



What nourishes maternal bonds? Focus on subjective bottle and breastfeeding experiences predicting parental bonding

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Abstract

The notion that breastfeeding contributes to mother-infant bonding is well accepted in both popular culture, and in the academic discourse regarding the benefits of breastfeeding. Nonetheless, studies examining the relationship between breastfeeding and maternal bonding have failed to convincingly demonstrate a significantly beneficial contribution of breastfeeding to maternal bonding. The aim of this study was to address the gap between theory and research by focusing on a new variable: maternal subjective feeding experience. To examine the possible contribution of maternal subjective feeding experiences to maternal bonding, this study examined 99 community-based women, who intended to breastfeed while pregnant. The research design was a follow-up study that included three time: at pregnancy, three and six months postnatal. Data was collected through self-report questionnaires and telephone interviews. Feeding data included quantitative characteristics of infant feeding and maternal subjective feeding experiences. Bonding was measured six months postnatally. Bonding to fetus and postpartum depression were added as control variables. Findings showed that feeding experiences up to three months postnatally predict maternal bonding six months postnatal. The more positive and less negative the feeding experience, the greater the bonding. In contrast, the feeding characteristics did not have a unique and significant contribution to bonding prediction. This study suggests that maternal feeding experiences, rather than the actual feeding style, contribute to the maternal bonding to the infant. Hence, feeding experiences are an essential variable that needs to be further explored.

Keywords Motherhood · Bonding · Breastfeeding · Mother infant bonding · Feeding experience

Introduction

The benefits of breastfeeding for health, nutrition, and physical development of the infant have been demonstrated in many studies, and few disagree with the findings (León-Cava et al., 2002; Stuebe, 2009; Oddy et al., 2011). Adopting those findings that support breastfeeding as a recommended method of infant feeding affects the dominant cultural perception, according to which a good mother is a breastfeeding mother, and thus dictates public and social policies to encourage breastfeeding (Kornides & Kitsantas, 2013; Stuebe, 2009). Following this, in recent decades, there has been an increase in the number of women (between 78 and

90% in Western countries) who, during pregnancy, report that they intend to breastfeed their baby, and start breastfeeding after birth (Redshaw & Martin, 2013; Wilkinson & Scherl, 2006). However, only a minority continue to breastfeed according to the Health Organization recommendations, which encourage exclusive breastfeeding for up to six months and continuation of breastfeeding up to one or two years of age (Redshaw & Henderson, 2012; Tharner et al., 2012). Whether the reason for ceasing to breastfeed is related to breastfeeding difficulties or maternal choices, the tension between the social discourse and the mother's actions, may place great pressure on her, and may lead to feelings of failure amongst mothers who are unable, or do not want to breastfeed (Martin & Redshaw, 2011). Indeed, studies that followed the cessation of breastfeeding, reported that in those mothers who stopped breastfeeding even though they wanted to breastfeed, feelings of failure, guilt, and shame, and these were often expressed in relation to their maternal function (Kukla, 2006; Lee, 2008). However, when women

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are asked **why** breastfeeding is so important for them, one of the three common answers (in addition to the belief that breast milk is healthier and more natural for the baby) is a desire for a closer emotional bond with the baby (Kim et al., 2011). This answer is not based on the proven benefits of breastfeeding for an infant's health and development, but rather expresses the belief that breastfeeding plays a role in creating and establishing the bond between mother and baby (Peñacoba & Catala, 2019) But is this so?

Theoretically, the contribution of breastfeeding to maternal bonding is clearly explained: Breastfeeding is accompanied by the secretion of maternal hormones (oxytocin and prolactin) associated with bonding, promotes physical proximity, skin to skin contact, and requires the mother to remain close to the baby during the first months of life (Jansen et al., 2008; Tharner et al., 2012). Nonetheless, studies examining the relationship between breastfeeding and maternal bonding have failed to convincingly demonstrate a significantly beneficial contribution of breastfeeding to maternal bonding (Jansen et al., 2008).

The aim of this study was to address the gap between theory that predicts a connection between breastfeeding and bonding, and human research that has difficulty demonstrating such a connection. This was addressed by focusing on a new variable: maternal subjective feeding experience. Feeding the baby (whether nursing or bottle feeding) stimulates different feelings in different mothers, and therefore excluding this variable of mothers' experience from previous studies may limit detection of the association between breastfeeding and maternal bonding, even if, and when, it exists. Moreover, feeding experience may have a significant contribution to maternal bonding. In other words, exploring *how the mother feels* while she is feeding her baby, may be more illuminating about her relationship with the infant than investigating *how she feeds him or her*.

Background

There is agreement in the developmental field, regarding the importance of a mother's emotional and practical response to her infant during early infancy, to the mother-infant bond and normal childhood development (Crittenden & Ainsworth, 1989; Deave, 2005; Le Bas et al., 2020; Thamby et al., 2022). Rutter (1972) quotes Bowlby, who claimed that just as proteins and vitamins are essential for physical health, maternal love in infancy and childhood is vital for mental health (Rutter, 1972). Accordingly, studies dealing with extreme disruptions in bonding, which can be expressed through parental rejection, neglect, or abuse, have shown the extent to which these may endanger the normal development of infants (Brockington et al., 2006; Cirulli et al., 2003; Landry et al., 1997).

The term bonding refers to the emotional response of the mother to her infant (Brockington et al., 2006; Hill & Flanagan, 2019; Van Bussel et al., 2010) based on a sense of belonging, with the mother feeling that this baby is especially related to her (Klaus & Kennell, 1976). Bonding may be seen as the "emotional glue" that connects the mother and baby and enables the mother to take on the many tasks of parenting with pleasure (Klaus & Kennell, 1976). Maternal bonding rapidly develops into the first year of parenthood and is often regarded as the emotional basis for the special relationship between mother and child (Klaus & Kennell, 1976; Spratt et al., 2016).

The study of maternal bonding has focused primarily on biological and behavioral processes occurring postnatally, which are critical to establishing a stable emotional bond between mother and infant. Animal studies have demonstrated that in mammals, separation after birth causes the mother to relinquish care for the offspring even when they meet again (Myers, 1984). In contrast, postpartum physical proximity triggers a sequence of caring behaviors that follow one another: breastfeeding, touching, gazing, and closeness. Therefore, it was hypothesized that in humans too, there are hormonal physiological processes that take place after birth and drive maternal actions and feelings.

Research has shown that maternal bonding is more complex in humans than in other mammals, and that in addition to hormonal influences, cognitive, affective, and environmental factors play a significant role (Corter & Fleming, 2002; Kennell & Klaus, 1984; Lamb & Hwang, 1982; Thomson & Dykes, 2011). Interestingly studies that directly examine the relationship between breastfeeding and bonding are relatively few, and the findings from these studies have failed to establish a significant advantage of breastfeeding over bottle feeding. Some studies found no correlation between breastfeeding and bonding (Davis & Sclafani, 2022; Hairston et al., 2019; Vukšić et al., 2022), in others the results are inconclusive (Else-Quest et al., 2003), and even when a positive correlation between breastfeeding and maternal bonding has been found, the effect attributed to breastfeeding was minimal, depending on measurement time and measurement instruments (Else-Quest et al., 2003; Krol & Grossmann, 2018).

However, despite weak empirical support, the belief that breastfeeding fosters maternal bonding has remained widely accepted (Krol & Grossmann, 2018). This belief has not been refuted even in the face of empirical studies which fail to consistently demonstrate a beneficial contribution of breastfeeding to bonding (Hairston et al., 2019; Jansen et al., 2008).

Moreover, the studies that were able to show a beneficial effect of breastfeeding have demonstrated this when comparing infants at both ends of the spectrum, i.e., infants

exclusively breastfed, and those never breastfed (Kim et al., 2011). Subtle differences regarding different levels of breastfeeding were not found to be associated with bonding (Britton et al., 2006; Hairston et al., 2019). In addition, the possibility that mothers exhibiting higher maternal bonding tend to breastfeed, and not vice versa, has not been adequately examined. This gap between the prevailing perception of the importance of breastfeeding and the findings does not necessarily indicate that breastfeeding does *not* play a role in mother-infant bonding, but rather invites further empirical investigation.

Breastfeeding experiences and feeding experiences

One possibility as to why previous research failed to consistently detect a link between breastfeeding and bonding is that thus far, there has been insufficient reference to the mother's breastfeeding *experience*. Contrary to popular belief, breastfeeding is not "born" with the baby, but is an acquired skill that tends to change over time and varies from mother to mother (Larsen et al., 2008). Studies of breastfeeding experiences have described how the mother's physical-emotional experience differs from the way she imagined it during pregnancy, and this often surprises new mothers (Hoddinott et al., 2012; Schmied et al., 2001). Some describe the experience of breastfeeding as pleasant. Breastfeeding is experienced by them as an experience of togetherness, of intimacy, of connection, and of giving. In contrast, other mothers experience it as a demanding, stressful, unpleasant, and stressful experience. These women experience a violation of their autonomy while breastfeeding, and feel like an object, a cow, or a "milking machine". The most difficult experience of all is described when breastfeeding is accompanied by intense physical pain and discomfort. Women experiencing these difficulties describe breastfeeding as a "battleground", as a "bloody bloody struggle" (Schmied et al., 2001). These negative breastfeeding experiences can explain the gap between the number of women who started breastfeeding postnatal and those who persisted with it according to the recommendations of health organizations that endorse breastfeeding for at least one year (Stuebe, 2009). When mothers stop breastfeeding the infant before it reaches one year of age, they often report feelings ranging from relief at finding a solution and resolving the difficulties of breastfeeding, to feelings of grief, guilt, shame, and tension over what they interpret as failure (Lee, 2008; Marshall et al., 2007). Therefore, it may be the case that maternal feelings while feeding are more significant for bonding formation than the type of food the infant eats or the way in which it is consumed.

Other studies focusing on breastfeeding experiences have shown that breastfeeding is a learned skill. The experience

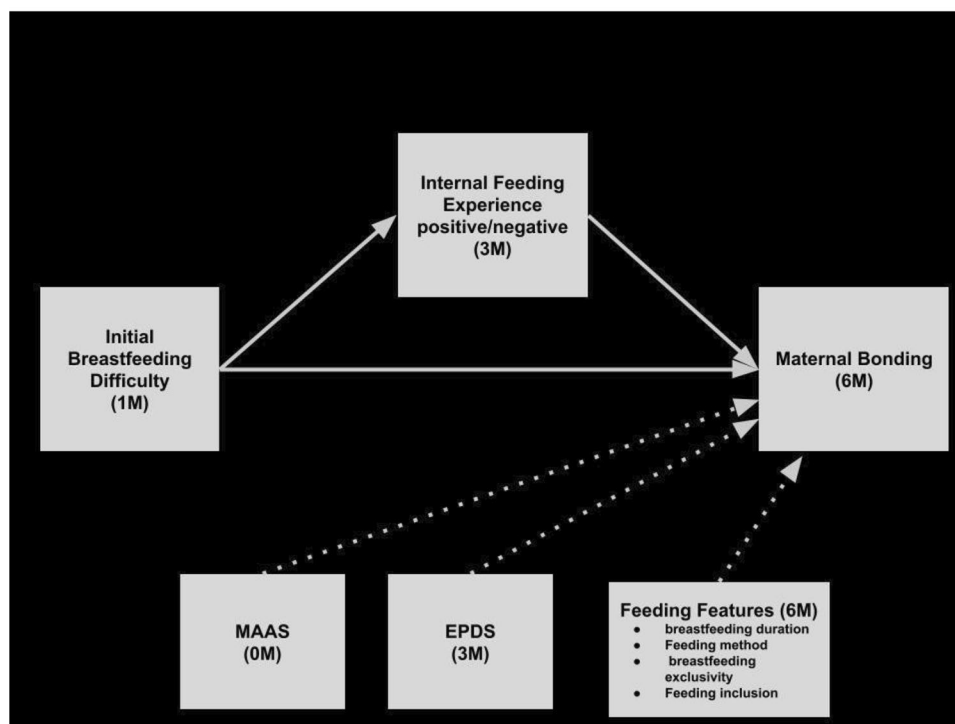
of breastfeeding tends to change substantially over time (Kronborg et al., 2015). The initial breastfeeding experience differs from one mother to another: some describe great pain, despair, frustration, and disappointment, while others experience initial practical difficulties but manage to overcome them relatively easily (Schmied & Barclay, 1999; Schmied et al., 2001). Most mothers are concerned about breastfeeding in the first few weeks after giving birth, and many experience breastfeeding as their first maternal "test" (Kronborg et al., 2015). The results of this "test" (whether the mother eventually manages to breastfeed or turns to bottle-feeding) are likely to contribute to her feeding experiences later (Larsen et al., 2008; Nelson, 2006). Since the bottle-feeding experience of those who intended to breastfeed but discontinued for various reasons tends to be complex, it can be assumed that it contributes to maternal bonding in a similar way to breastfeeding experiences, in those who continue to breastfeed.

In conclusion, studies regarding breastfeeding experiences have pointed out the variation in the recommendations of the health organizations for exclusive breastfeeding, and the everyday reality that mothers face where breastfeeding is part of the complex care of the infant and entails many challenges. Furthermore, meta-synthesis research on this topic has indicated that the division between good and bad in a mother's experience is linked to the success of breastfeeding (Burns et al., 2010; McInnes et al., 2008; Thomson et al., 2011). Therefore, public health recommendations that propound an ideal which may not necessarily be a realistic view, could exacerbate the tension and vulnerability of mothers at this sensitive stage of motherhood. Alternatively, current research on breastfeeding experiences recommends that knowledge about the common and real maternal experience should be accessible. Feeding experience in general, and breastfeeding in particular, should be shown as being something complex and not a dichotomous "yes or no" variable (Hoddinott et al., 2012). However, since most of the literature on breastfeeding experiences is based on qualitative studies, our study is unique in that it measures breastfeeding experiences quantitatively, thus opening the door to investigating the impact of feeding experiences on both developmental and maternal variables.

The current study

Considering the abovementioned review of the literature, the aim of this study was to examine the possible contribution of maternal subjective feeding experiences to maternal bonding. We hypothesized that the more positive and less negative the feeding experience is, the higher maternal bonding would be. Given the unique impact of the initial encounter with breastfeeding, we hypothesized that feeding

Fig. 1 Study's model



experiences in the first three months (whether nursing or bottle feeding) would mediate the relationship between initial breastfeeding difficulties (first-month breastfeeding attempts) and maternal bonding at six months. To ascertain the direction of the connection, and to rule-out the possibility that maternal bonding is the predictor of the chosen feeding style and accompanying feeding experience and not the opposite, maternal bonding to the fetus measured prenatally was taken into account. Also, given the theoretical and empirical connection between postpartum depression and maternal bonding (Brockington, 2004; Figueiredo et al., 2009; Kumar, 1997) postpartum depression was added as control variable. The study model is shown in Fig. 1.

Method

Design

The study is a longitudinal study, consisting of three time points: during pregnancy (T1), three months (T2), and six months (T3) postnatally.

Participants

This research is part of a large-scale longitudinal study focusing on the transition to parenting. The broad study sample included 104 community-based families of co-living heterosexual couples, expecting their first child.

Participating families were recruited through internet advertisements, flyers and medical centers. Mothers were fluent in writing and speaking Hebrew and lived in central Israel. Participants' ages ranged from 23 to 42 years ($M=30.82$, $SD=3.63$). 89% of the mothers had an academic education. About half of the mothers (51.6%) had a below average salary while 35% of the mothers had an above average salary and 12.6% had an average salary. Criteria for inclusion in the present research sample were the intention to breastfeed, and to start breastfeeding after delivery. Out of 104 participants in the broad study, three mothers did not attempt to breastfeed postpartum, and one infant was older than three months when the study was conducted. Therefore, findings were conducted on 99 mothers.

Ethical considerations

The Reichman University Ethics Committee approved the research. Participants signed a consent form and received an explanation of the purpose of the study, and the procedure. We made it clear that participation in the research study was voluntary and that the mothers could terminate their participation in the research study at any stage.

The research team was in touch with the families at the time of the study and addressed the difficulties and problems involved in participating in it. The research team also pledged to give families feedback if the data collection raised a risk or concern for the well-being or development of the infants.

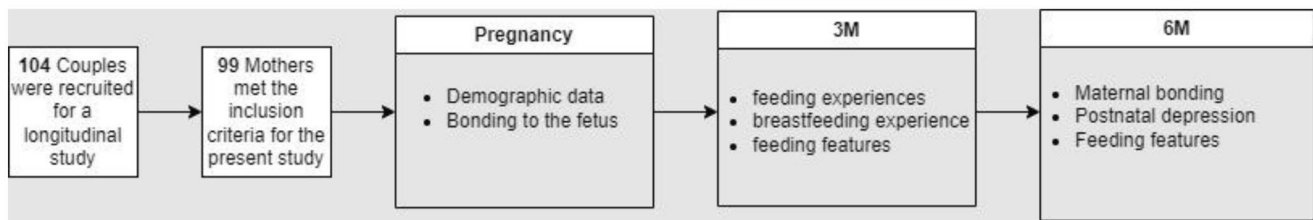


Fig. 2 Research procedure

Procedure

At T1, while the women were in their third trimester, data collection included demographic characteristics, prenatal maternal bonding, and screening for psychopathology. At T2, three months postnatally, data regarding feeding experiences was collected. Additionally, phone interviews were conducted to collect data pertaining to birth characteristics and feeding characteristics. At T3, six months postnatally, data about maternal bonding, postpartum depression, and additional feeding data was taken. Research procedure is presented in Fig. 2.

Measures

Bonding measures Maternal bonding to fetus was measured via The **Maternal Antenatal Attachment Scale** (MAAS; Condon, 1993), a self-report questionnaire containing 19 items relating to maternal bonding to the fetus during pregnancy. All items are indicated on a Likert scale between 1 and 5, with a higher score reflecting high and positive bonding to the fetus while a low score reflects low or negative bonding to the fetus. The questionnaire has been widely used in developmental studies and was found reliable and valid in previous samples (Busonera et al., 2016; Navarro-Aresti et al., 2016). In the present study, the alpha-Cronbach coefficient was calculated and found to be $\alpha=0.80$.

Maternal bonding to infant was measured via The **Maternal Postpartum Attachment Scale** (MPAS; Condon & Corkindale, 1998). The MPAS is a self-report test used to assess a mother's emotional response to her infant. The tool refers to the inner emotional experience in a mother's relationship with her baby, and not to attitudes, beliefs, or behaviors about that relationship. The underlying theoretical model of the tool describes the central emotion that characterizes the maternal bonding — love — as evoking different emotional needs that express it or deal with it. The mother can describe her own emotional needs and feelings, and these are therefore accessible for self-report. A high rating on the MPAS reflects a strong bond to the infant, while a low rating reflects a difficulty or problem in the infant-mother bonding. The measure is considered reliable and valid (Scopesi et al., 2004; Van Bussel et al., 2010).

The Alpha Cronbach coefficient of the global score on the MPAS in the present study was. $\alpha=0.74$.

Feeding characteristics By tracking the feeding patterns up to six months postnatally, information was collected on four variables that characterized the mode of feeding: (1) *breastfeeding duration* - number of months the infant was breastfed; (2) *feeding method* - exclusive breastfeeding, exclusive bottle feeding, or combination of two methods; (3) *feeding inclusion* - number of bottles the infant gets each day by someone other than his or her mother; and (4) *breastfeeding exclusiveness* - on a four level scale ranging from 1 (solely direct breastfeeding) to 4 (solely bottle feeding).

Initial breastfeeding difficulty was measured through questions concerning the perceived difficulty of breastfeeding in the first month (e.g., “In the first weeks of your motherhood, how easy or difficult did you find breastfeeding your baby”). Also, following studies describing initial attempts with breastfeeding as coping with physical pain, frustration, and mental stress (Kronborg et al., 2015), questions measuring these experiences directly in breastfeeding were added. Mothers were asked to report on a scale of 1–5 (‘1 ‘indicates’ I did not feel this way at all, ‘and ‘5’ ‘I felt this way to a large extent) how much these feelings were present during the first month of breastfeeding (e.g., “It hurts when I breastfeed”; “When I breastfeed, I feel frustrated”; “When I breastfeed I feel stressed”). The final score was calculated by summing these four items, with a higher score reflecting more acute breastfeeding difficulties. The reliability of the scale in the present study was $\alpha=0.79$.

Maternal feeding experiences up to three months postpartum were measured using a new instrument developed for the purposes of the current study. A new instrument was necessary since most of the research done in the field is qualitative research. We formulated 14 items reflecting possible experiences while feeding a baby, describing emotions, thoughts, and bodily sensations that may arise while feeding. Items were based on data from Lee's (2008) study that included in-depth interviews about their feeding experience with women who bottle-fed, qualitative data from in-depth interviews with breastfeeding mothers (Kronborg et al., 2015; Ryan et al., 2011), and a meta-analysis of

qualitative studies on breastfeeding experiences (Larsen et al., 2008). Participants were asked to describe the extent to which they felt these experiences when they fed. Mothers responded twice for each item, once for her present experience (when the baby is three months old), and once for her first-month experience. Mothers were instructed to respond according to their current feeding style (breastfeeding or bottle feeding). Mothers who combined breastfeeding and bottle-feeding were asked to describe their experience with breastfeeding. A pilot study with a sample of twenty-five mothers of infants was conducted to ensure that the items were understood correctly. Exploratory factor analysis with oblique rotation questionnaire items revealed two orthogonal dimensions: positive experiences in feeding (four items) and negative feeding experiences (five items). Accordingly, two scores were obtained for each participant. One score reflects the positive feeding experiences, and a second score reflects the negative feeding experiences. The reliability was $\alpha = 0.72$ and $\alpha = 0.72$ for the positive and negative experiences, respectively. The correlation between the factors was moderately negative ($r = -.23, p < .05$).

To establish structure validity, we compared breastfeeding experiences obtained through the new tool with scores of a well-established questionnaire to evaluate the breastfeeding experience: the Maternal Breastfeeding Experience Scale MBFES (Leff et al., 1994). We could not use the MBFES in our current study due to two problems: firstly, mothers had to persevere with breastfeeding for at least a month, and secondly, it could not be used to compare breastfeeding and non-breastfeeding experiences. Therefore, we calculated a correlation between the scores of the breastfeeding mothers in the two tools only. As expected, the correlation with the positive feeding experiences was positive ($r = .40, p < .001$), whereas the correlation with the feeding experiences was negative ($r = -.48, p < .001$).

To test the predictive validity, we tested against variables that theoretically should be related. We specifically tested for parenting sense of competence (PSOC; Johnston & Mash, 1989) and postpartum depression (EPDS; Cox et al., 1987). As expected, the less positive and more negative the feeding experience was, the lower the feelings of parenting efficiency and confidence. Also, more negative feeding experiences were associated with higher levels of maternal depression.

Control variables

Demographic data Participants completed a demographic questionnaire that included questions about socioeconomic status, age, education, and employment status. An initial screening for psychopathology was conducted using the Brief Symptom Inventory (BSI; Derogatis, 1993).

Relationships between demographic variables and study variables were explored. None of the demographic variables were found to be related to any of the study's variables, and therefore were not controlled for in further analyses.

Postpartum Depression was assessed by the Edinburg Postnatal Depression Scale (EPDS) (Cox et al., 1987) It is a 10-item self-report questionnaire constructed to assess postpartum depressive symptoms. The items are on a four-grade Likert scale (0–3). The scale showed high internal reliability ($\alpha = 0.85$) as well as good repeat test reliability (Figueiredo et al., 2009). Alpha Cronbach coefficient in the present study was $\alpha = 0.83$.

Data analysis

The study hypotheses were tested using SPSS software, version 25. The Kolmogorov-Smirnov test was carried out for all the continuous variables. The distribution of results was found to be significantly different from the norm ($p < .05$) for most of the variables (initial breastfeeding difficulty, positive and negative feeding experience, breastfeeding duration, maternal depression, and maternal bonding at 6 months). Thus, we used both non-parametric tests and parametric tests with bootstrapping. The first hypotheses were tested using Spearman adapters and hierarchical regression analyses. Next, mediation hypotheses and moderated mediation were examined using the Process Ordinance (Hayes, 2013).

Results

Descriptive statistics

Feeding variables are presented in Table 1. Study variables, distributions, and correlations are presented in Table 2. As can be seen in Table 1, most of the mothers combined bottle and breastfeeding at the beginning of their children's life (56.6% at age 2 weeks), and many of them chose exclusive breastfeeding at that point (38.4%). At the following measurement points, the proportion of mothers who chose exclusive breastfeeding or the combination of breastfeeding and bottle-feeding gradually decreased (at 3 months: 23.2% and 48.5%; at 6 months: 21.4% and 39.8%, respectively). The frequency of exclusive bottle feeding gradually increased between time points (5.1% of the mothers at 2 weeks, 28.3% at 3 months, and 38.8% at 6 months).

As shown in Table 2, no significant relationships were found between feeding variables (feeding type, feeding duration, feeding figures number, and the number of bottles given by a person other than the mother), and feeding experience at three months or maternal bonding at six months.

Table 1 Descriptive Statistics of Feeding Variables Over Times

| Variable | | | |
|---|---------------------------------|------|-------|
| Feeding type – 2 weeks (n, %) | | | |
| | <i>Exclusive breastfeeding</i> | 38 | 38.4% |
| | <i>Exclusive bottle-feeding</i> | 5 | 5.1% |
| | <i>Combination</i> | 56 | 56.6% |
| Feeding type – 3 months (n, %) | | | |
| | <i>Exclusive breastfeeding</i> | 23 | 23.2% |
| | <i>Exclusive bottle-feeding</i> | 28 | 28.3% |
| | <i>Combination</i> | 48 | 48.5% |
| Feeding type- 6 months (n, %) | | | |
| | <i>Exclusive breastfeeding</i> | 21 | 21.4% |
| | <i>Exclusive bottle-feeding</i> | 38 | 38.8% |
| | <i>Combination</i> | 39 | 39.8% |
| Number of people feeding the infant per day (M, SD) | | 2.09 | 1.29 |
| Meals given by person other than the mother per day (M, SD) | | 0.90 | 0.90 |

Initial breastfeeding difficulty and feeding experience at three months

As shown in Table 2, initial breastfeeding difficulty was positively correlated with negative feeding experience at three months. Still, no significant correlation was found with positive feeding experience at that time point.

Table 2 Descriptive statistics and Spearman correlations of Study’s Variables

| | M (SD) | 1 | 2 | 3 | 4 | 5 | 6 |
|-------------------------------------|--------------|---------|---------|---------|---------|-------|---------|
| 1. Prenatal Bonding | 4.06 (0.37) | - | | | | | |
| 2. Initial breastfeeding difficulty | 14.01 (4.58) | 0.03 | - | | | | |
| 3. Positive feeding experiences | 3.48 (1.04) | 0.31** | -0.12 | - | | | |
| 4. Negative feeding experiences | 2.05 (0.75) | -0.20* | 0.56*** | -0.26* | - | | |
| 5. Breastfeeding Duration | 4.41 (2.25) | -0.07 | -0.29** | 0.10 | -0.06 | - | |
| 6. Maternal Depression | 5.79 (4.14) | -0.19 | 0.19 | -0.06 | 0.22* | 0.07 | - |
| 7. Maternal bonding | 79.04 (6.80) | 0.45*** | -0.08 | 0.42*** | -0.32** | -0.10 | -0.32** |

* $p < .05$, ** $p < .01$, *** $p < .001$. M = months

Table 3 Regression analyses for the prediction of feeding experience at three months by initial breastfeeding difficulty, controlling feeding style at three months

| Step | Predictor | Positive feeding experience | | Negative feeding experience | |
|------|----------------------------------|-----------------------------|-------------|-----------------------------|-------------|
| | | B (SE) | 95% CI | B (SE) | 95% CI |
| 1 | Exclusive breastfeeding | -0.24 (0.27) | -0.81; 0.28 | -0.14 (0.17) | -0.47; 0.19 |
| | Exclusive bottle-feeding | -0.36 (0.25) | -0.85; 0.14 | 0.24 (0.19) | -0.11; 0.60 |
| | R^2 | 0.02, $F(2,93) = 1.10$ | | 0.01, $F(2,93) = 1.69$ | |
| 2 | Exclusive breastfeeding | -0.25 (0.27) | -0.79; 0.24 | -0.11 (0.10) | -0.32; 0.10 |
| | Exclusive bottle-feeding | -0.28 (0.25) | -0.78; 0.21 | -0.04 (0.20) | -0.46; 0.35 |
| | Initial breastfeeding difficulty | -0.02 (0.03) | -0.08; 0.03 | 0.09 (0.02)*** | 0.06; 0.12 |
| | R^2 | 0.03, $F(3,92) = 1.07$ | | 0.30, $F(3,92) = 14.44$ *** | |
| | ΔR^2 | 0.01, $F(1,92) = 1.02$ | | 0.28, $F(1,92) = 38.57$ *** | |

*** $p < .001$

In order to control the possible effect of feeding style on feeding experience, the relationships between initial breastfeeding difficulty and feeding experience were also evaluated through hierarchic regression analyses, in which feeding style at three months was entered at the first step (as two dummy-variables: exclusive breastfeeding and exclusive bottle-feeding), and the initial breastfeeding difficulty was entered at the second step. The coefficients were computed through bootstrapping. As can be seen in Table 3, initial breastfeeding difficulty significantly explained 28% of the variance in the negative feeding experience, beyond feeding style. The positive experience model did not reach significance. Feeding style at three months made no significant contribution to the prediction of feeding experience.

Feeding experience at three months and maternal bonding at six months

As shown in Table 2, Maternal bonding at six months was positively correlated with positive feeding experience and negatively correlated with negative feeding experience at three months. It should be mentioned that the correlation between positive and negative experience measures was significant but relatively weak.

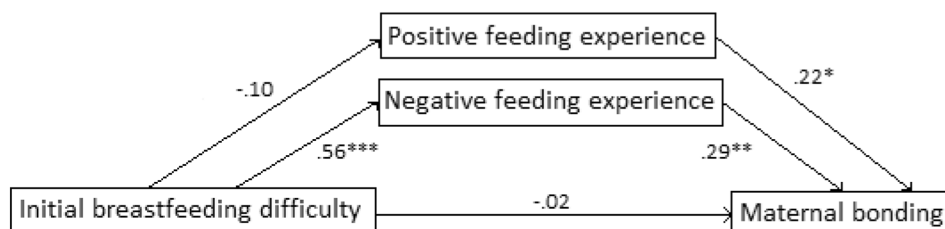
Next, using hierarchic regression analysis, we examined the possible effects of feeding experiences on post-natal maternal bonding beyond prenatal maternal bonding, maternal depression and feeding style at three months. The coefficients were computed through bootstrapping. As can

Table 4 Regression analysis for the prediction of maternal bonding at six months by feeding experience at three months, controlling for maternal bonding at pregnancy, maternal depression, feeding style at three months and breastfeeding duration

| Step | Predictor | B (SE) | 95% CI | |
|------|-------------------------------------|----------------------------|--------------|--|
| 1 | Prenatal Maternal bonding | 8.79 (1.52)*** | 5.49; 11.47 | |
| | Exclusive breastfeeding – 3 months | -0.14 (1.59) | -3.39; 3.11 | |
| | Exclusive bottle-feeding – 3 months | -0.48 (4.70) | -8.63; 10.10 | |
| | Breastfeeding duration – 6 months | -0.17 (0.95) | -1.71; 2.04 | |
| | Maternal depression – 6 months | -0.41 (0.14) | -0.69; -0.14 | |
| | R^2 | 0.33, $F(5,90) = 8.99$ *** | | |
| 2 | Prenatal maternal bonding | 6.90 (1.65)*** | 3.55; 9.90 | |
| | Exclusive breastfeeding – 3 months | 0.20 (1.67) | -3.25; 3.40 | |
| | Exclusive bottle-feeding – 3 months | 0.33 (3.78) | -5.98; 9.17 | |
| | Breastfeeding duration – 6 months | -0.23 (0.78) | -1.46; 1.59 | |
| | Maternal depression – 6 months | -0.35 (0.15)* | -0.66; -0.06 | |
| | Positive feeding experience | 1.41 (0.59)* | 0.29; 2.62 | |
| | Negative feeding experience | -1.79 (0.75)* | -3.26; -0.36 | |
| | R^2 | 0.42, $F(7,88) = 9.10$ *** | | |
| | ΔR^2 | 0.09, $F(2,88) = 6.59$ ** | | |

* $p < .05$, ** $p < .01$, *** $p < .001$

Fig. 3 Feeding experience mediates the relationship between initial breastfeeding difficulty and maternal bonding at six months



* $p < .05$, ** $p < .01$, *** $p < .001$.

be seen in Table 4, maternal bonding during pregnancy and maternal depression significantly contributed to the prediction of maternal bonding at six months. The control variables altogether explained 33% of postnatal maternal bonding variability. Feeding experience measures added 9% explained variance. Both positive and negative experience significantly contributed to the model.

Feeding experience mediates the relationship between initial breastfeeding difficulty and maternal bonding at six months

The mediation model was explored using regression analyses and Process command (Hayes, 2013), model 4. Positive and negative feeding experiences were entered into the model as parallel mediators. Maternal bonding during pregnancy, maternal depression, feeding type, and breastfeeding duration were entered as covariates. The model, including standardized coefficients, is presented in Fig. 3. The mediation effect of positive feeding experience was insignificant (95% CI: -0.15, 0.03), and the mediation effect of negative

feeding experience was significant (95% CI: -0.53, -0.07). In sum, negative, but not positive feeding experience mediated the relationship between initial breastfeeding difficulty and maternal bonding. Initial difficulties in breastfeeding led to more negative experience, which in turn led to weakening of maternal bonding.

Discussion

It is commonly believed that breastfeeding contributes to the mother-infant bond and *nourishes* the bond between mother and infant (Krol & Grossmann, 2018). Theoretically, the connection between breastfeeding and maternal bonding is well explained. However, studies examining the association between breastfeeding and maternal bonding have failed to convincingly demonstrate this beneficial contribution of breastfeeding to maternal bonding (Davis & Sclafani, 2022; Jansen et al., 2008). The aim of the present study was to address this gap between theory and research by focusing on a new variable: maternal subjective feeding experiences.

The study's hypotheses were supported, and findings showed that feeding experiences up to three months postnatally predict maternal bonding six months postnatal. The more positive and less negative the feeding was experienced, the higher the bonding appeared to be. As expected, there was a correlation between positive and negative feeding experiences, but this correlation was relatively weak.

We were particularly interested in the way early breastfeeding difficulties, which are characteristic a common occurrence in most mothers and accompany breastfeeding learning, contribute to maternal feeding experiences. We questioned whether primary breastfeeding difficulties have a negative effect on maternal bonding. Accordingly, we collected information about the initial encounter with the breastfeeding experience (breastfeeding difficulties in the first month) and about the internal feeding experiences - negative and positive up to the age of three months. In line with the study's hypothesis, an indirect link was found between initial difficulty with breastfeeding and maternal bonding, mediated by negative feeding experiences. Early difficulty with breastfeeding led to more negative feeding experiences, which in turn led to weaker bonding. Contrary to the hypothesis of the study that there would be an association between primary breastfeeding difficulties and bonding to the infant through positive and negative feeding experiences, no direct relationship was found between breastfeeding difficulty, and maternal bonding through positive feeding experiences. There was no association between breastfeeding difficulties in the first month and positive feeding experiences three months after birth.

This is an interesting finding that raises the question of what causes positive feeding experiences (Meaning? Love?) And perhaps if it is not possible to reduce the difficulty (because sometimes breastfeeding is very painful at first) it is possible to increase positive experiences in other ways.

While a positive association was found between positive feeding experiences and maternal bonding, no association was found between initial breastfeeding difficulties and positive feeding experiences. These findings suggest that positive feeding experiences are not necessarily related to initial breastfeeding difficulties, that is, breastfeeding can begin with hurdles and difficulties yet still be experienced positively later. This reinforces our understanding that these experiential aspects of feeding are independent. Negative feeding experiences appear to have been the result of difficult experiences, frustration, and a lack of adequate breastfeeding experience. The question of the source of positive feeding experiences remains open at this stage. Whatever their origin, this study shows that positive feeding experiences predict the maternal bonding to the infant no less than negative feeding experiences. Moreover, since we did not find a direct link between initial breastfeeding difficulties

and maternal bonding, but only a link mediated through negative feeding experiences at three months postnatal, these findings highlight how important it is to emotionally process and support mothers' experiences of initial breastfeeding difficulties. Processing breastfeeding experiences, which often tend to be complex, is essential in maintaining both breastfeeding and good bonding, even in the face of initial challenges.

As to the question pertaining to the possible associations between maternal bonding and feeding characteristics—whether the baby was bottle-fed, the number of bottles they received, and who fed the baby—the results of the study revealed no association between these variables. To further the meaning of this finding and understand the magnitude of the effect, we performed a hierarchical regression in which convincing results were obtained: feeding experiences had a significant unique contribution to predicting maternal bonding *beyond* the prediction obtained from control variables (postpartum depression and fetal attachment). In contrast, the feeding characteristics (even when grouped) did not have a unique and significant contribution to bonding prediction. That is, the way in which the baby is fed is unrelated to maternal bonding to the infant. Not finding a correlation between infant feeding method to maternal bonding is consistent with other studies, which also did not find such a link (Davis & Sclafani, 2022; Hairston et al., 2019; Martone & Nash, 1988) And certainly challenges the common belief that breastfeeding is essential for maternal bonding.

Plausible alternative explanations: prenatal bonding to fetus and postpartum maternal depression and their contribution to maternal bonding

A potentially alternative explanation for the study results is that the association between feeding experiences and bonding does indeed exist but it operates in the opposite direction, that is, higher prenatal bonding fosters higher chances of breastfeeding, and hence a better feeding experience postnatally. To explore this alternative explanation, maternal bonding to the fetus during pregnancy was measured and added to the study as a control variable. While significant associations were found between bonding to fetus and bonding to infant at six months, as well as between prenatal bonding and positive feeding experiences, the study model findings described above remained significant after controlling for prenatal bonding.

Postpartum maternal depression was also used in the current work as a control variable. This was due to the known association between postpartum depression levels and bonding (Figueiredo et al., 2009). As expected, findings showed that postpartum depression is associated with

negative feeding experiences (but not positive feeding experiences) and maternal bonding. The more depressed the mother was, the more negative her feeding experience, and the bonding tended to be lower. However, the findings of the study model did not change when maternal depression was controlled.

Study limitations

First, because our sample was part of a larger study, which required a significant investment of resources in each participant (home visits, laboratory visits, and a two-year longitudinal study), our sample was not large, and the data analysis was performed on 99 mothers. Therefore, despite the promising direction indicated by the results of the study, the results should be replicated in a wider study.

Second, the data regarding initial feeding experience (up to one month postpartum) was obtained retrospectively by interview conducted three months postpartum. The reason for the retrospective measurement was due to research constraints. We did not want to add an interview in the first weeks after birth which is a sensitive period for mothers. The use of retrospective information in research is not without problems and is vulnerable to various memory biases (Henry et al., 1994). However, studies regarding maternal experiences have shown that women's memories of their initial experiences as mothers even a year after giving birth are quite similar to the original experience (Robson & Kumar, 1980). Therefore, reliance on experiential memory from the postpartum period, especially after first birth, seems valid (Barrett & Fleming, 2011; Røseth & Bongaardt, 2019; Taylor et al., 2005).

In summary, this study suggests that feeding experiences are an essential variable and should be further explored. Improving the exploration of feeding experiences in follow-up studies by improving measures, and adding prospective measurements (e.g., using feeding diaries), may help understand how feeding experiences contribute to maternal bonding and other essential variables.

Finally, in the present study, we focused on the maternal benefits of better feeding experiences to maternal bonding. However, do those feeding experiences also contribute to infant's attachment? In our study, we looked at the maternal aspect of the mother-infant bond, which is the glue that connects the mother to the infant and ensures that she cares for and enjoys her child. Nevertheless, is it beneficial for the infant itself? In the empirical literature, the benefits of breastfeeding for infant attachment are controversial. Some studies have found benefits, and some have not (Davis & Sclafani, 2022; Jansen et al., 2008). Perhaps for this question, too, the maternal experience has a unique contribution.

Conclusion

This study focused on feeding characteristics and feeding experiences, and their contribution to maternal bonding to infants. We suggested that feeding experiences, rather than feeding characteristics, contribute to that bond and predict maternal bonding to the infant over time. Data obtained through a longitudinal study showed that positive and negative feeding experiences at three months postnatal predicted almost a quarter (23%) of the variance in maternal bonding to the infant six months postnatally. After adjusting control variables (prenatal bonding to infant and maternal postpartum depression), the contribution of feeding experiences to prediction remained significant. In contrast, feeding characteristics in general, and breastfeeding characteristics, did not contribute to the prediction of maternal bonding. These findings support the idea that maternal experiences that accompany practical care actions have a significant impact when it comes to human relationships.

When it comes to the practical application of the current work, it is important to acknowledge that the many resources invested in encouraging and preserving breastfeeding have many benefits. It is undoubtable that both infants and mothers can derive significant nutritional and health benefits from prolonged breastfeeding. However, the findings of the current work indicate that attempting to sustain breastfeeding at any cost can end up being a double-edged sword and could unintentionally cause more harm than good in the face of significant difficulties while establishing breastfeeding. Such mothers can develop negative experiences towards breastfeeding, which in turn hinders the mother's emotional bond to her infant. In light of this, we suggest promoting a public policy that focuses on the nutritional benefits of breastfeeding while presenting the psychological benefits—as a function of the mother's subjective experience. This approach may result in a more sensitive, tailored-made, and personal treatment of women, one that considers individual differences and histories when recommending and supporting young mothers in their early days of mothering.

Our findings further tentatively suggest that the inner, subjective experience accompanying breastfeeding might be more significant to the prediction of maternal bonding than the act of breastfeeding itself. During the perinatal phase, the encounter with breastfeeding is often a significant and often stressful experience. As practitioners and clinicians, as well as policy makers, it emerges that there is value in paying attention not only to the pragmatic or technical aspects of breastfeeding, but also to the subjective feeding experiences mothers have. By affirming, validating, and containing women's experiences while feeding their infants, especially allowing for the expression of negative feelings, we can promote processing these negative feelings

and moving toward a more accepting and positive experience of feeding the infant. This, as shown by the current work, is likely to promote more positive bonding between the mother and her infant. Adopting such a clinical direction could result in shifting the emphasis from performance to experience, and thereby promoting more positive and healthy relationships between mothers and their infants.

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Data material availability The datasets generated during and analyzed during the current study are not publicly available hence the study is still in progress but are available from the corresponding author on reasonable request.

Declarations

Conflict of interest The authors have no competing interests to declare that are relevant to the content of this article.

Ethical approval statement The research was approved by the IDC institutional review board, Israel, and is complied with APA ethical standards.

Consent All participants gave consent of participation for their children and for themselves. The participants were informed that they are free to leave the research at any time, that all their personal information will be kept strictly confidential and that all the data collected will be kept anonymously and will not be used for any other purpose other than the current research. Data was collected omitting participants' names and subject numbers were used instead.

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