Universidade do Minho
Escola de Psicologia

Zaida Gonzalez Barbeitos

Is breastfeeding associated with prenatal and postnatal mother-infant bonding?

October 2024

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Is breastfeeding associated with prenatal and postnatal mother-infant bonding?

Dissertação de Mestrado
Mestrado em Psicologia Clínica da Infância e Adolescência

Supervised by
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October 2024

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Universidade do Minho, 21 de outubro de 2024



(Zaida Gonzalez)

Is breastfeeding associated with prenatal and postnatal mother-infant bonding?

Abstract:

Breastfeeding is a natural practice that ensures the infant's physical and mental development. Beyond its nutritional value, breastfeeding enhances mother-infant bonding, an emotional connection from mother to infant, which begins during pregnancy and continues postnatally. This study, with a longitudinal design, aims to explore the bidirectional associations between prenatal mother-infant bonding (at third trimester of pregnancy) and exclusive breastfeeding (1 and 6 months postpartum), as well as between exclusive breastfeeding (1 and 6 months postpartum) and postnatal mother-infant bonding, controlling for maternal depression. 170 primiparas mothers (18-39 years) were included, mostly Portuguese, who completed the Socio-demographic Questionnaire, Index of Breastfeeding Status (IBS), Bonding Scale (BS), and Edinburgh Postnatal Depression Scale (EPDS). ANCOVAs and MANCOVAs analyses were used. Findings revealed higher prenatal mother-infant bonding was associated to the exclusive breastfeeding at 1 and 6 months postpartum, as well as exclusive breastfeeding at 1 and 6 months postpartum was also associated with postnatal mother-infant bonding. Non-exclusive breastfeeding mothers tend to report lower prenatal and postnatal mother-infant bonding. The study highlights the need for early detection of mother-infant bonding issues and targeted interventions to support breastfeeding and promote the maternal emotional connection with the infant.

Key words: exclusive breastfeeding, mother-infant bonding, prenatal, postpartum, emotional connection

Está a amamentação associada ao vínculo mãe-bebé pré-natal e pós-natal?

Resumo:

Amamentação é uma prática natural que assegura o desenvolvimento físico e mental do bebé. Além do valor nutricional, a amamentação fortalece o vínculo mãe-bebé, uma conexão emocional da mãe para o bebé, iniciada na gravidez e continua durante pós-parto. Este estudo, com um design longitudinal, teve como objetivo explorar as associações bidirecionais entre o vínculo mãe-bebé pré-natal (3º trimestre de gravidez) e a amamentação exclusiva (aos 1 e 6 meses pós-parto), bem como entre a amamentação exclusiva (aos 1 e 6 meses pós-parto) e o vínculo mãe-bebé pós-natal, controlando para a depressão materna. Foram incluídas 170 mães primíparas (18-39 anos), maioritariamente portuguesas, que preencheram o Questionário Sociodemográfico, Index of Breastfeeding Status (IBS), Bonding Scale (BS), e Edinburgh Postnatal Depression Scale (EPDS). Foram efetuadas ANCOVAs e MANCOVAs, que revelaram a associação entre um maior vínculo mãe-bebé pré-natal com a amamentação exclusiva aos 1 e 6 meses pós-parto, e a associação entre amamentação exclusiva aos 1 e 6 meses pós-parto com maior vínculo mãe-bebé pós-natal. Mães que não amamentam exclusivamente tendem a relatar menor vínculo mãe-bebé pré-natal e pós-natal. Destaca-se a necessidade da deteção precoce de problemas no vínculo mãe-bebé e de intervenções direcionadas a promoção da amamentação e da conexão emocional materna.

Palavras-chave: amamentação exclusiva, vínculo mãe-bebê, pré-natal, pós-parto, conexão emocional.

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IS BREASTFEEDING ASSOCIATED WITH PRENATAL AND POSTNATAL MOTHER-INFANT BONDING?

Introduction

Breastfeeding is the most natural and safe food to ensure infant health and survival (World Health Organization [WHO] & United Nations Children's Fund [UNICEF], 2022). The WHO and UNICEF (2018) recommend breastfeeding should be initiated within the first hour after birth, continued exclusively for the first six months of the infant's life, and up to 2 years or beyond with complementary food. Exclusive breastfeeding until six months postpartum provides optimal conditions – nurturing, nutrients, and energy – for the infant's physical and mental development (WHO & UNICEF, 2018). Although the average global of newborns initiating breastfeeding within the first hour of birth (47%) is still below the 2030 target of 70%, significant progress has been made in the percentage of infants under six months who are exclusively breastfed (48%), reflecting a 10% increase compared to the decade previous (WHO & UNICEF, 2022). In Portugal, more than 87% of mothers initiate exclusive breastfeeding, 33-59% continuing at 3 months postpartum, and 14-21% maintaining exclusive breastfeeding for 6 months postpartum or longer (Figueiredo et al., 2021; Kana et al., 2018; Rito et al., 2019).

The benefits of exclusive breastfeeding for mother's and infant physical health, mental health, and well-being are extensively documented in the literature (e.g., Chowdhury et al., 2015; Victora et al., 2016). Benefits for the well-being and mental health of breastfeeding mothers include attenuated stress response and reductions in negative mood (Groër, 2005; Mezzacappa, 2005), lower latency to sleep and longer duration of sleep (Kendall-Tackett et al., 2018) and decreased risk of postpartum depression (Figueiredo et al., 2021; Hahn-Holbrook et al., 2013; Ystrom, 2012).

The practice of breastfeeding is also associated with increased maternal, protective, and social behaviors (Peñacoba & Catala, 2019). It is a natural opportunity for skin-to-skin contact and proximity, which can make the mother feel more synchronized with her infant (Jansen et al., 2008). Breastfeeding mother-infant dyads tends to show fewer negative interactions (Field et al., 2010), engage more time in emotional care activities (Smith & Ellwood, 2011) and show more infant attachment security behaviors (Gibbs et al., 2018). Additionally, breastfeeding provides a setting that can enhance mother-infant bonding during the early months of the infant's life (Cernadas et al., 2003; Else-Quest et al., 2003; Nishioka et al., 2011). The frequent interactive behaviors and emotional exchanges that occur during breastfeeding, strengthen the mother-infant bonding (Kim, 2019). Although some mothers struggle to overcome the difficulties of breastfeeding such as nipple pains, latch-on difficulties, insufficient milk supply, particularly

in the first months, and especially mothers who intended to breastfeed. It has been linked to maternal concerns about missed bonding opportunities with their infant (Williamson et al., 2012).

Mother-infant bonding is defined as an emotional connection from the mother to her infant; more specifically, the emotions and feelings that the mother experiences in relation to the infant (Kinsey & Hupcey, 2013). The core of the parental bonding is an emotional state (e.g., love), which gives rise to a set of needs or dispositions of the parents (e.g., knowing, being with, avoiding separation and loss from, protecting, gratifying the infant's needs) which, in turn, can triggers the expression of behaviors directed towards the infant (Condon & Corkindale, 1998). Thus, mother-infant bonding encompasses the emotional involvement and representational of the infant, as well as the mother's behaviors directed towards the infant (Condon, 1993; Jansen et al., 2008).

The concept of mother-infant bonding was first introduced by Rubin (1967) as part of his theory of the maternal role. Later, Klaus and Kennell (1976) proposed that all mothers are biologically primed to form a bonding, during a sensitive period, shortly after birth, facilitated by physical contact with the infant. Although this hypothesis was revised to acknowledge that while physical contact can enhance bonding, it is not a necessary condition (Kennell & Klaus, 1984). In recent conceptualizations and research, it is concluded the development of mother-infant bonding initiate during pregnancy (e.g. Alhusen, 2008), continues after birth, and can be extended throughout the infant's life (Kinsey & Hupcey, 2013).

During the prenatal period, mothers begin to elaborate internal mental representations of the fetus, developing an emotional connection that initiates the mother-infant bonding process (Condon, 1993). This can be seen as the earliest form of preparation for parenthood (de Cock et al., 2016). Mother-infant bonding typically strengthens as pregnancy progresses, especially as the infant's presence becomes more tangible through experiences such as feeling fetal movements and viewing ultrasound images (Alhusen, 2008; van Bussel et al., 2010). Mother's behaviors through pregnancy may be influenced by mother-infant bonding in the prenatal period. Higher prenatal mother-infant bonding in the second trimester was linked to healthier maternal behaviors and better neonatal outcomes (Alhusen et al., 2012), as well as stronger postnatal mother-infant bonding in the first month after birth (Shreffler et al., 2021). Conversely, difficulties in establishing prenatal mother-infant bonding are associated with negative health behaviors during pregnancy (van den Bergh & Simons, 2009), unwanted future pregnancies (Shreffler et al., 2021), and maternal prenatal and postpartum depressive symptoms (Alhusen, 2008; Figueiredo & Costa, 2009; Goecke et al., 2012; Rollè et al., 2020). Prenatal and

postnatal mother-infant bonding have an impact in infant later socioemotional development. Higher prenatal mother-infant bonding predicted better developmental outcomes and emotional and social competence in early childhood (Cildir et al., 2020). Similarly, higher postnatal mother-infant bonding was associated with a positive social-emotional development in infants (Mason et al., 2011).

The bonding who a mother feels toward her infant prenatally is important for mother-infant bonding postnatally. Prenatal mother-infant bonding predicts higher levels of maternal sensitivity (Maas et al., 2016) and early mother-infant relationship in the early postpartum period (Siddiqui & Hägglöf, 2000). Various studies found associations between mother-infant bonding in the second or third trimester of pregnancy, and early postpartum (1- 3 months postpartum; Dubber et al., 2015; Shreffler et al., 2021), and later postpartum period (6 months postpartum; de Cock et al., 2016; Tichelman et al., 2019). Also, mother-infant bonding tends to remain stable from pregnancy to the postpartum period (de Cock et al., 2016; van Bussel et al., 2010). In the postpartum period, mother-infant bonding is reinforced by the infant's behaviors, such as crying, smiling, and visual engagement and is also expressed through the mother's behaviors directed of proximity and care towards to the infant (Jansen et al., 2008; Kim, 2019). Higher postnatal mother-infant bonding is associated with increased physical proximity between mother and infant immediately after birth (Altaweli & Roberts, 2010) and better adjustment to the maternal role (Müller, 1994). Conversely, impairment in postnatal mother-infant bonding is associated with physical separation at birth, such as in cases of premature birth (Broedsgaard & Wagner, 2005), as well as to postpartum maternal depressive symptoms (Dubber et al., 2015; Figueiredo & Costa, 2009; Nishioka et al., 2011; Tichelman et al., 2019).

Breastfeeding can be associated with both prenatal and postnatal mother-infant bonding. Pregnant mothers often expect positive psychosocial benefits from breastfeeding, beyond its nutritional value, considering it important for emotional connection and strengthened bonding with their infant (Earle, 2002; Moore & Coty, 2006; Roll & Cheater, 2016). Also, psychological interventions focused on enhancing prenatal mother-infant bonding have been linked to increased breastfeeding rates (Goertz-Schroth et al., 2023; Shariat & Abedinia, 2017). Breastfeeding can also promote postnatal mother-infant bonding, mothers who breastfeed exhibit higher levels of postnatal mother-infant bonding than those who use formula-feeding at four (Else-Quest et al., 2003) and at five months postpartum (Nishioka et al., 2011). Additionally, higher levels of postnatal mother-infant bonding at the immediate postpartum are associated with longer duration of exclusive breastfeeding at six months postpartum (Cernadas et al., 2003).

The present study aims to contribute to mother-infant bonding research and clinical practice, by exploring the bidirectional associations between exclusive breastfeeding and prenatal and postnatal mother-infant bonding thought the perinatal period, controlling the maternal depression. Therefore, specific aims are to study: 1) the associations between prenatal mother-infant bonding (at the third trimester of pregnancy) and exclusive breastfeeding (at 1 and 6 months postpartum); 2) the associations between exclusive breastfeeding (at 1 and 6 months postpartum) and postnatal mother-infant bonding (at 1 and 6 months postpartum). Prenatal and postpartum maternal depression due to its well-established association with both breastfeeding and mother-infant bonding, was controlled in this study to clarify the objectives and prevent potential interference in the associations. Particularly, prenatal depression has been associated with lower mother-infant bonding (Rollè et al., 2020; Alhusen, 2008; van Bussel et al., 2010; Figueiredo & Costa, 2009; Goecke et al., 2012) and has been linked to early cessation of exclusive breastfeeding (Figueiredo et al., 2021; Hahn-Holbrook et al., 2013; Ystrom, 2012). Also, postpartum depression with reduced postnatal mother-infant bonding (Dubber et al., 2015; Figueiredo & Costa, 2009; Tichelman et al., 2019; Nishioka et al., 2011).

Method

Procedures

The data used in the present study was drawn from a larger longitudinal study (PTDC/SAU/SAP/116738/2010), conducted between 2011 and 2015 by the Research Center in Psychology at the University of Minho. The study protocol was approved by the Ethics Committees of all institutions involved. Participant recruitment took place at two public hospitals in Northern Portugal. Initial contact with pregnant women was established during the third trimester of pregnancy at a routine prenatal appointment, where they were invited to voluntarily participate in the study and informed about its objectives and procedures. Participants who agreed to participate signed informed consent forms and the questionnaires were sent via email and completed online. This current study had a longitudinal design with three assessment waves: 1) third trimester of pregnancy, 2) 1 month, and 3) 6 months postpartum. The questionnaires were presented to the participants as follows: the Socio-demographic Questionnaire (mother and infant sociodemographic information) was completed in the third trimester of pregnancy; the Index of Breastfeeding Status (IBS; breastfeeding) was administered during the postpartum assessments; the Bonding Scale (BS; prenatal and postnatal mother-infant bonding) and the Edinburgh Postnatal Depression Scale (EPDS; prenatal and postpartum maternal depressive symptoms) were completed at all assessment waves. The exclusion criteria for participation in the original study included multiple

pregnancies, experiencing gestational complications, and neonatal death. Additionally, participants were required to be able to read Portuguese. In the present study, further exclusions were made for multiparous mothers, preterm births (< 37 weeks), low infant' birth weight (< 2500 g) and infants were hospitalized for more than one day during the first six months of life.

From the 258 mothers who completed the EPDS and BS at the third trimester of pregnancy, 211 completed the remaining measures at 1 month and 6 months postpartum (81.8%). There were no significant differences between the mothers who responded at the third trimester of pregnancy and those who respond across the three assessments wave of the study in terms of prenatal mother-infant bonding (BS scores at the third trimester of pregnancy) and prenatal depression (EPDS scores at the third trimester of pregnancy). For those participants who responded in all the assessments, after applying the exclusion criteria of the present study, 170 mothers (80.6%) were included in the final sample. The final sample (N = 170) completed the sociodemographic questionnaire, BS and EDPS at third trimester of pregnancy (*M* = 32.01 gestational weeks; SD = 5.00); the IBS, BS and EDPS at 1 month postpartum (*M* = 3.59 postpartum weeks; SD = 2.23), and the IBS, BS and EDPS at 6 months postpartum (M = 28.16 postpartum weeks; SD = 3.54).

Instruments

Sociodemographic characteristics. The Socio-demographic Questionnaire (Figueiredo et al., 2009) was used for collecting maternal sociodemographic and obstetric information (e.g., age, birthplace, ethnicity, marital status, occupational status, socioeconomic status, years of education, type of delivery, gestational weeks, etc.), as well as sociodemographic and biometric information about the infant (e.g., gender, birth' weight, age (weeks), birth' reanimation, etc.).

Breastfeeding. The Index of Breastfeeding Status (IBS; Labbok & Coffin, 1997; Labbok & Krasovec, 1990) was used to define breastfeeding. According to the IBS, the feeding types are categorized as follows: 1) Exclusive breastfeeding (levels 1 and 2: Full breastfeeding – when only breast milk is used; Almost exclusive breastfeeding – when water is also used); 2) Partial breastfeeding (levels 3 to 7– when breast milk is combined with formula milk in different percentages); 3) Exclusive formula feeding (when infant fed exclusively on non-breast milk). In this study, breastfeeding was categorized as exclusive breastfeeding and non-exclusive breastfeeding. Exclusive breastfeeding group, include IBS levels 1 and 2. Non-exclusive breastfeeding group includes the remaining IBS levels.

Mother-infant bonding. The Bonding Scale (BS; Figueiredo et al., 2005; Figueiredo & Costa, 2009), an extended and validated Portuguese version of the Mother-to-Infant Bonding Scale (MIBS; Taylor et al., 2005), was used to assess mother-infant bonding. The scale consists of eleven self-report items scored based on the intensity of emotion felt by the parental figure towards the fetus or the infant on a four-point Likert-type scale [from 0 (not at all) to 3 (very much)]. It includes a total bonding scale and three subscales: 1) "Positive Bonding" – 3 items (Loving, Protective, and Joyful) related to positive emotions toward the infant; 2) "Negative Bonding" – 6 items (Mad, Aggressive, Sad, Resentful, Dislike, and Disappointed) related to negative emotions toward the infant; 3) "Not Clear Bonding" – 2 items (Fearful and Neutral/Feel nothing) related to the presence of not clear emotions toward the infant. The scale and subscale scores range from 0 to 3, with mother-infant bonding considered poor with a score between 0 and 1, moderate between 1 and 2, and high between 2 and 3. This instrument showed good internal consistency during the third trimester of pregnancy and 3 months postpartum (α = .61, α = .75; Figueiredo & Costa, 2009). In the present study had a good internal consistency at pregnancy' third trimester (Cronbach's α = 0.75), at 1 month postpartum (Cronbach's α = 0.62), and at 6 months postpartum (Cronbach's α = 0.80).

Depression symptoms. The Edinburgh Postnatal Depression Scale (EPDS; Cox et al., 1987), Portuguese version (Tendais et al., 2014), was used to assess maternal depression symptoms during the prenatal and postpartum periods. It is a self-reported scale that comprises ten items referring to the intensity of symptoms over the past seven days, scored on a four-point Likert-type scale (0 to 3). Portuguese version showed good internal consistency and an optimal cutoff score of 9 for prenatal depression and 7 for postpartum depression (α = .82 and .88, respectively; Tendais et al., 2014). In the present study had a good internal consistency at the third trimester of pregnancy (Cronbach's α = 0.84), at 1 month postpartum (Cronbach's α = 0.89), and at 6 months postpartum (Cronbach's α = 0.81).

Participants

The sample consisted of 170 primiparous mothers ranging from 18 to 39 years old (M = 30.58, SD = 4.30). Most of the participants were Portuguese (91.8%), Caucasian (93.3%), married or living with their partner (81.7%), and employed (77.1%). Most infants were born at term (> 37 weeks of gestation; 91.7%) and were not resuscitated at birth (91.1%). At 1 month postpartum, most participants were exclusively breastfeeding (78.2%). At 6 months postpartum, non-exclusive breastfeeding (partial breastfeeding or exclusive formula feeding) and exclusive breastfeeding groups are similar (respectively, 55.9%; 44.1%,). All the participants, in the third trimester of pregnancy, intended to breastfeed their

infants. Participants' sociodemographic, obstetrics and biometric characteristics are presented in Table 1.

Table 1

Sociodemographic, obstetrics and biometrics characteristics of total sample (N = 170)

Characteristics	Total sample	
	n	%
Maternal		
Age (yrs.)		
18 – 28	53	31.2
29 – 39	117	68.8
Birthplace		
Portugal	156	91.8
Other	14	8.2
Ethnicity		
Caucasian	153	93.3
Other	11	6.7
(missing)	6	3.5
Marital Status		
Married	138	81.7
Single	31	18.3
(missing)	1	0.6
Occupational status		
Employed	131	77.1
Unemployed	39	22.9
Years of schooling		
≤ 12 years	60	35.3
> 12 years	110	64.7
Income		
Lower/Middle	84	50.0
Upper	84	50.0
(missing)	2	1.2
Delivery type		
Vaginal	109	64.5
Caesarean	60	35.5
(missing)	1	0.6
Infant		
GA at birth (wks.)		
≤ 37	14	8.3
> 37	155	91.7
(missing)	1	0.5
Gender		
Masculine	91	53.8
Feminine	78	46.2

(missing)	1	0.6
Reanimation		
Yes	15	8.9
No	154	91.1
(missing)	1	0.6
EBF at 1 month postpartum		
No	37	21.8
Yes	133	78.2
EBF at 6 months postpartum		
No	95	55.9
Yes	75	44.1

Note. GA = gestational age; EBF = exclusive breastfeeding. Married category includes living with the partner. Single category includes divorced and separated participants. Unemployed category includes other situations of occupational status, e. g., student, housemaid.

Statistical Analysis

Statistical Analysis was performed using the SPSS software, version 29 (IBM SPSS Statistics). Descriptive statistics were conducted on participants' sociodemographic characteristics data. Statistical significance was considered with $p < .05$ and marginal significance was considered with $p < .10$. The effect size measure partial eta squared (η_p^2) was estimated for all the Analysis of Covariance (ANCOVAs) and Multivariate Analysis of Covariance (MANCOVAs). Pairwise comparisons using Bonferroni correction were performed to determine the mean differences between the exclusive breastfeeding groups.

Two ANCOVAs and two MANCOVAs were conducted to examine the association between prenatal mother-infant bonding and exclusive breastfeeding, adjusting for prenatal maternal depression. The first ANCOVA included prenatal mother-infant bonding scale (BS' total score at the third trimester of pregnancy) as dependent variable and exclusive breastfeeding at 1 month postpartum (0 = non-exclusive, 1 = exclusive) as independent variable. The second ANCOVA included prenatal mother-infant bonding scale (BS' total score at the third trimester) as dependent variable and exclusive breastfeeding at 6 months postpartum (0 = non-exclusive, 1 = exclusive) as independent variable. The first MANCOVA included prenatal mother-infant bonding subscales (BS' positive, negative, and not clear scores at third trimester of pregnancy) as dependents variables and exclusive breastfeeding at 1 month postpartum (0 = non-exclusive, 1 = exclusive) as independent variable. The second MANCOVA included prenatal mother-infant bonding subscales (BS' positive, negative, and not clear scores at the third trimester of pregnancy) as dependent variables and exclusive breastfeeding at 6 months postpartum (0 = non-exclusive, 1 =

exclusive) as independent variable. All models included prenatal maternal depression (EPDS < 9 = 0; EPDS ≥ 9 = 1, at third trimester of pregnancy) as covariate.

Four MANCOVAs were conducted to examine the association between exclusive breastfeeding and postnatal mother-infant bonding, adjusting for postpartum maternal depression. The first MANCOVA included exclusive breastfeeding at 1 month postpartum (0 = non-exclusive, 1 = exclusive) as independent variable and postnatal mother-infant bonding scale (BS' total score at 1 and 6 months postpartum) as dependent variables. The second MANCOVA included exclusive breastfeeding at 6 months postpartum (0 = non-exclusive, 1 = exclusive) as independent variable and postnatal mother-infant bonding scale (BS' total score at 1 and 6 months postpartum) as dependent variables. The third MANCOVA included exclusive breastfeeding at 1 month postpartum (0 = non-exclusive, 1 = exclusive) as independent variable and postnatal mother-infant bonding subscales (BS' positive, negative, and not clear scores at 1 and 6 months postpartum) as dependent variables. The fourth MANCOVA included exclusive breastfeeding at 6 months postpartum (0 = non-exclusive, 1 = exclusive) as independent variable and postnatal mother-infant bonding subscales (BS' positive, negative, and not clear scores at 1 and 6 months postpartum) as dependent variables. The first and third models included postpartum maternal depression at 1 month postpartum (EPDS < 7 = 0; EPDS ≥ 7 = 1) as covariate, while the second and fourth models include postpartum maternal depression at 6 months postpartum (EPDS < 7 = 0; EPDS ≥ 7 = 1) as covariate.

Results

Association between prenatal mother-infant bonding and exclusive breastfeeding. Marginally significant univariate differences were found on prenatal mother-infant bonding (total BS score) according to exclusive breastfeeding at 1 month postpartum (F (1,169) = 3.61, p = .06, η_p^2 = .02). Mothers who were exclusively breastfeeding at 1 month postpartum reported higher prenatal mother-infant bonding (M = 2.83, SD = 0.02) than those who were non-exclusively breastfeeding at 1 month postpartum (M = 2.76, SD = 0.03). Marginally significant univariate differences were found on prenatal mother-infant bonding (total BS score) according to exclusive breastfeeding at 6 months postpartum (F (1, 169) = 3.11, p = .08, η_p^2 = .02). Mothers who were exclusively breastfeeding at 6 months postpartum reported higher prenatal (M = 2.84, SD = 0.02) than those who were non-exclusively breastfeeding at 6 months postpartum (M = 2.79, SD = 0.02).

Results revealed a statistically significant univariate differences on not clear prenatal mother-infant bonding according to exclusive breastfeeding at 1 month postpartum (F (1,169) = 5.23, p = .02,

η_{p^2} = .03). Mothers who were exclusively breastfeeding at 1 month postpartum reported lower not clear prenatal mother-infant bonding than those who were non-exclusively breastfeeding at 1 month postpartum. Non-significant multivariate differences of prenatal mother-infant bonding (BS' subscales scores) was found on exclusive breastfeeding at 1 month postpartum (Λ = .97, F (3, 165) = 1.90, p = .13, η_{p^2} = .03). Non-significant univariate differences of positive and negative prenatal mother-infant bonding according to exclusive breastfeeding at 1 month postpartum (p > .10; see Table 2).

Table 2

Association between prenatal mother-infant bonding and exclusive breastfeeding at 1 month postpartum, adjusted for prenatal maternal depression (N = 170)

	Non-EBF (n = 37)	EBF (n = 133)		
	M (SD)	*M (SD)*	*F*	η_{p^2}
Prenatal mother-infant bonding	-	-	1.90	.03
Positive	2.60 (0.08)	2.70 (0.04)	1.36	.01
Negative	0.05 (0.02)	0.03 (0.01)	0.52	.00
Not clear	0.60 (0.07)	0.41 (0.04)	5.23**	.03

Note. EBF = exclusive breastfeeding; *p < .10, **p < .05, ***p < .01, ****p < .001. Means scores adjusted for EPDS = .33 at third trimester of pregnancy.

Significant multivariate differences on prenatal mother-infant bonding (BS' subscales scores) were found according to exclusive breastfeeding at 6 months postpartum (Λ = .91, F (3, 165) = 5.45, p = .001, η_{p^2} = .09). Results revealed a statistically significant univariate differences on not clear prenatal mother-infant bonding according to exclusive breastfeeding at 6 months postpartum (F (1, 169) = 13.85, p < .001, η_{p^2} = .08). Mothers who were exclusively breastfeeding at 6 month postpartum reported lower not clear prenatal mother-infant bonding than those who were non-exclusively breastfeeding at 1 month postpartum. Non-significant univariate differences of positive and negative prenatal mother-infant bonding was found on exclusive breastfeeding at 6 months postpartum (p > .10; see Table 3).

Table 3.

Association between prenatal mother-infant bonding and exclusive breastfeeding at 6 months postpartum, adjusted for prenatal maternal depression (N = 170)

Variables	Non-EBF (n = 95) *M (SD)*	EBF (n = 75) *M (SD)*	*F*	η_{p^2}
Prenatal mother-infant bonding	-	-	5.45***	.09
Positive	2.66 (0.05)	2.70 (0.05)	0.30	.00
Negative	0.03 (0.01)	0.04 (0.01)	0.01	.00
Not Clear	0.56 (0.04)	0.32 (0.05)	13.85****	.08

Note. EBF = exclusive breastfeeding; *p < .10, **p < .05, ***p < .01, ****p < .001. Means scores adjusted for EPDS = .33 at third trimester of pregnancy.

Association between exclusive breastfeeding and postnatal mother-infant bonding. Significant multivariate differences of exclusive breastfeeding at 1 month postpartum were found on postnatal mother-infant bonding (BS total scores) (Λ = .94, F (2, 166) = 4.93, p = .01, η_{p^2} = .06). Significant univariate differences of exclusive breastfeeding at 1 month postpartum were found on postnatal mother-infant bonding at 6 months postpartum (F (1, 169) = 6.74, p = .01, η_{p^2} = .04). Mothers who were exclusively breastfeeding at 1 month postpartum reported higher postnatal mother-infant bonding at 6 months postpartum (M = 2.93, SD = 0.01) than those who were non-exclusively breastfeeding at 1 month postpartum (M = 2.86, SD = 0.02). Marginally significant univariate differences of exclusive breastfeeding at 1 month postpartum were found on postnatal mother-infant bonding at 1 month postpartum (F (1, 169) = 3.46, p = .07, η_{p^2} = .02). Mothers who were exclusively breastfeeding at 1 month postpartum reported higher postnatal mother-infant bonding at 1 month postpartum (M = 2.89, SD = 0.01) than those who were non-exclusively breastfeeding at 1 month postpartum (M = 2.84, SD = 0.02).

Results revealed significant univariate differences of exclusive breastfeeding at 6 months postpartum on postnatal mother-infant bonding (BS total score) at 6 months postpartum (F (1, 169) = 4.70, p = .03, η_{p^2} = .03). Mothers who were exclusively breastfeeding at 6 months postpartum reported higher postnatal mother-infant bonding at 6 months postpartum (M = 2.94, SD = 0.02) than those who were non-exclusively breastfeeding at 6 months postpartum (M = 2.89, SD = 0.02). Marginally significant multivariate differences of exclusive breastfeeding at 6 months postpartum were found on postnatal mother-infant bonding (BS total scores) (Λ = .97, F (2, 166) = 2.59, p = .08, η_{p^2} = .03). Non-significant

univariate differences of exclusive breastfeeding at 6 months postpartum were found on postnatal mother-infant bonding at 1 month postpartum.

Statistically significant multivariate differences of exclusive breastfeeding at 1 month postpartum were found on postnatal mother-infant bonding (BS' subscales scores) (Λ = .92, F (6, 162) = 2.23, p = .04, η_{p^2} = .08). Results revealed a statistically significant univariate differences of exclusive breastfeeding at 1 month postpartum on positive and negative postnatal mother-infant bonding at 6 months postpartum (F (1, 169) = 4.76, p = .03, η_{p^2} = .03; F (1, 169) = 6.38, p = .01, η_{p^2} = .04, respectively). Mothers who were exclusively breastfeeding at 1 month postpartum reported higher positive and lower negative postnatal mother-infant bonding at 6 months postpartum than those who were non-exclusively breastfeeding at 1 month postpartum. Marginally significant univariate differences of exclusive breastfeeding at 1 month postpartum were found on not clear postnatal mother-infant bonding at 1 month postpartum (F (1, 169) = 3.82, p = .05, η_{p^2} = .02). Mothers who were exclusively breastfeeding at 1-month postpartum reported lower not clear postnatal mother-infant bonding at 1 month postpartum than those who were non-exclusively breastfeeding at 1 month postpartum. Non-significant univariate differences of exclusive breastfeeding at 1 month postpartum were found on positive and negative postnatal mother-infant bonding at 1 month postpartum; and on not clear postnatal mother-infant bonding at 6 months postpartum (p > .10; see Table 4).

Table 4

Association between exclusive breastfeeding at 1 month postpartum and postnatal mother-infant bonding, adjusted for postpartum maternal depression (N = 170)

Variables	Non-EBF (n = 37) *M (SD)*	EBF (n = 133) *M (SD)*	*F*	η_p^2
Postnatal mother-infant bonding	-	-	2.23**	.08
Positive at 1 month	2.77 (0.06)	2.83 (0.03)	0.78	.01
Negative at 1 month	0.06 (0.02)	0.03 (0.01)	1.82	.01
Not Clear at 1 month	0.38 (0.05)	0.27 (0.03)	3.82*	.02
Positive at 6 months	2.72 (0.07)	2.85 (0.03)	4.76**	.03
Negative at 6 months	0.07 (0.02)	0.01 (0.01)	6.38**	.04
Not Clear at 6 months	0.17 (0.04)	0.14 (0.02)	0.45	.00

Note. EBF = exclusive breastfeeding; *p < .10, **p < .05, ***p < .01, ****p < .001. Means scores adjusted for EPDS = 0.31 at 1 month postpartum.

Significant univariate differences of exclusive breastfeeding at 6 months postpartum were found on positive postnatal mother-infant bonding at 6 months postpartum (F (1, 169) = 4.75, p = .03, η_p^2 = .03). Mothers who were exclusively breastfeeding at 6 months postpartum reported higher positive postnatal mother-infant bonding at 6 months postpartum than those who were non-exclusively breastfeeding at 6 months postpartum. Results revealed a marginally significant univariate differences of exclusive breastfeeding at 6 months postpartum on negative postnatal mother-infant bonding at 6 months postpartum (F (1, 169) = 2.89, p = .09, η_p^2 = .02). Mothers who were exclusively breastfeeding at 6 months postpartum reported lower negative postnatal mother-infant bonding at 6 months postpartum than those who were non-exclusively breastfeeding at 6 months postpartum. Non-significant multivariate differences of exclusive breastfeeding at 6 months postpartum were found on postnatal mother-infant bonding (BS' subscales scores) (Λ = .96, F(6, 162) = 1.01, p = .42, η_p^2 = .04). Non-significant univariate differences of exclusive breastfeeding at 6 months postpartum were found on positive and negative postnatal mother-infant bonding at 1 months postpartum; and on not clear postnatal mother-infant bonding at 1 month and at 6 months postpartum (p > .10; see Table 5).

Table 5.

Association between exclusive breastfeeding at 6 months postpartum and postnatal mother-infant bonding, adjusted for postpartum maternal depression (N = 170)

Variables	Non-EBF (n = 78) *M (SD)*	EBF (n = 69) *M (SD)*	*F*	η_p^2
Postnatal mother-infant bonding	-	-	1.01	.04
Positive at 1 month	2.78 (0.04)	2.85 (0.04)	1.61	.01
Negative at 1 month	0.04 (0.01)	0.03 (0.01)	0.09	.00
Not Clear at 1 month	0.30 (0.03)	0.28 (0.04)	0.07	.00
Positive at 6 months	2.77 (0.03)	2.88 (0.04)	4.75**	.03
Negative at 6 months	0.04 (0.01)	0.01 (0.01)	2.89*	.02
Not Clear at 6 months	0.15 (0.02)	0.14 (0.03)	0.08	.00

Note. EBF = exclusive breastfeeding; *p < .10, **p < .05, ***p < .01, ****p < .001. Means scores adjusted for EPDS = 0.26 at 6 months postpartum.

Discussion

The present study aimed to analyze the association between prenatal mother-infant bonding and exclusive breastfeeding and the association between exclusive breastfeeding and postnatal mother-infant bonding. The findings revealed associations of prenatal mother-infant bonding and exclusive breastfeeding. An association of prenatal mother-infant bonding at the third trimester of pregnancy and exclusive breastfeeding at 1 month and at 6 months postpartum. Namely, an association of not clear prenatal mother-infant bonding at the third trimester of pregnancy and breastfeeding at 1 month and at 6 months postpartum. The study findings also revealed an association of exclusive breastfeeding and postnatal mother-infant bonding. An association of exclusive breastfeeding at 1 month postpartum and postnatal mother-infant bonding at 1 month and at 6 months postpartum. Namely, an association of exclusive breastfeeding at 1 month postpartum and positive and negative postnatal mother-infant bonding at 6 months postpartum. And an association of exclusive breastfeeding at 1 month postpartum and not clear postnatal mother-infant bonding at 1 month postpartum. Also, an association of exclusive breastfeeding at 6 months postpartum and positive and negative postnatal mother-infant bonding at 6 months postpartum.

High prenatal mother-infant bonding and lower not clear emotions toward the fetus was associated with exclusive breastfeeding at 1 month and 6 months postpartum. As this study shows, higher prenatal mother-infant bonding is linked to the maintenance of exclusive breastfeeding for at least 6

months postpartum. This finding is incongruent with other studies on the topic, which did not observe a significant association (e.g. Costin et al., 2024; Cuijlits et al., 2019; Sukriani et al., 2020). However, pregnant mothers tend to consider breastfeeding important for emotional connection and strengthened bonding with their infant (Earle, 2002; Moore & Coty, 2006; Roll & Cheater, 2016). A previous study found pregnant mothers who intended breastfeeding had a higher prenatal mother-infant bonding than mothers who intended to non-exclusive breastfeeding or formula-feeding (Huang et al., 2004). Also, higher prenatal mother-infant bonding in the second trimester was linked to healthier maternal behaviors and better neonatal outcomes (Alhusen et al., 2012). Additionally, there is evidence that psychological interventions promoting prenatal mother-infant bonding have led to higher breastfeeding rates (Goertz-Schroth et al., 2023; Shariat & Abedinia, 2017). These interventions involve support in connecting with the unborn infant, boosting the mother's self-confidence, and enhancing her ability to cope with stress. Such interventions appear to have improved both breastfeeding initiation rates and the maintenance of breastfeeding for at least 6 months postpartum. This literature suggests, like our study, that prenatal mother- infant bonding can foster a stronger emotional connection with the unborn infant, which in turn enhances emotional preparation for the postpartum and encourages adherence to recommended practices, such as exclusive breastfeeding. This sense of connection with the fetus during pregnancy may predispose mothers to exclusive breastfeeding thought the postpartum.

Exclusive breastfeeding mothers reported higher postnatal mother-infant bonding, with higher positive emotions and lower negative emotions towards their infants, both at 1 and 6 months postpartum, compared to non-exclusive breastfeeding mothers (partial breastfeeding and formula-feeding). The results suggested that exclusive breastfeeding for up to 1 month can enhance the emotional connection with the infant through to 6 months postpartum. Previous findings support these results. For example, mothers who practiced breastfeeding reported higher levels of mother-infant bonding at 4 months postpartum (Else et al., 2003) and at 5 months postpartum compared to those in the formula-feeding group (Nishioka et al., 2011). Another study, which assessed mother-infant bonding through observations in the immediate postpartum period (two days), found that higher mother-infant bonding significantly reduced the risk of cessation of exclusive breastfeeding at any point up to 6 months postpartum (Cernadas et al., 2003). Breastfeeding naturally facilitates skin-to-skin contact and proximity with the infant, fostering frequent interactive behaviors and emotional exchanges that strengthen the mother-infant bonding and contributing to the mother feel more synchronized with her infant (Jansen et al., 2008; Kim, 2019; Smith & Ellwood, 2011). Research indicates that breastfeeding mothers experience lower stress, and negative mood than formula-feeding mothers, likely due to physiological factors such as improved cardiac vagal

tone, lower blood pressure, and reduced heart rate reactivity (Groër, 2005; Mezzacappa et al., 2005). The present study highlights that mothers who exclusively breastfeed can experience emotional and psychological benefits that may enhance their emotional connection with their infants throughout the postpartum period. Exclusive breastfeeding plays a crucial role in promoting close physical contact and emotional interactions, which strengthens the mother-infant bonding. These findings underscore the importance of breastfeeding in fostering a nurturing early emotional connection from the mother to the infant.

On the other hand, mothers who did not exclusively breastfeed (partial breastfeeding or formula-feeding) tended to show lower mother-infant bonding during pregnancy and postpartum, expressing fewer positive emotions and more negative or neutral feelings toward their infants. Consistently, mothers often consider breastfeeding important for fostering an emotional connection and strengthening the bond with their infant (Earle, 2002; Moore & Coty, 2006; Roll & Cheater, 2016). Especially who intended to breastfeed but faced challenges during the process, as these difficulties have been linked to concerns about missed bonding opportunities (Williamson et al., 2012). The way mothers process breastfeeding experiences also plays a significant role, with negative processing of early challenges predicting lower mother-infant bonding (Gradman & Shain, 2024). Our findings suggest that mothers who do not exclusively breastfeed may be more vulnerable to lower bonding levels, potentially due to prenatal anticipations or current frustrations and difficulties with breastfeeding, which can lead to feeling less emotionally connected to their infant.

Strengths and limitations. This study provides insight into mother-infant bonding from pregnancy to 6 months postpartum, comparing exclusive breastfeeding with non-exclusive breastfeeding. Its longitudinal design allows for a comprehensive understanding of bidirectional associations between exclusive breastfeeding and mother-infant bonding thought the perinatal period. Prenatal and postpartum maternal depression symptoms were also used as a control variable in the current study. Controlling maternal depression allowed for a clearer understanding of the associations between the variables, ensuring that the observed associations were not influenced by the effects of maternal depression. The instruments used showed good internal consistency, ensuring reliable measurement of key variables. Additionally, the sample was well-representative of the Portuguese primiparous mothers, those increases the study's relevance for the reliability of the conclusions and makes the results more useful for informing public health policies and interventions related to breastfeeding and mother-infant bonding.

Despite the significance of the study, several limitations should be considered. First, the inclusion of both non-breastfeeding and partially breastfeeding mothers in the same group makes it difficult to differentiate between their experiences, because partially breastfeeding mothers may still experience some benefits of breastfeeding. Many effect sizes of statistical analyses were small, and some p-values were marginal, which may suggest that other unmeasured variables could be influencing mother-infant bonding outcomes. Lastly, the findings may have limited generalizability, as the sample was primarily composed of primiparous mothers from northern Portugal with higher education and better economic standing, which may not reflect other populations.

Implications for practice and research. First, the use of a brief and simple questionnaire, the Bonding Scale, that identifies potential mother-infant bonding problems could be valuable for early detection, potentially starting as early as the prenatal period. By applying such measures during pregnancy, healthcare providers may be able to detect early warning signs as higher negative and not clear maternal emotions, indicating the need for support and intervention programs that promote prenatal mother-infant bonding and highlight the benefits of breastfeeding. Also, it's crucial to provide targeted support for mothers who ceased the exclusive or total breastfeeding, as they experience reduced emotional connection with their infants, which are key contributors to perinatal psychological distress (Billings et al., 2024). Early intervention programs can help mothers in adjusting psychologically and promote healthier mother-infant bonding, even when exclusive breastfeeding is not maintained.

Future research should focus on understanding the trajectories of mother-infant bonding over time. Analyzing how mother-infant bonding evolves throughout the breastfeeding practice could help identify individual variations in the process and uncover mother-infant bonding patterns across different subgroups. Additionally, research could include more diverse populations, such as multiparous women, mothers of premature infants, and cross-cultural samples.

Conclusion

The study demonstrated bidirectional associations between exclusive breastfeeding and mother-infant bonding from late pregnancy to 6 months postpartum, while controlling for maternal depression. It was found that higher prenatal mother-infant bonding was associated to the exclusive breastfeeding at 1 and 6 months postpartum. Exclusive breastfeeding at 1 and 6 months postpartum was also associated with postnatal mother-infant bonding. Mothers who did not exclusively breastfeed were more likely to experience lower prenatal and postnatal mother-infant bonding. These findings underscore the crucial early detection of mother-infant bonding issues and the importance of support programs to promote

prenatal mother-infant bonding and provide education about breastfeeding. Also, postpartum support programs that nurture postnatal mother-infant bonding are needed for mothers who ceased exclusive or total breastfeeding.

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