

Infant Temperament: Association with Maternal Depression Symptoms in Pregnancy and Postpartum

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Abstract: Research regarding the association between child temperament and maternal symptoms of depression remains inconclusive. This study aimed to compare the temperament of babies during their first year of life in relation to their mother's depression symptoms in pregnancy and/or postpartum. The study also identified risk factors for negative affectivity, extraversion, and effortful control. Fifty-four mother-infant dyads participated in the study, divided according to maternal depression symptoms into four groups: symptoms during pregnancy, postpartum, at both times, and without symptoms. The Edinburgh Postpartum Depression Scale and Infant Behavior Questionnaire were used. Children of mothers with depression symptoms had higher negative affectivity scores, activity levels, and lower effortful control scores. The prediction analysis revealed that negative affectivity and effortful control were explained by maternal postpartum depression symptoms, indicating that caring for the mother in her adaptation to motherhood can prevent impairment to infant temperament.

Keywords: personality, childhood development, depression, postpartum depression

Temperamento Infantil: Associação com Sintomas Depressivos Maternos na Gestação e no Pós-Parto

Resumo: As pesquisas ainda são inconclusivas quanto à associação entre temperamento da criança e sintomas depressivos maternos. Este estudo teve por objetivo comparar o temperamento de bebês durante o primeiro ano de vida, diferenciando-os quanto à presença de sintomas depressivos maternos na gestação e/ou pós-parto e identificar fatores de risco para afeto negativo, extroversão e controle com esforço. Participaram 54 díades mãe-bebê, divididas quanto aos sintomas depressivos maternos em quatro grupos: sintomas na gestação, no pós-parto, nos dois momentos e sem sintomas depressivos. Utilizou-se a escala de Depressão Pós-Parto de Edimburgo e Infant Behavior Questionnaire. Filhos de mães com sintomas depressivos obtiveram maiores escores de afeto negativo, nível de atividade e menor escore de controle com esforço. Na análise de predição, o afeto negativo e controle com esforço foram explicados pelos sintomas depressivos maternos pós-parto, sinalizando que cuidar da mãe, em sua adaptação à maternidade, pode evitar prejuízos ao temperamento infantil.

Palavras-chave: personalidade, desenvolvimento infantil, depressão, depressão pós-parto

Temperamento Infantil: Asociación con Síntomas Depresivos Maternos en el Embarazo y el Posparto

Resumén: Las investigaciones no son concluyentes con respecto a la asociación entre temperamento infantil y síntomas depresivos maternos. Este estudio tuvo como objetivo comparar el temperamento de bebés durante el primer año de vida, diferenciándolos en cuanto a la presencia de síntomas depresivos maternos en el embarazo y/o el posparto y identificando factores de riesgo para afecto negativo, extroversión y control con esfuerzo. Participaron 54 díadas madre-bebé, divididas en cuatro grupos: síntomas depresivos maternos gestacionales, posparto, en los dos momentos y sin síntomas depresivos. Se utilizaron la Escala de Depresión Posparto de Edimburgo y el Cuestionario de Comportamiento Infantil. Hijos de madres con síntomas depresivos tenían puntajes más altos de afecto negativo, nivel de actividad y más bajos de control con esfuerzo. En el análisis de predicción, síntomas depresivos maternos posparto explicaron afecto negativo y control con esfuerzo, señalizando que cuidar de la adaptación de la madre a la maternidad, puede prevenir daños al temperamento infantil.

Palabras clave: personalidad, desarrollo infantil, depresión, depresión post-parto

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Article derived from the first author's master's dissertation under the supervision of the third author, defended in 2021 in the Postgraduate Program in Public Health of the Universidade Estadual Paulista "Júlio de Mesquita Filho".

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Children have variability in their individual reactions to internal and external stimuli from an early age (called temperament), and the theoretical approach most used today to explain it is Rothbart's psychobiological theory. From this epistemological perspective, temperament is understood as individual differences with a constitutional basis in reactivity, meaning the level of responsiveness and in self-regulation which shape attention, emotion and activity.

The term constitutional refers to the biological bases of temperament, which (in Rothbart's view) are influenced at all times by heredity, maturation, and experience (Linhares, Dualibe, & Cassiano, 2013).

Temperament comprises three major factors: negative affectivity, extraversion, and effortful control (Rothbart, 1981). Negative affectivity is characterized by primitive forms of irritation and anguish, and later more organized states related to frustration and fear appear. Extraversion includes activity and impulsivity levels, high-intensity pleasure, perceptual sensitivity, and reactivity. In turn, effortful control refers to the ability to focus attention, have satisfaction with low-intensity activities, and exert inhibitory control (Linhares et al., 2013).

In literature reviews on child temperament, it was found that although some studies indicate the relationship between temperament and biological variables, others point to the impact of environmental variables (Cosentino-Rocha & Linhares, 2013; Linhares et al., 2013), reinforcing Rothbart's multifactorial conception. In the case of biological variables, there are studies indicating the relationship between temperament and gender and prematurity (Cassiano, Provenzi, Linhares, Gaspardo, & Montirosso, 2020; Cosentino-Rocha & Linhares, 2013). Studies regarding environmental variables associate educational practices, maternal care and mother-child interaction with the child's temperament (Cassiano & Linhares, 2015; Granat, Gadassi, Gilboa-Schechtman, & Feldman, 2017; Parade, Armstrong, Dickstein, & Seifer, 2017; Vismara, Sechi, & Lucarelli, 2020).

Maternal depression deserves to be highlighted to the extent that the mother's initial interaction with her baby is an important mediating factor between perinatal events and later development, including temperament (Cassiano & Linhares, 2015). There is evidence in the literature on the association of maternal depression symptoms with negative outcomes in the mother-infant bond, in the child's development and behavior (Dib, Padovani, & Perosa, 2019; Schiavo & Perosa, 2020). There are studies regarding the child's temperament which have focused on its association with maternal depression during pregnancy (Davis et al., 2007; Madigan et al., 2018), others with maternal depression in the postpartum period (Feldman, 2009; Granat et al., 2017; Hanington, Ramchandani, & Stein, 2010; Shapiro, Jolley, Hildebrandt, & Spieker, 2020), and a few have evaluated the relationship between infant temperament and maternal depression in the pre- and postnatal periods (McGrath, Records, & Rice, 2008; Nieto, Lara, Navarrete, & Manzo, 2019).

Considering the gestational period, it was identified that the presence of depression symptoms and cortisol levels in the blood in the third gestational trimester correlated with infant temperament at the end of the 2nd month of life, specifically with the fear dimension, a component of the negative affectivity factor. The authors explain that the fetus is quite vulnerable in the prenatal period and maternal physiological changes, such as increased cortisol, could have future repercussions (Davis et al., 2007). In a recent review, Madigan et al. (2018) point out that although

there are data showing the association between gestational depression and difficult temperament of the child, the results are still inconclusive.

Maternal depression symptoms in the postpartum period have been associated with the child's difficult temperament in the first months of life (Hanington et al., 2010), especially regarding the baby's negative affectivity (Rigato, Stets, Bonneville-Roussy, & Holmboe, 2020; Shapiro et al., 2020). However, the results do not allow us to draw conclusions about causal relationships between these variables. It remains to be seen whether maternal depression symptoms help to predict a child's difficult temperament or whether it is the child's difficult temperament that exacerbates maternal depression and the way the mother interacts with the child. Or further, if both effects are present and interact with each other, configuring a bidirectional effect (Rigato et al., 2020).

In one of the few studies found that evaluated maternal depression symptoms during both pregnancy and postpartum, it was identified that only postpartum symptoms were associated with the child's temperament, when she was 6 months old (Nieto et al., 2019).

Contextual variables, such as socioeconomic conditions and family context seem to play a moderating role in the relationship between depression symptoms and childhood temperament. In the study by Melchior et al. (2012), children of depressed mothers from low-income families were more likely to have temperamental difficulties. In the work by Parade et al. (2017), maternal depression only affected the child's temperament in dysfunctional families and when mothers had low sensitivity. All the results of the studies presented report being in favor of a concept of temperament in which, in addition to biological mechanisms, environmental factors act after birth, especially the nature and quality of mother-child interaction (Cassiano & Linhares, 2015; Hanington et al., 2010). In a review and meta-analysis study by Spry et al. (2020), there is a great complexity in transmission which cannot only be explained by biological programming in utero, but includes the mother-infant dyad relationship, possibly altered by depression symptoms. Given this variability, there is a need for further studies aimed at understanding the effects of depression, focusing on both gestational and postpartum periods to deepen the understanding of the variables that influence the child's temperament.

Given the above, it can be concluded that the results on the effects of both gestational and postpartum depression on the child's temperament are still inconclusive. Thus, this study aimed to compare the temperament of babies during the first year of life, differentiating them regarding the presence of maternal depression symptoms during pregnancy and/or postpartum, and to identify risk factors for negative affectivity, extraversion and effortful control.

This study is based on the hypothesis that children of mothers who present depression symptoms, especially in the postpartum period, would have higher negative affectivity and extraversion levels and less effortful control when compared to babies of mothers without depression,

since the importance of the mother-infant relationship for infant temperament is understood.

Method

This is a cohort study using the database of a previous study which evaluated the presence of depression symptoms in pregnant women in a city in the interior of São Paulo state, Brazil.

Participants

A convenience sample was constituted from a database with 306 pregnant women who received prenatal care at the public health service of a city in the interior of São Paulo state, Brazil. According to the information in the database, 65 (21%) had depression symptoms in the third trimester of pregnancy, according to a score (score ≥ 13) on the Edinburgh Postpartum Depression Scale (EPDS). Of these, 24 were not located, 2 lost the baby, 7 refused to participate and 13 accepted to participate, but were not located on the day of the visit. Therefore, 19 mothers among those with gestational depression symptoms participated in this study.

Next, 110 women among the mothers who did not present depression symptoms during pregnancy ($n = 241$) were randomly selected, of which 63 were not located, 9 refused to participate and 3 moved away. In the end, 35 women without gestational depression symptoms participated in the study.

Considering the 54 participating mothers, the median age of the participants was 28 years, ranging from 17 years to 45 years; 66.7% had completed high school, 77.8% had a partner and 72% did not have a formal job. The majority reported not having had health problems during pregnancy (85.2%), having had social support during pregnancy (85.2%) and in the puerperium (81.5%), while 42.6% reported not having wanted/planned the pregnancy. Most of the children were female (57.4%), 53.7% were born by vaginal delivery, few needed hospitalization (16.7%) or an incubator (11.1%), and only one (1.9%) was born prematurely.

The mothers were subsequently divided into four groups from the results on depression symptoms obtained in the prenatal (database) and postnatal evaluation: mothers with depression symptoms only during pregnancy (SN), mothers with depression symptoms only in the postnatal period (NS), mothers with depression symptoms at both moments (SS), and finally, mothers who did not present depression symptoms at any time (NN). The cut-off point adopted on the EPDS scale to identify possible depression was a score ≥ 13 (Baptista, Baptista, & Torres, 2006) during both pregnancy and postpartum.

Instruments

Questionnaire on sociodemographic characteristics (age, marital status, education, family income, number of children) and *gestational characteristics* (previous abortions,

threat of current abortion, health complications during pregnancy, including mental health).

Questionnaire regarding birth and baby: birth route, duration, location, obstetric complications (changes in blood pressure, bleeding, decreased oxygenation, reactions to anesthesia) and with the baby (decreased oxygenation and meconium aspiration), hospitalization time; gestational age, weight of the child and need for an incubator.

Edinburgh Postpartum Depression Scale (EPDS): developed to identify postpartum depression symptoms. It was validated in several countries, including Brazil by Santos, Martins and Pasquali (1999), and it has also recently been used during pregnancy (Kliemann, Böing, & Crepaldi, 2017). It consists of 10 self-administered questions that assess the presence and intensity of symptoms in the last seven days. The sum of the points constitutes the total score, which can vary between 0 and 30 points. The cut-off point for possible depression adopted for this study was a score ≥ 13 (Baptista et al., 2006), either during pregnancy or postpartum. The sensitivity in a study that adopted this cut-off point in the postpartum period was 63.9, and the specificity was 98.9 (Figueira, Corrêa, Malloy-Diniz, & Romano-Silva, 2009).

Infant Behavior Questionnaire (IBQ): is intended to assess the temperament of babies from 3 to 12 months of age. It is based on Rothbart's psychobiological framework with translation into Portuguese by Klein, Putnam and Linhares (2009), and is available for use in research. It has 191 questions, and parents or caregivers must assess the frequency of the target behavior during the last week and the last two weeks. The score is on a Likert scale which varies from 1 to 7, or NA (not applicable) when it does not receive a score. The 191 questions are grouped into 14 dimensions, subdivided into three factors: negative affectivity, extraversion, and effortful control. In the end, a score is obtained for each of the 14 dimensions and for the three temperament factors, whose values can vary from 1 to 7. The instrument translation maintained values above 0.70 for Cronbach's alpha for all scales (Costa & Figueiredo, 2018).

Procedures

Data collection. Women who were in the third trimester of pregnancy with low obstetric risk and who underwent prenatal care at the basic health units of a city in the interior of São Paulo state were invited to participate in a prospective cohort study, which aimed to identify determinants and repercussions on maternal and child health from gestational depression. A team of researchers applied the EPDS scale for pregnant women who agreed to participate in the research while waiting for the prenatal consultation at the health units.

After permission to use the database, contact was made with the mothers who were invited to participate in a new data collection stage when the children were aged between 7 and 12 months. A meeting was scheduled for

those who agreed to participate at their home, on a day and time of their choice. The researcher responsible for the collection was unaware of the participant's EPDS score during the gestational period.

After explaining the research in the face-to-face meeting, the mother subsequently signed the informed consent form and answered the EPDS and the IBQ questionnaires, respectively. A chart was presented with a graphic representation of the magnitude of the response to facilitate responses to the IBQ.

Data analysis. The data were typed and stored in an Excel spreadsheet after collection. A descriptive analysis of the sociodemographic and clinical variables and of the selected instruments (EPDS, IBQ) was subsequently performed in two moments.

The four groups were compared in terms of their sociodemographic, clinical (mother and child) characteristics and birth conditions using the Kruskal-Wallis test for numerical variables and the Goodman or Fisher's exact test for categorical variables, followed by the Dunn's test to identify significantly different groups.

The four groups were then compared for child temperament in terms of the three factors and their dimensions using the ANOVA test, followed by Bonferroni's and Dunn's tests to identify which groups differed statistically from each other.

Finally, three multiple regression models were set up considering the variables that showed significance ($p < 0.05$) or tendency to significance ($p < 0.10$) in comparing the groups for the negative affectivity, extraversion and effortful control outcomes. A collinearity test was performed to exclude possible collinear variables and the coefficient of double determination (adjusted R^2) was calculated to determine the variation percentage in the outcome that is explained by the linear A model. A standard statistical significance level of $p < 0.05$ was adopted to reject the null hypothesis.

Ethical Considerations

The research project was submitted for consideration and approved by the Research Ethics Committee of the Faculty of Medicine of Botucatu - UNESP (CAAE No. 08530219.1.0000.5411, Opinion No. 3.197.190), and its execution was in accordance with the ethical guidelines of the Resolutions 466/2012 and 510/2016 of the National Commission for Research with Human Beings (CONEP).

Results

It was observed that there were no significant differences in the comparison of the four groups with respect to most

sociodemographic, clinical and birth conditions, except for the desire for pregnancy and social support. Women without depression symptoms at both times (NN) reported more social support during pregnancy compared to the group with depression symptoms at both times (SS) ($p = 0.025$), and women with depression symptoms at both times (SS) wanted pregnancy less when compared with the other three groups ($p = 0.001$).

When evaluating temperament based on maternal perception, children had a higher median in the extraversion factor (Med: 5.70; Min: 4.08 - Max: 6.50) and a lower median in the negative affectivity factor (Med: 3.95; Min: 1.45 - Max: 5.90). The median of effortful control was 4.94 (Min: 3.30 - Max: 6.52).

Significant differences were observed in the negative affectivity and effortful control factors between children of mothers with and without depression symptoms (Table 1). Children of mothers with postpartum depression symptoms (NS) had a higher score on the negative affectivity factor when compared with children of mothers without symptoms (NN). Considering the dimensions of negative affectivity, it was found that children whose mothers had depression symptoms in the postpartum period (NS) and in both moments (SS) had a higher distress score than the group of children of mothers without symptoms (NN). The sadness dimension showed a significant difference between the groups, but it was not possible to identify which groups differed from each other.

It can be observed that children of mothers without depression symptoms (NN) obtained a higher score for effortful control in the cuddliness dimension when compared with children of mothers with depression symptoms at both moments (SS).

The activity level dimension of children of mothers with depression symptoms at both moments (SS) was higher in the extraversion factor than that of children of mothers without symptoms (NN).

When trying to identify risk and protective factors for temperament factors, as can be seen in Table 2, the children's negative affectivity was predicted in 20% of the sample by maternal depression symptoms in the postpartum period ($b = 1.03$; $p \leq 0.003$); this means children whose mothers had postpartum depression symptoms had higher negative affectivity scores during the first year of life. Maternal postpartum depression symptoms were also predictors of lower scores in the children's effortful control in 15% of the sample ($b = -0.51$; $p \leq 0.025$). In turn, extraversion was the only outcome in which a child variable was a predictor of temperament. Male children were less likely to have high extraversion scores than girls in 15% of the sample ($b = -0.042$; $p \leq 0.008$).

Table 1
 Comparison of the four groups with different depression symptoms (NN; NS; SN; SS) in relation to temperament factors and dimensions.

Temperament factors and dimensions (IBQ)	NN (n = 27)		SN (n = 7)		NS (n = 8)		SS (n = 12)		p	C
	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
NEGATIVE AFFECTIVITY										
Distress to limitations	3.51	1.04	3.76	0.74	4.68	0.72	4.34	1.01	0.010	NN < NS
Fear	3.92	1.19	4.31	1.08	5.23	0.60	5.06	0.88	0.003	NN < NS, SS
Sadness	2.84	1.41	2.82	1.09	3.94	1.07	3.44	1.48	0.173	
EXTRAVERSION										
Approach	3.62	1.32	4.11	1.08	4.88	0.71	4.54	0.99	0.027	
Vocal reactivity	5.64	0.54	5.86	0.32	5.48	0.72	5.54	0.49	0.542	
High-intensity pleasure	6.23	0.66	6.48	0.32	6.19	0.65	6.23	0.52	0.775	
Activity level	5.26	0.71	5.79	0.62	4.94	1.12	5.21	0.86	0.237	
Smiling and laughter	6.52	0.57	6.10	0.60	6.09	0.64	6.27	0.65	0.178	
Perceptual sensitivity	4.58	1.03	4.98	0.71	5.23	1.03	5.65	0.71	0.027	NN < SS
EFFORTFUL CONTROL										
Soothability	5.75	0.88	6.13	1.05	5.45	1.15	5.07	0.75	0.074	
Low-intensity pleasure	5.48	1.17	5.68	0.55	4.96	0.65	4.88	1.03	0.208	
Cuddliness	5.15	0.69	5.35	0.50	4.71	0.56	4.59	0.72	0.029	NN > SS
Duration of orienting	5.13	0.96	5.10	0.74	4.09	0.85	4.62	1.29	0.064	
Decreased vocal reactivity	5.28	0.97	5.32	1.18	5.17	0.70	4.73	0.59	0.322	
	5.75	0.83	5.90	0.57	5.24	0.41	4.89	0.98	0.011	NN > SS
	4.67	1.15	5.17	1.14	4.76	0.83	4.13	1.23	0.262	
	5.15	0.92	5.27	0.83	4.33	1.08	4.56	1.27	0.109	

Note. Standard Deviation (SD); C (significant comparisons) - significant differences at $p < 0.05$. NN (No depression symptoms in both moments); SN (with depression symptoms during pregnancy); NS (with postpartum depression symptoms); SS (with depression symptoms in both moments); ANOVA test followed by Bonferroni test and Dunn test.

Table 2

Association between child temperament factors - negative affectivity, extraversion and effortful control - and maternal, family and infant characteristics.

	<i>b</i>	95%CI	<i>p</i>
NEGATIVE AFFECTIVITY			
<i>Maternal and family characteristics</i>			
Income	0.00	0.00	0.00
Number of children	0.16	-0.26	0.59
Education	0.12	-0.42	0.67
Marital status	0.29	-0.51	1.09
Social support during pregnancy	0.57	-0.45	1.59
Depression symptoms in pregnancy	-0.19	-0.91	0.52
Postpartum depression symptoms	1.03	0.38	1.67
Psychiatric treatment in life	-0.40	-1.11	0.32
Desired pregnancy	-0.51	-1.25	0.23
<i>Baby characteristics</i>			
Gender	-0.50	-1.07	0.07
Childbirth	0.12	-0.48	0.73
Birthweight	-0.094	-2.40	0.52
Overall model fit measures: $R^2 = 38\%$; $R^2_{aj} = 20\%$; $F_{12,41} = 2.08$			
EXTRAVERSION			
<i>Maternal and family characteristics</i>			
Income	0.00	0.00	0.00
Number of children	-0.10	-0.33	0.12
Education	0.12	-0.17	0.40
Marital status	0.27	-0.16	0.63
Social support during pregnancy	-0.07	-0.61	0.47
Depression symptoms in pregnancy	0.08	-0.29	0.46
Postpartum depression symptoms	-0.12	-0.46	0.22
Psychiatric treatment in life	0.09	-0.29	0.47
Desired pregnancy	0.14	-0.25	0.54
<i>Baby characteristics</i>			
Gender	-0.42	-0.73	-0.12
Childbirth	-0.24	-0.56	0.08
Birthweight	0.06	-0.71	0.83
Overall model fit measures: $R^2 = 34\%$; $R^2_{aj} = 15\%$; $F_{12,41} = 1.77$			
EFFORTFUL CONTROL			
<i>Maternal and family characteristics</i>			
Income	0.00	0.00	0.00
Number of children	-0.10	-0.39	0.19
Education	0.10	-0.27	0.48
Marital status	-0.17	-0.72	0.38
Social support during pregnancy	0.19	-0.51	0.89
Depression symptoms in pregnancy	-0.05	-0.54	0.45
Postpartum depression symptoms	-0.51	-0.96	-0.07
Psychiatric treatment in life	0.36	-0.13	0.85
Desired pregnancy	0.19	-0.32	0.70
<i>Baby characteristics</i>			
Gender	-0.31	-0.71	0.08
Childbirth	-0.25	-0.67	0.17
Birthweight	0.25	-0.76	1.26
Overall model fit measures: $R^2 = 34\%$; $R^2_{aj} = 15\%$; $F_{12,41} = 1.76$			

Note. Beta value (*b*); Confidence Interval (CI); *R*-squared or coefficient of determination (R^2); Adjusted *R*-squared (R^2_{aj}); (*F*) Fisher-Snedecor *F* distribution; multiple regression using SPSS 21 software program.

Discussion

Corroborating the initial hypothesis, the results of the present study point to an association between maternal depression symptoms and child temperament, with increased negative affectivity and decreased effortful control levels. Although negative affectivity was the factor with the lowest score in all groups, children of mothers with postpartum depression symptoms (NS) had higher negative affectivity levels when compared to children of mothers without depression symptoms (NN). Other studies have identified an association between postpartum depression symptoms and high negative affectivity rates (Feldman, 2009; Vismara et al., 2020). In a cohort study, children of mothers with depression had more crying and more negative emotionality at three different times (2nd day, 6th and 9th months) (Feldman, 2009).

Among the dimensions of negative affectivity, the scores for sadness, but mainly anguish, were significantly higher in the children of mothers with depression symptoms in the puerperium and in both moments when compared with the children of mothers who did not present depression symptoms at any time. Granat et al. (2017) observed that depressed mothers had less synchrony of looking and touching the child during the interaction, and in turn the diminished social synchrony resulted in the children's emotional maladjustment and insecurity. However, in the systematic review by Śliwerski, Kossakowska, Jarecka, Świtalska and Bielawska-Batorowicz (2020), it was found that despite the data pointing to an association between maternal depression and insecure attachment of the child, they are still not conclusive. For the authors, as it is a complex and dynamic relationship, the possible negative effects of depression can be offset by effective maternal involvement in care. The results of Parade et al. (2017) reinforce this hypothesis, since maternal depression was associated with the infant's temperament when maternal sensitivity was low, which was not the case when maternal sensitivity was high.

The fact that negative affectivity had the lowest score of the three factors coincides with the results of two other studies in which participants were close in age to the current study (Brito, Pedroso, Cruz, & Moreira, 2018; Cassiano & Linhares, 2015), possibly because the development of emotional regulation begins in this age group, allowing the child to already regulate some affections, feel less insecure, with less irritation and fear (Cassiano & Linhares, 2015).

Postpartum depression symptoms were shown to be risk factors for negative affectivity in the regression model. There is evidence in the literature showing that maternal depression in the postpartum period enabled predicting the difficult temperament of children (Hanington et al., 2010; Melchior et al., 2012; Nieto et al., 2019; Rigato et al., 2020; Shapiro et al. 2020; Vismara et al., 2020). According to Rigato et al. (2020), maternal depression symptoms end up producing a cascade effect, meaning the presence of symptoms 2 weeks after the child's birth allowed us to predict high negative affectivity rates in the child at 4 months,

and depression symptoms at 4 months were predictors of higher infant negative affectivity scores at six months.

In another study, Shapiro et al. (2020) observed that postpartum maternal depression was associated with increased child negative affectivity at 6 months of age. For these authors, mothers with depression symptoms have difficulty regulating emotions and low sensitivity, leading to more dysfunctional interactions between the dyad, and in turn the child is sadder and has a difficult temperament. However, McGrath et al. (2008) raise a different hypothesis with similar data: maternal depression would be altering the mother's perception of the baby's temperament, which reinforces the need for new intervention strategies in which health professionals help these mothers to identify positive characteristics of their child.

In addition to postpartum depression, as in the Schmidt, Azeredo, Vieira, and Crepaldi (2018) study, child gender was also associated with negative affectivity, with girls being more likely to have higher scores on the negative affectivity factor than boys. However, it is important to emphasize that the child's temperament was evaluated according to the mother's report and there is evidence in the literature that maternal depression symptoms and anxiety in the prenatal period are associated with their perception of their daughters' difficulties at the end of the first year of life, which does not happen with boys (Savory et al., 2020).

However, in a meta-analysis involving studies carried out with children aged between three months and 13 years, Else-Quest, Hyde, Goldsmith and Van Hulle (2006) found little evidence of a relationship between gender and negative affectivity. The authors warn that it is necessary to consider stereotypes when analyzing gender. Girls are believed to have more fearful and sad reactions and less angry reactions than boys, and based on these stereotypes, parents tend to encourage or reinforce their children to display socially accepted behaviors and reactions (Cosentino-Rocha & Linhares, 2013; Else-Quest et al., 2006).

The factor with the highest median in the present study was extraversion, even higher than that found in other studies: with children aged close to one year (Brito et al., 2018), with children born at term and preterm evaluated when were 4 to 6 years old (Cassiano & Linhares, 2015), and with older children (Schmidt, Bossardi, Gomes, Crepaldi, & Vieira, 2013).

There were no significant differences regarding the extraversion factor in the four groups, but one of its dimensions (the activity level) was significantly higher in children of mothers with depression symptoms at both moments when compared with babies of mothers without depression symptoms. In the study by Feldman (2009), postpartum depression was associated with increased agitation at 9 months of age. Shapiro et al. (2020) also found that maternal depressed mood two months after delivery was associated with more agitation in the child at 6 months of age. The high activity levels observed are worrisome since high extraversion scores, especially with an increase in the activity level dimension in the first year of life, were associated with personality characteristics, behavior

problems and psychopathologies in the medium and long term in the literature (Linhares et al., 2013).

Finally, the median in relation to effortful control obtained in the current study was lower when compared to the scores of previously mentioned studies (Brito et al., 2018; Cassiano & Linhares, 2015; Schmidt et al., 2013). Corroborating the initial hypothesis, children whose mothers had depression symptoms since pregnancy had lower effortful control scores when compared to children whose mothers did not have depression symptoms, possibly associated with a high level of gestational cortisol (Davis et al., 2007) and the mother's difficulty in acting as a postpartum co-regulator (Granat et al., 2017).

It is also worth noting that the children of mothers with depression symptoms since pregnancy in the present study showed a high activity level at the same time in addition to having lower levels of the effortful control factor, reinforcing the thesis that the three factors interconnected are more likely to harm the child's mental health (Auerbach et al., 2008; Gracioli & Linhares, 2014). It was observed in research with preschoolers that high anger and impulsivity levels at nine months associated with low inhibitory control were predictors of externalizing behavior problems at four years of age (Gracioli & Linhares, 2014). When investigating the possible relationship between temperament and ADHD, Auerbach et al. (2008) identified that a high activity level index at 7, 12 and 25 months allowed to predict hyperactivity-impulsivity symptoms ten years later when the subjects were entering adolescence, and it was possible to predict attention deficit disorder if the children had low effortful control in addition to hyperactivity.

Only postpartum depression symptoms remained a risk factor for effortful control in the regression model. Children whose mothers had postpartum depression symptoms were more likely to have difficulties in regulating their affections, their attention and their own activity than children of mothers without depression. Several authors consider that effortful control is strongly influenced by the regulation experience offered by caregivers (Gracioli & Linhares, 2014; Granat et al., 2017). In this sense, the low responsiveness, apathy and poor expression of positive affectivity of some depressed mothers, as well as the intrusive, coercive and impatient behaviors of others, which have already been associated with more negative and dysfunctional parenting styles (Dib et al., 2019; Oliveira, Silva, Pizeta, & Loureiro, 2021), can affect the regulation and appearance of emotional symptoms in children (Oliveira et al., 2021).

In summary, the regression results support the initial hypothesis that infant temperament in the first year of life is associated with maternal depression symptoms, in particular, negative affectivity and effortful control. This finding may be reflecting a depressed mother's negative perception of her child's temperament (Rigato et al., 2020) or it reinforces Rothbarth's conception that temperament does not only depend on biological bases, but is also moderated by experience; in this case, the mother-child interactions in the family environment. These are hypotheses which need to be better investigated in future research, even resorting

to neurophysiological and/or observational measures of the baby to better identify their temperament characteristics.

On the other hand, the association found reinforces the need for psychological assistance for women who have difficulties adapting in their transition to motherhood to avoid damage to child temperament (Nieto et al., 2019). As a large number of women with postpartum depression symptoms already had them in the gestational period, it is suggested that pregnant women with depression symptoms be identified and referred to mental health services starting from prenatal care, especially if the woman does not have a social support network. If postpartum depression symptoms are identified, in addition to the need for psychological or psychiatric follow-up, professionals could assist in the emotional adaptation to motherhood, in the guidance of techniques to care for their babies and encourage educational practices that facilitate the puerperal women (Nieto et al., 2019).

Although the results reinforce the initial hypothesis, some limitations need to be pointed out to guide further studies. First, the sample size limitation. Despite the effort made, only 30% of women with depression symptoms in the original database participated in the present study. Even with the address and contact telephone number provided by the pregnant women when they were evaluated in the third gestational trimester, most of them were not located, mainly due to the exchange of cell phones and population mobility. The sample size is one of the major obstacles to longitudinal research in Brazil, which limits the generalization of results, and new actions must be implemented in future databases to reduce the loss percentages.

Another limitation is only assessing child temperament through maternal reports. When it comes to very young children, the mother seems to be the best person to inform about their development and behavior. However, depression symptoms can impair the mother's perception of her child, with a more negative evaluation (Rigato et al., 2020; Vismara et al., 2020). In this sense, it is suggested that other informants who have close contact with the child evaluate them, such as parents and grandparents, or that observational measures are also used in future works, which could reduce possible information biases.

Regarding the instrument used to assess temperament, the IBQ for children aged between 3 and 12 months is quite extensive, with many response options (1 to 7), and despite offering mothers a chart with a graphic representation of the magnitude of the response, some had difficulty filling in the questionnaire and others had difficulty keeping attentive until the end of the evaluation. The possibility of using the abbreviated form of the IBQ is suggested, as long as it is translated into Portuguese and its psychometric qualities are verified.

Finally, one of the strengths of the study was the choice of a longitudinal design with the assessment of maternal depression symptoms during pregnancy and postpartum. Due to the scarcity of longitudinal-prospective studies in the literature that relate indicators of child temperament with maternal depression, it seems necessary to use this

type of design from a developmental perspective in order to follow the evolution of regulatory processes throughout the different evolutionary phases.

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Authors' Contribution:

All authors made substantial contributions to the conception and design of this study, data analysis and interpretation, and to the manuscript revision and approval of the final version. All the authors assume public responsibility for the manuscript content.

Associate editor:

Wanderlei Abadio de Oliveira

Received: Mar. 24, 2022

1st Revision: Jun. 10, 2022

Approved: Jul. 04, 2022

How to cite this article:

Garcia, N. V., Padovani, F. H. P., & Perosa, G. B. (2022).

Infant temperament: Association with maternal depression symptoms in pregnancy and postpartum. *Paidéia (Ribeirão Preto)*, 32, e3227. doi:<https://doi.org/10.1590/1982-4327e3227>