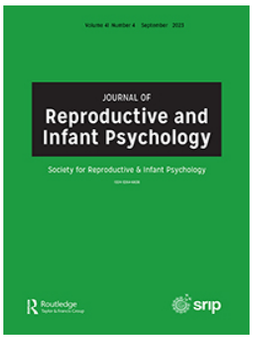

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Maternal childbirth-related posttraumatic stress symptoms, bonding, and infant development: a prospective study

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ABSTRACT

Background: Childbirth-related posttraumatic stress symptoms (CB-PTSS) including general symptoms (GS, i.e., mainly negative cognitions and mood and hyperarousal symptoms) and birth-related symptoms (BRS, i.e., mostly re-experiencing and avoidance symptoms) may disrupt mother-infant bonding and infant development. This study investigated prospective and cross-sectional associations between maternal CB-PTSS and mother-infant bonding or infant development (language, motor, and cognitive).

Method: We analysed secondary data of the control group of a randomised control trial (NCT 03576586) with full-term French-speaking mother-infant dyads ($n = 55$). Maternal CB-PTSS and mother-infant bonding were assessed via questionnaires at six weeks (T1) and six months (T2) postpartum: PTSD Checklist for DSM-5 (PCL-5) and Mother-Infant Bonding Scale (MIBS). Infant development was assessed with the Bayley Scales of Infant Development at T2. Sociodemographic and medical data were collected from questionnaires and medical records. Bivariate and multivariate regression were used.

Results: Maternal total CB-PTSS score at T1 was associated with poorer bonding at T2 in the unadjusted model (B = 0.064, $p = 0.043$). In the adjusted model, cross-sectional associations were found at T1 between a higher total CB-PTSS score and poorer bonding (B = 0.134, $p = 0.017$) and between higher GS and poorer bonding (B = 0.306, $p = 0.002$). Higher BRS at T1 was associated with better infant cognitive development at T2 in the unadjusted model (B = 0.748, $p = 0.026$).

Conclusions: Results suggest that CB-PTSS were associated with mother-infant bonding difficulties, while CB-PTSS were not significantly associated with infant development. Additional studies are needed to increase our understanding of the intergenerational consequences of perinatal trauma.

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Introduction

Up to 30–45% of women report perceiving birth as traumatic (Alcorn et al., 2010; Creedy et al., 2000; Soet et al., 2003). Childbirth may be classified as a traumatic event when the mother perceived it as a life threat for herself and/or her infant according to the stressor criteria of the Diagnostic and Statistical Manual of Mental Disorders – 5th Ed (DSM-5) (American Psychiatric Association, 2013). A traumatic childbirth may lead to childbirth-related posttraumatic stress disorder (CB-PTSD). This mental health disorder consists of four symptom clusters, namely re-experiencing, avoidance, negative cognition and mood, and hyperarousal (American Psychiatric Association, 2013). CB-PTSD has similar symptoms as general PTSD. Although childbirth could trigger PTSD that existed prior to childbirth, related to a previous traumatic event, such as sexual violence, CB-PTSD specifically refers to the traumatic experience of childbirth itself, with symptoms developing after experiencing a traumatic birth (Heyne et al., 2022).

However, in contrast to general PTSD, CB-PTSD symptoms can be divided into general symptoms (GS) and birth-related symptoms (BRS), which is why some authors have argued that CB-PTSD should be acknowledged as a sub-type of PTSD (Horesh et al., 2021). The two symptoms clusters (GS and BRS) of CB-PTSD were identified through exploratory factor analysis and were replicated in several studies across different countries (Ayers et al., 2018; Bayrı Bingöl et al., 2020; Handelzalts et al., 2018; Nakić Radoš et al., 2020; Sandoz et al., 2022). GS mostly contain symptom criteria of hyperarousal, negative cognitions, and mood, (Ayers et al., 2018; Sandoz et al., 2022; Weathers et al., 2013) while BRS mainly include criteria of intrusions and avoidance (Ayers et al., 2018; Sandoz et al., 2022; Weathers et al., 2013).

The prevalence of maternal CB-PTSD was reported to be 4.7% and approximately 12.3% of mothers have significant levels of childbirth-related posttraumatic stress symptoms (CB-PTSS) but without fulfilling diagnostic criteria (Heyne et al., 2022). These prevalence rates can depend on the mode of childbirth, e.g. in one cohort study, 27.3% of mothers reported CB-PTSS after emergency C-sections compared to 18.8% after vaginal birth (Schobinger et al., 2020). With approximately 701 million births worldwide from 2015 to 2020, more than 86 million women and their families might be affected by CB-PTSS every year (United Nations, 2019). Evidence suggests maternal CB-PTSS may have negative consequences for the whole family. For example, at one month postpartum, maternal CB-PTSS was associated with a lower rate and shorter duration of breastfeeding (Cook et al., 2018; Garthus-Niegel et al., 2018; Ayers et al., 2018). This may carry negative consequences, as breastfeeding has been associated with several positive developmental outcomes in infants (i.e., brain development, language skills, and motor development) (Grace et al., 2016; Herba et al., 2013; Whitehouse et al., 2011). Associations between breastfeeding and increased maternal sensitivity or enhanced attachment security were also reported (Tharner et al., 2012).

Moreover, CB-PTSS negatively affected mothers' relationships with their partner and their plan for pregnancy in the future to avoid another traumatic birth (Beck & Beck, 2015). CB-PTSS has a negative impact on couple relationship satisfaction, which is mediated by postpartum depression symptoms (Garthus-Niegel et al., 2018). The quality of the couple's relationship plays a pivotal role in their parenting, thereby influencing the child's attachment to their parents (Coln et al., 2013). This attachment, indeed, has profound

implications for the child's mental well-being and overall development trajectory (Coln et al., 2013; Sroufe, 2005).

CB-PTSS can also negatively affect mother-infant bonding (Dekel et al., 2019; Stuijfzand et al., 2020), although some studies found maternal CB-PTSS was not associated with mother-infant bonding (Handelzalts et al., 2021; Nakić; Radoš et al., 2020). When investigating further the associations between GS or BRS and mother-infant bonding, GS indirectly affected mother-infant bonding negatively via maternal depressive symptoms (Nakić Radoš et al., 2020). These inconsistent results might be attributed to differences in methodology, age group, and instruments used. For example, the study by Nakić Radoš et al. (2020) included infants ranging in age from one to 12 months and was done cross-sectionally, while the study by Dekel et al. (2019), even though also with a cross-sectional design, only included infants aged up to 6 months. Difficulties in mother-infant bonding can lead to challenges in the mother-infant relationship and may negatively impact infant development, including aspects such as brain development, emotional well-being, and behaviour (Brockington, 2004; Brockington et al., 2006)

In the long term, CB-PTSS might also have negative consequences on child development (Feeley et al., 2011; Garthus-Niegel et al., 2017; Parfitt et al., 2014). To the best of our knowledge, three studies investigated the associations between maternal CB-PTSS and child development, with mixed results (Feeley et al., 2011; Garthus-Niegel et al., 2017; Parfitt et al., 2014) and with only one study exploring infant development at six months (Feeley et al., 2011). When measured prospectively, CB-PTSS assessed at eight weeks and five months postpartum was associated with poorer negative social development outcomes at 24 months postpartum, especially for boys (Garthus-Niegel et al., 2017), and lower cognitive outcomes at 17 months postpartum (Parfitt et al., 2014), respectively. However, in a cross-sectional analysis, maternal CB-PTSS was not associated with infant development at six months postpartum (Feeley et al., 2011). Differences in the methodology of these studies (i.e., use of various self-report questionnaires, distinct time points of data collection, and different sample sizes) might contribute to these mixed results. In the study by Garthus-Niegel et al. (2017), a maternal self-report questionnaire was used to measure child development at two years, while Feeley et al. (2011) and Parfitt et al. (2014) used Bayley Scales of Infant Development III (i.e., a clinician-administered standardised observational assessment) to measure child development at six months and 17 months, respectively. Moreover, participants in the study by Feeley et al. were very low birthweight infants who had been hospitalised in a neonatal intensive care unit (Feeley et al., 2011). Given the inconsistent results concerning the associations between CB-PTSS and mother-infant bonding and infant development, as well as the recent introduction of the GS and BRS distinction, more research is needed.

This study aimed to investigate the prospective and cross-sectional associations between 1) maternal CB-PTSS and mother-infant bonding and 2) maternal CB-PTSS and infant development. We hypothesised higher maternal CB-PTSS would be associated with poorer mother-infant bonding and a lower score of infant development. Furthermore, we explored the role of covariates on mother-infant bonding and on infant development. For the bonding outcome, the potential covariates we identified by a systematic search of the literature were depression symptoms (Suetsugu et al., 2020; Taylor et al., 2005; Tichelman et al., 2019), anxiety symptoms (Davies et al., 2008; Handelzalts et al., 2021; Stuijfzand et al., 2020), parity (Yoshida et al., 2020), infant temperament (Nolvi et al., 2016; Takács

et al., 2020), and history of trauma (Seng et al., 2013). For infant temperament, based on previous research (Nolvi et al., 2016; Takács et al., 2020), we considered positive temperament and negative temperament as potential covariates for bonding. For infant developmental outcome, the potential covariates we identified from the literature were maternal symptoms of depression (Aoyagi & Tsuchiya, 2019; Garthus-Niegel et al., 2017; Parfitt et al., 2014), maternal symptoms of anxiety (Parfitt et al., 2014), sex of the infants (Garthus-Niegel et al., 2017), and Apgar score at 5 minutes, which is a predictor to measure the infant development in the long term (Moster et al., 2002; Razaz et al., 2019).

Methods

Participants

This study is a secondary analysis of data from the control group of a randomised controlled trial, the Swiss TrAumatic biRth Trial (START) (NCT 03576586) (Sandoz et al., 2019). START aimed to test the efficacy of an early brief behavioural intervention including a visuospatial task to prevent maternal CB-PTSS. Recruitment occurred at two Swiss university hospitals at ≤ six hours postpartum. In our study, two time points were used: six weeks postpartum (T1), and six months postpartum (T2). At the time of study conception, no comparable previous research existed that would have allowed us to compute the sample size based on their effect size. However, we aimed for our sample size to be comparable to other relevant studies (Feeley et al., 2011; Parfitt et al., 2014). The current study included 55 mother-infant dyads from the START control group. To be eligible for the current study, mothers had to be ≥18 years old who had an emergency caesarean section as well as a fluent French speaking level, and had to have given birth to a healthy infant at ≥37 weeks of gestation who was aged approximately six months at the time of assessment.

Figure 1 illustrates the participants' flowchart, while Table 1 shows descriptive data of sociodemographic and medical data of the mothers and infants.

Procedure

Participants completed online maternal-report questionnaires (using the Research Electronic Data Capture (REDCap) software) at T1 measuring maternal CB-PTSS, mother-infant bonding, and covariates (depression and anxiety symptoms, infant temperament, history of trauma). At T2, participants were contacted again through a phone call, a message, or e-mail to fill in the same online questionnaires and to arrange an appointment to assess infant development. Infant development at T2 was assessed at the hospital via a clinician-administered standardised observational assessment. Sociodemographic data were assessed by maternal-report questionnaire and medical data were extracted from hospital records.

Instruments

Maternal CB-PTSS was measured with the PTSD Checklist for DSM-5 (Weathers et al., 2013), a 20-item self-report questionnaire assessing PTSS over the past month. The traumatic event referred to childbirth. Participants responded using a Likert scale from

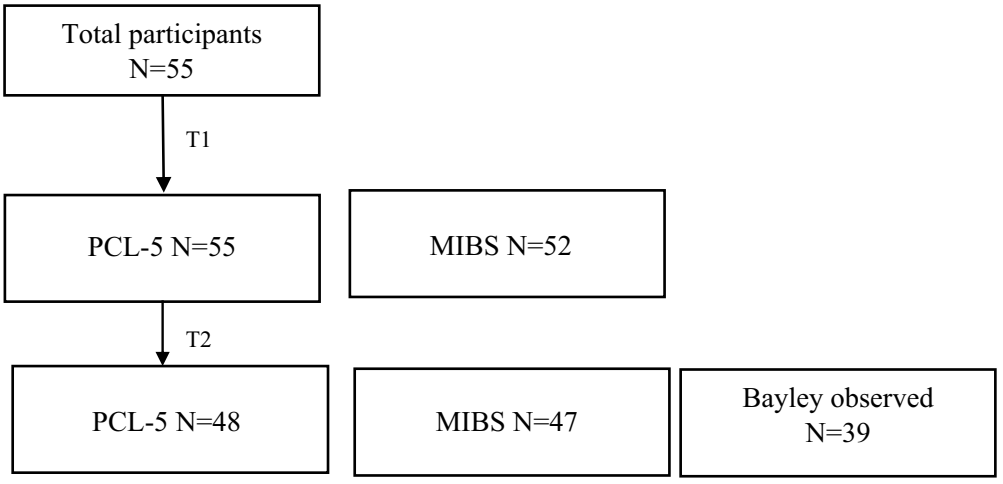

Figure 1. Flowchart of participants who completed the instruments of the main variables (PCL-5, MIBS, and Bayley). PCL-5 = PTSD Checklist for DSM-5. MIBS = Mother-Infant Bonding Scale.

0 (not at all) to 4 (extremely), with a higher score indicating more maternal PTSS (Weathers et al., 2013). PCL-5 BRS consists of items 1 to 8, and 10 to 11, e.g. repeated, disturbing, and unwanted memories of the stressful experience; avoiding memories, thoughts, or feelings related to recent childbirth (Weathers et al., 2013). PCL-5 GS consists of items 9, and 12 to 20, e.g. loss of interest in activities; feeling distant or cut off from other people (Weathers et al., 2013). The French version of the PCL-5 showed strong validity (Ashbaugh et al., 2016). In our study, Cronbach's alpha at six weeks was 0.89 and at six months was 0.90. For the subscale BRS, Cronbach's alpha was 0.90 at six weeks and 0.89 at six months. For the subscale GS, Cronbach's alpha at six weeks was 0.81 and at six months was 0.88; all of the above indicating good internal consistency.

Mother-infant bonding was measured with the Mother-Infant-Bonding Scale (MIBS), a self-report questionnaire consists of 8 items evaluating mothers' feelings towards their infants in the first few weeks after birth (Taylor et al., 2005). The MIBS has been used in infants aged six months in previous research (Takács et al., 2020). Items are rated on a 4-point Likert scale ranging from 0 (very much) to 3 (not at all) for items 1, 4, and 6, and on a reversed scale for the remaining items, with a higher value indicating poorer bonding. Moreover, the French version of the MIBS has been validated and showed an alpha score of 0.71 (Bienfait et al., 2017). In our study, the Cronbach alpha at six weeks was 0.55 and at six months was 0.52, indicating low internal consistency. After removing item 2, which had a low correlation, Cronbach alpha increased to 0.67 at six weeks and to 0.60 at six months. Low internal consistency of MIBS (0.68) was also observed in another study, even though this was a Swedish version of MIBS (Mörelius et al., 2021).

Infant development was assessed with the Bayley Scales of Infant Development, 3rd edition (Bayley III) (Bayley & Reuner, 2006), which encompasses a cognitive, a language, and a motor subscale. Raw scores from each scale were transformed into three standardised scores with a higher score indicating better development in three domains. The scales were administered in French by trained members of the research team based on a standardised protocol (Sandoz et al., 2019). Bayley Scales have been standardised and

Table 1. Descriptive characteristics of the participants ($n = 55$).

Variables	*M* (*SD*) or *n* (%)
Characteristics of mothers	
Maternal age	33.62 (4.6)
Nationality	
Swiss	26 (47.3)
European	19 (34.6)
Non-european	3 (5.4)
Missing values	7 (12.7)
Civil status	
Single	14 (25.5)
Married/cohabitating	33 (60)
Separated/divorced	1 (1.8)
Missing values	7 (12.7)
Education	
Primary education	1 (1.8)
Secondary education	1 (1.8)
Higher secondary education	2 (3.7)
Apprenticeship	16 (29.1)
University or university of applied sciences	27 (49.1)
Other	1 (1.8)
Missing values	7 (12.7)
Professional activity	
Working	32 (58.2)
Not working	15 (27.3)
Missing values	8 (14.5)
Parity	
Primipara	32 (58.2)
Multipara	23 (41.8)
History of traumatic birth	
Yes	19 (34.5)
No	17 (30.9)
Missing values	19 (34.5)
Characteristics of infants	
Sex of the infant	
Girls	27 (49.1)
Boys	28 (50.9)
Weeks of gestation	39.6 (1.3)
Birth weight (gram)	3273.2 (479.2)
Apgar at 5 minutes	9.33 (0.9)

extensively reviewed for its psychometric quality and tested for reliability ($r = 0.86–0.93$) and validity using large samples of children with and without developmental delay (Bayley & Reuner, 2006).

Regarding maternal psychological vulnerabilities, maternal depression and anxiety symptoms were used as covariates for both outcomes. Maternal depression symptoms were measured with the Edinburgh Postnatal Depression Scale (EPDS), a self-report questionnaire evaluating the severity of postnatal depression symptoms over the past week (Cox et al., 1987). The 10 items are scored on a 4-point Likert scale from 0 to 3, with a higher total score indicating higher severity. The French version of the EPDS has been validated (Guedeney & Fermanian, 1998). The Cronbach alpha in our study when measuring at six weeks was 0.80 and at six months was 0.86, which demonstrated good internal consistency.

Anxiety symptoms were measured with the anxiety subscale of the Hospital Anxiety and Depression Scale (HADS-A). This self-report questionnaire consists of 7 items evaluating the severity of postnatal depression symptoms over the past week (Zigmond & Snaith,

1983). Items are scored on a 4-point Likert scale from 0 to 3, with a higher total score indicating higher severity. The French version of the HADS, including the HADS-A, has been previously validated (Bocéréan & Dupret, 2014). The Cronbach alpha in our study when measured at six weeks was 0.62 and at six months was 0.81, which is acceptable.

Infant temperament, as a covariate for the mother-infant bonding outcome, was measured with a maternal self-report instrument named the Infant Behavior Questionnaire – Revised Very Short Form (IBQ-R) consists of 37 items assessing the frequency of certain infant behaviours during the previous two weeks (Putnam et al., 2014). Good psychometric properties were reported for this questionnaire (Putnam et al., 2014). IBQ-R has three factors: Negative Emotionality (NEG), Positive Affectivity/Surgency (PAS), and Orienting/Regulatory Capacity (ORC). Based on previous studies, we only considered positive temperament and negative temperament as potential covariates for bonding (Nolvi et al., 2016; Takács et al., 2020). Items are scored on a 7-point Likert scale from 1 (never) to 7 (always), with a higher score indicating higher negative behaviour (in NEG factor) or higher positive behaviour (in PAS factor). There was no validated French version of the IBQ-R available. The forward-backward method was applied for cultural adaptation and French translation as part of START study. The Cronbach alpha in our study for positive temperament was 0.75 and for negative temperament was 0.75.

Medical covariates, i.e., Apgar score (rapid standardised assessment of neonates after birth to determine the need for immediate resuscitation intervention (Apgar, 1953)) at 5 minutes, parity status, and sex of the infant were extracted from medical records. History of trauma (yes/no), civil status, (single, married/cohabiting, separated/divorced/widowed/other), and education level (primary education, secondary education, upper secondary education, apprenticeship, university or school of applied sciences, other) were measured via a self-report sociodemographic questionnaire.

Statistical analyses

The statistical analyses were conducted with the software R, version 4.1.3 (R Core Team, 2021). Missing data for sociodemographic data is indicated in Table 1. Aside from those variables, for 55 participants, missing data included $n = 3$ MIBS at T1, $n = 8$ MIBS at T2, $n = 15$ Bayley, $n = 3$ HADS-A at T1, $n = 8$ HADS-A at T2, $n = 3$ EPDS at T1, and $n = 8$ EPDS at T2, $n = 5$ IBQ-R. For the purpose of analysis of the main outcomes, the missing data of main variables (the predictor and outcomes) was removed from the analysis since the missing values were not missing at random, preventing them from being imputed (Kang, 2013).

To test (cross-sectional and prospective) associations between maternal CB-PTSS and mother-infant bonding, we carried out statistical analyses without covariates (unadjusted model) and with covariates (adjusted model), as presented in Tables 2 and 3. For the adjusted model, potential covariates for mother-infant bonding were infant temperament (negative and positive emotionality), depression symptoms, anxiety symptoms, history of trauma, and parity. Only covariates significantly associated with the outcomes were introduced in the adjusted models (see Table 1 in supplementary material).

To test (cross-sectional and prospective) associations between maternal CB-PTSS and infant development outcomes (cognitive, motor, and language), we conducted bivariate linear regressions for the unadjusted models and adjusted models to test the significance of potential covariates (depression, anxiety, sex of the infants, and

Table 2. Linear regression PCL-5 and MIBS (unadjusted model).

Predictor	Dependent variable	N	B	95% CI	P
PCL-5 total at T1	MIBS at T1	50	0.152	[0.079, 0.224]	0.000***
PCL-5 GS at T1	MIBS at T1	50	0.268	[0.155, 0.381]	0.000***
PCL-5 BRS at T1	MIBS at T1	50	0.150	[0.009, 0.292]	0.037*
PCL-5 total at T1	MIBS at T2	45	0.064	[0.002, 0.127]	0.043*
PCL-5 GS at T1	MIBS at T2	45	0.101	[−0.004, 0.206]	0.059
PCL-5 BRS at T1	MIBS at T2	45	0.081	[−0.026, 0.188]	0.136
PCL-5 total at T2	MIBS at T2	46	0.033	[−0.014, 0.081]	0.166
PCL-5 GS at T2	MIBS at T2	46	0.021	[−0.054, 0.096]	0.574
PCL-5 BRS at T2	MIBS at T2	46	0.114	[0.014, 0.215]	0.025*

Note. BRS = birth-related symptoms. GS = general symptoms. MIBS = Mother-Infant Bonding Scale. PCL-5 = PTSD Checklist for DSM-5.
* $p < .05$.** $p < .01$.*** $p < .001$.

Table 3. Linear regression PCL-5 and MIBS (adjusting for EPDS and HADS-A).

Predictor	Dependent variable	N	B	95% CI	P
PCL-5 total at T1	MIBS at T1	50	0.134	[0.025, 0.243]	0.017*
PCL-5 GS at T1	MIBS at T1	50	0.306	[0.117, 0.496]	0.002**
PCL-5 BRS at T1	MIBS at T1	50	0.073	[−0.081, 0.228]	0.347

Note. BRS = birth-related symptoms. EPDS = Edinburgh Postnatal Depression Scale. GS = general symptoms. HADS-A = anxiety subscale of the Hospital Anxiety and Depression Scale. MIBS = Mother-Infant Bonding Scale. PCL-5 = PTSD Checklist for DSM-5.
* $p < .05$.** $p < .01$.*** $p < .001$.

Apgar score at 5 minutes) associated with cognitive, motor, and language development. Significant covariates were used in the adjusted model for multivariate regression analysis. In all analyses, p-values of < 0.05 were considered statistically significant.

For mother-infant bonding outcomes, in the cross-sectional analysis at T1, from 52 participants, two outliers were identified through Mahalanobis distance ($p < .001$) and deleted (Tabachnick & Fidell, 2001). In the prospective analysis (PCL-5 at T1 and MIBS at T2), for 47 participants, two outliers were identified and deleted. In the cross-sectional analysis at T2, for 47 participants, one outlier was identified and deleted. For infant development outcomes, no outliers were identified.

Results

Associations of maternal CB-PTSS and mother-infant bonding

The analysis of mother-infant bonding outcomes is described in Tables 2 and 3. In the unadjusted model at T1, significant cross-sectional positive associations were found: (1) between higher PCL-5 total score and higher MIBS total score ($p = 0.000$, B = 0.152, 95% CI 0.079–0.224, Cohen's f2 = 0.121); (2) between PCL-5 GS score and MIBS total score ($p = 0.000$ B = 0.268, 95% CI 0.155–0.381, Cohen's f2 = 0.475; and (3) between PCL-5 BRS score and MIBS total score ($p = 0.037$ B = 0.150, 95% CI 0.009–0.292, Cohen's f2 = 0.095). In the adjusted model (controlling for EPDS and HADS-A at T1), significant cross-sectional positive associations were found: (1) between PCL-5 total score and MIBS total score ($p = 0.017$, B = 0.134, 95% CI 0.025–0.243, Cohen's partial f2 = 0.133) and (2) between PCL-

5 GS score and MIBS total score ($p = 0.002$, B = 0.306, 95% CI 0.117–0.496, Cohen's partial f2 = 0.230).

In the cross-sectional analysis at T2, we found a significant positive association between PCL-5 BRS score and MIBS total score ($p = 0.025$, B = 0.114, 95% CI 0.014–0.215, Cohen's f2 = 0.121). No significant covariates were identified, thus we did not have an adjusted model for cross-sectional analysis between PCL-5 and MIBS at T2.

In the prospective analysis, in the unadjusted model, only a prospective significant positive association was found between PCL-5 total score and MIBS total score ($p = 0.043$, B = 0.064, 95% CI 0.002–0.127, Cohen's f2 = 0.371). No significant covariates were identified, thus we did not have an adjusted model for prospective analysis between PCL-5 and MIBS.

Associations of maternal CB-PTSS and infant development outcomes

In the prospective analysis shown in Table 4, for the unadjusted model, we found that higher BRS at T1 were associated with a higher infant cognitive subscale score of Bayley III at T2 ($p = 0.026$, B = 0.748, 95% CI 0.092–1.404). Cohen's f2 was 0.144, indicating a small-to-medium effect size (Cohen, 1988). For the adjusted model as shown in Table 5, we identified EPDS at T1 as a significant covariate for motor development but did not find any significant associations in this adjusted model.

For the cross-sectional associations between PCL-5 (total, GS, BRS scores) and infant development (cognitive, language, and motor) at T2, we did not find any significant associations. A significant covariate identified was EPDS at T2 but no significant results were found in this adjusted model.

Table 4. Linear regression PCL-5 and Bayley scale (cognitive, language, motor development) (unadjusted model).

Predictor	Dependent variable	n	B	95% CI	P
PCL-5 total at T1	Cognitive subscale of Bayley III	39	0.251	[−0.096, 0.599]	0.152
PCL-5 GS at T1	Cognitive subscale of Bayley III	39	0.163	[−0.440, 0.766]	0.587
PCL-5 BRS at T1	Cognitive subscale of Bayley III	39	0.748	[0.092, 1.404]	0.026*
PCL-5 total at T1	Motor subscale of Bayley III	39	0.166	[−0.214, 0.547]	0.381
PCL-5 GS at T1	Motor subscale of Bayley III	39	0.235	[−0.412, 0.882]	0.467
PCL-5 BRS at T1	Motor subscale of Bayley III	39	0.326	[−0.421, 1.074]	0.382
PCL-5 total at T1	Language subscale of Bayley III	39	−0.158	[−0.558, 0.240]	0.425
PCL-5 GS at T1	Language subscale of Bayley III	39	−0.137	[−0.817, 0.543]	0.686
PCL-5 BRS at T1	Language subscale of Bayley III	39	−0.427	[−1.204, 0.349]	0.272
PCL-5 total at T2	Cognitive subscale of Bayley III	39	0.147	[−0.178, 0.474]	0.365
PCL-5 GS at T2	Cognitive subscale of Bayley III	39	0.173	[−0.335, 0.683]	0.494
PCL-5 BRS at T2	Cognitive subscale of Bayley III	39	0.370	[−0.349, 1.089]	0.304
PCL-5 total at T2	Motor subscale of Bayley III	39	0.139	[−0.213, 0.491]	0.428
PCL-5 GS at T2	Motor subscale of Bayley III	39	0.141	[−0.408, 0.691]	0.604
PCL-5 BRS at T2	Motor subscale of Bayley III	39	0.393	[−0.381, 1.168]	0.310
PCL-5 total at T2	Language subscale of Bayley III	39	−0.166	[−0.534, 0.200]	0.364
PCL-5 GS at T2	Language subscale of Bayley III	39	−0.166	[−0.741, 0.407]	0.560
PCL-5 BRS at T2	Language subscale of Bayley III	39	−0.477	[−1.283, 0.328]	0.238

Note. BRS = birth-related symptoms. GS = general symptoms. PCL-5 = PTSD Checklist for DSM-5.
* $p < .05$.** $p < .01$.*** $p < .001$.

Table 5. Linear regression PCL-5 and motor subscale of Bayley III (adjusted for EPDS).

Predictor	Dependent variable	n	B	95% CI	P
PCL-5 total at T1[a]	Motor subscale of Bayley III	39	−0.241	[−0.771, 0.288]	0.361
PCL-5 GS at T1[a]	Motor subscale of Bayley III	39	−0.587	[−0.524, 0.349]	0.211
PCL-5 BRS at T1[a]	Motor subscale of Bayley III	39	−0.150	[−1.017, 0.716]	0.726
PCL-5 total at T2[b]	Motor subscale of Bayley III	39	−0.279	[−0.781, 0.222]	0.266
PCL-5 GS at T2b	Motor subscale of Bayley III	39	−0.534	[−1.278, 0.209]	0.153
PCL-5 BRS at T2[b]	Motor subscale of Bayley III	39	−0.145	[−1.102, 0.811]	0.073

BRS = birth-related symptoms. EPDS = Edinburgh Postnatal Depression Scale. GS = general symptoms. PCL-5 = PTSD Checklist for DSM-5. [a]Adjusting for EPDS at T1. [b]Adjusting for EPDS at T2.
* $p < .05$.** $p < .01$.*** $p < .001$.

Discussion

This longitudinal study specifically focused on a mode of birth associated with a higher risk of CB-PTSS: emergency C-sections (Yildiz et al., 2017). We found that higher maternal CB-PTSS (total score, BRS, GS) were cross-sectionally associated with lower mother-infant bonding at six weeks postpartum in the unadjusted model. After adjusting for depression and anxiety symptoms, cross-sectional associations between maternal CB-PTSS (GS and total score) and mother-infant bonding were still significant. At six months postpartum, significant associations emerged between BRS and mother-infant bonding in the unadjusted model. Prospectively, we found associations between a total score of CB-PTSS and mother-infant bonding in the unadjusted model. For infant development outcomes, we detected a prospective association between higher BRS and better cognitive infant development in the unadjusted model. However, the latter is likely due to a type-II error.

Our results showed mothers with more symptoms of maternal CB-PTSS had more difficulties in mother-infant bonding. Our cross-sectional results at six weeks postpartum aligned with several previous studies (Handelzalts et al., 2021, 2019; Nakić; Radoš et al., 2020; Stuijfzand et al., 2020). The prospective association found between maternal CB-PTSS and lower mother-infant bonding and the cross-sectional association between BRS and mother-infant bonding at six months postpartum are consistent with a previous study (Dekel et al., 2019).

Our unexpected finding showing infants of mothers with higher symptoms of BRS had better cognitive development is not consistent with previous studies that found either no association (Feeley et al., 2011) or a negative association (Garthus-Niegel et al., 2017; Parfitt et al., 2014). Noteworthy, these three studies did not test prospective associations between maternal CB-PTSS and infant development in infants younger than one-year-old and they did not differentiate between GS and BRS (Feeley et al., 2011; Garthus-Niegel et al., 2017; Parfitt et al., 2014). These methodological differences may partly explain the discrepancy of our findings with previous studies.

Alternatively, this unexpected result might reflect a type-II error. If this is the case, there may be no real significant relationship between these two variables, which is consistent with the study by Feeley, which also measured infant development at six months postpartum, although they tested the association cross-sectionally (Feeley et al., 2011). An alternative explanation may be that following traumatic childbirth, mothers have been reported to feel guilty (Ayers et al., 2019; Beck, 1996). They may feel also guilty towards their infants because they perceive themselves as not being good enough as mothers (Blegen et al., 2010; Venard

et al., 2023) and may overcompensate and invest in their infants more, resulting in better infant cognitive development (Cook et al., 2018; Garthus-Niegel et al., 2020). However, this alternative explanation is contradicted by the fact that guilt is a negative emotion, which is included in GS and not BRS. In addition, we did not look into the role of fathers or other co-parents. This might cause bias, as father/co-parent – child interactions or any regular paternal involvement may affect the development of the children (Hall et al., 2014; Wang et al., 2005), especially the cognitive and psychological infant outcomes (Hall et al., 2014).

Our study is the first longitudinal study to identify the associations between CB-PTSS and infant development in infants under one-year-old whose mothers underwent emergency C-sections. We assessed infant development using validated and standardised clinical assessments. Moreover, we controlled for maternal and infant covariates in the analysis. However, some limitations must be pointed out. Our findings cannot be generalised to other modes of childbirth than emergency C-sections with term babies. Aside from that, the generalisability of our findings may be limited because a sizeable proportion of our participants were single mothers. According to one study, unmarried women had higher bonding with their infants compared to married women (Kinsey et al., 2014). The self-report questionnaire used to measure maternal CB-PTSS may not be as robust as an objective, clinical assessment to examine CB-PTSD. Nonetheless, PCL-5 is an appropriate instrument, as it is valid, reliable, and widely used in both research and clinical practice. In addition, the Cronbach alpha for MIBS in our participants was borderline and results should therefore be interpreted with caution. Replication of our results with a larger sample size, taking into consideration the involvement of the father or other co-parents is recommended. Furthermore, exploring mother-infant bonding and infant developmental trajectories over a longer period is a helpful recommendation for future studies. This extended investigation would provide a more comprehensive understanding of the dynamic processes involved. Moreover, objective measures of CB-PTSS and mother-infant interactions could be added in future studies.

Conclusion

Maternal CB-PTSS after emergency C-sections were associated with negative mother-infant bonding outcomes to some extent. Maternal CB-PTSS were not significantly associated with infant development. Further research is needed to replicate this study with a bigger sample size, controlling for father/co-parent involvement.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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