protects women's mental health by inducing calm reactions to stressors and promoting nurturing behavior. Therefore, breastfeeding protects maternal mood and has a protective effect on mothers' mental health.

2.2 Maternal Mental Health

The period after childbirth is a critical period in which maternal mental health symptoms develop in a mother. Akman et al. (2019) enrolled 60 mothers in a prospective, longitudinal study and revealed that a higher Edinburgh Postnatal Depression Scale (EPDS) score is associated with breastfeeding cessation by four months after childbirth. Similarly, a prospective cohort study among Hispanic women done in Western Massachusetts proclaimed that mothers with depression during pregnancy, in consonance with the EPDS tool, were less likely to aspire to breastfeeding as compared to mothers without depression (Insaf et al., 2011).

A prospective cohort study conducted in Malaysia among 2,072 mothers discovered that mothers who were not exclusively breastfeeding their newborns were associated with the symptoms of depression. Depression symptoms were assessed using the EPDS tool (Yusuff et al., 2016). Thus, exclusive breastfeeding was negatively associated with postnatal depression for mothers living in Malaysia (Yusuff et al., 2016).

A systematic review on breastfeeding and depression was conducted by Dias and Figueiredo (2015), and 48 studies were included in the final data extraction. This review revealed that breastfeeding duration is associated with maternal postpartum depression in most of the studies included, and breastfeeding cessation can be a predictor for postpartum depression in some studies.

A recent case-control study by Assarian et al. (2014) was conducted in Iran with 458 mothers, out of which 227 were cases (mothers who both bottle-fed and breastfed—unsuccessful breastfeeding) and 231 were controls (mothers who exclusively breastfed—successful breastfeeding). This study revealed a significant association between maternal mental health and breastfeeding status ($p =$

0.001 and OR = 1.83). Mothers with unsuccessful breastfeeding were 1.83 times more likely to have a psychological disorder, as compared to mothers with successful breastfeeding.

Hahn-Holbrook et al. (2013) did research in California, USA, among 205 women. The EPDS tool was used to measure depressive symptomatology after childbirth: 3, 6, 12, and 24 months postpartum. This study found a bi-directional relationship between breastfeeding and depression, with early breastfeeding resulting in lower depression cases and early depression resulting in less breastfeeding.

Ciftçi and Arikan (2012) conducted an experimental study in Turkey with 62 mothers, in which 32 of them were in the experimental group and 30 of them were in the control group. The mothers in the experimental group were only trained in breastfeeding practices. This study revealed that the frequency of breastfeeding affects the level of maternal anxiety, and the level of anxiety among mothers decreased with the increase in frequency of breastfeeding. It concluded that informing mothers about breastfeeding reduces anxiety and improves their breastfeeding practice.

A few studies have found that mothers with high levels of anxiety and depression are more likely to give supplementary nutrition, and they are also less likely to continue breastfeeding (Dunn et al., 2006; Galler et al., 2006; Watkins et al., 2011; and Thome et al., 2006). Similarly, several studies have discovered a link between maternal anxiety and breastfeeding difficulties, as well as shorter breastfeeding intention and duration. (Ali et al., 2009; Fairlie et al., 2009; Ystrom, 2012).

A prospective study was done by Hamdan and Tamim (2012) in Arabic, and they included 137 mothers to analyze the relationship between postpartum depression and breastfeeding. This study found that breastfeeding mothers had lower scores on the EPDS at two and four months postpartum

($p < 0.0037$ and $p < 0.0001$) and concluded that postpartum depression might decrease the frequency of breastfeeding.

A cross-sectional study among 1058 mothers in Iceland showed that mothers who had a high education had an increased tendency to breastfeed exclusively, while low education, high depressive symptoms, and single motherhood decreased the possibility of exclusive breastfeeding (Thome et al., 2006). This study stated that depression symptoms among mothers are related to a lower frequency of exclusive breastfeeding.

Henderson et al. (2003) did research among a cohort of 1745 women in Australia and investigated the relationship between maternal depression after childbirth and breastfeeding duration. The EPDS tool was used to screen for depression. This study found that 18% of women had developed depression in the 12 months after childbirth and depressed mothers decreased their breastfeeding rapidly after six months as compared to non-depressed mothers. Thus, breastfeeding cessation was significantly associated with maternal depression after childbirth with an adjusted hazard ratio of 1.25.

Maternal mental health conditions are not only caused by neurochemical factors but also by other factors like low socioeconomic status (SES)—employment, marital status, and education. Women of low SES are 11 times more likely to show depression symptoms as compared to women of higher SES (National Partnership for Women and Families, 2021). Also, people of color are disproportionately affected. Maternal depression is more common in Latina and black mothers than in white mothers, and depression after childbirth has also been linked to housing instability (National Partnership for Women and Families, 2021).

2.3 Gaps in Knowledge

Maternal anxiety and depression can be dreadful in their severe forms, which are preventable causes of maternal and infant morbidity/mortality. There was a paucity of studies in Clark County, Nevada, exploring whether maternal mental health negatively influences breastfeeding (both exclusive and continued breastfeeding) practices. Undiagnosed and untreated mental health conditions like anxiety and depression could result in long-standing negative consequences for both mothers and their children. As far as we know, the links between anxiety and depression have never been explored among breastfeeding mothers, either. Thus, there was a need to shed light on the relationship between anxiety and depression symptoms of mothers and the role of these factors in influencing exclusive and continued breastfeeding practices. A lack of proper knowledge about the combined effects of these mental health states on breastfeeding can have a negative impact on national breastfeeding promotion activities by health professionals and other concerned stakeholders.

Chapter 3: Methods

3.1 Research Question

Does maternal mental health (anxiety and depression) negatively impact exclusive and continued breastfeeding practices?

3.2 Hypothesis

The hypothesis of this study was that the frequency of breastfeeding practices (exclusive and continued) are lower among mothers with mental health issues such as anxiety and depression.

3.3 Study Setting

Clark County, the 14th largest county in the US and the largest county in Nevada, occupies 8,102 square miles and is home to 70% of Nevada's population. It comprises six jurisdictions: the City of Las Vegas, the City of Henderson, the City of North Las Vegas, Boulder City, the City of Mesquite, and unincorporated Clark County. The population of Clark County as of 2022 was 2,350,206, in which most of the residents were white (54.0%), followed by black or African American (12.7%), and Asian (10.2%) (Healthy Southern Nevada, 2022). Among them, Hispanics or Latinos represented 32.8% of the population. Similarly, 50.2% of the total population were female, with 35.6% being between the ages of 18 and 44. As of 2022, 35.7% of households in Clark County had an income of less than $49,999, with 7.2% of families having children living below the poverty line (Healthy Southern Nevada, 2022).

The exclusive breastfeeding prevalence through six months in Nevada was 22.3%, which is lower than the national prevalence (24.9%) and the breastfeeding rate at twelve months in Nevada was 27.6%, which is also lower than the national prevalence (35.9%) (CDC, 2022). There are only two hospitals that are designated as "Baby Friendly Hospital Initiative" in Clark County, meaning they

are certified to protect, support, and promote breastfeeding. Moreover, only 17.3% of adults were diagnosed with mental health issues like depression, as compared to the national value of 18.8%. Also, the prevalence of adult depression is higher among females (20.7%) than males (12.3%) in Clark County, Nevada (Healthy Southern Nevada, 2022). Similarly, the national prevalence of adult depression among females (23.4%) is also higher among males (13.1%) (CDC, 2023). Likewise, a recent study showed that about 6% of mothers having children under six months old and living in Clark County, Nevada, were at high risk for postnatal depression (Saniatan et al., 2023).

3.4 Study Design

This cross-sectional study consisted of the analysis of survey data targeting mothers having children 0 - 23 months old of age in Clark County (Boulder City, Henderson, Las Vegas, North Las Vegas, and Mesquite), Nevada, and investigated a wide range of maternal sociodemographic characteristics, perinatal characteristics, infant/child characteristics, maternal mental health, and breastfeeding outcomes. Ethical approval was granted by the Institutional Review Board (Protocol UNLV-2022-372) of the University of Nevada, Las Vegas.

3.5 Sampling

Power analysis was conducted using G Power 3.1.9.2 to determine the sample size at small effect size of 0.2 with 80% power, cohen's d= 0.2 (Faul et al., 2007). The estimated minimum sample size was 71 mother-child dyads. A total of 358 mothers responded to the survey, including 123 mothers with children under six months, 235 mothers with children from 7-23 months, and 152 mothers with children 12-23 months. Thus, our sample size exceeded the minimum requirement as estimated.

Eligible mothers were 18 years old or older, had a child from 0 to 23 months old, and resided in Clark County, Nevada (including the cities of Las Vegas, North Las Vegas, Henderson, Mesquite, and Boulder City). Furthermore, 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 difficult breastfeeding practices were excluded.

3.6 Data Collection

Data collection happened from November 2022 to March 2023. A convenience sampling technique was employed to recruit mothers attending WIC, birth, lactation, and pediatric care centers in Clark County, as well as through social media (e.g., Facebook, Instagram). Eligible mothers responded to the survey with close-ended questions related to the maternal sociodemographic characteristics, perinatal characteristics, infant/child characteristics, maternal mental health, and breastfeeding outcomes. Both English and Spanish surveys were available. Informed consent was received prior to the beginning of the survey. The participation of mothers in this study was voluntary, and written informed consent was obtained before starting to respond to the survey. Anonymity, confidentiality, and privacy of the information was maintained.

3.7 Measurements

Outcomes: Exclusive and continued breastfeeding practices are the key dependent variable of interest. The age group for each outcome are different, in which exclusive breastfeeding was measured for children under six months old and continued breastfeeding was measured for 7-23 months old children. 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 (WHO, 2021).

Exclusive breastfeeding was defined as the percentage of infants under six months old who were fed breast milk exclusively during the previous day (with no other drink or food, not even water). Exclusive breastfeeding was 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/food choices. If the child received only breastmilk and no other liquid or food in the previous 24 hours, it was considered exclusive breastfeeding.

Continued breastfeeding was defined as the percentage of children 7-23 months old who were breastfed during the previous day (WHO, 2021). Continued breastfeeding was determined by the question, "From yesterday morning until this morning, what has your child eaten? Check all that apply." The response options were "yes" or "no" for all the liquid/food choices. If the child received breastmilk in the previous 24 hours, with other liquid/food items, that was considered as continued breastfeeding. Additional analysis based on the WHO official definition of the continued breastfeeding indicator utilizing the sample of children 12-23 months old were conducted and are reported in Appendix III.

Independent Variables:In this study, two independent variables were used to characterize maternal mental health status: anxiety and depression. Standard tools were used to assess them:

Anxiety: The Generalized Anxiety Disorder 7-Item Scale (GAD-7) was used to detect mothers at risk for anxiety (Spitzer et al., 2006). GAD-7 is a seven-item instrument that assesses the severity of anxiety. 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. Then, mild, moderate, and severe anxiety were categorized as 'Presence' of anxiety, and minimal anxiety was re-categorized as 'Absence' of anxiety.

Depression: The Edinburgh Postnatal Depression Scale (EPDS) was used to detect mothers at risk of depression (Cox et al., 1987). EPDS is a ten-item instrument that assesses the severity of depression. Each item was asked how the mother has 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 and was classified as: 0-6 for minimal depression, 7-13 for mild depression, 14-19 for moderate depression, and 19-30 for severe depression. Then, mild, moderate, and severe depression were re-categorized as 'Presence' of depression, and minimal depression was categorized as 'Absence' of depression.

Co-variables: Selection of covariables was guided by the conceptual hierarchical framework (Victora et al., 1997) and empirical evidence supporting associations with maternal mental health and breastfeeding outcomes (Rollins et al., 2016; Hahn-Holbrook et al., 2013; Pope and

Mazmanian, 2016; Loret de Mola et al., 2016; Assarian et al., 2014; Dias and Figueiredo, 2015). 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 (Figure 1).

Maternal socio-demographic characteristics included household income (up to $74,999; more than $75,000), age of mother (18–24; 25–34; 35–44), education (graduate degree) (yes; no), 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 breastmilk (yes; no). Infant/child characteristics included pre-term/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), child attending day care/ pre-K (yes; no), and co-sleeping (yes; no).

Figure 1. Conceptual framework:

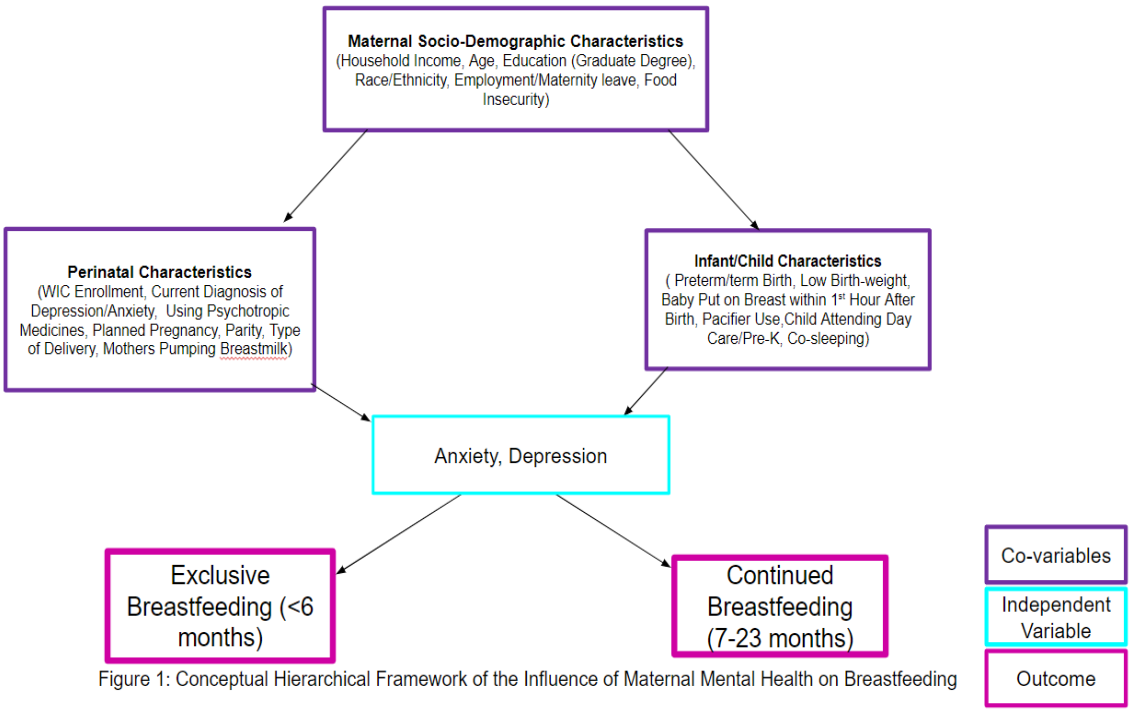


Figure 1: Conceptual Hierarchical Framework of the Influence of Maternal Mental Health on Breastfeeding

3.8 Data Analysis

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

3.8.1 Descriptive and Bivariate

A descriptive analysis to explore the outcome, independent variables, and covariables was performed. Pearson's $\chi 2$ test was used to evaluate the bivariate association between the outcomes with independent variables and covariables. Variables associated with outcomes with a $p \leq 0.20$ were included in the multivariate logistic regression models.

3.8.2 Multivariate Logistic Regression Models

Logistic regression findings were expressed as adjusted odds ratios (AORs) and confidence intervals (95% CI). Models estimated the associations between the outcomes with maternal anxiety (Model 1) and maternal depression (Model 2), adjusted by covariables.

3.8.3 Interaction Models

Interaction happens when, in the presence of two factors, the outcome occurs more frequently than would be expected based on the independent effects of each factor. By independent effect, we mean the effect of one factor in the absence of the other factor (Schwartz S, 2006). We examined the interaction between both anxiety and depression combined on the outcomes (Model 3).

Chapter 4: Results

A total of 358 mothers from Clark County, Nevada was reached. Among them, 123 mothers had children under six months old with more than a third (35.0%) exclusively breastfeeding, and 235 mothers had children from 7-23 months old with half of them (50.9%) continuing breastfeeding. Regarding maternal mental health, 66.4% of mothers had symptoms of anxiety and 58.9% had symptoms of depression (Table 1).

Among all mothers, 56.6% had incomes greater than $75,000, and more than 60.0% of mothers belonged to the age group of 25-34 years. The risk for food insecurity was reported by 31.3% of the mothers. Most of the mothers had a planned pregnancy (69.0%), were multiparous (51.1%), and had a vaginal delivery (58.9%). In addition, a higher percentage of mothers, 70.1%, put their babies on their breasts within the first hour of birth. More pacifier use was observed for mothers with infants under six months (63.6%) in contrast to mothers with infants or children 7-23 months old (30.4%) (Table 1).

Table 1. Descriptive analysis of breastfeeding outcomes, maternal mental health, socio-demographic, perinatal, and infant/child characteristics, 2023.

Variables	All (0-23 months) (n=358)	<6 months (n=123)	7-23 months (n=235)
	n (%)	n (%)	n (%)
Outcomes			
Exclusive breastfeeding			
Yes	-	43 (35.0)	-
No	-	80 (65.0)	-
Continued breastfeeding			
Yes	-	-	114 (50.9)
No	-	-	110 (49.1)
Independent variables			
Anxiety			
Presence	233 (66.4)	80 (66.7)	153 (66.2)
Absence	118 (33.6)	40 (33.3)	78 (33.8)
Depression			
Presence	201 (58.9)	66 (56.9)	135 (60.0)
Absence	140 (41.1)	50 (43.1)	90 (40.0)
Co-variables			
Maternal socio-demographic characteristics			
Household income			
Up to $74,999	155 (43.3)	55 (45.1)	100 (42.6)
More than $75,000	202 (56.6)	67 (54.9)	135 (57.4)
Age of mother (Years)			
18 - 24	45 (12.6)	19 (15.4)	26 (11.1)
25 - 34	229 (64.0)	81 (65.9)	148 (63.0)
35-44	84 (23.5)	23 (18.7)	61 (26.0)
Graduate degree (Education)			
Yes	94 (26.3)	32 (26.0)	62 (26.4)
No	264 (73.7)	91 (74.0)	173 (73.6)
Mother's race/ethnicity			
Non-Hispanic White	170 (47.5)	59 (48.0)	111 (47.2)
Others	188 (52.5)	64 (52.0)	124 (52.8)
Mother's employment			
Working	-	-	149 (63.4)
Not working	-	-	86 (36.6)
Had maternity leave			
Yes	-	90 (73.2)	-
No	-	33 (26.8)	-
Food insecurity			
Food secure	246 (68.7)	89 (72.4)	157 (66.8)
Food insecure	112 (31.3)	34 (27.6)	78 (33.2)

Table 1 Continued. Descriptive analysis of breastfeeding outcomes, maternal mental health, socio-demographic, perinatal, and infant/child characteristics, 2023.

Variables	All (0-23 months) (n=358)	<6 months (n=123)	7-23 months (n=235)
	n (%)	n (%)	n (%)
Perinatal characteristics			
WIC enrollment			
Yes	75 (20.9)	26 (21.1)	49 (20.9)
No	283 (79.1)	97 (78.9)	186 (79.1)
Current diagnosis of depression/anxiety			
Yes	106 (30.3)	42 (34.7)	64 (27.9)
No	244 (69.7)	79 (65.3)	165 (72.1)
Using psychotropic medications			
Yes	54 (15.1)	21 (17.1)	33 (14.0)
No	304 (84.9)	102 (82.9)	202 (86.0)
Planned pregnancy			
Yes	247 (69.0)	86 (69.9)	161 (68.5)
No	111 (31.0)	37 (30.1)	74 (31.5)
Parity			
Primiparous	175 (48.9)	50 (41.0)	124 (52.8)
Multiparous	183 (51.1)	72 (59.0)	111 (47.2)
Type of delivery			
Vaginal	211 (58.9)	71 (57.7)	140 (59.6)
C-section	147 (41.1)	52 (42.3)	95 (40.4)
Mothers' pumping breastmilk			
Yes	135 (38.4)	72 (60.0)	63 (27.2)
No	217 (61.6)	48 (40.0)	169 (72.8)
Infant/child characteristics			
Pre-term/term birth			
Pre-term birth	69 (19.3)	31 (25.2)	38 (16.2)
Term birth	289 (80.7)	92 (74.8)	197 (83.8)
Low birth weight			
Yes	25 (7.0)	15 (12.3)	10 (4.3)
No	331 (93.0)	107 (87.7)	224 (95.7)
Baby put on the breast within the first hour after birth			
Yes	251 (70.1)	89 (72.4)	162 (68.9)
No	107 (29.9)	34 (27.6)	73 (31.1)
Pacifier use (last 24 hour)			
Yes	147 (41.9)	77 (63.6)	70 (30.4)
No	204 (58.1)	44 (36.4)	160 (69.6)
Child attending day care/Pre-K			
Yes	56 (15.8)	9 (7.4)	47 (20.2)
No	299 (84.2)	113 (92.6)	186 (79.8)
Co-sleeping			
Yes	251 (71.5)	111 (91.7)	140 (60.9)
No	100 (28.5)	10 (8.3)	90 (39.1)

In the bivariate analysis, exclusive breastfeeding was associated with depression (p=0.037), type of delivery (p=0.047), mothers' pumping breast milk (p=0.008), and babies put on the breast within the first hour after birth (p=0.004). The prevalence of exclusive breastfeeding was higher for mothers who had no symptoms of depression (46.0%, p=0.037), having a vaginal delivery (42.3%, p=0.047), mothers' pumping breast milk (44.4%, p=0.008), and babies put on breast within the first hour after birth (42.7%, p=0.004), as opposed to those mothers who had symptoms of depression, c-section delivery, mothers' not pumping breastmilk, and babies who were not put on breast within the first hour after birth, respectively (Table 2).

Similarly, the prevalence of continued breastfeeding was more frequent for mothers who had no symptoms of anxiety (61.3%, p=0.03), not working mothers (62.4%, p=0.007), multiparous mothers (59.4%, p=0.015), vaginal delivery (56.3%, p=0.046), mothers' pumping breast milk (86.7%, p<0.001), no pacifier use (56.2%, p=0.013), and co-sleeping (59.3%, p=0.001) as compared with mothers who had symptoms of anxiety, working mothers, primiparous mothers, c-section, mothers' not pumping breast milk, pacifier use, and not co-sleeping, respectively (Table 2).

Table 2. Bivariate analysis of breastfeeding outcomes by maternal mental health, socio-demographic, perinatal, and infant/child characteristics, 2023.

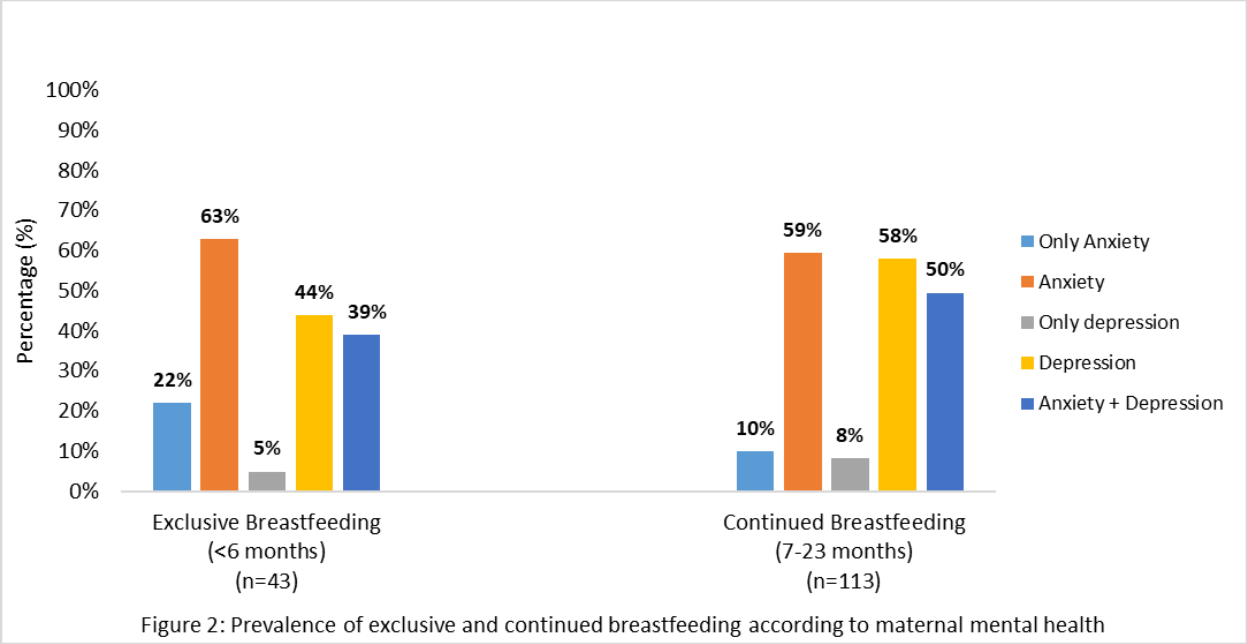
Variables	Exclusive Breastfeeding (<6 months) n=123			Continued Breastfeeding (7-23 months) n=235		
	n	%	P value	n	%	P value
Anxiety						
Presence	27	33.8	0.501	67	45.9	0.03*
Absence	16	40.0		46	61.3	
Depression						
Presence	18	27.3	0.037*	65	50.0	0.447
Absence	23	46.0		47	55.3	
Household income						
Up to $74,999	17	30.9	0.364	45	46.4	0.239
More than $75,000	26	38.8		69	54.3	
Age of mother (Years)						
18 - 24	8	42.1	0.726	9	37.5	0.215
25 - 34	28	34.6		79	54.9	
35 - 44	7	30.4		26	46.4	
Graduate degree (Education)						
Yes	15	46.9	0.10*	28	47.5	0.54
No	28	30.8		86	52.1	
Mother's race/ethnicity						
Non-Hispanic White	21	35.6	0.89	59	54.6	0.28
Others	22	34.4		55	47.4	
Mother's employment						
Working	-	-	-	61	43.9	0.007*
Not working	-	-		53	62.4	
Had maternity leave						
Yes	29	32.2	0.293	-	-	-
No	14	42.4		-	-	-
Food insecurity						
Food secure	33	37.1	0.425	81	54.0	0.185*
Food insecure	10	29.4		33	44.6	
WIC enrollment						
Yes	6	23.1	0.152*	19	41.3	0.144*
No	37	38.1		95	53.4	
Current diagnosis of depression/ anxiety by a health professional						
Yes	11	26.2	0.192*	32	52.5	0.842
No	30	38.0		80	51.0	
Using psychotropic medications						
Yes	4	19.0	0.093*	15	48.4	0.764
No	39	38.2		99	51.3	
Planned pregnancy						
Yes	34	39.5	0.105*	78	51.3	0.854
No	9	24.3		36	50.0	

Table 2 Continued. Bivariate analysis of breastfeeding outcomes by maternal mental health, socio-demographic, perinatal, and infant/child characteristics, 2023.

Variables	Exclusive Breastfeeding (<6 months) n=123			Continued Breastfeeding (7-23 months) n=235		
	n	%	P value	n	%	P value
Parity						
Primiparous	20	40.0	0.501	51	43.2	0.015*
Multiparous	23	31.9		63	59.4	
Type of delivery						
Vaginal	30	42.3	0.047*	76	56.3	0.046*
C-section	13	25.0		38	42.7	
Mothers' pumping breastmilk						
Yes	32	44.4	0.008*	52	86.7	<0.001*
No	10	20.8		60	37.3	
Pre-term/Term birth						
Pre-term birth	7	22.6	0.095*	13	36.1	0.053*
Term birth	36	39.1		101	53.7	
Low birth weight						
Yes	3	20.0	0.187*	3	30.0	0.172*
No	40	37.4		111	52.1	
Baby put on the breast within the first hour after birth						
Yes	38	42.7	0.004*	86	55.5	0.039*
No	5	14.7		28	40.6	
Pacifier use (last 24 hour)						
Yes	24	31.2	0.279	25	37.9	0.013*
No	18	40.9		86	56.2	
Child attending day care/Pre-K						
Yes	2	22.2	0.395	17	38.6	0.069*
No	41	36.3		96	53.9	
Co-sleeping						
Yes	40	36.0	0.308*	80	59.3	0.001*
No	2	20.0		31	36.9	

*p <0.20

Figure 2. Prevalence of exclusive and continued breastfeeding according to maternal mental health



Among exclusive breastfeeding mothers, 22% reported symptoms of only anxiety and 39% reported symptoms of both anxiety and depression, whereas among continued breastfeeding mothers only 10% reported symptoms of only anxiety and 49.6% reported symptoms of both anxiety and depression (Figure 2).

In the multivariate analysis, exclusive breastfeeding was independently associated with the presence of symptoms of depression (AOR = 0.13, 95% CI: 0.03- 0.51) compared to mothers without symptoms of depression. The interaction between symptoms of both anxiety and depression was also independently associated with exclusive breastfeeding practices (AOR= 0.15, 95% CI: 0.04-0.57) compared to mothers without symptoms of depression and anxiety. Likewise,

continued breastfeeding was significantly associated with the presence of anxiety (AOR=0.41, 95% CI: 0.18-0.91) compared to mothers without anxiety (Table 3). The interaction between symptoms of anxiety and depression was not associated with continued breastfeeding practices.

Table 3. Adjusted odds ratio for exclusive breastfeeding (<6 months) and continued breastfeeding (7-23 months) including the interaction of maternal mental health.

Study Variables	**EBF**			**CBF**		
	Model 1 EBF & Anxiety	Model 2 EBF & Depression	Model 3 EBF & Anxiety & Depression	Model 1 CBF & Anxiety	Model 2 CBF & Depression	Model 3 CBF & Anxiety & Depression
	AOR (95% CI)[a]	AOR (95% CI)[a]	AOR (95% CI)[a]	AOR (95% CI)[c]	AOR (95% CI)[c]	AOR (95% CI)[c]
Anxiety		-			-	-
Absence	1		-	1		
Presence	0.91 (0.33-2.53)			0.41 (0.18-0.91)*		
Depression	-			-		
Absence		1			1	
Presence		0.13 (0.03-0.51)*			0.77 (0.36-1.64)	
Anxiety & Depression					-	
Absence			1			1
Presence			0.15 (0.04-0.57)*			0.50 (0.23-1.09)

Abbreviations: EBF, Exclusive Breastfeeding; CBF, Continued Breastfeeding; AOR, adjusted odds ratio; CI, confidence interval; * $p<0.05$

[a]Odds ratio adjusted by logistic regression for household income, age of mother, graduate degree (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 breastmilk, pre-term/term birth, low birth weight, and baby put on the breast within the first hour after birth.

[c]Odds ratio adjusted by logistic regression for household income, age of mother, graduate degree (education), race/ethnicity, mother's employment, food insecurity, WIC enrollment, parity, type of delivery, mothers' pumping breastmilk, pre-term/term birth, low birth weight, baby put on the breast within the first hour after birth, pacifier use (last 24 hour), child attending day care/Pre-K, and co-sleeping.

Chapter 5: Discussion and Conclusion

5.1 Discussion

To our knowledge, our study is one of the first studies to document exclusive breastfeeding and continued breastfeeding indicators as well as maternal anxiety and depression prevalences in Clark County, Nevada. Our findings identified maternal anxiety and depression as an independent risk factor for decreasing frequency of breastfeeding practices among mothers of children under two years old. In addition, we identified the interaction of both maternal anxiety and depression on lower frequency of breastfeeding practices. Our study highlighted the crucial role of sound maternal mental health, considering it as a key criterion for exclusive and continued breastfeeding. These findings call attention to the maternal mental health and breastfeeding concerns of maternal dyads living in urban areas of the state of Nevada.

About breastfeeding practices, our study found a prevalence of exclusive breastfeeding (35.0%) and continued breastfeeding (50.9%). The exclusive breastfeeding rate is higher than the national average (24.9%) but lower than what was observed in a recent study in Clark County, Nevada (53.6%) (CDC 2022; Saniatan et al., 2023). The Centers for Disease Control and Prevention (CDC) only reports continued breastfeeding rates for children at one year of age. The continued breastfeeding rate in the US according to the CDC at one year of age is 35.9% (CDC, 2022), whereas our study indicated a much higher prevalence at two years, exactly 50.9%. This might be because in our study setting (Clark County, Nevada), most of our sample mothers had higher education and income. Well-educated and high-income mothers tend to have better accessibility to breastfeeding resources and are more aware of the health benefits of breastfeeding for both mothers and infants, which motivates them to practice and continue breastfeeding. Our findings

also highlighted the importance of recording continued breastfeeding for two years in the US following the recommendation of the American Academy of Pediatrics (AAP) and the World Health Organization (WHO) (CDC, 2022; Meet et al., 2022).

More than half of the participants in our study reported symptoms of postpartum anxiety and depression. The only data on maternal perinatal mental health available in Nevada refers to 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 (Neupane et al., 2023), which is similar to the frequency of only depression symptoms found in our current study (5-8%). Our findings are important due to the existing disparities in higher depression rates among females (vs. males) in Nevada and the US (Healthy Southern Nevada, 2022; CDC, 2023; America's Health Rankings, 2020; CDC, 2023). In addition, Clark County in Nevada is considered a Mental Health Professional Shortage Area (i.e., a geographic area of populations that lack enough mental health care providers to address the mental health care needs of that population) (Nevada Public Health Institute, 2022) which specifically prevents communities of color in the county from receiving responsive perinatal support (Saniatan et al., 2023). While the contributing factors related to disparities in adult depression in Nevada are not specified in the literature, considering the existing mental health disparities, our study highlights the importance of assessing the impact of maternal postpartum anxiety and depressive symptoms within our local maternal-child communities.

In our study mothers reporting postpartum anxiety symptoms had significantly lower odds of continuing breastfeeding after 6 months of postpartum. Our results are consistent with existing evidence that postnatal anxiety is a predictor of breastfeeding interruption (Hoff et al., 2019; Fallon et al., 2016; Ystrom, 2012; Ali et al., 2009; Fairlie et al., 2009). A longitudinal study in Canada

showed that anxiety in the postpartum period is associated with lower exclusive breastfeeding and continued breastfeeding (Adedinsewo et al., 2013). Furthermore, mothers with higher anxiety were found to be formula-feeding their child (Fukui et al., 2021). Anxiety is possibly influencing breastfeeding practices through two pathways. First, maternal anxiety affects the mother's self-esteem, which can have a negative impact on mother-child bonding and interactions, declining the mother's self-efficacy related to breastfeeding (Coo et al., 2020; Hoff et al., 2019; Zanardo et al., 2009). Second, maternal anxiety is linked to maternal stress, interfering with the production of oxytocin, affecting the milk ejection reflex, and adversely impacting breastfeeding physiologically (Hoff et al., 2019; Zanardo et al., 2009). Therefore, we provided a critical piece of information about maternal anxiety and emphasized the need to diagnose and treat maternal anxiety because not treating such conditions can have even worse detrimental impacts on the mental health of mothers, eventually impacting both maternal and child well-being.

Our study also indicated that mothers with the symptoms of postpartum depression had significantly lower odds of exclusively breastfeeding. Our results are in line with previous literature that showed a link between maternal depression and breastfeeding difficulties, as well as shorter breastfeeding duration (Coo et al., 2020; Ystrom, 2012; Ali et al., 2009; Fairlie et al., 2009). Correspondingly, reduced breastfeeding span was predicted by postpartum depression (Yusuff et al., 2016; Dias & Figueiredo, 2015; Hahn-Holbrook et al., 2013; Hamdan & Tamim, 2012; Thome et al., 2006; Henderson et al., 2003). A recent study in Greece also showed that the presence of postpartum depression decreased the likelihood of exclusive breastfeeding (Dagla et al., 2021). Our study showed that mentally burdened mothers have breastfeeding difficulties and thus choose to interrupt it early (Dagla et al., 2021). Postnatal depression can result from birth trauma, which

might cause emotional distress and post-traumatic stress disorder (PTSD). Furthermore, mothers are more vulnerable to postpartum depression because of a pre-existing history of mental illness and post-traumatic stress after childbirth, making it difficult for mothers to engage in nurturing behaviors and bonding and therefore affecting successful breastfeeding (Ertan et al., 2021; Van Niel & Payne, 2020).

We found that the interaction between anxiety and depression symptoms among mothers had a negative influence on exclusive breastfeeding rates. To our knowledge, no previous studies have investigated the interaction between anxiety and depression and its influence on exclusive breastfeeding. Therefore, our study highlighted an important area of research that provided an insight into the challenges faced by mothers who are facing the double burden of anxiety and depression, and its negative influence on breastfeeding practices. This might be because the first six months of postpartum are the peak time for anxiety and depression to occur among mothers because of both physical and emotional fatigue, challenging parenting, social isolation and poor social support, sleep deprivation, and a negative self-perception about breastfeeding inadequacy (Mughal et al., 2022). On the other hand, our study did not find any association between the interaction of both maternal anxiety and depression symptoms with continued breastfeeding practices. This might be because the feelings of depression might gradually decrease after six months postpartum as mothers may take time to emotionally adjust to new motherhood roles and responsibilities. Anxiety, depression, self-doubt, and overwhelm might be more intense in early postpartum than later. Still, further research is needed to explore the psychological benefits of breastfeeding for the mother, considering both early and late postpartum (Husada A, 2021).

When the government and healthcare professionals investigate the reasons for the shorter duration of breastfeeding, they do not consider what a mother's psycho-emotional state was in the prenatal period. Healthcare professionals, whose mothers mostly rely on breastfeeding support, prioritize breastfeeding positions and techniques in mothers rather than meticulously examining their mood, worries, and feelings (Dagla et al., 2021). That is why a mental health continuum of care is crucial during the perinatal period. The continuum of care for perinatal mental health should focus on four main areas: (1) **promotion interventions:** these culturally appropriate interventions encompass comprehensive strategies to raise awareness on the importance of maternal mental health and promote perinatal mental health (Pezley et al., 2022) ; (2) **universal preventive interventions:** creating clinical processes during the prenatal and postnatal period for universal screening and counseling for mothers-to-be and recent mothers on mental health issues. Programs for universal screening for perinatal mood and anxiety disorder (PMAD) have been linked with higher mental health service use, referral rates, and reduced symptomatology (Peifer et al., 2022; Bright et al., 2020); (3) **selective preventive intervention:** support of mental health and well-being through effective referrals to mental health support groups. Research shows group interventions are the most effective (and preferred by patients) treatment modalities for PMADs (Peifer et al., 2022; Bright et al., 2020) and (4) **indicated preventive intervention:** providing one-on-one clinical interventions (therapies) as needed. Short-term models that included interventions from acceptance and commitment therapy (ACT), dialectical behavioral therapy (DBT), and cognitive behavioral therapy (CBT) over the course of 6-12 weeks have proven to decrease parental anxiety and reduce overall mental illness symptoms, while also improving self-awareness, social support, and relationship satisfaction (Peifer et al., 2022; Gómez et al., 2021). These actions should not only be

confined to the individual level but also involve partners, family members like grandparents, and other social support networks (Peifer et al., 2022; Pezley et al., 2022). Likewise, improved accessibility, affordability, and cultural competency in services are required at the community level. Ultimately, policy level interventions such as better maternity leave policies, child care support, and adhering to the Baby Friendly Hospital Initiative (BFHI) known to promote and increase breastfeeding practices should incorporate interventions to promote the continuum of care on perinatal mental health As poor mental health undermines breastfeeding, it is crucial to address these barriers (Dias & Figueiredo, 2015; Ystrom, 2012).

Our study had some limitations too that should be considered while interpreting the results. First, convenience sampling techniques were employed to recruit mothers with children 0-23 months old in Clark County. Most of the mothers were recruited through social media despite the efforts to collect data across birth, pediatric, lactation, and other health care centers, which might have limited the diversity of mothers in terms of race, education, and income. However, we assessed the characteristics of the sample with data from Clark County, Nevada and they have similar education and income. Albeit our survey was disseminated in both English and Spanish, which ensured that our survey was inclusive and culturally sensitive and led to more comprehensive and reliable data. Second, this study surveyed mothers having children 0-23 months old about their perinatal and infant/child characteristics, which could have caused recall bias due to differences in the accuracy of recalling memories of past experiences. Also, we adopted the 24-hour diet recall method to measure breastfeeding practice as recommended by the WHO to eliminate recall bias; however, an infant/child might be misclassified as not being breastfed at present if the infant or child was not breastfed during the last 24 hours, even if the infant or child was breastfed prior to

24 hours or only a few days a week. Validated self-reported instruments like Generalized Anxiety Disorder 7-Item Scale (GAD-7) and the Edinburgh Postnatal Depression Scale (EPDS) were used to assess anxiety and depression symptoms, respectively, which might have led to response bias. On the other hand, the use of validated and widely used psychometric tools to measure anxiety and depression allows our findings to be compared to other studies across different settings.

Third, this study did not include mothers living in rural regions; thus, the findings may not be generalized to all the mothers living in rural areas in the United States. However, our study findings could be generalized to mothers living in urban areas with similar population proportions as Clark County in the U.S. Lastly, as this study was cross-sectional in nature, the temporal sequence between breastfeeding outcomes and maternal mental health cannot be established; therefore, reverse causality cannot be ruled out. Moreover, given the absence of postpartum mental health and continued breastfeeding data in Nevada, our study can serve as a baseline for future longitudinal research aiming at shedding light on this causal relationship.

In a nutshell, we found that maternal mental health is a barrier to breastfeeding practices, which has implications on maternal and child health. However, this relationship needs more clarification and research. Undiagnosed and untreated maternal mental health conditions like anxiety and depression can lead to infant and maternal morbidity and mortality, as well as imposing an enormous health-cost burden on families and society (Howard et al., 2020; Walker et al., 2020). With this being said, it highlights the importance of screening for maternal anxiety and depression, starting from prenatal period and continuing until postpartum period to identify the mothers at risk for such conditions so that they can assist mothers at risk with necessary care and support. Hence,

evidence-based strategies and interventions should be implemented to reduce maternal anxiety and depression as it is linked up to breastfeeding success and well-being of mothers and children.

5.2 Conclusion

This research determined the breastfeeding status and maternal mental health of mothers living in Clark County, Nevada, and added to the growing scope of work that explores the relation between maternal mental health and breastfeeding practices. Early identification of maternal anxiety and depression symptoms, including the promotion and protection of breastfeeding practices, can foster the good health and well-being of infants and mothers. Considering the importance of breastfeeding—both exclusive and continued breastfeeding for both mother and child—as well as the mutual association between breastfeeding and maternal mental health, this kind of research has a great public health significance 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.

Appendix I: Variables Table

Table 4. Variables (Outcome, Independent variables, and Covariable) Table

Variables	Definition/Tool	Classification
Outcome: **Breastfeeding**		
Exclusive Breastfeeding	Exclusive breastfeeding means feeding your baby only breast milk, not any other foods or liquids (including infant formula or water), except for medications or vitamin and mineral supplements.	Yes No
Continued Breastfeeding	Percentage of children 12–23 months of age who were fed breast milk during the previous day.	Yes No
Independent Variables: **Maternal Mental Health**		
Anxiety	Anxiety is an emotion characterized by feelings of tension, fear, dread, uneasiness, worried thoughts and physical changes (like increased blood pressure). The Generalized Anxiety Disorder Assessment (GAD-7) is a seven-item instrument that is used to measure or assess the severity of generalized anxiety disorder (GAD). Each item asks the individual to rate the severity of his or her symptoms over the past two weeks. Response options include “not at all”, “several days”, “more than half the days” and “nearly every day” (23). Responses are scored 0, 1, 2 and 3 based on the seriousness of the symptom.	Presence Absence

Depression	Depression is an illness that negatively affects how you feel, the way you think, and how you act. The Edinburgh Postnatal Depression Scale (EPDS) is a set of 10 screening questions that can indicate whether a parent has symptoms that are common in women with depression and anxiety during pregnancy and in the year following the birth of a child. The tool has 10 items and the mother checks how she has felt during the previous 7 days. Responses are scored 0, 1, 2 and 3 based on the seriousness of the symptom.	Presence Absence
Co-variables: ***Maternal socio-demographic characteristics***		
Household Income	The combined incomes of all people sharing a particular household.	Up to $74,999 More than $75,000
Age of mother (years)	The amount of time during which the mother has lived or existed.	18 - 24 25 - 34 35 – 44
Graduate Degree (Education)	The level of education or schooling (graduate degree) that mothers have received thus far.	Yes No
Mother's race/ethnicity	Race refers to the physical characteristics of a person, like skin color, while ethnicity refers to cultural characteristics like religion, history, language, and customs.	Non-Hispanic White Others
Mother's Employment	The mother is engaged in any kind of employment/job.	Working Not working
Had maternity leave	Mother got paid/unpaid leave after the birth of her child.	Yes No

Food insecurity	Lack of consistent access to enough food for an active, healthy life. The Seattle Short Form (A validated 2-item Food Security Screen) is used to assess Food Insecurity.	Food Secure Food Insecure .
Perinatal Characteristics		
WIC Enrollment	Mothers were enrolled in WIC (governmental assistance) program or not.	Yes No
Current diagnosis of depression/anxiety	Mothers were currently diagnosed of anxiety/depression by a health professional or not.	Yes No
Using psychotropic medications	Mothers were currently using psychotropic medications like antidepressants, anti-anxiety medications, mood stabilizers, etc. or not.	Yes No
Planned Pregnancy	The pregnancy is planned or not.	Yes No
Parity	The number of times the mother has given birth to a fetus with a gestational age of 24 weeks or more, regardless of whether the child was born alive or was stillborn.	Primiparous Multiparous
Type of delivery	The method used to give birth. For example, vaginal, cesarean, or any other type of assisted delivery.	Vaginal C-section
Mothers' pumping breastmilk	Mothers were pumping breastmilk at least one time a day or not.	Yes No

Infant/child characteristics		
Pre-term/term birth	Mothers went into labor before 37 weeks of pregnancy (pre-term birth) or after 38 weeks of pregnancy (term birth).	Pre-term birth Term birth
Low birthweight	The weight of newborn baby with less than 5 pounds, 8 ounces (2,500 grams).	Yes No
Baby put on the breast within the first hour after birth	Mothers put their newly born infant on the breast within the first hour after birth or not.	Yes No
Pacifier Use (last 24 hour)	Child used a pacifier in the last 24 hour.	Yes No
Child attending day care/Pre-K	The child is currently attending early childhood education program (day care/pre-K).	Yes No
Co-sleeping	The baby sleeps in the same room with parents or not.	Yes No

Appendix II: Descriptive and Bivariate Analysis for 12-23 months old children

Table 5. Descriptive analysis of breastfeeding outcomes, maternal mental health, socio-demographic, perinatal, and infant/child characteristics for 12-23 months old children, 2023.

Variables	12-23 months (n=152)
	n (%)
Outcomes	
Continued breastfeeding	
Yes	57 (39.9)
No	86 (60.1)
Independent variables	
Anxiety	
Presence	95 (63.8)
Absence	54 (36.2)
Depression	
Presence	82 (56.9)
Absence	62 (43.1)
Co-variables	
Maternal socio-demographic characteristics	
Household income	
Up to $74,999	65 (42.8)
More than $75,000	87 (57.2)
Age of mother (Years)	
18 - 24	15 (9.9)
25 - 34	94 (61.8)
35-44	43 (28.3)
Graduate degree (Education)	
Yes	47 (30.9)
No	105 (69.1)
Mother's race/ethnicity	
Non-Hispanic White	47 (30.9)
Others	105 (69.1)
Mother's employment	
Working	105 (69.1)
Not working	47 (30.9)
Food insecurity	
Food secure	106 (69.7)
Food insecure	46 (30.3)
Perinatal characteristics	
WIC enrollment	
Yes	30 (19.7)

No	122 (80.3)
Current diagnosis of depression/anxiety	
Yes	35 (23.8)
No	112 (76.2)
Using psychotropic medications	
Yes	21 (13.8)
No	131 (86.2)
Planned pregnancy	
Yes	106 (69.7)
No	46 (30.3)
Parity	
Primiparous	87 (57.2)
Multiparous	65 (42.8)
Type of delivery	
Vaginal	91 (59.9)
C-section	61 (40.1)
Mothers' pumping breastmilk	
Yes	24 (15.9)
No	127 (84.1)
Infant/child characteristics	
Pre-term/term birth	
Pre-term birth	22 (14.5)
Term birth	130 (85.5)
Low birth weight	
Yes	7 (4.6)
No	144 (95.4)
Baby put on the breast within the first hour after birth	
Yes	105 (69.1)
No	47 (30.9)
Pacifier use (last 24 hour)	
Yes	45 (30.2)
No	104 (69.8)
Child attending day care/Pre-K	
Yes	34 (22.7)
No	116 (77.3)
Co-sleeping	
Yes	86 (57.7)
No	63 (42.3)

Table 6. Bivariate analysis of breastfeeding outcomes by maternal mental health, socio-demographic, perinatal, and infant/child characteristics for 12-23 months old children, 2023.10

Variables	Continued Breastfeeding (12-23 months) n=152		
	n	%	P value
Anxiety			
Presence	29	32.2	0.016*
Absence	27	52.9	
Depression			
Presence	32	40.5	0.852
Absence	24	42.1	
Household income			
Up to $74,999	22	34.4	0.228
More than $75,000	35	44.3	
Age of mother (Years)			
18 - 24	4	26.7	0.430
25 - 34	39	43.3	
35 - 44	14	36.8	
Graduate degree (Education)			
Yes	19	43.2	0.59
No	38	38.4	
Mother's race/ethnicity			
Non-Hispanic White	15	33.3	0.28
Others	42	42.9	
Mother's employment			
Working	32	33.3	0.023*
Not working	25	53.2	
Food insecurity			
Food secure	43	43.4	0.190*
Food insecure	14	31.8	
WIC enrollment			
Yes	9	31.0	0.277
No	48	42.1	
Current diagnosis of depression/ anxiety by a health professional			
Yes	12	36.4	0.572
No	44	41.9	
Using psychotropic medications			
Yes	7	36.8	0.773
No	50	40.3	
Planned pregnancy			
Yes	40	40.8	0.730
No	17	37.8	
Parity			

Primiparous	30	36.1	0.286
Multiparous	27	45.0	
Type of delivery			
Vaginal	40	46.0	0.063*
C-section	17	30.4	
Mothers' pumping breastmilk			
Yes	42	35.0	0.004*
No	15	68.2	
Pre-term/Term birth			
Pre-term birth	5	25.0	0.143*
Term birth	52	42.3	
Low birth weight			
Yes	2	28.6	0.522
No	55	40.7	
Baby put on the breast within the first hour after birth			
Yes	44	44.4	0.093*
No	13	29.5	
Pacifier use (last 24 hour)			
Yes	11	26.2	0.029*
No	45	45.9	
Child attending day care/Pre-K			
Yes	7	22.6	0.027*
No	49	44.5	
Co-sleeping			
Yes	41	50.0	0.004*
No	15	25.9	

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Curriculum Vitae

SMRITI NEUPANE

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Career Focus: A well-structured, driven, adaptable, motivated, dedicated, and experienced professional with a Master's degree in Public Health and a strong background in research and data analysis. Possessing a favorable work attitude, good leadership traits, being a quick learner, and a strong background in data analysis, I am actively looking for opportunities to contribute my expertise to the scope of public health.

Expertise and skills: Research | Literature Reviews | Systematic Reviews | Quantitative Data Analysis | SPSS | STATA | Qualitative Interviews and Coding | Database Management | Data Visualization | Report Writing and Presentation | Teamwork | Strong Interpersonal Skills | Stakeholder Collaboration | Detail-Oriented | Professionalism | Time Management | Flexible | Computer Proficiency (MS Office)

Education:

Master of Public Health ***GPA- 3.97*** ***08/2021-12/2023***

University of Nevada, Las Vegas | Las Vegas | NV

Bachelor of Public Health ***GPA- 3.*****75** **08/2013- 09/2017**

Pokhara University | Kaski | Nepal

Related Course Work: Specialization in Social and Behavioral Health | Biostatistical Methods (Qualitative and Quantitative) | Research Methods | Health Program Evaluation | US Healthcare System

Professional and Research Experiences:

Graduate Research Assistant ***80/2021-12/2023***

School of Public Health, University of Nevada, Las Vegas | Las Vegas | NV

- Graduate research assistant for more than two years on the maternal and child health research project, Early Responsive Nurturing Care in Nevada (EARN) and worked directly under supervisor Dr Gabriela Buccini, PhD, MSc, IBCLC, Assistant Professor of Social and Behavioral Health
- Conducted rigorous literature reviews
- Performed systematic reviews on breastfeeding and food insecurity (currently writing manuscript)
- Assisted in completing and management of Institutional Review Board protocols
- Developed detailed research project plan, managed resources, and disseminated quantitative research (EARN 2021 and EARN 2022) in communities
- Assisted in data collection, data cleaning, and analyzed data using SPSS/STATA
- Developed and maintained databases, ensuring data quality and security
- Produced epidemiologic reports to monitor health data and inform the public
- Assisted in publishing manuscripts and writing reports
- Maintained flexibility in workload management to meet assigned deadlines

Student Intern ***05/2022-07/2022***

Nevada Partners | North Las Vegas | NV

- Contributed to community health-focused activities as part of the Health Pillar initiative (Healthy Children, Families, and Communities) in North Las Vegas

- Supported the implementation of data collection
- Conducted telephone interviews with research participants (mothers) for a survey regarding maternal and child nutrition, accommodating their availability and maintaining a flexible work schedule and ensuring clear and accurate data collection
- Managed the vaccination event, targeting racial minorities and homeless population
- Provided support to various health programs, involving tasks such as designing promotional materials (like flyers) for health-related occasions, documented meeting minutes, and assembled monthly newsletters

Health Educator (Counselor) ***10/2020-07/2021***

Star Children (Beyond The Orphanage) | Pokhara | Nepal

- Directed the implementation of the initiative, 'Home for HIV Infected Children'
- Provided counseling and health education to adolescents (14-18 years) concerning on relevant health issues, especially focusing on HIV, AIDS, STDs, and their implications
- Aided in identifying underprivileged and economically disadvantaged children affected by HIV in the community
- Provided oversight for the health of HIV-affected youngsters while maintaining the confidentiality and security of their records
- Conducted training sessions covering sexual and reproductive health as well as other relevant health issues of concern (like COVID-19 protocols)
- Cultivated a cooperative environment among other staffs and partners to foster a positive environment

Technical Skills and Interests:

Technical skills: Microsoft Office (Word, PowerPoint, Excel) | Statistical Package for Social Sciences (SPSS) | STATA | Zotero | Epi Data | End Note

Interests: Public Health Research | Statistical Analysis | Health Equity | Maternal and Child Health

Honors and Awards:

Stacy Darling Scholarship (May 2023) University of Nevada, Las Vegas

Distinguished Contribution Award (December 2022) University of Nevada, Las Vegas

Fall 2022 Anthem Scholar (August 2022) University of Nevada, Las Vegas

Stacy Darling Scholarship (April 2022) University of Nevada, Las Vegas

Dean's List Honoree (February 2018) Pokhara University, Nepal

Publications:

Saniatan, K. L., Neupane, S., Cross, C., & Buccini, G. (2023). Socio-demographic, maternal, and infant characteristics associated with pacifier use among six-months old infants in Clark County, Nevada. *PloS one*, *18*(4), e0285097. https://doi.org/10.1371/journal.pone.0285097