



# Breastfeeding Difficulties Predict Mothers' Bonding with Their Infants from Birth to Age Six Months

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## Abstract

**Objectives** We examined the association between breastfeeding difficulties and trajectories of bonding in the first 6 months postpartum.

**Methods** Each month for the first 6 months following birth, 121 mothers of newborn infants (age = 23–45 years,  $M = 32.31 \pm 4.79$ , 57% White, 23% Asian, 11% Hispanic, 9% Multiracial, 1% Black/African American) were invited to complete self-assessments of bonding. At the first postpartum assessment, mothers who intended to breastfeed also reported whether breastfeeding was more difficult than they had anticipated. We conducted linear mixed modelling to test whether early breastfeeding difficulty was associated with bonding trajectories and examined whether effects remained when accounting for postnatal depression symptoms.

**Results** We found main effects of breastfeeding difficulty ( $\beta = -.20$ , 95% CI [ $-.34, -.06$ ]) and postpartum month ( $\beta = .13$ , 95% CI [ $.07, .20$ ]) on bonding. On average, women who reported breastfeeding difficulty reported lower bonding than women who did not (Cohen's  $d = -0.44$ , 95% CI [ $-0.81, -0.06$ ]). Additional analyses indicated that, independent of breastfeeding difficulties, women who reported higher postnatal depressive symptoms across the first 6 months postpartum reported lower levels of bonding, on average. Further, within-individual decreases in postnatal depressive symptoms across the first six months were associated with relative improvements in bonding across this period.

**Conclusions for Practice** Our findings suggest that mothers who experience breastfeeding difficulties are at risk for reduced bonding with their infants in the first 6 months after birth. Moreover, while postnatal depressive symptoms are also associated with reduced bonding, the effect of breastfeeding difficulties on bonding persists over and above the effect of postnatal depressive symptoms.

**Keywords** Mother–infant bonding · Breastfeeding · Nursing · Postpartum

## Significance statement

The strength of a mother's bond with her infant is associated with child outcomes; however, predictors of differences in bonding across the first months of life have not yet been elucidated. Breastfeeding difficulties may influence a mother's feelings of connection toward her infant. We provide

evidence for a main effect of breastfeeding difficulties on bonding, such that mothers who reported initial breastfeeding difficulties also reported less positive bonding with their infants across the first 6 months postpartum. This finding remained significant even when accounting for postnatal depressive symptoms.

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## Introduction

Most previous work examining the development of emotional ties between the infant and the mother has explored the nature of an infant's developing attachment to the mother, in line with attachment theory (Bowlby 1958). While less well studied, the development of a mother's bond with her infant may be influenced by early

postpartum experiences (Feldman et al. 1999) and can be reliably assessed via self-report measures (Bienfait et al. 2011). A mother's bond with her infant reflects her emotional involvement with her child (Bicking Kinsey and Hupcey 2013; Figueiredo et al. 2009), which may be manifested in specific caregiving behaviors (i.e., proximity seeking, responsiveness to infant cues, "motherese" vocalizations). The mother-to-infant bond results from a complex interplay between the infant's socioemotional signals and the mother's appraisal of and response to those signals (Galbally et al. 2011). George and Soloman (1999) posit that mothers' positive feelings about their newborn infants motivate them to provide care during what may be a challenging developmental period. Indeed, the first weeks of life are characterized by a range of child-rearing tasks, fragmented sleep in mothers, and the absence of a social smile in infants (Messinger and Fogel 2007). The mother-to-infant bond may enable mothers to provide care for their newborn (i.e., maintenance of proximity and provision of protection; Brockington 1996). Importantly, infants of mothers who report more positive bonds (i.e., more positive feelings towards their infants) have better outcomes, including increased rates of secure attachment (Ziv et al. 2002), better cognitive and neurobehavioral development (Feldman and Eidelman 2007), and a greater capacity for self-regulation and empathy across childhood and adolescence (Feldman 2007).

Mothers' self-reported bonding with their infants typically increases across the first 6 months of life (Muzik et al. 2013), although there are individual differences in both initial levels of bonding and its trajectory. For example, whereas some mothers may report stable levels of bonding, others may experience less positive bonding initially but greater increases in bonding over time. Given the benefits for infant development of a more positive bond, it is important to identify predictors of initial levels of bonding (i.e., levels within the first month after birth) and to examine the trajectory of mothers' self-reported bonding across the first months of the infant's life. By examining predictors of bonding, we may inform treatments focused on improving the mother–infant relationship and infant outcomes.

One major component of caring for newborns is their frequent need to feed. Women are encouraged to initiate breastfeeding as soon as possible after birth and to continue breastfeeding exclusively for a minimum of 6 months (and to continue breastfeeding until the child is two years of age; World Health Organization 2003, 2019). Thus, new mothers are often told "breast is best" (Murphy 1999; Stanway and Stanway 1978); these messages have fueled the perception of breastfeeding as both a medical ideal for infant feeding and a moral indicator of good mothering (Knaak 2005). This messaging may have unintended

consequences for mothers and infants who experience difficulties in breastfeeding. Indeed, women who intend to breastfeed but experience difficulties report feelings of failure, shame, and guilt about "not succeeding as a mother" (Crouch and Manderson 1995; Hauck et al. 2002; Hegney et al. 2008; Lobbok 2008; Lee 2008; Mozingo et al. 2000; Williamson et al. 2012).

Variations in early breastfeeding experiences may influence the mother–infant bond. Many women report that breastfeeding is critical for forming an emotional connection with their baby (Hegney et al. 2008). Although breastfeeding is often assumed to enhance a mother's bond with her infant, empirical evidence is equivocal (see review, Jansen et al. 2008). While some studies have found a positive association between breastfeeding and bonding (e.g., Ceriani Cernadas et al. 2003), other research has reported limited to no evidence for such an association (Bicking Kinsey et al. 2014; Hairston et al. 2019; Martone and Nash 1988). Women who intend to breastfeed but subsequently face difficulties (e.g., insufficient milk supply, trouble getting infants to latch, nipple pain; Brown et al. 2016) report fewer feelings of connection toward their infants (Williamson et al. 2012). Importantly, however, initially poorer bonding due to difficulties in breastfeeding may resolve over time. In one prospective study, Else-Quest et al. (2003) examined bonding at two time points across the first year of life in mothers who did and did not breastfeed and found that while breastfeeding was positively associated with bonding at 4 months postpartum, this effect was no longer significant at 12 months. Mothers' difficulties in intended breastfeeding were not examined, however, and thus it is not clear whether difficulties in breastfeeding would moderate these findings. Given that mothers who intend to breastfeed may differ in important ways from mothers who do not intend to breastfeed (Raissian and Su 2018), exploring the effect of breastfeeding *difficulties* on bonding among mothers who intend to breastfeed may increase our understanding of the association between breastfeeding and bonding. Moreover, multiple time points of assessment are needed to examine the shape of the bonding trajectory over time (e.g., whether the trajectory is linear or curvilinear).

In the current study we used a longitudinal design in which mothers were assessed every month for the first 6 months postpartum to examine the effects of difficulties in breastfeeding on initial levels of self-reported bonding with their infants and the trajectory of bonding over time. We hypothesized that mothers who experienced difficulties breastfeeding would report less positive initial bonding (i.e., bonding at 1 month postpartum; breastfeeding difficulties are most commonly reported in the first month following birth [Scott et al. 2006]). Consistent with previous literature suggesting that bonding improves in the first 6 months postpartum (Muzik et al. 2013), we hypothesized that

bonding would become more positive for mothers regardless of reported breastfeeding difficulties. We also examined whether these effects remained when accounting for symptoms of postnatal depression.

## Methods

### Participants

Participants were 125 mothers of newborn infants (age = 23–45 years,  $M = 32.31 \pm 4.79$ ; 57% White, 15% East Asian, 8% South Asian, 11% Hispanic, 9% Multiracial, 1% Black/African American) who were recruited from local obstetric clinics, the Stanford Women's Wellness psychiatric clinic, and with postings in the community between September 2011 and July 2016. Both primiparous and multiparous women were included in the study. All procedures performed were in accordance with prevailing ethical standards. The Stanford University Institutional Review Board approved the study, and all participants provided informed consent prior to participating. Participants completed an initial interview session in the third trimester of pregnancy ( $M$  weeks gestation = 33.48,  $SD = 4.19$  weeks). An item asking if participants intended to breastfeed was added after data collection began; all of the 108 women who were asked whether they intended to breastfeed responded in the affirmative. At monthly intervals for 6 months after delivery, participants completed follow-up surveys via the online tool SurveyMonkey. Participants who did not complete surveys after initial prompts received e-mail reminders and, if necessary, telephone prompts. All 125 participants were invited to complete follow-up surveys. Postpartum surveys yielded a total of 594 observations. To be included in the analysis, follow-up survey responses were required to be recorded within 1 month of the target date (i.e., at monthly intervals following the baby's due date); responses that were recorded more than 1 month after the target date were excluded. 117 participants responded within the target date and were included in the final sample for a total of 556 observations. 101 of the 108 women who initially reported that they intended to breastfeed were included in the final sample. The average number of survey responses for each participant was 4.75.

### Measures

Participants completed surveys each month for the first 6 months following birth. Although several questionnaires were included in the survey, the present analyses focus on the Mother-to-Infant Bonding Scale (MIBS; Taylor et al. 2005), an 8-item self-report questionnaire designed to assess

a mother's feelings toward her infant, and the Edinburgh Postnatal Depression Scale (EPDS; Cox et al. 1987).

The MIBS was designed to detect abnormal levels of bonding and contains items assessing both negative (e.g., resentment, dislike, disappointment) and positive (e.g., love, joy, protection) feelings toward the infant. The MIBS has demonstrated adequate internal consistency ( $\alpha = 0.71$ ) and is related to maternal mood in the early postpartum period (Taylor et al. 2005). In this sample, Cronbach's alpha for the 8-item MIBS was 0.76. Scores greater than  $\pm 3$  standard deviations from the mean were winsorized to 3 standard deviations from the mean for the current analyses. The MIBS was scored such that higher scores indicated more positive bonding.

The EPDS is a 10-item self-report measure designed to assess ante- and postnatal depression symptoms. It is a validated and widely used screening tool for the identification of clinical depression symptom levels in women during the postpartum period (Boyd et al. 2005). In this sample, the EPDS demonstrated good internal consistency ( $\alpha = 0.88$ ). Raw scores greater than  $\pm 3$  standard deviations from the mean were winsorized to 3 standard deviations from the mean. Scores on this measure were square-root-transformed to normalize the distribution.

In addition to these measures, mothers responded to two questions assessing breastfeeding and breastfeeding difficulty, respectively. Specifically, mothers reported whether they were currently breastfeeding (yes/no) and whether breastfeeding was more difficult than anticipated (yes/no). Although these two questions were included in every follow-up survey, we defined breastfeeding difficulty reported only in the first 2 months as "initial breastfeeding difficulties" in order to examine the effects of initial difficulties on bonding trajectories. If mothers reported difficulty on their first postpartum survey and completed their first survey within 2 months postpartum, they were coded as having initial breastfeeding difficulties (1 = reported difficulty, 0 = reported no difficulty).

### Statistical Analysis

Statistical analyses were conducted using R (R Core Team 2018). Given the nested structure of the data (repeated reports of bonding across time nested within individuals), we used multilevel modeling (Woltman et al. 2012) to test the relation of breastfeeding difficulties with initial levels of bonding and the trajectory of bonding over the first 6 months postpartum. Multilevel modeling (also known as mixed modeling, hierarchical linear modeling, linear mixed-effects modeling, and random-effects modeling) is a statistical approach that is useful in this study given that it is able to handle observations from the same individual provided over time and allows for missing data in the outcome variable. Longitudinal data

are non-independent (i.e., within an individual, bonding ratings are likely to be correlated with one another) and multi-level modeling allows for modeling both within-subject and between-subject changes over time. The multilevel model was fit using the *nlme* package (Pinheiro et al. 2019) with restricted maximum likelihood and an autoregressive covariance matrix (i.e., reports of bonding closer in time were assumed to be more highly correlated), as follows:

$$\text{Bonding}_{ij} = \beta_0 + \beta_{1j}(\text{month}_{ij}) + \beta_{2j}(\text{difficulty}_i) + \beta_{3j}(\text{month}_{ij} \times \text{difficulty}_i) + r_{ij} \quad (1)$$

where difficulty was effect-coded ( $-1, 1$ );  $\beta_0$  was the estimated initial level of bonding;  $\beta_{1j}$  was the main effect of month, or the estimated slope of bonding across time;  $\beta_{2j}$  is the main effect of breastfeeding difficulty on bonding;  $\beta_{3j}$  is the interactive effect of month and breastfeeding difficulty; and  $r_{ij}$  is the random effect of subject intercept. A significant interaction between month and breastfeeding difficulty indicates that change in bonding over the first 6 months depends on whether or not the mother experienced initial breastfeeding difficulty.

Because the EPDS was collected simultaneously with self-reported bonding, we were able to examine both within- and between-subject changes in depressive symptoms. To examine how changes in depressive symptoms tracked with bonding over time, we added the within-subject and between-subject effects of depressive symptoms as time-varying covariates in a second multilevel model, as follows:

$$\text{Bonding}_{ij} = \beta_0 + \beta_{1j}(\text{month}_{ij}) + \beta_{2j}(\text{difficulty}_i) + \beta_{3j}(\text{month}_{ij} \times \text{difficulty}_i) + \beta_{4j}(\text{depression}_{ij}) + \beta_{5j}(\text{depression}_i) + r_{ij} \quad (2)$$

where  $\beta_{4j}$  was the within-subject effect of depressive symptoms, which was obtained by “person mean-centering”, or subtracting each subject’s mean score on the EPDS across assessments from their EPDS score at each assessment; and  $\beta_{5j}$  was the between-subject effect of depression symptoms, obtained by taking each subject’s mean EPDS score across all assessments.

## Results

Of the women asked about their intention to breastfeed during pregnancy ( $n = 101$ ), 94 (93.1%) indicated that they were breastfeeding at 1 month postpartum. Further, all 16 women who were not assessed regarding intention to breastfeed during pregnancy indicated at 1 month postpartum that they were breastfeeding. Thus, 7 mothers in the final sample of

117 (6.0%) were not breastfeeding at 1 month postpartum; a total of 17 mothers (14.5%) stopped breastfeeding within 3 months postpartum, and a total of 25 mothers (21.4%) stopped breastfeeding within 6 months. Thirty-nine percent of mothers ( $n = 46$ ) reported initial difficulty breastfeeding on their first survey obtained within the first 2 months postpartum. After winsorizing, MIBS scores across all 6 months ranged from 13.81–24.00 ( $M = 21.90$ ,  $SD = 2.34$ ).

First, we examined overall patterns in bonding across the first 6 months postpartum. Our analyses yielded a main effect of postpartum month: on average, mothers reported increases in positive bonding across time ( $\beta = 0.13$ , 95% CI [0.02, 0.18],  $b = 0.19$ ,  $SE = 0.05$ ,  $t(431) = 4.05$ ,  $p < 0.001$ ). Overall (i.e., after holding constant postpartum month), mothers who reported breastfeeding difficulty reported lower bonding ( $M = 21.29$ ,  $SD = 2.53$ ) than did mothers who did not report breastfeeding difficulty ( $M = 22.32$ ,  $SD = 2.10$ ;  $\beta = -0.20$ , 95% CI [ $-0.34$ ,  $-0.06$ ],  $b = -0.44$ ,  $SE = 0.17$ ,  $t(115) = -2.53$ ,  $p = 0.01$ ; Cohen’s  $d = -0.44$ , 95% CI [ $-0.81$ ,  $-0.06$ ]). Bonding trajectories across the first 6 months postpartum for mothers who did and did not report breastfeeding difficulties are presented in Fig. 1 (Supplementary). Average bonding scores from the raw data for mothers who did and did not report breastfeeding difficulty across each of the first 6 months postpartum are presented in Supplemental Table 1.

Second, we examined whether the difference in bonding between women with and without breastfeeding difficulties persisted over time. The interaction between time and initial breastfeeding difficulty was not significant ( $\beta = 0.03$ , 95% CI [ $-0.06$ ,  $0.20$ ],  $b = 0.05$ ,  $SE = 0.05$ ,  $t(431) = 1.02$ ,  $p = 0.308$ ), suggesting that the slope of bonding for mothers who reported initial difficulty did not differ from that for mothers who reported no difficulty. We evaluated whether the effects were moderated by parity and found no evidence of this factor influencing the patterns of findings.

Finally, we examined whether the main effects of breastfeeding difficulty and postpartum month held when time-varying effects of postnatal depressive symptoms were included in the model. The main effects of breastfeeding difficulty ( $b = -0.33$ ,  $SE = 0.15$ ,  $t(114) = -2.15$ ,  $p = 0.03$ ) and postpartum month ( $b = 0.17$ ,  $SE = 0.05$ ,  $t(430) = 3.79$ ,  $p < 0.001$ ) remained significant when within- and between-subject changes in depressive symptoms were included as covariates. The between-subjects effect of depressive symptoms was significant ( $b = -0.96$ ,  $SE = 0.17$ ,  $t(114) = -5.78$ ,  $p < 0.001$ ), indicating that women who reported higher average levels of depressive symptoms across the first 6 months postpartum also reported lower average levels of bonding. Moreover, within-individual decreases in postnatal depressive symptoms across the first 6 months were associated with improvements in bonding across this period ( $b = -0.28$ ,  $SE = 0.12$ ,  $t(430) = -3.02$ ,  $p = 0.003$ ).



## Discussion

In the present study we examined whether breastfeeding difficulties were associated with initial levels of mothers' self-reported bonding and trajectories of bonding over the first 6 months postpartum. Consistent with prior work examining changes in bonding over the first few months of life (Else-Quest et al. 2003; Muzik et al. 2013), we found that, on average, bonding became more positive across the first 6 months postpartum. We added to existing work by providing evidence of a main effect of initial breastfeeding difficulties on bonding trajectories, such that among mothers who intended to breastfeed, those who reported initial breastfeeding difficulties also reported lower levels of bonding on average across the first 6 months of postpartum. Notably, this pattern of results remained significant even when accounting for postnatal depressive symptoms. Results from this second model indicate that over the first 6 months postpartum, higher levels of postnatal depressive symptoms are associated with reduced bonding and, further, within-individual decreases in postnatal depressive symptoms are associated with improvements in bonding. Taken together, these findings suggest that postnatal depression and breastfeeding difficulties present unique pathways for understanding bonding between mothers and their infants. Addressing both postnatal depressive symptoms and breastfeeding difficulties may be effective in improving the relationship between a mother and her infant in the first months of life.

To date, no other studies have used a quantitative approach to measure the association between breastfeeding difficulties and the bond between a mother and her infant. A number of studies have examined qualitative themes in narratives about breastfeeding experiences, reporting that mothers faced with breastfeeding difficulties or with the prospect of stopping breastfeeding earlier than planned frequently express concerns about lost opportunities for closeness and bonding with their infants (Demirci et al. 2015; Palmér et al. 2012; Williamson et al. 2012).

Another line of research has examined the relation between breastfeeding difficulties and incidence of postpartum depression, with mounting evidence indicating that breastfeeding difficulties are associated with increased incidence of depression in the first months following birth (Ali et al. 2009; Brown et al. 2016; Seimyr et al. 2004; Tamminen 1988; Watkins et al. 2011). Further, breastfeeding difficulties are among the most commonly reported reasons for maternal distress in the early postpartum period (Hall et al. 2014; Henshaw et al. 2015). Our study adds to this literature by demonstrating that breastfeeding difficulties are associated with impaired bonding between mothers and their infants, and that this effect persists over and above the effect of postnatal depressive symptoms. This pattern of results suggests

that the effect of breastfeeding difficulties on bonding is not explained by depressive symptoms. Rather, both breastfeeding difficulties and postnatal depression are uniquely important in explaining variation in bonding during the early postpartum period.

Several potential mechanisms may explain why mothers without breastfeeding difficulties reported more positive bonding than mothers with difficulties. Factors associated with the physical intimacy of breastfeeding may explain differences in bonding between mothers who experience difficulties and mothers who do not; breastfeeding requires close proximity, skin-to-skin contact, and the act of suckling, all of which may cause the mother to feel more in tune with her infant (Feldman et al. 2007; Jansen et al. 2008). A mother can respond directly to sensory cues provided by her infant, which may increase her attunement to her infant during feeding (Jansen et al. 2008). Feldman et al. (1999) found that nursing and other predictors of mother–infant proximity influence the intensity of a mother's preoccupations with her infant, thereby increasing the mother's sense of connectedness with her infant. Previous research shows that breastfeeding increases maternal affectionate touch and improves mother–infant interactions (Feldman and Eidelman 2003).

While the physical intimacy of breastfeeding may have a positive impact on a mother's bond with her infant, some mothers encounter physical challenges during breastfeeding, including nipple pain, latch-on difficulties, or tight frenulum (Moore and Coty 2006). It is possible that physical challenges during breastfeeding contribute to impaired bonding by reducing opportunities for maternal affective touch; mothers who experience physical discomfort may engage in less affectionate touch during feeding episodes. Breastfeeding also triggers the release of hormones that may enhance the maternal bond. Oxytocin and prolactin are released in response to suckling, and may influence maternal caregiving behavior and the maternal bond (Feldman et al. 2007). Further, oxytocin levels are increased following skin-to-skin contact (Feldman and Eidelman 2003). During a challenging feeding episode, babies may not be latching on and skin-to-skin contact may be reduced, both of which could result in lower levels of circulating maternal oxytocin and prolactin. More research is needed to determine whether reduced affectionate touch or reduced levels of hormones related to affiliative feelings explain the association between breastfeeding difficulties and less positive bonding.

Other endocrine factors may also contribute to early differences in bonding. Breastfeeding difficulties may increase maternal stress and, consequently, cortisol levels. Previous work has linked cortisol with reduced mother–child synchrony (Gordon et al. 2010) and fewer affectionate maternal behaviors (Feldman et al. 2007), indicating that increased stress may negatively affect interactions that promote positive bonding. Among mothers who intend to breastfeed but

encounter difficulty, the effort to identify and remedy impediments such as poor latch, weak suck, or insufficient milk supply can involve inordinate amounts of time and effort on the part of the mother as well as provoke frustration in the infant (Moore and Coty 2006; Palmér et al. 2012), and the stress experienced by both parties as a result could also potentially impede bond formation (Feldman et al. 2011; Jansen et al. 2008). Although no mothers in our sample reported intending to formula feed, a future comparison of bonding trajectories with an intentionally formula-feeding sample could be instructive in this regard.

Additional psychological factors are also likely to affect mothers' perceptions of their relationship with their infants. Many mothers who intend to breastfeed but experience difficulties report feeling disconnected from their infants (Moore and Coty 2006) and guilty or anxious about not succeeding in the mothering role and about the consequences for their infants' health if they stop breastfeeding (Labbok 2008; Williamson et al. 2012). Previous work suggests that breastfeeding difficulties predict increased postnatal depression and anxiety symptoms (Brown et al. 2016; Labbok 2008; Lee 2008). In addition, mothers with low breastfeeding confidence may interpret breastfeeding difficulties as further evidence of their inability to provide good maternal care (Palmér et al. 2012; Williamson et al. 2012) or attribute the difficulties toward their infant. Blame-oriented attributions of one's infant are a risk factor for child maltreatment (Bugental and Happaney 2004).

Previous work has demonstrated that the practice of breastfeeding may have transient effects on a mother's perceptions of her bond with her infant. Specifically, compared to bottle-feeding, early breastfeeding was associated with more positive bonding at 4 months postpartum; however, these differences were no longer evident at 12 months postpartum (Else-Quest et al. 2003). Our findings contribute to this earlier work by indicating that *difficulties* in breastfeeding may have an impact on bonding for the first 6 months postpartum.

This study has several limitations. First, bonding was assessed using a self-report measure. Although self-report measures may be the most appropriate way to capture subjective experiences of maternal connection, future studies assessing the impact of breastfeeding experiences on bonding may benefit from the addition of an observational component, in which mother–infant interactions are coded by an objective observer. There is evidence to suggest that self-reported bonding and actual behavior with one's infant are related (Muzik et al. 2013), although additional research is needed to examine the strength of the association between these measures of the caregiving environment. Second, our measure of breastfeeding difficulty was binary; mothers were not asked to specify the type of breastfeeding challenge they experienced and whether they stopped breastfeeding due to

these difficulties. This limits our ability to elucidate possible mechanisms underlying the differences in bonding observed in this sample. Third, we did not include additional factors that may also influence mothers' self-reported bonding. For example, negative experiences during pregnancy and birth may affect breastfeeding experiences and bonding processes (Hobbs et al. 2016; van Reenen and van Rensburg 2013; Weisman et al. 2010). It will be important that future studies include factors beyond postnatal depressive symptoms that may influence bonding to gain a more comprehensive understanding of the effect of breastfeeding difficulties on early bonding experiences. Finally, given that the women in this study may not be representative of the general population (notably, none reported intentions to formula-feed rather than breastfeed whereas epidemiological studies indicate 16% of women in the United States never breastfeed; US Department of Health and Human Services 2019), these findings may not be generalizable to other samples of women.

Despite these limitations, there are significant strengths of this study. Specifically, we have identified that difficulties in breastfeeding are associated with reduced bonding between mothers and infants across the first 6 months postpartum. This is an important advance over previous work, which did not differentiate between mothers who planned to formula feed and mothers who were unsuccessful at breastfeeding. This eliminates the possibility that pre-existing differences between mothers who plan to breastfeed versus those who plan to formula feed could explain the observed differences in the bonding trajectories. Additionally, we provide evidence that while postnatal depressive symptoms are also associated with reduced bonding, the effect of breastfeeding difficulties on bonding is not explained by maternal depressive symptoms.

It remains an open question whether the adverse effect of breastfeeding difficulties on mother-to-infant bonding is mediated by the loss of the breastfeeding relationship itself, or by negative maternal self-assessments in response to societal pressure to breastfeed. This may be an important distinction to pursue in future research, as the first possibility would suggest an approach of improving education and support around lactation, while the second possibility would indicate that de-emphasizing successful lactation and reducing the societal pressure on women who are unable to breastfeed would be a more efficacious approach.

## Conclusions

Investigations such as the present study are important for identifying whether and to what extent infants and mothers may be at risk for subsequent difficulties and are likely to

benefit from interventions to enhance the mother-to-infant bond following early breastfeeding difficulties. Our results suggest that mothers who are experiencing early breastfeeding difficulties are at risk for impaired bonding with their infants across the first 6 months postpartum, and that this effect remains significant even when accounting for postnatal depressive symptoms. While further research is needed to explore the potential impacts of reduced bonding in the first 6 months of life, these findings indicate that mothers who report breastfeeding difficulties may benefit from interventions aimed at improving bonding in early life, and that breastfeeding difficulties and postnatal depressive symptoms are unique targets for intervention.

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## References

- Ali, N. S., Ali, B. S., & Azam, I. S. (2009). Post partum anxiety and depression in peri-urban communities of Karachi, Pakistan: a quasi-experimental study. *BMC Public Health*, *9*, 384. <https://doi.org/10.1186/1471-2458-9-384>.
- Bicking Kinsey, C., Baptiste-Roberts, K., Zhu, J., & Kjerulf, K. H. (2014). Birth-related, psychosocial, and emotional correlates of positive maternal-infant bonding in a cohort of first-time mothers. *Midwifery*, *30*(5), e188–e194. <https://doi.org/10.1016/j.midw.2014.02.006>.
- Bicking Kinsey, C., & Hupcey, J. E. (2013). State of the science of maternal-infant bonding: A principle-based concept analysis. *Midwifery*, *29*(12), 1314–1320. <https://doi.org/10.1016/j.midw.2012.12.019>.
- Bienfait, M., Maury, M., Haquet, A., Faillie, J. L., Franc, N., Combes, C., et al. (2011). Pertinence of the self-report mother-to-infant bonding scale in the neonatal unit of a maternity ward. *Early Human Development*, *87*(4), 281–287. <https://doi.org/10.1016/j.earlhumdev.2011.01.031>.
- Bowlby, J. (1958). The nature of the child's tie to his mother. *International Journal of Psychoanalysis*, *39*, 350–373.
- Boyd, R. C., Le, H. N., & Somberg, R. (2005). Review of screening instruments for postpartum depression. *Archives of Women's Mental Health*, *8*(3), 141–153. <https://doi.org/10.1007/s00737-005-0096-6>.
- Brockington, I. (1996). *Motherhood and mental health*. Oxford: Oxford University Press.
- Brown, A., Rance, J., & Bennett, P. (2016). Understanding the relationship between breastfeeding and postnatal depression: The role of pain and physical difficulties. *Journal of Advanced Nursing*, *72*(2), 273–282. <https://doi.org/10.1111/jan.12832>.
- Bugental, D. B., & Happaney, K. (2004). Predicting infant maltreatment in low-income families: The interactive effects of maternal attributions and child status at birth. *Developmental Psychology*, *40*(2), 234–243. <https://doi.org/10.1037/0012-1649.40.2.234>.
- Ceriani Cernadas, J. M., Noceda, G., Barrera, L., Martinez, A. M., & Garsd, A. (2003). Maternal and perinatal factors influencing the duration of exclusive breastfeeding during the first 6 months of life. *Journal of Human Lactation*, *19*(2), 136–144. <https://doi.org/10.1177/0890334403253292>.
- Cox, J. L., Holden, J. M., & Sagovsky, R. (1987). Detection of postnatal depression: development of the 10-item Edinburgh Postnatal Depression Scale. *The British Journal of Psychiatry*, *150*(6), 782–786.
- Crouch, M., & Manderson, L. (1995). The social life of bonding theory. *Social Science and Medicine*, *41*(6), 837–844. <https://doi.org/10.1016/j.seppur.2003.10.011>.
- Demirci, J. R., Happ, M. B., Bogen, D. L., Albrecht, S. A., & Cohen, S. M. (2015). Weighing worth against uncertain work: The interplay of exhaustion, ambiguity, hope and disappointment in mothers breastfeeding late preterm infants. *Maternal and Child Nutrition*, *11*(1), 59–72. <https://doi.org/10.1111/j.1740-8709.2012.00463.x>.
- Else-Quest, N. M., Shibley Hyde, J., & Clark, R. (2003). Breastfeeding, bonding, and the mother-infant relationship. *Merrill-Palmer Quarterly*, *49*(4), 495–517.
- Feldman, R. (2007). Parent–infant synchrony: Biological foundations and developmental outcomes. *Current Directions in Psychological Science*, *16*(6), 340–345. <https://doi.org/10.1111/j.1467-8721.2007.00532.x>.
- Feldman, R., & Eidelman, A. I. (2003). Direct and indirect effects of breast milk on the neurobehavioral and cognitive development of premature infants. *Developmental Psychobiology*, *43*(2), 109–119. <https://doi.org/10.1002/dev.10126>.
- Feldman, R., & Eidelman, A. I. (2007). Maternal postpartum behavior and the emergence of infant–mother and infant–father synchrony in preterm and full-term infants: The role of neonatal vagal tone. *Developmental Psychobiology*, *49*(3), 290–302. <https://doi.org/10.1002/dev>.
- Feldman, R., Gordon, I., & Zagoory-Sharon, O. (2011). Maternal and paternal plasma, salivary, and urinary oxytocin and parent-infant synchrony: Considering stress and affiliation components of human bonding. *Developmental Science*, *14*(4), 752–761. <https://doi.org/10.1111/j.1467-7687.2010.01021.x>.
- Feldman, R., Weller, A., Leckman, J. F., Kuint, J., & Eidelman, A. I. (1999). The nature of the mother's tie to her infant: Maternal bonding under conditions of proximity, separation, and potential loss. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, *40*(6), 929–939. <https://doi.org/10.1017/S0021963099004308>.
- Feldman, R., Weller, A., Zagoory-Sharon, O., & Levine, A. (2007). Evidence for a neuroendocrinological foundation of human affiliation: Plasma oxytocin levels across pregnancy and the postpartum period predict mother-infant bonding. *Psychological Science*, *18*(11), 965–970. <https://doi.org/10.1111/j.1467-9280.2007.02010.x>.
- Figueiredo, B., Costa, R., Pacheco, A., & Pais, Á. (2009). Mother-to-infant emotional involvement at birth. *Maternal and Child Health Journal*, *13*(4), 539–549. <https://doi.org/10.1007/s10995-008-0312-x>.
- Galbally, M., Lewis, A. J., Ijzendoorn, M. V., & Permezel, M. (2011). The role of oxytocin in mother-infant relations: A systematic review of human studies. *Harvard Review of Psychiatry*, *19*(1), 1–14. <https://doi.org/10.3109/10673229.2011.549771>.
- George, C., & Solomon, J. (1999). Attachment and caregiving: The caregiving behavioral system. In J. Cassidy & P. Shaver (Eds.), *Handbook of attachment: Theory, research and clinical applications* (pp. 649–670). New York: Guilford Press.
- Gordon, I., Zagoory-Sharon, O., Leckman, J. F., & Feldman, R. (2010). Oxytocin, cortisol, and triadic family interactions. *Physiology and Behavior*, *101*(5), 679–684. <https://doi.org/10.1016/j.physbeh.2010.08.008>.
- Hairston, I. S., Handelzalts, J. E., Lehman-Inbar, T., & Kovo, M. (2019). Mother-infant bonding is not associated with feeding



- type: A community study sample. *BMC Pregnancy and Childbirth*. <https://doi.org/10.1186/s12884-019-2264-0>.
- Hall, H., McLelland, G., Gilmour, C., & Cant, R. (2014). "It's those first few weeks": Women's views about breastfeeding support in an Australian outer metropolitan region. *Women and Birth*, 27(4), 259–265. <https://doi.org/10.1016/j.wombi.2014.06.007>.
- Hauck, Y. L., Langton, D., & Coyle, K. (2002). The path of determination: Exploring the lived experience of breastfeeding difficulties. *Breastfeeding Review: Professional Publication of the Nursing Mothers' Association of Australia*, 10(2), 5–12.
- Hegney, D., Fallon, T., & O'Brien, M. L. (2008). Against all odds: A retrospective case-controlled study of women who experienced extraordinary breastfeeding problems. *Journal of Clinical Nursing*, 17(9), 1182–1192. <https://doi.org/10.1111/j.1365-2702.2008.02300.x>.
- Henshaw, E. J., Fried, R., Siskind, E., Newhouse, L., & Cooper, M. (2015). Breastfeeding self-efficacy, mood, and breastfeeding outcomes among primiparous women. *Journal of Human Lactation*, 31(3), 511–518. <https://doi.org/10.1177/0890334415579654>.
- Hobbs, A. J., Mannion, C. A., McDonald, S. W., Brockway, M., & Tough, S. C. (2016). The impact of caesarean section on breastfeeding initiation, duration and difficulties in the first four months postpartum. *BMC Pregnancy and Childbirth*, 16(1), 90. <https://doi.org/10.1186/s12884-016-0876-1>.
- Jansen, J., de Weerth, C., & Riksen-Walraven, J. M. (2008). Breastfeeding and the mother-infant relationship—A review. *Developmental Review*, 28(4), 503–521. <https://doi.org/10.1016/j.dr.2008.07.001>.
- Knaak, S. (2005). Breast-feeding, bottle-feeding and Dr. Spock: The shifting context of choice. *Canadian Review of Sociology & Anthropology*, 42(2), 197–216. <https://doi.org/10.1111/j.1755-618X.2005.tb02461.x>.
- Labbok, M. (2008). Exploration of guilt among mothers who do not breastfeed: The physician's role. *Journal of Human Lactation*, 24(1), 80–84. <https://doi.org/10.1177/0890334407312002>.
- Lee, E. (2008). Living with risk in the age of "intensive motherhood": Maternal identity and infant feeding. *Health, Risk and Society*, 10(5), 467–477. <https://doi.org/10.1080/13698570802383432>.
- Martone, D. J., & Nash, B. R. (1988). Initial differences in postpartum attachment behavior in breastfeeding and bottle-feeding mothers. *Journal of Obstetric, Gynecologic, & Neonatal Nursing*, 17(3), 212–213. <https://doi.org/10.1111/j.1552-6909.1988.tb00427.x>.
- Messinger, D., & Fogel, A. (2007). The interactive development of social smiling. *Advances in Child Development and Behavior*, 35, 327–366. <https://doi.org/10.1016/B978-0-12-009735-7.50014-1>.
- Moore, E. R., & Coty, M. B. (2006). Prenatal and postpartum focus groups with primiparas: Breastfeeding attitudes, support, barriers, self-efficacy, and intention. *Journal of Pediatric Health Care*, 20(1), 35–46. <https://doi.org/10.1016/j.pedhc.2005.08.007>.
- Mozingo, J. N., Davis, M., Droppleman, P., & Merideth, A. (2000). "It wasn't working": Women's experiences with short-term breastfeeding. *MCN The American Journal of Maternal/Child Nursing*, 25(3), 120–126.
- Murphy, E. (1999). 'Breast is best': Infant feeding decisions and maternal deviance. *Sociology of Health & Illness*, 21(2), 187–208.
- Muzik, M., Bocknek, E. L., Broderick, A., Richardson, P., Rosenblum, K. L., Thelen, K., & Seng, J. S. (2013). Mother-infant bonding impairment across the first 6 months postpartum: The primacy of psychopathology in women with childhood abuse and neglect histories. *Archives of Women's Mental Health*, 16(1), 29–38. <https://doi.org/10.1007/s00737-012-0312-0>.
- Palmér, L., Carlsson, G., Mollberg, M., & Nyström, M. (2012). Severe breastfeeding difficulties: Existential lostness as a mother-Women's lived experiences of initiating breastfeeding under severe difficulties. *International Journal of Qualitative Studies on Health and Well-Being*, 7(1), 10846. <https://doi.org/10.3402/qhw.v7i0.10846>.
- Pinheiro, J., Bates, D., DebRoy, S., Sarkar, D., & R Core Team. (2019). *nlme: Linear and Nonlinear Mixed Effects Models* (R package version 3.1–137). <https://cran.r-project.org/package=nlme>
- R Core Team. (2018). *R: A Language and Environment for Statistical Computing* (3.0.0). R Foundation for Statistical Computing. <https://www.r-project.org/>
- Raissan, K. M., & Su, J. H. (2018). The best of intentions: Prenatal breastfeeding intentions and infant health. *SSM—Population Health*, 5(January), 86–100. <https://doi.org/10.1016/j.ssmph.2018.05.002>.
- Scott, J. A., Binns, C. W., Oddy, W. H., & Graham, K. I. (2006). Predictors of breastfeeding duration: Evidence from a cohort study. *Pediatrics*, 117(4), e646–e655. <https://doi.org/10.1542/peds.2005-1991>.
- Seimyr, L., Edhborg, M., Lundh, W., & Sjögren, B. (2004). In the shadow of maternal depressed mood: Experiences of parenthood during the first year after childbirth. *Journal of Psychosomatic Obstetrics and Gynecology*, 25(1), 23–34. <https://doi.org/10.1080/01674820410001737414>.
- Stanway, P., & Stanway, A. (1978). *Breast is best: A commonsense approach to breastfeeding*. London: Pan.
- Tamminen, T. (1988). The impact of mother's depression on her nursing experiences and attitudes during breastfeeding. *Acta Paediatrica*, 77, 87–94.
- Taylor, A., Atkins, R., Kumar, R., Adams, D., & Glover, V. (2005). A new Mother-to-Infant Bonding Scale: Links with early maternal mood. *Arch Womens Ment Health*. <https://doi.org/10.1007/s00737-005-0074-z>.
- US Department of Health and Human Services. (2019). *Healthy People 2020*. <https://www.healthypeople.gov/2020/topics-objectives/topic/maternal-infant-and-child-health/objectives>
- van Reenen, S. L., & van Rensburg, E. (2013). The influence of an unplanned caesarean section on initial mother-infant bonding: Mothers' subjective experiences. *Journal of Psychology in Africa*, 23(2), 269–274. <https://doi.org/10.1080/14330237.2013.10820623>.
- Watkins, S., Meltzer-Brody, S., Zolnoun, D., & Stuebe, A. (2011). Early breastfeeding experiences and postpartum depression. *Obstetrics and Gynecology*, 118(2), 214–221. <https://doi.org/10.1097/AOG.0b013e3182260a2d>.
- Weisman, O., Granat, A., Gilboa-Schechtman, E., Singer, M., Gordon, I., Azulay, H., et al. (2010). The experience of labor, maternal perception of the infant, and the mother's postpartum mood in a low-risk community cohort. *Archives of Women's Mental Health*, 13(6), 505–513. <https://doi.org/10.1007/s00737-010-0169-z>.
- Williamson, I., Leeming, D., Lyttle, S., & Johnson, S. (2012). "It should be the most natural thing in the world": Exploring first-time mothers' breastfeeding difficulties in the UK using audio-diaries and interviews. *Maternal and Child Nutrition*, 8(4), 434–447. <https://doi.org/10.1111/j.1740-8709.2011.00328.x>.
- Woltman, H., Feldstain, A., Mackay, J. C., & Rocchi, M. (2012). An introduction to hierarchical linear modeling. *Tutorials in Quantitative Methods for Psychology*, 8(1), 52–69.
- World Health Organization. (2003). Global strategy for infant and young child feeding. *World Health Organization*. <https://doi.org/10.1111/mcn.12222>.



World Health Organization. (2019). *Nutrition: Breastfeeding*. [https://www.who.int/nutrition/topics/exclusive\\_breastfeeding/en/](https://www.who.int/nutrition/topics/exclusive_breastfeeding/en/)

Ziv, Y., Sagi, A., Aviezer, O., Gini, M., & Koren-Karie, N. (2002). Emotional availability in the mother–infant dyad as related to the quality of infant–mother attachment relationship.

*Attachment & Human Development*, 2(2), 149–169. <https://doi.org/10.1080/14616730050085536>.

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