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Quality of mother-infant interaction, breastfeeding, and perinatal mental health

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ABSTRACT

Introduction: The quality of mother-infant interactions is crucial for child development. Studies show that breastfeeding contributes to maternal sensitivity and the development of a positive mother-infant bond. Maternal mental health difficulties negatively impact both maternal sensitivity and breastfeeding. Thus, it is unclear whether breastfeeding contributes to the quality of mother-infant interactions independent from mental health. The purpose of this study is to examine the contribution of exclusive breastfeeding at 3 months postpartum to the quality of the mother-infant relationship at 6 months postpartum, controlling for maternal mental health in a community sample of mothers in Chile.

Materials and method: Eighty women completed self-report measures of mental health and breastfeeding during the third trimester of pregnancy and 3 and 6 months postpartum. At 6 months after childbirth, the mother-infant interaction was assessed by coding a free-play session between mothers and infants. Logistic regression analysis was used to examine the contribution of breastfeeding practices and mental health to the quality of mother-infant interactions.

Results: Exclusive breastfeeding at 3 months postpartum increased the likelihood of displaying positive mother-infant interactions controlling for maternal mental health. Mothers who continued to breastfeed at 6 months postpartum reported less symptoms of antenatal depression and anxiety and higher levels of sensitivity and cooperation towards their infants.

Conclusion: Breastfeeding contributes to maternal sensitivity and cooperation even when controlling for maternal mental health. Implications for health practitioners and limitations due to the sample characteristics are discussed.

1. Introduction

Sensitive parenting is crucial for infant well-being and development. Studies exploring factors that promote maternal sensitivity in early infancy have highlighted the role of breastfeeding, which may enhance sensitivity by facilitating close physical contact between the mother and the infant and by giving mothers the opportunity to read their infant cues associated with hunger and satiety during feeding (Feldman & Eidelman, 2003; Jansen et al., 2008). In contrast, there is also evidence about the negative impact of maternal symptoms of depression and anxiety on sensitivity towards the infant (Tronick & Reck, 2009). Interestingly, bidirectional associations between maternal mental health and breastfeeding have been described, thus their individual role in promoting maternal sensitivity warrants further examination (Coo et al., 2020; Figueiredo et al., 2014; Ystrom, 2012).

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Maternal sensitivity refers to the mother's ability to accurately perceive and interpret the infant's signals and cues and to respond to them promptly and appropriately (Ainsworth, 1978), meaning, the ability to understand and respond to her child's needs and intentions. There is significant empirical evidence that maternal sensitivity promotes the development of a range of cognitive and socioemotional outcomes, such as quality of infant attachment, socioemotional development (Barlow et al., 2014), self-regulation (Ispa et al., 2017), language and academic performance (Hirsh-Pasek & Burchinal, 2006). Thus, highlighting the relevance of identifying factors that promote maternal sensitivity and positive mother-infant interactions during early infancy, such as breastfeeding and maternal mental health (Abuhammad & Johnson, 2018; Weaver et al., 2018).

There is evidence of both cross-sectional and longitudinal associations between breastfeeding and high maternal sensitivity. Early studies showed that the close physical contact and direct sensory feedback involved in breastfeeding enhance the emotional bond between mother and infant (Feldman & Eidelman, 2003; Jansen et al., 2008). Mesman et al. (2018) identified proximity as a crucial component of sensitivity, with breastfeeding being associated with an increase in observed maternal sensitivity over time. Also, Jonas et al. (2015) have shown that mothers who breastfeed their three-month-old infants are more sensitive in their interactions with them at six months postpartum, than women who do not breastfeed. In a more recent study, the impact of breastfeeding on maternal sensitivity was studied in mothers randomly assigned to breastfeed versus bottle-feed, with results showing more maternal sensitivity towards their infants immediately after feeding (Hahn-Holbrook et al., 2021).

Another identified mechanism, different from physical closeness, by which breastfeeding promotes maternal sensitivity is by supporting the maternal ability to detect and interpret infant cues (Whitfield & Ventura, 2019), which is usually addressed as responsiveness. This is partly because during breastfeeding the mother does not know how much the infant consumes and must learn to trust her infant's cues to determine feeding adequacy (Crow et al., 1980).

From a different perspective, maternal mental health difficulties, particularly depression and anxiety have been found to negatively impact maternal sensitivity. Depressed mothers are more likely to be disengaged or withdrawn in their interactions with their infants and to have less coordinated interactions than non-depressed mothers (Tronick & Reck, 2009). Similarly, mothers reporting high levels of anxiety are at higher risk of displaying intrusive and controlling behaviors when interacting with their infants (Reck et al., 2018). Studies conducted in Chile have found similar results. An intervention study involving 134 women found that new mothers who reported low symptoms of depression and anxiety displayed more sensitive and cooperative behaviors towards their 2- to 3-month-old infants than mothers with high depressive and anxiety symptoms (Olhaberry et al., 2015). More recently, Binda et al. (2019) observed low sensitivity and high intrusiveness in mothers who reported symptoms of depression in a sample of 177 mothers and their 2–12 months old infants.

As shown by the previously mentioned research, both breastfeeding and maternal mental health influence maternal sensitive independently. Interestingly, associations between maternal mental health and breastfeeding have been reported. Studies have consistently shown that maternal depression and anxiety are associated with breastfeeding cessation (Ystrom, 2012), reduced exclusive breastfeeding at three months postpartum (Coo et al., 2020) and overall shorter breastfeeding duration (Figueiredo et al., 2021). These studies suggest that maternal mental health both during pregnancy and the postpartum period affect breastfeeding practices. In contrast, exclusive breastfeeding is associated with lower symptoms of maternal depression at three months postpartum (Figueiredo et al., 2014), and has been shown to protect women who experience prenatal depression from maintaining their symptoms in the postpartum depression (Figueiredo et al., 2021).

These associations challenge our understanding of the association between breastfeeding, mental health and maternal sensitivity. Specifically, it is difficult to clarify whether the association between breastfeeding and sensitive maternal responses reflects the actual contribution of breastfeeding or if it is indicative of other factors, such as maternal mental health, which may explain why breastfeeding mothers are also more sensitive. A recent review concludes that disentangling this association is made more difficult by the diverse definitions and variability in instruments used to assess the mother–child relationship and the limited number of studies that assesses the mother-infant bond using external observations, instead of more easily biased forms of assessment, such as maternal self-report on maternal interaction quality, which are more frequently used (Peñacoba & Catala, 2019).

The first aim of the present study is to examine the impact of maternal mental health during late pregnancy and at three months postpartum and breastfeeding practices at three months postpartum on maternal sensitivity towards the six months-old infants. We hypothesize that breastfeeding and maternal mental health at three months postpartum will be independently associated with higher maternal sensitivity towards the infant at six months of age. We also hypothesize that symptoms of maternal depression and anxiety will be associated with lower levels of sensitivity during the mother-infant interaction.

A second aim is to assess the association between mental health during late pregnancy and three months postpartum and breastfeeding practices at three months postpartum. We hypothesize that maternal mental health during pregnancy and at three months postpartum will predict exclusive breastfeeding at three months postpartum.

2. Materials and method

2.1. Participants

The sample was a non-representative community sample, consistent of 80 pregnant women attending two public health centers who were recruited between May 2018 and December 2019. This was a subsample of a larger study that followed 164 Chilean women from the third trimester of pregnancy until six months postpartum. To be eligible, women had to be at least 18 years old and fluent in Spanish. The first 80 women who completed the final assessment (i.e., six months postpartum) were selected for this study, to allow the timely coding of mother-infant interaction videos. Five of the 80 women included in the study were unable to complete the second

assessment (i.e. three months postpartum, $N = 75$). For demographic information of the sample and general information related to birth and infant characteristic see Tables 1 and 2, respectively.

We referred all cases of women who reported high levels of depression or anxiety to the corresponding health services for assessment and treatment. Ethics approval was obtained from the Ethics Committees of the Universidad del Desarrollo and the Health Service at Concepción and the study complied with the Code of Ethics of the World Medical Association Declaration of Helsinki (WMA-DOH; 1964–2014). All participants provided informed consent before joining the study.

2.2. Measures

Edinburgh Postnatal Depression Scale (EPDS) (Cox et al., 1987): This 10-item, self-report questionnaire screens for current (i.e., over the past week) symptoms of depression using a 4-point scale (i.e., "I have been able to laugh and see the funny side of things"). The global score is obtained by summing the scores from individual items. This scale has been validated in Chile, with high reliability (Cronbach's alpha =.77), sensitivity (100%), and specificity (80%) (Jadresic et al., 1995). Cronbach's alpha was.86 in our sample.

Perinatal Anxiety Screening Scale (PASS) (Somerville et al., 2014): This 31-item, self-report questionnaire assesses perinatal anxiety over the past month (i.e., "Difficulty adjusting to recent changes", "Worry about the baby/pregnancy"). A total score is calculated by adding the scores of all items and indicates anxiety severity: minimal (0–20 points), mild to moderate (21–41 points) and severe (42−93). The PASS includes four subscales, namely general worry and specific fears; perfectionism, control and trauma; social anxiety; and acute anxiety and adjustment. The authors have reported high reliability for the subscales and the total scale (Cronbach's alpha ranged from 0.86 to 0.96). The PASS has been adapted to be used in Chilean populations with good psychometric properties (Coo et al., 2022). Cronbach's alpha in our study was.94 for the global score.

Ainsworth Maternal Sensitivity Scales (AMSS) (Ainsworth, 1969): The AMSS consist of four subscales, each rated from 1 to 9. In this study, the sensitivity and cooperation scales were used. The sensitivity subscale assesses the caregiver's capacity to be aware of, interpret, and respond to the infant's signals appropriately and promptly. The cooperation subscale assesses the caregiver's degree and frequency of physical cooperation and lack of interference with the infant's activity. High scores are indicative of more sensitive and cooperative (i.e., less interfering) behavior towards the infant. Coder reliability, assessed by intraclass correlation coefficients (ICCs), was computed on 20% of the interactions and ranged from.82 (sensitivity) to.84 (cooperation).

Demographic and obstetric information. A questionnaire was developed to assess sociodemographic characteristics. In the postnatal assessments, the questionnaire included questions about delivery, and child's health.

Infant feeding status. At six months postpartum breastfeeding status was assessed. Women were asked how they fed their infantes. Exclusive breastfeeding was defined as "feeding the infant with maternal milk only". The non-exclusive group included women who fed their infants "with a combination of maternal milk and formula" or "exclusively with formula". We only assessed breastfeeding continuation at 6 months postpartum, due to the common recommendation to introduce solid food in the infant́s diet at this age.

Table 1
Sociodemographic and obstetric characteristics of the participants.

	%	*n*
Age		
18-24	22.5	18
25-34	61.3	49
> 35	16.2	13
Nationality		
Chile	79.5	62
Venezuela	15.4	12
Other Latin American countries	5.1	6
Marital status		
Lives with partner	42.5	34
Married	28.8	23
Single	8.7	7
Other (divorced, doesn't live with partner)	20	16
Educational level		
Incomplete schooling	1.3	1
Completed high school	23.7	19
Incomplete university or technical studies	20	16
Completed technical studies	22.5	18
Completed university studies	32.5	26
Work situation		
Gainfully employed	56.3	45
Primiparous		
No	58.7	47
Yes	41.3	33
Type of birth		
Vaginal	41.3	31
C-section	56	42
Assisted vaginal birth	2.7	2

Table 2
Spearman correlations between maternal sensitivity, cooperation, and mental health (n = 80).

	1	2	3	4	5	6	7
1. Sensitivity							
2. Cooperation	.83**						
3. EPDS 3°trimester	-.06	-.17					
4. PASS 3°trimester	.04	.04	.63**				
5. EPDS 3 months PP	-.01	-.11	.48**	.5**			
6. PASS 3 months PP	.12	.03	.40**	.63**	.7**		
7. EPDS 3 months PP	.02	.03	.30**	.31**	.48**	.57**	
8. PASS 3 months PP	.04	-.04	.22*	.4**	.33**	.61**	.75**

Note. ** = $p < .01$. PP = Postpartum.

2.3. Procedure

Expectant mothers in their third trimester of pregnancy who received care from two public primary health centers in two Chilean cities (i.e., Santiago and Concepción) were invited to participate in this study. Members of the research team approached potential participants at the health centers while they waited for their prenatal consultation. Women who agreed to participate completed the questionnaires on demographic characteristics and mental health at the health centers or by telephone after providing written consent. We contacted the mothers by phone at three months postpartum to apply the questionnaires for the second assessment. At six months postpartum we scheduled an appointment with the mothers and their infants at the health centers, where we asked the women to complete the final set of questionnaires and to interact with their babies with a set of age-appropriate toys for 10 min as they would normally do at home. This interaction was videotaped by a trained research assistant and coded for maternal sensitivity and cooperation by four trained coders, including two of the authors (i.e., SC and F.P). The coders did not video tape the interactions and were blind to maternal data at the time of coding.

2.4. Data analysis

We conducted preliminary analyses to evaluate descriptive information and univariate distributions of maternal variables for normality and outliers. We also explored possible differences in breastfeeding practices according to parity and type of delivery using t-tests and chi-squares as appropriate. Maternal sensitivity and cooperation were not normally distributed. The examination of boxplots and histograms revealed that a majority of the scores were clustered around central scores (i.e., 3 and 4). Given the limited variability of the data, we recoded these variables as high or low sensitivity and cooperation, using the 50th percentile as the cut-off score.

To address our first research aim, we used hierarchical logistic regression analyses to assess the association between maternal symptoms of depression and anxiety during late gestation and at three months postpartum and breastfeeding practices at three months after childbirth with maternal sensitivity towards the six months old infant coded as a categorical variable (i.e., high or low). Mental health variables were entered as continuous predictors, whereas breastfeeding was entered as a categorical predictor with 2 categories, namely exclusive and mixed breastfeeding. Due to high correlation in the two subscales of the maternal sensitivity scales (i.e. sensitivity and cooperation) logistic regression analyses were preformed independently to avoid multicollinearity issues). All the variables were entered in the model using the Enter method. Power analysis using G*Power showed that a sample size of 63 participants was needed to detect a large effect in our regression analyses using 5 predictors. For our secondary aim, we used additional logistic regression analyses to examine the association between maternal mental health and breastfeeding at three months postpartum.

All the analyses were conducted in IBM SPSS 25. We calculated bootstrap confidence intervals for *p* values to minimize the effect of sampling variation.

3. Results

3.1. Descriptive results

Table 1 shows the demographic and obstetric characteristics of the participants. All women in the study gave birth to a full-term infant (gestational weeks: $X = 39.13$, $SD = 1.25$) and initiated breastfeeding. At 3 months postpartum 58.1% of them were feeding their infants with breastmilk only (i.e., exclusive breastfeeding), 39.2% combined breastfeeding with formula (i.e., mixed feeding), and only 2.7% of the infants were exclusively formula fed. In view of these results, we combined mixed feeding mothers with formula feeding mothers in one group and compared them against exclusive breastfeeding mothers. Most mothers reported a positive breastfeeding experience and 94,6% of them reported that their partner supported them to breastfeed their child. At six months postpartum 85.5% of the participants continued breastfeeding their infants. Regarding maternal sensitivity, Assessment with the Ainsworth Maternal Sensitivity Scales (including the sensitivity and cooperation subscales), participants showed average low to moderate levels in both subscales, sensitivity ($X = 3.76$, $SD = 1.53$) and cooperation ($X = 3.4$, $SD = 1.4$), during the interaction with their six months old infants.

During the third trimester of pregnancy, 10% of the women screened positive for depressive symptomatology according to the EPDS, and 12.5% reported severe anxiety symptoms, according to the PASS. The percentage of mothers reporting emotional distress increased in the postpartum period with 18.7% and 16.5% screening positive for depressive symptomatology according to EPDS, at

three and six months postpartum, respectively. At three and six months postpartum 12% and 20.9% of the participants reported severe anxiety symptoms, respectively. Chi square analysis showed no significant differences in breastfeeding practices (i.e., exclusive v/s mixed) when the participants were compared in terms of parity (i.e., first-time v/s experienced mothers) (X^2 =.37[1], p = .54) and type of delivery (i.e., cesarean section v/s vaginal delivery) (X^2 = 1.74[1], p = .19). Therefore, the sample was not split in groups based on these categories. Spearman correlations showed significant associations between maternal mental health variables, but no significant relationships between maternal mental health, sensitivity and cooperation scores (see Table 2).

3.2. Associations between mental health, breastfeeding, and maternal sensitivity

Regarding our first research aim, a hierarchical logistic regression analysis was performed to assess the effect of maternal prenatal and three-month postnatal anxiety and depressive symptoms and breastfeeding practices on maternal sensitivity. Maternal sensitivity and cooperation (i.e., the subscales of the maternal sensitivity scale) were analyzed independently. In accordance with our hypothesis the final logistic regression model predicting sensitivity (as measured by the sensitivity subscale in the Ainsworth scale) was statistically significant, X^2 (3, N = 73) = 19.46, p = .00, with the model explaining 31% of the variance (Nagelkerke R^2) of the variance in sensitivity, correctly classifying 74% of the cases according to high/low sensitivity (i.e., as indicated by the 50th percentile score). Results show that maternal depressive symptoms during pregnancy (OR = 0.80, 95% CI [−0.56, −0.02]) and breastfeeding exclusivity (OR = 7.86, 95% CI [0.86, 4.7]) at tree months postpartum significantly predicted sensitivity levels, when all variables were included in the model. Mothers who breastfeed exclusively were 7.89 more likely to have high sensitivity as for mother who did not exclusively breastfeed. Maternal prenatal anxiety symptoms (OR = 1.06, 95% CI [−0.01, 0.19]), three-month postnatal symptoms of anxiety (OR = 1.01, 95% CI [−0.09, 0.09]) and depression (OR = 1.01, 95% CI [−0.22, 0.26]), did not significantly predict maternal sensitivity level toward her 6-month-old infant (see Table 3).

The final logistic regression model predicting cooperation (i.e., the second subscale of the Ainsworth scale) was also statistically significant, X^2 (3, N = 73) = 14.97, p = .00), with the model explaining 25,2% of the variance (Nagelkerke R^2) of the variance in cooperation, correctly classifying 72.6% of the cases according to high/low cooperation (i.e., as indicated by the 50th percentile score). Results show that maternal depressive symptoms during pregnancy (OR = 0.80, 95% CI [−0.52, −0.05]) and breastfeeding exclusivity (OR = 4.77, 95% CI [0.29, 3.73]) at tree months postpartum significantly predicted cooperation levels, when all variables were included in the model. Mothers who breastfeed exclusively were 4.77 more likely to have high levels of cooperation as for mother who did not exclusively breastfeed. Maternal prenatal anxiety symptoms (OR = 1.04, 95% CI [−0.02, 0.14]), three-month postnatal symptoms of anxiety (OR = 1.00, 95% CI [−0.08, 0.08]) and depression (OR = 1.00, 95% CI [−0.24, 0.23]), did not significantly predict maternal cooperation level toward her 6-month-old infant (see Table 4).

Regarding our second research aim, a hierarchical logistic regression analysis was performed to assess the influence of maternal prenatal and three months postpartum anxiety and depressive symptoms on breastfeeding exclusivity. In a first step, maternal prenatal depressive and anxiety symptoms were entered in the model, this resulted in a X^2 (2, N = 73) = 2.74, p = .25, indicating that prenatal mental health symptoms did not predict breastfeeding exclusivity. The second model which included prenatal mental health symptoms and maternal postnatal depressive and anxiety symptoms at three months postpartum showed a X^2 (4, N = 73) = 3.57, p = .47, indicating that postnatal maternal mental health symptoms, controlling for prenatal mental health symptoms, did not significantly predict breastfeeding exclusivity at three months postpartum (see Table 5).

4. Discussion

Our results suggest that women who breastfeed their infants exclusively at three months postpartum are more likely to display higher levels of maternal sensitivity with their six-month-old infants. By both showing more frequent sensitive behaviors indicative of

Table 3
Hierarchical logistic regression analysis of the effect of depression and anxiety during pregnancy and at 3 months postpartum and exclusive breastfeeding at 3-months postpartum on maternal sensitivity towards her 6-months old infant (n = 73).

	B	*SE B*	Wald χ^2	*p*	*OR*	95% LL *CI OR*	95% UL *CI OR*
Constant	-.2	.24	.71	.4	.82	-.69	.26
Step 1							
Constant	-.08	.5	.03	.86	.92	-1.15	1.01
Depression during pregnancy	-.17	.08	4.35	.04	.84	-.35	-.02
Anxiety during pregnancy	.04	.02	3.01	.08	1.04	-.00	.09
Step 2							
Constant	-1.68	.76	4.91	.03	.19	-4.78	-.3
Depression during pregnancy	1.23	.11	4.56	.03	.8	-.56	-.02
Anxiety during pregnancy	.06	.04	2.8	.09	1.06	-.01	.19
Depression at 3 months PP	.01	.1	.00	.96	1.01	-.22	.26
Anxiety at 3 months PP	.01	.03	.1	.76	1.01	-.09	.09
Breastfeeding (3-months)	2.06	.64	10.26	.00	7.86	.86	4.7

Note. B= unstandardized coefficient; SE= standard error; OR= odds ratio; 95% LL CI= Bootstrap Lower Limit 95% Confidence Interval; 95% UL CI= Bootstrap Upper Limit 95% Confidence Interval

Table 4
Hierarchical logistic regression analysis of the effect of depression and anxiety during pregnancy and at 3 months postpartum and exclusive breastfeeding at 3-months postpartum on maternal cooperation towards her 6-months old infant (n = 73).

	B	*SE B*	Wald χ^2	*p*	*OR*	95% LL *CI OR*	95% UL *CI OR*
Constant	-.5	.25	4.1	.04	.61	-1.04	-.03
Step 1							
Constant	.07	.52	.02	.89	1.08	-.94	1.23
Depression during pregnancy	-.21	.09	5.75	.02	.81	-.42	-.04
Anxiety during pregnancy	.03	.02	1.64	.2	1.03	-.02	.077
Step 2							
Constant	-1.09	.72	2.28	.13	.34	-3.43	.34
Depression during pregnancy	-.23	.10	5.21	.02	.8	-.52	-.05
Anxiety during pregnancy	.04	.03	1.44	.23	1.04	-.02	.14
Depression at 3 months PP	.00	.1	.00	.97	1	-.24	.23
Anxiety at 3 months PP	.00	.03	.01	.91	1	-.08	.08
Breastfeeding (3-months)	-1.09	.72	6.64	.01	4.77	.29	3.73

Note. B= unstandardized coefficient; SE= standard error; OR= odds ratio; 95% LL CI= Bootstrap Lower Limit 95% Confidence Interval; 95% UL CI= Bootstrap Upper Limit 95% Confidence Interval

Table 5
Hierarchical logistic regression analysis of the effect of prenatal and postpartum depression and anxiety on exclusive breastfeeding at 3-months postpartum (n = 73).

	B	*SE B*	Wald χ^2	*p*	*OR*	95% LL *CI OR*	95% UL *CI OR*
Constant	-.36	.25	2.29	.15	.70	-.91	.08
Step 1							
Constant	-1.00	.56	3.77	.05	.37	-2.26	.04
Prenatal depression	-.02	.09	.04	.86	.99	-.21	.15
Prenatal anxiety	.03	.03	1.96	.18	1.03	-.01	.10
Step 2							
Constant	-.93	.60	3.27	.07	.39	-2.27	.12
Prenatal depression	-.03	.12	.15	.75	.97	-.32	.17
Prenatal anxiety	.04	.04	2.40	.20	1.04	-.01	.14
Postpartum depression (3-months)	.06	.10	.48	.50	1.06	-.11	.30
Postpartum anxiety (3-months)	-.03	.04	.78	.44	.98	-.17	.12

Note. B= unstandardized coefficient; SE= standard error; OR= odds ratio; 95% LL CI= Bootstrap Lower Limit 95% Confidence Interval; 95% UL CI= Bootstrap Upper Limit 95% Confidence Interval

their capacity of identifying and properly responding to the child cues as well as cooperative behaviors, thus the mother's ability to collaborate with the child instead of interfering or controlling his or her behavior. Our results only partially support our hypothesis, since they show that exclusive breastfeeding at three months postpartum and low symptoms of depression prenatal depressive symptoms contribute high maternal sensitivity and cooperation towards the infant. Yet, contrary to what was expected, maternal prenatal anxiety and postnatal anxiety and depression did not predict maternal sensitivity. Although unexpected, this finding is consistent with previous studies in non-clinical samples of mother-infant dyads at psychosocial risk; which have found no significant associations between maternal sensitivity and maternal postnatal mental health (Alvarenga & Palma, 2013; Sidor et al., 2011). Interestingly, an in line with our hypothesis, the effect of breastfeeding on maternal sensitivity seems to be independent from maternal mental health. This is consistent with an earlier study, which showed that breastfeeding was associated with greater maternal sensitivity and less intrusiveness in both depressed and non-depressed mothers who breastfed their three months old infants, compared to mothers who bottle-fed (Field et al., 2010). This association is possibly supported both by behavioral and physiological aspects inherent to breastfeeding. Frequent close physical contact and direct sensory feedback involved in breastfeeding may enhance mother-child interaction's quality by triggering a set of underlying neuro-hormonal pathways that may promote maternal caregiving behavior and bond formation. Specifically, endogenous oxytocin, which increases during breastfeeding, affects molecular pathways that buffer stress reactivity, support positive mood, and regulate healthy mothering behaviors (Bell et al., 2014). Plasma levels of oxytocin during pregnancy and the postpartum period have been associated with maternal bonding behaviors, including gaze, vocalizations, positive affect, and affectionate touch (Feldman et al., 2007). Also, higher oxytocin levels have been identified among mothers who display higher levels of synchrony in interaction with their babies (Feldman et al., 2011).

Results also show, contrary to our expectations, no significant correlations between maternal mental health, sensitivity, and cooperation. Only when dividing the participants between those with a high versus low sensitivity and cooperation behaviors toward their infant, exclusive breastfeeding and prenatal depressive symptoms predicted maternal sensitivity level. This may be explained by the limited sample size and the overall homogeneous levels of mental health, sensitivity, and cooperation reported by our participants. The mixed evidence in the literature about the association between maternal mental health and sensitivity may indicate that this

relationship is more complex that we expect. It may be possible that individual characteristics of mothers buffer the negative impact of symptoms of depression and anxiety on their sensitivity towards their infants. However, maternal mental health may also impact the quality of mother-infant interactions beyond maternal sensitivity. Although the latter is crucial for assessing the mother-infant relationship, it may not account for all its characteristics. This warrants the use of measures that consider diverse aspects of the mother-infant relationship that are relevant in the study of mothers and infants. Future studies could combine the assessment of maternal sensitivity with other aspects, such as maternal attitudes, internal working models, and mentalization, to further explore the relationship with these characteristics with maternal mental health.

To our surprise, maternal mental health was not significantly associated with breastfeeding practices. This may be related to the overall healthy profile of the participants and the high rates of reported breastfeeding. Given the evidence supporting bidirectional links between maternal emotional wellbeing and breastfeeding, different results are likely to be obtained in more diverse samples. The high rates of breastfeeding initiation, exclusivity and maintenance may be explained by the Chilean national initiative to promote breastfeeding. Women who give birth in public hospitals are usually offered support to initiate breastfeeding during hospitalization, and additional support to maintain and promote breastfeeding in the following months is available at public health centers. Further, the Chilean Infant Policy allows mothers to take six months of paid postpartum maternity leave to promote maternal involvement in breastfeeding and infant care. These initiatives are likely to have a positive impact on breastfeeding rates in Chilean populations and may also account for the lack of differences we observed in breastfeeding practices in terms of parity and type of delivery. Earlier studies have shown that first-time mothers report more breastfeeding difficulties and mixed feeding at hospital discharge than experienced mothers (Hackman et al., 2015) Similarly, women who have cesarean section deliveries have a late initiation of breastfeeding and are at higher risk of experiencing breastfeeding problems (Cetisli et al., 2018). This is particularly relevant in Chile due to the high rate of cesarean section deliveries, which was 56% in our sample, in line with the alarming national prevalence, which reaches up to 51% (Sadler et al., 2018).

Our findings support the World Health Organization recommendations to promote exclusive breastfeeding (WHO, 2017). From a medical perspective, breastfeeding has been associated with a wide range of positive health outcomes for infants and mothers (see Brahm & Valdés, 2017 for a review). Our study adds to the body of evidence that show the benefits of breastfeeding are not limited to health outcomes, but also contribute to the development of a positive mother-infant relationship.

The results from the present study should be considered in light of some limitations, many of which offer directions for future research. Our sample was small (n = 80), nonclinical, and the mothers reported high breastfeeding rates, overall positive mental health, and medium quality of mother-infant interaction. Also, maternal sensitivity scores had limited variability, which led us to recode this continuous variable into a categorical one (i.e., high and low sensitivity). Thus, different results could be achieved in more diverse samples. Participation in the study was voluntary, which might affect the selection of the sample. Due to these characteristics, our results should be considered as preliminary and need to be confirmed by larger studies using more diverse samples, that include high-risk women and more diverse groups. Regarding the instruments, the PASS has been validated for its use in Chile; however, cut-off scores have not yet been developed for Spanish-speaking populations, therefore we used the internationally available cut-off scores to describe perinatal anxiety in our participants. Future studies working with samples that include clinical women could complement the use of self-report measures with other instruments and diagnostic interviews, if appropriate.

Despite these limitations, the present study has several strengths, such as using a repeated measures design and including three assessment time points from late pregnancy to six months after childbirth. This allows the assessment of the prospective contribution of breastfeeding to the quality of mother-infant interactions, while also taking into account antenatal and postnatal symptoms of maternal depression and anxiety. The use of an observational measure to assess the quality of the interactions between mother and child also contributes to a better understanding of the positive impact breastfeeding has on integral child health.

Our findings have practical implications for health practitioners who work with perinatal women. The role of antenatal mental health in maternal sensitivity and cooperation highlights the relevance of the early identification and treatment of women who may present with mental health difficulties during pregnancy and the early postpartum period. This is particularly relevant in Chile, where despite the excellent protocols to screen for symptoms of perinatal depression, a very limited number of women access treatment (Rojas, 2013). Our results also highlight the relevance of delivering interventions to support breastfeeding practices to promote infant and maternal health, as well as a positive mother-infant bond. This is especially valuable considering that most factors associated with poor mother-infant interactions, such as maternal mental health, parental stress, and vulnerable socioeconomic background are complex and very hard to modify through targeted interventions (Dau et al., 2019). In contrast, there is considerable evidence about the effectiveness of breastfeeding promoting practices and interventions to increase breastfeeding rates and duration, that could additionally contribute to the quality of mother-infant interactions (Haroon et al., 2013; Ossandón et al., 2000).

5. Conclusion

Mother-infant interactions are crucial to promote healthy child development. Breastfeeding seems to contribute to maternal sensitivity and cooperation independent of maternal mental health. Interventions supporting effective breastfeeding may contribute to both physical and socioemotional aspects of child development.

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Author statement

SC worked on the conceptualization of the study, methodology design, coding of videos on mother-infant interactions, data analysis, writing of the original manuscript and revision of the current version of the document.

MIG contributed to data collection, research data maintenance, coding of videos on mother-infant interactions, writing of the original mansucript and revision of the current version of the document.

FP contributed to coding of videos on mother-infant interactions, writing of the original mansucript and revision of the current version of the document.

CRediT authorship contribution statement

Fernanda Prieto: Writing – review & editing, Writing – original draft, Investigation. **María Ignacia García:** Writing – review & editing, Writing – original draft, Investigation, Data curation. **Soledad Coo:** Writing – review & editing, Writing – original draft, Supervision, Project administration, Methodology, Funding acquisition, Formal analysis, Conceptualization.

Data Availability

Data will be made available on request.

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