

# Maternal-Fetal Attachment and Social-Emotional Development in Infants at 3 Months of Age: A Population-Based Study in Southern Brazil

Bárbara Borges Rubin<sup>1</sup>, Jéssica Puchalski Trettim<sup>1</sup>, Carolina Coelho Scholl<sup>1</sup>,

Fernanda Teixeira Coelho<sup>1</sup>, Elisa Freire Puccinelli<sup>1</sup>, Mariana Bonati de Matos<sup>1</sup>,

Gabriele Ghisleni<sup>1</sup>, Ricardo Tavares Pinheiro<sup>1</sup>, Luciana de Avila Quevedo<sup>1</sup>

**[1]** Postgraduate Programme in Health and Behaviour, Catholic University of Pelotas, Pelotas, Brazil.

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**Corresponding Author:** Mariana Bonati de Matos, Catholic University of Pelotas, Gonçalves Chaves, 377 - 411 C, CEP: 96015-560, Pelotas - RS – Brazil. E-mail: marianabonatidematos@gmail.com

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## Abstract

Studies relate Maternal-Fetal Attachment (MFA) to delays in child development, however, the relationship with the social-emotional development is still unclear. Thus, the aim of this study was to investigate the association between MFA and social-emotional development in infants at 3 months old, in a population-based sample in southern Brazil. This was a follow-up study corresponding to second and third wave of a population-based cohort study with pregnant women who were living in Pelotas (Southern Brazil). Social-emotional development was assessed using the Bayley Scales of Infant Development - Third Edition (BSID-III) and MFA was measured with the Maternal-Fetal Attachment Scale (MFAS). The sample consisted of 702 mother-infant dyads. In the adjusted analysis, MFA was a predictor of social-emotional development, even when controlled for sociodemographic, maternal mental health and infant characteristics. Thus, with each increase to one point in the MFA score, there was an increase of  $\beta = 0.14$ , 95% CI [0.05, 0.23] in the social-emotional development score. These findings highlight the importance of MFA in early child development. Thus, infants with positive experiences of affection since the gestational period will be able to develop positive social and emotional health.

## Keywords

maternal-fetal attachment, prenatal bond, pregnancy, bonding, child development, social-emotional development



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The first years of a child's life is a particularly important period of child development since it sets the stage for significant acquisitions and refinements in the motor, social-emotional, and cognitive domains (Grantham-McGregor et al., 2007). Social-emotional maturation has been related to the ability to experience, control and express emotions, as well as to establish interpersonal relationships. Progressively, infants acquire the ability to explore the environment, to understand their feelings and emotions and also the people around them, and consequently, establish satisfactory interactions (Gross, 2014; Parlakian, 2003; Thompson, 2010; Tomasello & Carpenter, 2007; Zeanah, 2018).

Several factors may affect a child's social-emotional development (Walker et al., 2011). The impact of maternal mental disorders and difficulties in mother-infant bonding after birth, have already been reported in the literature (Mason et al., 2011; Posada et al., 2002; Urizar & Muñoz, 2022; Walker et al., 2011). It is known that gestational and postpartum depression lead to impairment for both the mother and the baby. Depressed mothers are often less sensitive and available to the infant's needs and tend to precariously stimulate their children. They also have less internal availability for the bond with their baby, which starts from the gestational period, and is so important for child development (Field, 2010; Mason et al., 2011). It is known that a poorer mother-infant bond is associated with adverse long-term child social-emotional development (Ainsworth & Bowlby, 1991; Mason et al., 2011; Ranson & Urichuk, 2008).

Urizar and Muñoz (2022) found that pre and postpartum depression, as well as greater severity of the disease, were associated with worse social-emotional development for children. Similarly, the study of Junge et al. (2017) found that infants of mothers who were depressed in the prenatal period or in the postnatal period or at both time points, faced a risk increased by approximately three to fourfold of developing social-emotional problems. On the other hand, a systematic review by Kingston et al. (2012), on the effects of prenatal and postpartum maternal psychological distress in the infant development, indicated that there is limited evidence for an effect of postpartum distress on social development and no evidence about the effect of prenatal distress, especially with regard to the social-emotional domain. According to Foley et al. (2021), studies are increasingly recognizing the importance of pregnancy as a period of potential risk and opportunity for intervention. However, the authors point out that few studies on maternal psychological health have been conducted in Least Developed Countries, such as Brazil.

The association between variables such as prematurity, low birth weight, not having breastfed and negative infant outcomes have already been reported in the literature (Halpern et al., 2002; Junge et al., 2017). Lower economic class and lower maternal education were also associated with deficits in social-emotional development. Infants who live in unfavorable environments, with less economic and financial resources, often receive less cognitive and emotional stimulation (Metwally et al., 2016; Walker et al., 2011). In addition, infant characteristics such as male gender and poor child health were

also associated with poor infant outcomes, especially in the social-emotional domain (Junge et al., 2017).

There is a growing body of evidence that relates Maternal-Fetal Attachment (MFA) to delays in infant development, however, this relationship specifically with the social-emotional domain is still unclear (Alhusen, Gross, et al., 2012; Alhusen, Hayat, & Gross, 2013; Punamäki et al., 2017). MFA refers to the affective bond that the mother establishes with the baby during pregnancy. According to Cranley (1981), the MFA as the extent to which women engage in behaviors that represent affiliation and interaction with their unborn infant. It is related to the maternal expectations, emotions, thoughts and behaviors in relation to the fetus, pregnancy and motherhood (Rusanen et al., 2018).

Higher levels of MFA were associated the positive prenatal health practices such as quitting smoking, attending clinics and exercising regularly, as well as the affective behaviors, proximity, and caring behaviors towards the unborn infant, such as talking to baby and touching the belly (Alhusen et al., 2012; Cinar et al., 2017; Cranley, 1981). In addition, MFA is considered an important predictor of the mother-baby bond in the postpartum period (Dubber et al., 2015; Shin et al., 2006). Foley and Hughes (2018) found that MFA predicted caregiver sensitivity in interactions with their infant, which is a potent influence on infant's social-emotional development (Ainsworth & Bowlby, 1991; Mason et al., 2011; Mills-Koonce et al., 2015; Ranson & Urichuk, 2008).

Some studies have shown that lower levels of MFA during pregnancy were associated with worse early childhood outcomes. In a prospective study with low-income women and their babies, Alhusen et al. (2012) showed that lower levels of MFA were associated with a higher risk of adverse neonatal outcomes, such as prematurity, low birth weight, among others. Punamäki et al. (2017) carried out a study that involved dyads who lived in war conditions in Palestine Gaza Strip from prenatal to postpartum and found that positive MFA predicted better sensorimotor and language development in infant's as well as better mother-baby interaction in the postpartum period.

Branjerdporn et al. (2017) recently synthesized, in a meta-analysis, data from studies on the mother-baby emotional connection during pregnancy and child development outcomes. The authors found evidence to suggest that a higher MFA was generally associated with optimal infant development. However, the results should be interpreted with caution due to the limited number and low quality of many of the available studies.

Despite some evidence showing that maternal-fetal relationship is consistently associated with the child development outcomes, there is a need for more research with rigorous methodology and longitudinal design in order to identify a clearer relationship between these variables, mainly the association of the MFA with the social-emotional domain. Thus, the aim of this study was to investigate the association between MFA and social-emotional development in infants at 3 months old, in a population-based sample in southern Brazil. We hypothesize that children of mothers with lower MFA will have lower developmental scores in the socio-emotional domain.

## Materials and Method

### Design and Participants

This was a follow-up study corresponding to a second and third wave of a population-based cohort study with pregnant women living in the city of Pelotas, in Southern Brazil. Pelotas is a medium-sized city, with approximately 330.000 inhabitants. According to the 2010 Census of the Brazilian Institute of Geography and Statistics (IBGE), the urban zone of Pelotas contains 488 census sectors. Out of these, 244 (50%) were randomly drawn for the search of pregnant women up to the second trimester.

The first wave of assessment included 981 pregnant women and was carried out between May 2016 and August 2018. The second wave included 840 (85.6%) pregnant women and was conducted two months following the first wave. All pregnant women who participated in the first phase were invited to return for a follow-up assessment. Finally, the third wave of assessment included 756 (77.1%) women and their babies at three months postpartum. For our analysis, only those who participated in the three phases of assessment were included in the study, totaling 702 (71.6%) women and their babies at three months postpartum.

We calculate the power of the sample through the correlation between MFA and socioemotional development. Considering  $r = 0.115$  and alpha ( $\alpha$ ) of 5%, we found an 87% power for a sample of 702 pregnant women.

### Instruments

#### Social-Emotional Development

Social-emotional development was assessed using the Bayley Scales of Infant Development - Third Edition (BSID-III) by postgraduate students who were trained and supervised by an experienced clinical psychologist. The BSID-III is the most widely used tool for assessment of typically developing and high-risk infants. A cross-cultural adaptation study was recently published for the Brazilian context, with a Cronbach's  $\alpha$  of 0.90, indicating good reliability (Madaschi et al., 2016; Streiner, 2003).

The Bayley-III is an individually administered scale that assesses five key developmental domains in infants between 1-42 months of age: cognitive, language, motor, social-emotional and adaptive behavior. The first three domains are assessed through direct observation of the child in test situations, while the last two are assessed through questionnaires completed by the main caregiver.

It is noteworthy that this instrument allows the use of scales separately (Bayley, 2006; Madaschi et al., 2016). In this study, we only used socio-emotional scale, as according to the literature, we believe that this domain is directly related to the AMF. This is because the social-emotional development of a child begins to be developed during the intrauterine period and receives great influence from maternal aspects during this period, such as the mother's emotions and affections related to the baby (Gross, 2014;

Moon, 2011; Thompson, 2010; Zeanah, 2018). On the other hand, other domains such as motricity and cognition are influenced, to a great extent, by postpartum aspects, such as the quality of stimulation at home (Hamadani et al., 2010).

The scale assesses the attainment of important age-related milestones, including the capacity to engage and use a range of emotions, experiences, and expressions, as well as to comprehend various emotional signals and to elaborate upon a range of feelings through the use of words and other symbols (Breinbauer et al., 2010). The sum of all items was performed to obtain the gross score. Based on this score, weighted scores (according to the infant' months and adjusted for prematurity), the composite scores and the percentile ranks were calculated. For methodological purposes, we used the composite score for the scale as the outcome. Higher scores indicated better social-emotional development (Bayley, 2006; Madaschi et al., 2016).

### **Maternal-Fetal Attachment**

MFA was assessed using the Brazilian version of the Maternal-Fetal Attachment Scale (MFAS). The scale is a 24-item measure that contains Likert-type responses ranging from 1 (definitely no) to 5 (definitely yes). Examples of MFAS items include "I talk to my unborn baby" and "I do things to try to stay healthy that I would not do if I were not pregnant". The total score ranges from 24 to 120. In the validation of Brazilian version MFA, the use of the total scale instead of the subscales was suggested as a general measure of attachment. Higher scores indicate higher MFA levels (Cranley, 1981; Feijó, 1999). It presented a low reliability for the Brazilian context, with a Cronbach's  $\alpha$  of 0.63 (Feijó, 1999). However, a previous study carried out with the same sample as the present study showed an  $\alpha$  of 0.82, indicating good reliability (da Rosa et al., 2021; Streiner, 2003). This instrument was used in the second phase of the study.

### **Depressive Symptoms**

Depressive symptoms during pregnancy and postpartum were evaluated using the Edinburgh Postnatal Depression Scale (EPDS), in the second and third wave of the study, respectively. The EPDS is a 10 item self-report measure designed to screen women for emotional distress symptoms during pregnancy and the postnatal period. Each item is scored from 0 to 3 and the total score ranges from 0 to 30. Higher scores indicate higher depressive symptoms. In this study, the cutoff point used was 13, in both evaluations (during pregnancy and postpartum). Those subjects who presented 0–12 points had absence or minor symptoms and those with 13 points or more, showed depressive symptoms (no/yes, respectively; Santos et al., 2007). It presented a good reliability for the Brazilian context, with a Cronbach's  $\alpha$  of 0.87 (Malloy-Diniz et al., 2010; Streiner, 2003).

## Socio-Demographic Data

The socioeconomic status of the participants was evaluated using the criteria of the Brazilian Economic Classification Criteria of the [Brazilian Association of Research Companies \[ABEP\] \(2015\)](#). This classification is based on the total accumulation of material goods, the householder's schooling and other characteristics such as having access to tap water and residing in a paved street. For this study, the levels were categorized and named as: higher level (A + B), middle level (C), and lower level (D + E; [ABEP, 2015](#)).

A self-report questionnaire was also administered during pregnancy (second wave of the study) and included variables such as: education in years of study (up to 3 years, 4 to 7 years, 8 to 10 years, 11 years or more), maternal age (up to 23, 24 to 29 years, above 30 years), living with a partner (no, yes), previous pregnancy (no, yes), planned pregnancy (no, yes), social support from baby's father (no, yes). In addition, a self-report questionnaire was also administered in the postpartum (third wave of the study) and included variables such as: child gender (male, female), low birth weight  $\geq 2500\text{g}$  (no, yes), prematurity (no, yes), neonatal hospitalization (no, yes), breast-feeding (no, yes), siblings (no, yes).

## Ethical Aspects

This study was approved by the Ethics Committee of the Catholic University of Pelotas under the protocol number 47807915.4.0000.5339. All participants agreed to participate in the study by providing their free and informed consent and permission for their child's participation. For eligible participants under the age of 18, a written consent was also obtained from their parents or guardians. The participants with any psychiatric disorders were referred to a health service center, according to diagnostic assessments of the larger study.

## Statistical Analysis

The Statistical Package for the Social Sciences (SPSS) 22.0 software was used to run statistical analyses. The descriptive analysis was obtained by absolute and relative frequency, and means and standard deviations. Since the dependent variable (Social-Emotional Development) is continuous, bivariate analyses were conducted through *t*-test, ANOVA and Pearson correlation, according to the type of the independent variable.

Multiple regression was performed using Linear Regression. The variables that presented  $p \leq 0.20$  in the crude analysis were included in the adjusted analysis that aimed to control possible confounding factors and followed a conceptual hierarchical model, based on the literature on factors related to infant social-emotional development. According to the study of [Victora et al. \(1997\)](#), this model is divided into levels and assumes that variables located at the hierarchically higher level are determinants of the lower levels ([Victora et al., 1997](#)).

The model proposed for the approach of variables was determined in three levels. Level 1 included education. Level 2 included maternal age, previous pregnancy, maternal gestational depression and maternal-fetal attachment. Level 3 included siblings and maternal postpartum depression. In this regression model, the variables were controlled using the same or previous levels. Only the variables with  $p \leq .05$  remained in the models.  $p$ -values  $< .05$  were considered statistical significant (Victora et al., 1997).

To verify the multicollinearity in the regression analyses between the variables that remain in the regression model, we realized the detection tolerance. We considered values below 0.1 as the existence of collinearity among the variables.

## Results

The sample consisted of 702 mother-infant dyads. Table 1 shows demographic and socio-economic data, gestational, maternal mental health characteristics, infant characteristics and birth conditions associated with infant social-emotional development. The mean score for infant social-emotional development was 114.7 ( $SD \pm 14.0$ ) and the overall mean score for pregnant women's MFA was 98.6 ( $SD \pm 11.6$ ). Most women were from middle class C (56.3%), had 11 or more years of education (58.7%), were above 30 years (36.3%), and lived with a partner (86.1%).

**Table 1**

*Demographic, Socioeconomic, Gestational, Maternal Mental Health Characteristics, Infant Characteristics and Birth Conditions Associated With Social-Emotional Development, Pelotas, South of Brazil (2016–2018)*

Variable	N (%)	Social-Emotional Development M (SD)	<i>p</i>
<b>Economic class (N = 689)</b>			.690
High class (A+B)	188 (27.3)	114.26 (13.7)	
Middle class (C)	388 (56.3)	114.42 (13.9)	
Low class (D+E)	113 (16.4)	114.58 (14.4)	
<b>Maternal education (years of study) (N = 702)</b>			.092
Up to 3 years	12 (1.7)	115.91 (16.2)	
4-7 years	129 (18.4)	113.19 (14.3)	
8-10 years	149 (21.2)	114.67 (14.2)	
11 years or more	412 (58.7)	114.71 (13.7)	
<b>Maternal age (years) (N = 702)</b>			.198
Up to 23 years	212 (30.2)	115.00 (14.4)	
24-29 years	235 (33.5)	115.61 (12.8)	
Above 30 years	255 (36.3)	114.71 (14.6)	
<b>Lives with partner (N = 700)</b>			.711
No	97 (13.9)	114.18 (13.9)	

Variable	N (%)	Social-Emotional Development <i>M (SD)</i>	<i>p</i>
Yes	603 (86.1)	114.74 (14.0)	
<b>Previous pregnancy (N = 702)</b>			.058
No	297 (42.3)	113.54 (13.4)	
Yes	405 (57.7)	115.57 (14.3)	
<b>Planned pregnancy (N = 702)</b>			.776
No	316 (45.0)	105.86 (13.9)	
Yes	386 (55.0)	114.85 (13.4)	
<b>Social support from baby's father (N = 702)</b>			.453
No	26 (3.7)	112.69 (14.8)	
Yes	676 (96.3)	114.79 (10.0)	
<b>Maternal gestational depression (<math>\geq 13</math>) (N = 701)</b>			.048
No	629 (89.7)	115.04 (14.0)	
Yes	72 (10.3)	111.60 (13.7)	
<b>Maternal postpartum depression (<math>\geq 13</math>) (N = 700)</b>			.113
No	615 (87.9)	114.97 (14.1)	
Yes	85 (12.1)	112.41 (13.0)	
<b>Infant sex (N = 702)</b>			.281
Male	336 (47.9)	114.12 (14.2)	
Female	366 (52.1)	115.26 (13.7)	
<b>Low birthweight (&lt; 2500g) (N = 700)</b>			.618
No	644 (92.0)	114.72 (14.0)	
Yes	56 (8.0)	113.75 (13.2)	
<b>Prematurity (N = 695)</b>			.373
No	652 (93.8)	114.75 (14.0)	
Yes	43 (6.2)	112.79 (12.8)	
<b>Neonatal hospitalization (N = 702)</b>			.894
No	593 (84.5)	114.69 (14.3)	
Yes	109 (15.5)	114.86 (12.3)	
<b>Breast-feeding (N = 702)</b>			.321
No	29 (4.1)	117.24 (14.8)	
Yes	673 (95.9)	114.60 (13.9)	
<b>Siblings (N = 702)</b>			.102
No	281 (40.0)	113.65 (13.6)	
Yes	421 (60.0)	115.42 (14.2)	
<b>Total</b>	702 (100)	114.7 (14.0)	—

Regarding the gestational characteristics and maternal mental health, 57.7% of pregnant women had previous pregnancy, 45.0% did not plan pregnancy, and 3.7% did not feel

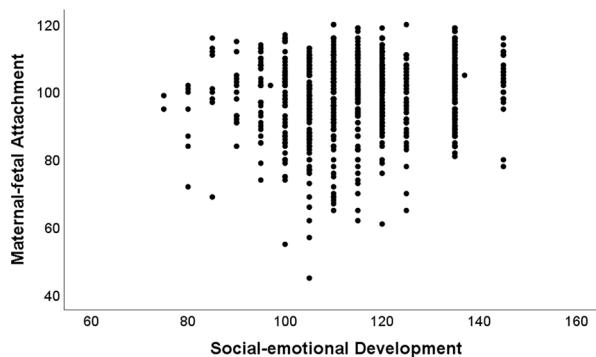
social support from baby's father during pregnancy. Moreover, 10.3% of pregnant woman had gestational depression and 12.1% of mothers had postpartum depression. For the infant characteristics and birth conditions, 52.1% of infants were female, 8.0% were born with low birthweight, and 6.2% were born premature. In addition, 15.5% had neonatal hospitalization, 4.1% were not breastfed, and 60.0% had siblings (Table 1).

The bivariate analysis showed that there social-emotional development was associated with the gestational depression ( $p = .048$ ). The variables education, maternal age, previous pregnancy, postpartum depression and siblings were used in the multivariate analysis because these variables had  $p < .20$  (Table 1).

Figure 1 demonstrates the correlation between MFA and social-emotional development. A weak and positive correlation can be observed ( $r = 0.115$ ;  $p = .002$ ).

**Figure 1**

*Correlation Between Maternal-Fetal Attachment and Social-Emotional Development, Pelotas, South of Brazil (2016–2018)*



*Note.*  $r = 0.115$ ;  $p = .002$ .

In the adjusted analysis, only MFA remained a predictor of social-emotional development,  $F(7, 692) = 2.734$ ;  $p = .008$ ;  $R^2 = 0.027$ . According to our hypotheses, higher levels of MFA in pregnant women were associated with higher levels of social-emotional development in infants. Thus, with each increase to one point in the MFA score, there was an increase of  $\beta = 0.14$  ( $t = 3.096$ , 95% CI [0.05, 0.23]) in the social-emotional development score. The regression model explains 2.7% of the variation in this response. The variables that included education, age, previous pregnancy, maternal gestational depression, maternal postpartum depression and siblings did not show any significant association with social-emotional development ( $p > .005$ ; Table 2).

**Table 2**

*Multiple Linear Regression Analysis of Demographic, Gestational, Maternal Mental Health Characteristics, Maternal-Fetal Attachment, Birth Conditions and Social-Emotional Development, Pelotas, South of Brazil (2016–2018)*

Variable	Social-Emotional Development				
	$\beta$	95% CI	<i>p</i>	<i>t</i>	<i>R</i> <sup>2</sup>
<b>Level 1</b>					
Maternal education (11 years or more) <sup>a</sup>	-0.75	-2.06, 0.55	.256	1.617	0.002
<b>Level 2</b>					
Maternal age (up to 23 years) <sup>a</sup>	1.17	-0.22, 2.56	.098	0.880	0.027
Previous pregnancy (no) <sup>a</sup>	1.68	-1.23, 4.60	.257	1.089	
Maternal gestational depression ( $\geq 13$ ) (no) <sup>a</sup>	-2.74	-6.45, 0.97	.148	-1.259	
Maternal-Fetal Attachment	0.14	0.05, 0.23	.002	3.096	
<b>Level 3</b>					
Maternal postpartum depression ( $\geq 13$ ) (no) <sup>a</sup>	-2.08	-5.52, 1.36	.235	0.690	0.027
Siblings (yes) <sup>a</sup>	-0.04	-2.96, 2.88	.977	0.143	

<sup>a</sup>Reference category

Table 3 shows that we did not observe the effects of multicollinearity among independent variables (tolerance  $> 0.1$ ).

**Table 3**

*Collinearity Statistics Tolerance Between Independents Variables, Pelotas, South of Brazil (2016–2018)*

Independent variable	Collinearity statistics tolerance
Maternal education	0.890
Maternal age	0.822
Previous pregnancy	0.510
Maternal gestational depression ( $\geq 13$ )	0.934
Maternal-Fetal Attachment	0.969
Maternal postpartum depression ( $\geq 13$ )	0.936
Siblings	0.517

## Discussion

This population based-study evaluated the association between MFA and social-emotional development in infants at 3 months of age, in Southern Brazil. According to our 1 hypotheses, we found that higher levels of social-emotional development in infants re-

mained associated with higher levels of MFA in pregnant women, even when controlled for sociodemographic, maternal mental health and infant characteristics.

To our knowledge, this is the first study to investigate the association between MFA and social-emotional development. Infants who live in developing countries are consistently exposed to a number of risk factors. Among the psychosocial factors, are cognitive stimulation, caregiver sensitivity and responsiveness to the child, caregiver affect (emotional warmth or rejection of child) and maternal depression (Walker et al., 2007). However, few studies on maternal aspects during pregnancy have been conducted in Least Developed Countries, such as Brazil (Foley et al., 2021). Thus, the findings of the present study demonstrate that in addition to the influence of postpartum aspects, prenatal factors such as the MFA can also have a considerable impact on a child's development. Furthermore, these findings highlight the importance of investigating factors that can serve as protection for these infants, due to their greater vulnerability.

Although the literature does not refer to this particular association, some studies can help us understand this relationship. Alhusen et al. (2012) found that women with lower levels of MFA were more likely to have an infant with adverse neonatal outcomes (such as low birth weight, prematurity and others). Healthy habits during pregnancy mediated the relationships of MFA and adverse neonatal outcomes. Thus, the adoption of risk behaviors during pregnancy by women with lower levels of MFA may influence birth outcomes.

Conversely, women with higher levels of MFA who engaged in healthier behaviors during pregnancy were closely linked to the fetus and were concerned with the fetus' well-being, resulting in the birth of a healthy infant. In this perspective, women with higher levels of MFA exhibited more affectionate behaviors towards their babies, such as stroking the belly, speaking and interacting with the unborn infant, and adhering to healthy habits.

Although we have not investigated the adoption of risk behaviors during pregnancy, these findings revealed that MFA can be considered an important predictor of child development, since it is related to the quality of behaviors that women will adopt during pregnancy. It is known that risk behaviors, such as consumption of substances abuse during pregnancy, are often associated with deficits in child development (Blanchard et al., 2005; Hernández-Martínez et al., 2017; Polanska et al., 2017).

Punamäki et al. (2017) found a direct association between MFA and child development, corroborating our findings. Their study involved mother-infant dyads living in war conditions in Palestine, from prenatal to postpartum (4 to 12 months). The results indicated that higher levels of MFA predicted better motor and language development in infants at 12 months of age, as well as better mother-infant interaction in the postpartum period. Although the social-emotional domain was not approached, the results showed the influence of MFA on the infant's outcomes.

Alhusen et al. (2013) in a study with 81 mother-infant dyads, analyzed the relationship between MFA, mothers' attachment style and child development outcomes (14–26 months of age) in an economically-disadvantaged sample of young African American women. The results showed that MFA in the second gestational trimester predicted infant's cognitive, motor and language development, only when postpartum depression and the mother's attachment style were not controlled. After controlling for these two variables, MFA did not remain associated with child development. In our study, MFA remained associated with socio-emotional development, despite including pre and postnatal depression in our adjustment model. A possible explanation for this difference in findings is that perhaps depression is an important risk factor of cognitive, motor and language development but not of socio-emotional development. In addition, it should be noted that this study has important limitations, due to the fact that it was carried out with a small sample, predominantly of low income, selected for convenience, which may have interfered in the results.

Studies have shown that the levels of attachment tend to remain stable after birth, being considered an important predictor of the quality of the relationship that the dyad will establish in the baby's first years of life (Dubber et al., 2015; Foley & Hughes, 2018; Shin et al., 2006). It is known that early mother-infant bonding can influence the child's future social-emotional development (Ainsworth & Bowlby, 1991; Mason et al., 2011; Mills-Koonce et al., 2015; Ranson & Urichuk, 2008). With the latest advances in technology and laboratory techniques, intrauterine life does not continue to be seen as sheltered from environmental stimulus and is now considered a phase in which the fetus is able to perceive light, sound, register sensations and even relate to the mother, recognizing her voice and capturing her emotional states (Kowalcek et al., 2002).

According to Moon (2011), the auditory and emotional stimulus that the fetus receives during pregnancy, whether positive or negative, may influence its development, as well as the mother-baby bonding after birth. It is known that the infant's social-emotional domain develops mainly through observation and learning, which occurs through the experience of the relationship with other people, especially with the maternal figure. In this sense, infants who have had positive experiences based on affection since the gestational period will be able to develop positive social and emotional health (Gross, 2014; Thompson, 2010; Tomasello & Carpenter, 2007; Zeanah, 2018).

As a limitation in this study, we must emphasize that both MFA and socio-emotional development were collected through maternal report. Thus, it is possible that there is a response bias, as an optimistic pregnant woman can answer both questionnaires positively. On the other hand, a pessimistic pregnant woman may respond negatively. We must also emphasize that the results should be interpreted with caution, given the small effect size observed. However, BSID-III is used in research worldwide and is considered the gold standard for assessing early child development. The main strength of

this population based-study was the sample size, which enabled the generalization and comparison of the results.

It is worth mentioning that although we found a statistically significant association between MFA and social-emotional development, the magnitude of this association was relatively small. Thus, the analyses indicated that from the variables included in the regression model only MFA was associated (despite including both pre and postnatal depression in our model) but MFA scores explained (only) 2.7% of the variance in scores of infant's socio-emotional development. In this sense, it is important to emphasize that the literature points to several other factors related to worse child social-emotional development. Among the main factors is premature birth, being male, lower maternal education, worse economic class, the difficulties in mother-infant bonding after birth and the impact of maternal mental disorders.

Therefore, our findings demonstrate that the mother-infant bond during the gestational period, in this case the MFA, is another important aspect, but not the only one, to be considered in preventive interventions for maternal-infant health and well-being. In addition, our results can be used not only as an indicator of the impact of MFA on infant's outcomes, especially at an early age, but also as a basis for future research with older children. In addition, the evaluation carried out at three months of age makes it possible to identify early developmental delays and start intervention as soon as possible.

In view of the current evidence, more research should be carried out with infants of other age groups in order to verify the impact of MFA on the first year of life, since it may be associated with negative health outcomes for offspring. In addition, pregnant women should receive prenatal care that can help prevent complications and give information about important steps they can take to protect their infant and ensure a healthy pregnancy. It is noteworthy that pregnancy is characterized by physical, hormonal, social and psychological changes, and is considered a period of great emotional vulnerability in a woman's life. In addition, to all the changes that are characteristic of the gestational period, the establishment of the mother-infant bond is also part of this process, which can influence the future development of the infant, as demonstrated by our findings.

However, it is very important to intervene in prenatal care, addressing the psychological and emotional aspects of the mother, and the mother-infant relationship. Along the physical aspects, the subjective aspects that permeate the gestational period, such as the MFA, must be considered by health professionals, as they are associated with better infant outcomes in the postpartum period. We suggest the implementation of groups of pregnant women in prenatal care, so that they can share their fears, anguish and feel supported, with the aim of stimulating MFA during pregnancy with positive implications for later childhood development.

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