



Childbirth related PTSD and its association with infant outcome: A systematic review[☆]

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ABSTRACT

Introduction: Maternal postnatal mental health problems may negatively impact child development. Postpartum research has mainly focused on the impact of maternal depression and anxiety due to their high prevalence (13–25 % and 10–18 %, respectively). However, maternal childbirth-related PTSD (CB-PTSD) could be another important risk factor in child development (estimated prevalence: 4.7 %).

Objective: We investigated whether maternal CB-PTSD (symptoms) are associated with a negative mother-child relationship and/or child developmental outcome for children aged 0–5 years. Furthermore, we examined whether maternal trauma-focused therapy can positively impact mother and child outcomes.

Methods: We performed a systematic review by searching three databases (Embase, Medline, PsycInfo). Search terms involved: 'birth or delivery modes', 'PTSD psychological trauma', and 'child development or child behavior'. Two independent reviewers evaluated all eligible papers.

Results: Thirty-five papers (30 samples) were included and qualitatively reported. Results suggest a negative association of maternal CB-PTSD (symptoms) with mother-infant attachment and child behavior. However, confounding factors may explain this association. The evidence on associations with breastfeeding, sleeping, socio-emotional development, and weight gain is insufficient. Research investigating the effect of maternal trauma-focused therapy on a child's outcome is scarce, contradictory, and of low quality.

Conclusion: This systematic review suggests that maternal CB-PTSD may be associated with an increased number of problems in mother-infant attachment and child behavior, but other domains remain scarcely investigated and methodologic issues are present (cross-sectional study design, influence of confounding variables, sample representativeness, diversity in assessment tools). Our results support a multidisciplinary approach to providing early prevention and screening of the maternal mental health state.

1. Introduction

A mother's perinatal mental health status may impact her young child's mental and physical development [1–4]. The quality of the mother-child relationship—starting even before birth—may play a key role in child development as it is essential for developing secure relationships throughout life and the child's mental health [5–7]. Maternal postpartum stress has also been associated with other infant

developmental domains such as difficulties with breastfeeding [4], deficits in growth, and neurodevelopment [8].

Previous research on maternal perinatal mental health problems and their potential effects on early child development has mainly focused on postpartum depression and anxiety disorders because of their high estimated prevalence (13–25 % and 10–18 %, respectively) [2]. After delivery, however, mothers may also be more vulnerable to other mental disorders like posttraumatic stress disorder (PTSD). PTSD is a disorder

Abbreviations: CB-PTSD, childbirth-related posttraumatic stress disorder; CB-PTSD(s), childbirth-related posttraumatic stress disorder and/or symptoms.

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that can develop after being exposed to or witnessing an actual or imminent death, severe injury, or sexual violence against oneself or others [9]. It is characterized by symptoms of avoidance, hypervigilance, intrusions, and negative mood and cognitions. Maternal childbirth-related PTSD and/or PTSD symptoms (CB-PTSD(s)) can be defined as the occurrence of PTSD symptoms in mothers who experienced themselves and/or their child as being in actual or threatening danger of death or severe injury during childbirth. The mean prevalence of maternal CB-PTSD is estimated to be 4.7 % [10]. Earlier research supports that PTSD(s) may occur in women after a traumatic birth experience [11–13].

Trauma-focused psychological therapies may be effective in reducing maternal CB-PTSD(s) [14–16]. Hypothetically, the impact of maternal CB-PTSD(s) on a developing child could diminish with an improved maternal mental health status. Early intervention after a traumatic childbirth experience may therefore benefit the prognosis of both mother and child. However, research concerning postnatal treatment of women with mental health problems and its possible effect on the mother-child relationship and/or child development is scarce and has mainly focused on postnatal depression. In a recent review based on two randomized controlled trials (RCTs), the outcome of children (mother-child relationship, attachment security, child behavior, and temperament) did not significantly improve when depressed mothers received postnatal treatment compared to routine primary care or a waiting list group [2]. The authors concluded that only the combined treatment of maternal postnatal depression and the mother-infant relationship seemed promising in improving mother and child outcomes.

In summary, childbirth is a unique but potentially stressful period, constituting a possible risk factor for the development of maternal CB-PTSD(s). Studies concerning other maternal perinatal mental health disorders, e.g. depression, showed a negative association with the development of the young child. Treatment of maternal disorders and/or improving the early mother-infant relationship may therefore improve the prognosis for both mother and child. In this study, we aimed to systematically review the existing research on the association of untreated and treated maternal CB-PTSD(s) with the mother-child relationship and early child development.

2. Material and methods

This systematic review is aimed at gathering evidence about the possible association of untreated versus treated maternal CB-PTSD(s) with early child development. The following research questions are considered:

- 1) Are maternal CB-PTSD(s) associated with the mother-child relationship and/or early child development?
- 2) If so, in what developmental domains is this association apparent?
- 3) Does treatment of maternal CB-PTSD(s) also affect the mother-child relationship and/or child developmental domains?

The study protocol has previously been published on Prospero (PROSPERO 2021 CRD42021183737). An experienced biomedical information specialist (WMB) developed a search in three databases: Embase.com, MEDLINE ALL via Ovid, and PsycInfo via Ovid. Search terms were grouped into three categories: 'birth or delivery modes', 'PTSD psychological trauma', and 'child development or child behavior' (see Appendix A for the complete search strategy). Databases were searched from inception until January 13th, 2022 (last search date), and the results were restricted to English publications only.

The inclusion criteria for the first two research questions were as follows. A sample of mothers or maternal data should be separately available if a broader sample was used (i.e. a combined sample of mothers and fathers). Data collection after childbirth, maternal PTSD(s) solely related to childbirth, or data on maternal PTSD(s) related to childbirth should be separately available when more stressors are

investigated. PTSD(s) are assessed using standardized instruments or clinical interviews conducted by a professional based on the DSM or ICD PTSD criteria [9,17]. Furthermore, included articles had to describe samples of children aged 0 to 5 years and use standardized instruments for child outcomes (physical, psychological, and mother-child relationship). Additionally, papers had to explore the association between maternal CB-PTSD(s) and child outcomes. Finally, all review articles were excluded, and no restrictions were imposed on the publication date.

Concerning the third research question, the following inclusion criteria were added to the above-mentioned search: mothers with CB-PTSD(s) were given trauma-focused therapy, and the outcome of the child was measured in relation to this applied therapy.

Articles were screened for suitability by applying the above-mentioned inclusion criteria by two independent authors (SVS and EdJ). Discrepancies between the reviewers were resolved by counseling a third reviewer (MLvdB).

2.1. Procedure

All eligible publications were evaluated using a data extraction form, developed for this review, which allowed for the collection of general article information, study eligibility, study and sample characteristics, methods and results of main/other outcomes, and risk of bias (quality) assessment. The JBI appraisal checklist for Studies Reporting Prevalence Data was used for the risk of bias (quality) assessment [18]. This checklist consists of 9 questions answered on a 4-point scale (0: no, 1: yes, 2: unclear, 3: not applicable) and an overall appraisal. In our review, we used poor, moderate, and good quality as overall appraisal outcome measures. The quality assessment was conducted by two independent authors for each eligible article. Discrepancies were handled in the same manner as throughout the selection process, involving a third reviewer (MLvdB) when necessary.

3. Results

The initial search identified 2260 references, from which 725 duplicates were removed. The titles and abstracts of the remaining 1535 articles were screened for suitability by applying the above mentioned inclusion criteria. After the removal of duplicates and solving discrepancies, a total of 81 articles underwent full-text review. Thirty-five articles met all inclusion criteria and were included in our systematic review (33 papers regarding the first two research questions and 2 papers regarding the third research question), as shown in Fig. 1.

3.1. General study characteristics

Thirty-five papers were included in this review, describing 30 individual study populations, published between 2003 and 2021. The results relevant to the first two research questions were classified into five categories according to the following child-related classes: mother-child relationship, child behavior/temperament, breastfeeding, eating/sleeping pattern, and other developmental domains. Several papers had outcome parameters relevant to more than one category and will be discussed accordingly. The majority of publications scored moderate quality (26/35) and only two papers were rated good quality. Table 1 provides an overview of the included articles.

The studies mainly originated from Europe (24/35). Other publications originated from Asia ($n = 6$) and Northern America ($n = 5$). The majority of papers ($n = 20/35$) used cross-sectional data, and fifteen studies used a longitudinal or prospective study design. Mothers were most often recruited from a hospital setting ($n = 14$, inpatient women and mothers of hospitalized newborns), where they were personally contacted during their stay at the maternity ward or NICU. Additionally, there were eight outpatient, seven community, and six combined samples. Outpatient women were recruited at antenatal courses or clinical

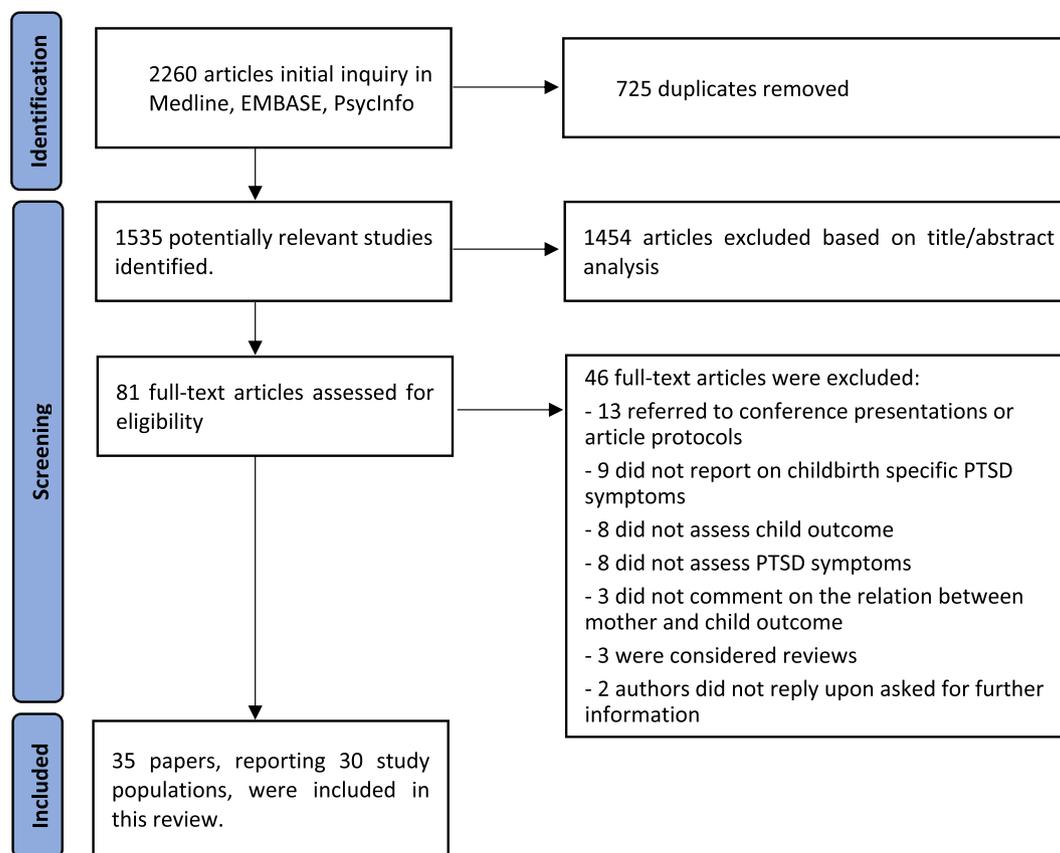


Fig. 1. Flow diagram of the study selection process.

check-ups during and after pregnancy, whereas community samples were addressed using online social media and announcements on childbirth-specific websites. Moreover, twelve studies used high-risk samples, i.e. mothers that explicitly had risk factors for developing CB-PTSD(s). The risks include women with higher stress levels (i.e. previous diagnosis of depression and/or PTSD(s) [19–23] or exposure to the COVID pandemic [24]), NICU samples (i.e. preterm births [25–29], low birth weight [30], and general NICU stay characteristics [31]), and operative birth [32].

Furthermore, three samples were discussed in more than one paper: data from the Akershus Birth Cohort (a prospective cohort study at Akershus University Hospital in Norway [33–35]), data from the original research study from Di Blasio et al. (2015) [36–38], and data from a longitudinal prospective birth cohort at the University of Lausanne Hospital recruited in 1998 [25,26,28].

A total of 11,551 women participated in the included studies. Maternal age was available for 20/25 papers (7176/11,551 women), with a mean of 25.9–39.6 years old (range 18–52 years old). Maternal CB-PTSD prevalence is estimated to be between 1.4 and 11.8 %, based on three studies using validated instruments with diagnostic potential [20,30,39]. The other papers reported a variety of instruments measuring the severity of maternal CB-PTSD(s), and eight papers did not report prevalence data. Using the clinical cut-offs for probable maternal CB-PTSD, the prevalence data ranged from 1.2 % to 59.8 %.

A total of 11,554 children were included. The difference between the number of mothers and children can be explained by a combination of drop-outs between the measuring points for mother and child assessment and the inclusion of multiple births [20,30,31,40,41]. The children's age—defined as the measuring point for child outcome—ranged from the day of birth to two years postpartum.

3.2. Mother-child relationship

Twenty-five out of thirty-five papers (9475/11,554 children and their mothers) investigated the association between maternal CB-PTSD (s) and the relationship between mother and child. The mother-child relationship covers various constructs, and different measurement tools are used to examine these aspects. In this paper, we differentiated between the mother-infant bond (*mothers emotions and feelings towards her child* [55]), mother-child attachment (*the reciprocal interaction between mother and child in which maternal, infant and dyadic behavior are important* [55]) via observational and non-observational tools and mother's object relation towards the child (*a mother's internal representation of the child's thoughts, feelings and intentions* [43,52]). For each subsection, general study characteristics and conclusions will be addressed first, followed by a more detailed presentation of the included research.

3.2.1. Mother-infant bonding

Fifteen papers, describing a total population of 7565 mothers and their children, assessed the association between CB-PTSD(s) and mother-infant bonding (Table 2). Only one study was rated as good quality [23], nine were moderate quality, and four were poor quality. Thirteen out of fifteen papers (7413/7565 patients) found a small to medium-sized significant association between CB-PTSD(s) and mother-infant bonding in zero-order analysis. Two studies found no such association (152/7565 women) [37,42]. Seven papers controlled their results for confounding variables. Only in one study, describing a large prospective cohort of 3006 women, did a significant association between CB-PTSD(s) and mother-infant bonding remain after controlling for maternal age, education, race, marital status, pregnancy intendedness, trouble paying for basic needs, maternal depression, maternal stress, and social support [51]. In the other six studies (with a combined

Table 1
Overview of included research and general study characteristics.

First author (date), country	Sample source Study design	Mother		PTSD instrument and prevalence	Child	
		N	Mean age (SD)		N	Mean age (SD)
Ayers S. (2007), United Kingdom [42]	Inpatient (<i>maternity ward</i>) Cross-sectional	64	32,4y (SD = 5,87y)	IES N = 3 (5 %)	64	9,41w (SD = 206)
Bahari S. (2021), Iran [22]	Inpatient (<i>postpartum ward</i>) Randomized controlled trial	165	Intervention group 26,78y (SD = 6,917); control group 28,39y (SD = 6,66y)	PCL-5 Intervention group: N = 3 (3,6 %), control group: N = 6 (7,2 %)	165	T1: 1–3 d, T2: 2 Mo
Camisasca E. (2017), Italy [38]	Inpatient (<i>obstetric department</i>) Cohort study	41	32,33 (SD = 3,70y)	PPQ N = 9 at 87 h and 3Mo (22 %); N = 11 at 17Mo, (23,8 %)	41	16,93 Mo (SD = 2,15)
Chiorino V. (2019), Italy [19]	Inpatient (<i>maternity ward</i>) Randomized controlled trial	37	EMDR: 36,47y (SD = 3,89y); Treatment as usual: 32,11y (SD = 6,25)	IES-R N = 15 at 6w (40 %) and n = 8 at 12 w (22 %)	37	T0: birth, T1: 6wk, T2 12wk
Davies J. (2008), United Kingdom [43]	Inpatient (<i>maternity ward</i>) Cross-sectional	211	Fully symptomatic: 26,13y (SD = 6,47y); partially: 30,40y (SD = 6,16y); no: 30,21y (SD = 5,64y)	PTSDQ, IES N = 8 meet criteria for PTSD, (3,8 %), N = 45 partially symptomatic (21,3 %)	211	6w
Dekel S. (2019), United States of America [44]	Community Cross-sectional	685	31y (SD = 4,8y)	PCL-5 N = 79 (12 %)	685	< 6Mo
Di Blasio P. (2018), Italy [45]	Community and outpatient Longitudinal cohort study	95	32,62y (SD = 3,79y)	LASC 3,1 %	95	3Mo
Di Blasio P. (2017), Italy [37]	Inpatient (<i>obstetric department</i>) Longitudinal cohort study	88	30,51y (SD 4,54y)	PPQ N = 24 at 87 h (27 %), N = 20 at 3 Mo (22 %), N = 16 at 18 Mo (18 %)	88	18Mo
Di Blasio P. (2005), Italy [46]	Outpatient Cross-sectional	36	34,47y	PPQ 22,2 %	36	18Mo
Ertan D. (2021), France [23]	Community Cross-sectional	916	Unknown	BiTS, PCL-5 n.a.	916	1–12Mo
Feeley N. (2017), Canada [30]	Inpatient (<i>postpartum unit and NICU</i>) Longitudinal cohort study	298	Significant differences per group ranging from 30,14y (SD = 5,18y) to 34,37y (SD = 5,13y)	PPQ: N = 33 at 5w (11,1 %), N = 24 at 8w (8,6 %), N = 16 at 26w (6,2 %) NWS: N = 4 at 8w (1,4 %), N = 6 at 26w (2,3 %)	257	26w
Forcada-Guex M. (2011), Switzerland [25]	Inpatient (<i>NICU and maternity ward</i>) Cross-sectional	47	unknown	PPQ N = 16 (34 %)	47	6Mo
Garthus-Niegel S. (2017), Norway [33]	Outpatient Longitudinal cohort study	1472	31,7y (SD = 4,5y)	IES 6,6 % clinically significant, 1,9 % probable PTSD	1472	2y
Garthus-Niegel S. (2018a), Norway [34]	Outpatient Longitudinal cohort study	1480	31,7y (SD = 4,5y)	IES N = 30 (2 %)	1480	2y
Garthus-Niegel S. (2018b), Italy [35]	Outpatient Longitudinal cohort study	1480	31,7y (SD = 4,5y)	IES 2 % at 8w, 1,2 % at 2y	1480	2y
Handelzalts J. (2019), Israel [47]	Community Cross-sectional	504	30,9y (SD = 3,5y)	BiTS n.a.	504	0–13Mo
Handelzalts J. (2021), Israel [48]	Inpatient (<i>maternity ward</i>) Longitudinal cohort study	210	32,14y (SD = 4,66y)	BiTS n.a.	210	T1: 1–4d, T2: 2Mo, T3: 6Mo
Hairston I. (2018), Israel [49]	Community and inpatient Cross-sectional	114	31,73y	mPPQ 6,2 %	114	7w
Ionio C. (2014), Italy [50]	Outpatient Cross-sectional	19	32,22y (SD = 4,32y)	PPQ 10,5 % at 2d, 21,1 % at 2Mo	19	2Mo
Kjerulf K. (2021), United States of America [51]	Inpatient, outpatient, community Longitudinal cohort study	3006	18–24 (n = 811, 27 %), 25–29 (n = 1193, 39,7 %), 30–35 (n = 1002, 33,3 %)	TSQ N = 225 (7,5 %)	3006	1Mo, 6Mo, 12Mo
Mayopoulos G. (2021), United States of America [24]	Community Cross-sectional	1274	32y	PCL-5 n.a.	1274	2Mo
McDonald S. (2011), United Kingdom [52]	Inpatient (<i>maternity ward</i>) Cohort study	81	31,63y (SD = 4,78y)	IES, PTSDQ 17,3 %	81	6w, 3Mo, 3y
Muller-Nix C. (2004), Switzerland [26]	Inpatient (<i>NICU and maternity ward</i>)	47		PPQ Control group: 4 %, low-risk	47	T1: 6Mo, T2: 18Mo

(continued on next page)

Table 1 (continued)

First author (date), country	Sample source Study design	Mother		PTSD instrument and prevalence	Child	
		N	Mean age (SD)		N	Mean age (SD)
	Longitudinal cohort study		Full term infant mothers (n = 25): 32y; low-risk preterm infant mothers (n = 19) 31y; high-risk preterm infant mothers (n = 28) 32y.	dyads: 21 %, high-risk dyads: 39 %		
Parfitt Y. (2014), United Kingdom [32]	Outpatient and inpatient Longitudinal cohort study	75	33.04y (SD = 5.19y)	PDS n.a.	75	11,7w, 14,56Mo
Parfitt Y. (2013), United Kingdom [40]	Outpatient and inpatient Cohort study	44	33.12 years (SD = 4.79y)	PDS n.a.	45	3Mo
Parfitt Y. (2009), United Kingdom [20]	Community Cross-sectional	126	30,92 years (SD = 4.8y)	PDS 5.5 %	150	10,76Mo
Petit A-C. (2016), France [27]	Inpatient (NICU) Longitudinal cohort study	62	30.4 years (SD = 5.5y)	mPPQ 40,2 % at 6Mo, 34 % at 12Mo	62	10,22Mo corrected age
Pierrehumbert B. (2003), Switzerland [28]	Inpatient (NICU) Case-control study	75	preterm high risk infant: (n = 27), 31.3 (SD = 5y); low risk infants: (n = 23) 30.9y (SD = 4.3y); control group (n = 25) 32.0y (SD = 4.3y)	PPQ Control group: 4 %, low-risk dyads: 26 %, high-risk dyads: 41 %	75	18,3Mo corrected age
Radoš S.N. (2020), Croatia [39]	Community Cross-sectional	603	30.64y (SD = 4.68y)	BiTS N = 71 (11.8 %)	603	6,12Mo
Sharp M. (2021), United States of America [31]	Community Cross-sectional	77	39y (SD = 5.78y)	PCL-5 N = 18, 23,4 %	84	65.85d (SD = 23.66d)
Smorti M. (2020), Italy [53]	Outpatient Cohort study	105	34.97y (SD = 4.43y)	PPQ n.a.	105	3Mo
Stuifzand S. (2020), Switzerland [41]	Outpatient Longitudinal cohort study	356	32.55y (SD = 4.4y)	PDS n.a.	368	1w, 1Mo, 3Mo, 6Mo
Türkmen H. (2019), Turkey [54]	Outpatient Longitudinal cohort study	102	25,94y (SD = 4.53y)	PTSD short scale 59.8 % at 4w	102	w, 3Mo, 6Mo
Williams C. (2016), United Kingdom [21]	Community Cross-sectional	502	31.46y (SD = 4.56y)	IES, PTSDQ 18.9 %	502	26,7w
Zhang T. (2020), China [29]	Inpatient (NICU) Cohort study	169	31.3y (SD = 4.2y)	PPQ 27,2 %	169	3Mo corrected age

BiTS: City Birth Trauma Scale, IES(-R): Impact of Events Scale (Revised), LASC: Los Angeles Symptoms Checklist, NWS: National Women's Study PTSD module, PCL-5: PTSD checklist for DSM-5, PDS: Posttraumatic Stress Diagnostic Scale, (m)PPQ: (modified) Perinatal Posttraumatic Stress Disorder Questionnaire, PTSDQ: Posttraumatic Stress Disorder Questionnaire, TSQ: Trauma Screening Questionnaire, Mo: months, n.a.: not applicable, W: week(s), Y: year(s).

population of 1263 children), the association was better explained by the confounding variables [32,38,39,41,45,52], cfr infra. We concluded that the evidence concerning the association between maternal CB-PTSD (s) and mother-child bonding is inconsistent and potentially spurious.

In a large sample of 3006 women, those with one or more symptoms characteristic of CB-PTSD were twice as likely to be considered in the bottom third of mother-infant bonding scores in the first twelve months postpartum as compared to women who had no CB-PTSD(s) [51]. As stated above, these results were stable after controlling for relevant maternal confounders. Another six independent studies, with a combined population of 3023 women, found significant associations between maternal CB-PTSD(s) and mother-infant bonding problems but did not control their data for confounders [20,23,24,47–49]. Mayopoulos et al. [24] conducted a mediation study linking acute stress responses after birth (related to the COVID-19 pandemic) to CB-PTSD(s), mother-infant bonding problems, and breastfeeding. These factors were mutually related and showed significant associations between CB-PTSD (s) and general bonding problems at two months postpartum. Handelzalts et al. [48] and Hairston et al. [49] investigated the role of CB-PTSD (s) as a mediator in the association between maternal attachment style and mother-infant bonding. In this mediation analysis, the associations between CB-PTSD(s) and mother-infant bonding problems remained significant. An earlier mediation analysis by Handelzalts et al. [47] found that, as a mediator in the association between maternal personality traits and the mother-infant bond, worse symptom severity of maternal CB-PTSD(s) predicted a better mother-infant bond.

Six studies, describing a total population of 1263 mothers and their children, found that the association between CB-PTSD(s) and mother-child bonding problems was better explained by maternal mind-

mindfulness [38], maternal sleeping problems [45], maternal depressive symptoms [52], unknown mediators other than maternal depressive symptoms [39], psychological distress at 1 month postpartum [41], and mother-baby bond at 3 months postpartum and infant's temperament at 15 months postpartum [32]. Finally, Ayers et al. [42] and Di Blasio et al. [37] failed to find any significant association between maternal CB-PTSD(s) and the mother-infant bond.

3.2.2. Mother-child attachment

3.2.2.1. Attachment via observational tools. We identified six papers (accounting for a total population of 430 children) using observational tools for evaluating mother-child attachment. All of these papers considered videotaped sessions scored by a trained observer and all, except one [25], were rated as moderate quality (Table 3). Four out of six studies suggested a negative association between maternal CB-PTSD (s) and mother-child attachment. However, none of the studies controlled their data for confounding variables and small sample sizes were used. Based on the available evidence, a negative association between maternal CB-PTSD(s) and mother-child attachment via observational tools is suggested, but caution in interpreting is advised as controlling for confounders is lacking.

According to a case-control study with 47 mothers of prematurely born children and 25 term controls, significantly lower rates of cooperative interaction patterns were observed between mother and child, as well as a more controlling pattern of dyadic interaction [25]. Muller-Nix et al. found similar results, where maternal sensitivity in the fraction of mothers with high CB-PTSD(s) was significantly lower than in the

Table 2
Overview of the included articles investigating the association between maternal CB-PTSD(s) and the mother-infant bond.

First author (date)	N child	Child outcome: instrument	Effect size (Association maternal CB-PTSD(s) and child outcome)	Quality assessment: overall appraisal
Ayers S. (2007) [42]	64	BMIS	Zero-order correlation: CB-PTSD intrusions symptoms: $r = 0.00$, $p > 0.05$ CB-PTSD avoidance symptoms: $r = 0.09$, $p > 0.05$	Poor
Camisasca E. (2017) [38]	41	PSI-SF P-CDI	* Zero-order correlation: At 17 Mo (CB-PTSD hyperarousal): $r = 0.31$, $p < 0.05$ * Mediation analysis, mediator maternal mind-mindedness: $\beta = 0.16$, $p > 0.05$	Moderate
Di Blasio P. (2018) [45]	95	PSI-SF P-CDI	* Zero-order correlation: $r = 0.235$, $p < 0.05$ * Mediation analysis, mediator maternal sleep: $\beta = 0.04$, $p > 0.05$	Poor
Di Blasio P. (2017) [37]	88	PSI-SF P-CDI	Zero-order correlation: $r = -0.11$, $p > 0.05$	Moderate
Ertan D. (2021) [23]	916	MIBS	Zero-order correlation with: PCL-5 score: $r = 0.396$, $p < 0.1$ BiTS score: $r = 0.345$, $p < 0.1$	Good
Handelzalts J. (2019) [47]	504	PBQ	* Zero-order correlation: $r = 0.06$, $p > 0.05$ * Mediation analysis (CB-PTSD(s) as a mediator in the association between maternal personality trait neuroticism and mother-child bonding problems): $\beta = -0.12$, $p < 0.05$	Poor
Handelzalts J. (2021) [48]	210	PBQ	* Zero-order correlation: $r = 0.36$, $p < 0.1$ * Mediation analysis (CB-PTSD(s) as a mediator in the association between maternal attachment style and mother-child bonding problems): $\beta = 0.06$, $p > 0.05$	Moderate
Hairston I. (2018) [49]	114	PBQ	* Zero-order correlation: PBQ general: $r = 0.415$, $p > 0.029$ PBQ anger: $r = 0.426$, $p < 0.029$ PBQ anxiety: $r = 0.372$, $p < 0.029$ * Mediation analysis (CB-PTSD(s) as a mediator in the association between maternal attachment	Poor

Table 2 (continued)

First author (date)	N child	Child outcome: instrument	Effect size (Association maternal CB-PTSD(s) and child outcome)	Quality assessment: overall appraisal
Kjerulff K. (2021), United States of America [51]	3006	PBQ	style and mother-child bonding problems): BPQ anger subscale: $\beta = 0.24$, $p < 0.05$ Multivariable logistic regression models (controlling for maternal age, education, race, marital status, pregnancy intendedness, trouble paying for basic needs, depression, stress, social support): At 1Mo: aOR = 2.5, 95 % CI (1.8;3.3), $p < 0.001$ At 6Mo: aOR = 2.1, 95 % CI (1.5;2.8), $p < 0.001$ At 12Mo: aOR = 2.2, 95 % CI (1.6;3.0), $p < 0.001$	Moderate
Mayopoulos G. (2021) [24]	1274	MIBS	Only combined data with results MAI are available: Multi-path mediation model linking study: $\beta = 0.07$, significant path	Moderate
McDonald S. (2011), United Kingdom [52]	81	PSI-SF P-CDI	* Zero-order correlation - PTSDQ: At 2y: $r = 0.37$ At 3Mo: $r = r = 0.27$, $p < 0.05$ At 6w: $r = 0.30$, $p < 0.01$ * Zero-order correlation - IES: At 2y: $r = 0.41$ At 3Mo: $r = r = 0.27$, $p < 0.05$ * Hierarchical multiple regression analysis at 2y PTSDQ/IES, mediator maternal depressive symptoms: no significant association, data not available	Moderate
Parfitt Y. (2014) [32]	75	PBQ	* Zero-order correlation 15Mo: $\rho = 0.28$, $p < 0.05$ * Hierarchical multiple regression analysis at 15 Mo, significant predictors mother-baby bond at 3Mo and infant's temperament at 15Mo: $\beta = 0.10$, $p > 0.05$	Moderate
Parfitt Y. (2009) [20]	126	PBQ	Zero-order correlation: $\rho = 0.36$, $p < 0.001$	Moderate
Radoš S.N. (2020), Croatia [39]	603	PBQ	* Zero-order correlation: $r = 0.30$, $p < 0.01$ * Path analysis:	Moderate

(continued on next page)

Table 2 (continued)

First author (date)	N child	Child outcome: instrument	Effect size (Association maternal CB-PTSD(s) and child outcome)	Quality assessment: overall appraisal
			Direct effect: Young child (≤ 6 Mo): $\beta = 0.05$, $p = 0.34$ Older child (7-12Mo): $\beta = 0.03$, $p = 0.58$ Indirect effect, mediator maternal depression: Young child (≤ 6 Mo): $\beta = 0.04$, $p = 0.08$ Older child (7-12Mo): $\beta = 0.03$, $p = 0.34$	
Stuijzand S. (2020), Switzerland [41]	368	MIBS	* Zero-order correlation: $r = 0.21$, $p < 0.01$ * Structural equation modeling: Predictive association: $\beta = 0.27$, $p < 0.05$ Mediator psychological distress at 1Mo: $\beta = 0.08$, $p > 0.05$	Moderate

BMIS: Bethlehem Mother-infant Interaction Scale, MIBS: Mother-to-Infant Bonding Scale self-report version, PBQ: Postpartum Bonding Questionnaire, PSI-SF P-CDI: Parenting Stress Index - Short Form Parent-Child Dysfunctional Interaction subscale.

aOR: adjusted odds ratio, β : regression beta coefficient, d: day(s) Mo: month(s), p: level of significance r: correlation coefficient, ρ : Spearman's rank correlation coefficient, SD: Standard deviation, W: week(s), Y: year(s).

fraction of mothers with no CB-PTSD(s) at six months postpartum, and child behavior became more compulsive at eighteen months postpartum [26]. Furthermore, in another sample of prematurely born infants, a significant association was found between the severity of maternal CB-PTSD(s) at six months postpartum and the quality of mother-child attachment at twelve months postpartum [27]. Additionally, Ionio et al. [50] reported that children of mothers with CB-PTSD(s) were more likely to show crying, arch positioning, and disorganized behavior during the play phase (Still Face Paradigm), whereas they were more likely to look away during the still phase. On the other hand, mothers with CB-PTSD(s) were more likely to show intrusive behaviors like touching their child or not keeping a typical interaction distance. Feeley et al. [30], however, found no significant association between mother, infant, and overall dyadic interaction in a cohort of 298 women and 257 infants using the GRS. In a smaller sample of 44 women and their infants, again, no significant association could be found between maternal CB-PTSD(s) and any variable in the Care index [40].

3.2.2.2. Attachment via non-observational tools. Six studies (accounting for a total population of 2824 children) used non-observational tools for evaluating mother-child attachment. One study was given a poor quality appraisal [25], and the other five were deemed to be of moderate quality (Table 4). All included studies reported a significant small-to-medium sized negative association between maternal CB-PTSD(s) and mother-child attachment. Three out of six studies controlled their data for confounding factors. In the study by Dekel et al. [44] (685 children), the association between CB-PTSD(s) and attachment remained significant after controlling for maternal age and education, pre-birth psychiatric conditions, acute distress during birth, and lack of breastfeeding.

Table 3

Overview of the included articles investigating the association between maternal CB-PTSD(s) and attachment via observational tools.

First author (date)	N child	Child outcome: instrument	Effect size (Association maternal CB-PTSD(s) and child outcome)	Quality assessment: overall appraisal
Feeley N. (2017) [30]	257	GRS observation	Correlational data not available, no significant associations	Moderate
Forcada-Guex M. (2011) [25]	47	CARE index	CARE index: χ^2 (df: 4) = 15.01, $p < 0.01$	Poor
Ionio C. (2014) [50]	19	Still face paradigm	Linear regression analysis: Child behavior: $\beta = 0.25-0.54$, $p < 0.05$ Maternal behavior: $\beta = 0.44-0.59$, $p < 0.05$	Moderate
Muller-Nix C. (2004) [26]	47	CARE index	Multivariate analysis of variance: Maternal sensitivity at 6Mo: $F(2.69) = 3.69$, $p = 0.03$ Maternal controlling at 6Mo: $F(2.69) = 5.94$, $p < 0.01$ Infant compliance at 18Mo: $F(2.67) = 3.83$, $p = 0.03$ Infant passivity at 18Mo: $F(2.67) = 5.63$, $p < 0.01$	Moderate
Parfitt Y. (2013) [40]	45	CARE index	Zero-order correlation: ρ range = $-0.16; 0.19$, no significant results	Moderate
Petit A-C. (2016) [27]	62	PIPE	Zero-order correlation: $r = 0.34$, $p = 0.008$	Moderate

Child-Adult Relationship Experimental Index, Global Rating Scales of Mother-Infant Interaction, Pediatric Infant Parent Exam and Still Face Paradigm.

β : regression beta coefficient, d: day(s) Mo: month(s), F: regression F value, p: level of significance r: correlation coefficient, ρ : Spearman's rank correlation coefficient, SD: Standard deviation, W: week(s), Y: year(s).

However, in two out of six studies (713 children) the association was explained by the presence of maternal depressive symptoms [21,43]. In conclusion, available evidence suggests a negative association between maternal CB-PTSD(s) and mother-child attachment using non-observational tools, but maternal depression and other confounding factors may explain this association.

In the above mentioned case-control study, by Forcada-Guex et al. [25], comparing 47 mothers of premature children to term controls, similar results were found for the non-observational tool (WMCI) and the Care Index. Women with CB-PTSD(s) showed significantly less balanced attachment than mothers without CB-PTSD(s). Additionally, Dekel et al. [44] demonstrated, in a cohort of 685 women and their infants before six months postpartum, that maternal CB-PTSD(s) severity predicted worse mother-child attachment even after controlling for: maternal age, education, mental health history, trauma history, primiparous, complications in childbirth, emergency cesarean vs. other, peritraumatic distress, NICU admission, skin-to-skin contact, rooming-in, breastfeeding, and general PTSD. Moreover, Smorti et al. [53] and Mayopoulos et al. [24] presented comparable results, concluding that maternal CB-PTSD(s) were negatively associated with mother-child attachment but did not control for possible confounders. However, in the studies by Davies et al. [43] and Williams et al. [21], the apparent association between maternal CB-PTSD(s) and attachment was better explained by maternal depressive symptoms.

Table 4

Overview of the included articles investigating the association between maternal CB-PTSD(s) and attachment via non-observational tools.

First author (date)	N child	Child outcome: instrument	Effect size (Association maternal CB-PTSD(s) and child outcome)	Quality assessment: overall appraisal
Davies J. (2008) [43]	211	MPAS	* Zero-order correlation: $d = 0.41$, $p < 0.01$ * Covariance analysis, maternal depression: data not available (non-significant association)	Moderate
Dekel S. (2019), [44]	685	MAI	* Comparison LSD (least significant difference) CB-PTSD vs no PTSD: $p = 0.00$ CB-PTSD vs general PTSD: $p = 0.04$ * Hierarchical multiple regression, premorbid factors: $\beta = -0.35$, $p < 0.05$ χ^2 (df: 4) = 18.66, $p < 0.001$	Moderate
Forcada-Guex M. (2011) [25]	47	WMCI		Poor
Mayopoulos G. (2021) [24]	1274	MAI	<i>Only combined data with results MIBS are available:</i> Multi-path mediation model linking study: $\beta = 0.07$, significant path	Moderate
Smorti M. (2020) [53]	105	MPAS	Zero-order correlation: $r = -0.38$, $p < 0.01$	Moderate
Williams C. (2016) [21]	502	MPAS	Structural equation modeling, maternal depression as mediator: β not available, non-significant path	Moderate

Maternal Postpartum Attachment Scale, Maternal Attachment Inventory, MIBS: Mother-to-Infant Bonding Scale self-report version and Working Model of the Child Interview.

β : regression beta coefficient; p: level of significance r: correlation coefficient.

3.2.3. Mother's object relation

Two studies of moderate quality, describing a population of 292 children, used the Mother's Object Relation Scale–Short Form (MORS-SF) with contradicting results (Table 5) [43,52].

On the one hand, McDonald et al. [52] found no significant association between early CB-PTSD(s) and the mother's object relation two years postpartum after controlling for maternal depression symptoms. On the other hand, Davies et al. [43] found a small significant association between maternal CB-PTSD(s) and the warmth subscale of the MORS-SF in 211 women at six weeks postpartum. This association remained significant after controlling for maternal depression symptoms.

3.3. Child behavior and/or temperament

We identified eight studies that evaluated child behavior and/or temperament: six of moderate quality and two of poor quality. General study characteristics and conclusions will be discussed first, followed by a more detailed presentation of the included research. Overall, small sample sizes were used (n range: 36–211), with a total population of 711 children. All studies found a significant negative association between maternal CB-PTSD(s) and child behavior/temperament. Five datasets

Table 5

Overview of the included articles investigating the association between maternal CB-PTSD(s) and mother's object relation.

First author (date)	N child	Child outcome: instrument	Effect size (Association maternal CB-PTSD(s) and child outcome)	Quality assessment: overall appraisal
Davies J. (2008) [43]	211	MORS-SF	* Zero-order correlation: MORS-SF warmth: $d = -0.22$, $p < 0.01$ MORS-SF invasion: $d = 0.37$, $p < 0.01$ * Covariance analysis, mediator maternal depression: Mors-SF warmth: $F(2, 207) = 3.45$, $p < 0.034$	Moderate
McDonald S. (2011) [52]	81	MORS-SF	* Zero-order correlation – PTSDQ/ MORS-SF invasion: At 2y: $r = 0.3$, $p = 0.006$ At 6w: $r = 0.27$, $p < 0.05$ * Zero-order correlation – IES/ MORS-SF invasion: At 2y: $r = 0.23$ $p = 0.041$ * Hierarchical multiple regression analysis at 2y, mediator maternal depression: no significant association, data not available	Moderate

MORS-SF: Mother's Object Relation Scale - Short Form.

β : regression beta coefficient, d: cohen's d coefficient p: level of significance r: correlation coefficient.

were controlled for relevant confounders and significant associations remained in three studies [37,38,45]. In two out of five studies significant associations disappeared after controlling for maternal depressive symptoms [43,52] (Table 6). Therefore, available evidence suggests a significant negative association between maternal CB-PTSD(s) and child behavior/temperament, indicating that children of mothers with more severe CB-PTSD(s) showed more behavioral problems/difficult temperament than children of mothers with less severe or no CB-PTSD (s). However, maternal depression and possibly other confounders may be an important explaining factor.

All eight studies reported significant associations between the severity of maternal CB-PTSD(s) and the level of difficulty in a child's behavior or temperament. This relation remained significant when controlled for maternal mind-mindedness [38] and maternal sleep problems [45], but not for maternal depression [43,52]. In one of the studies, Di Blasio et al. [37] evaluated child internalizing and externalizing behavior using the Child Behavior Checklist (CBCL). Here, the association between maternal CB-PTSD(s) and child internalizing behavior was significant and only partially mediated by the PSI-SF PD (parental distress) subscale. The association between maternal CB-PTSD (s) and child externalizing behavior, however, was fully mediated by the mother's opinion of her child being difficult (PSI-SF DC). Finally, in a retrospective sample of 77 children hospitalized in the NICU, maternal CB-PTSD(s) severity was significantly associated with the 'baby's appearance and behavior' subscale of the PSS:NICU (parental stressor scale specific to NICU hospitalization) [31].

Table 6
Overview of the included articles investigating the association between maternal CB-PTSD(s) and child behavior/temperament.

First author (date)	N child	Child outcome: instrument	Effect size (Association maternal CB-PTSD(s) and child outcome)	Quality assessment: overall appraisal
Camisasca E. (2017) [38]	41	PSI-SF DC	* Zero-order correlation: At 17 Mo (CB-PTSD hyperarousal): $r = 0.58, p < 0.05$ * Mediation analysis: $\beta = 0.57, p < 0.001$	Moderate
Davies J. (2008) [43]	211	ICQ	* Zero-order correlation: $d = 0.30, p < 0.01$ * Covariance analysis: data not available (non-significant association)	Moderate
Di Blasio P. (2018) [45]	95	PSI-SF DC	* Zero-order correlation: $r = 0.392, p < 0.01$ * Mediation analysis: $\beta = 0.20, p < 0.05$	Poor
Di Blasio P. (2017) [37]	88	PSI-SF DC, CBCL 1,5-5y	* CB-PTSD at 3 Mo: PSI-SF DC: $r = 0.20, p > 0.05$ CBCL internalizing: $r = 0.30, p < 0.01$ CBCL externalizing: $r = 0.24, p < 0.05$ * CB-PTSD at 18 Mo: PSI-SF DC: $r = 0.38, p < 0.01$ CBCL internalizing: $r = 0.46, p < 0.01$ CBCL externalizing: $r = 0.37, p < 0.01$ * Hierarchical multiple regression analyses at 18 Mo: CBCL internalizing, PSI-SF PD mediator: $\beta = 0.09, p < 0.005$ CBCL externalizing, PSI-SF DC mediator: $\beta = 0.06, p > 0.05$ $\chi^2 = 14.347, df = 4, p < 0.01$	Moderate
Di Blasio P. (2005) [46]	36	Interview built to assess the nine behaviors studied by Thomas and Chess	$\chi^2 = 14.347, df = 4, p < 0.01$	Poor
McDonald S. (2011) [52]	81	PSI-SF DC	* Zero-order correlation - PTSDQ: At 2y: $r = 0.36, p < 0.001$ At 3Mo: $r = 0.34, p < 0.01$ At 6w: $r = 0.30, p < 0.01$ * Zero-order correlation - IES: At 3Mo: $r = 0.34, p < 0.01$ * Hierarchical multiple regression analysis at 2y PTSDQ/IES: no significant association, data not available	Moderate
	75	ICQ		Moderate

Table 6 (continued)

First author (date)	N child	Child outcome: instrument	Effect size (Association maternal CB-PTSD(s) and child outcome)	Quality assessment: overall appraisal
Parfitt Y. (2014) [32]			Zero-order correlation: $\rho = 0.30, p < 0.05$	
Sharp M. (2021) [31]	84	PSS: NICU-BAB	Linear regression: $\beta = 0.83, p < 0.01$	Moderate

CBCL: Child Behavior Checklist, d: day(s), ICS: Infant Characteristics Questionnaire, PSI-SF DC: Parenting Stress Index - Short Form Difficult Child subscale, PSS:NICU-BAB: Parental Stressor Scale: Neonatal Intensive Care Unit, baby's appearance and behavior.

β : regression beta coefficient, d: day(s) Mo: month(s), F: regression F value, p: level of significance r: correlation coefficient, ρ : Spearman's rank correlation coefficient, SD: Standard deviation, W: week(s), Y: year(s).

3.4. Breastfeeding

General study characteristics and conclusion will be discussed first, followed by a more detailed presentation of the included research. Three papers of moderate quality, describing a large population of 2856 mothers and children, considered the association between maternal CB-PTSD(s) and breastfeeding (i.e. initiation of breastfeeding, exclusive

Table 7
Overview of the included articles investigating the association between maternal CB-PTSD(s) and breastfeeding.

First author (date)	N child	Child outcome: instrument	Effect size (Association maternal CB-PTSD(s) and child outcome)	Quality assessment: overall appraisal
Garthus-Niegel S. (2018a) [34]	1480	Breastfeeding according to the World Health Organization classification system.	* Zero-order correlation: No initiation of breastfeeding: $r = 0.15, p < 0.001$ No continued breastfeeding at 1 y: $r = 0.05, p < 0.05$ * Multivariate regression model: No initiation of breastfeeding: aOR 5.98, 95 % CI (1.79;19.97)	Moderate
Mayopoulos G. (2021) [24]	1274	A single question about the current breastfeeding status	Multi-path mediation model linking study: $\beta = 0.09, p < 0.05$	Moderate
Türkmen H. (2019) [54]	102	Breastfeeding self-efficacy scale	* Analysis of variance At 4wk: $F = 15.33, p < 0.001$ At 3Mo: $F = 917, p < 0.001$ * Multiple linear regression analysis: At 4wk: $\beta = -62.94, p < 0.001$ At 3Mo: $\beta = -27.714, p = 0.002$	Moderate

β : regression beta coefficient, d: day(s) Mo: month(s), F: regression F value, p: level of significance r: correlation coefficient, ρ : Spearman's rank correlation coefficient, SD: Standard deviation, W: week(s), Y: year(s).

breastfeeding, continued breastfeeding at two years postpartum, or breastfeeding self-efficacy) (Table 7). After controlling their results for relevant confounders (i.e. educational level, BMI, maternal age, paid employment, and emergency cesarean) Garthus-Niegel et al. [34] found that the association between maternal CB-PTSD(s) and initiation of breastfeeding remained significant, but not the association with the continuation of breastfeeding in the first year postpartum. Two additional studies, describing only early breastfeeding outcomes (2–4 months postpartum), did not control their results for relevant confounders.

In conclusion, the available evidence suggests that maternal CB-PTSD(s) may be associated with less favorable early breastfeeding outcomes (i.e. not initiating breastfeeding and breastfeeding at 2–4 months postpartum) [24,34,54].

In a large prospective cohort study including 1480 women and their infants, women with probable CB-PTSD at eight weeks postpartum were less likely to initiate breastfeeding and continue breastfeeding in the first year postpartum [34]. However, only the association between maternal CB-PTSD and breastfeeding initiation remained significant after controlling for relevant confounders. In the same study, no significant associations were found between maternal CB-PTSD(s) at eight weeks postpartum with exclusive breastfeeding during the first six months and breastfeeding continuation up to two years postpartum [34]. In their prospective longitudinal study on 102 women, Türkmen et al. [54], reported similar early breastfeeding results. Herein, maternal CB-PTSD (s) were negatively associated with breastfeeding self-efficacy at four weeks and three months after childbirth. Furthermore, in a multipath mediation analysis linking acute stress responses (related to the COVID-19 pandemic) to CB-PTSD, mother-child bonding problems, and breastfeeding problems, CB-PTSD(s) were significantly associated with breastfeeding problems in children younger than four months [24].

3.5. Sleeping- and/or eating pattern of child

Two papers of moderate quality investigated the possible association of maternal CB-PTSD(s) with the eating and/or sleeping patterns of children (Table 8). General study characteristics and conclusions will be discussed first, followed by a more detailed presentation of the included research. Both papers indicated a possible negative association between maternal CB-PTSD(s) and child's sleep (i.e. number and duration of night awakenings, settling time, and perceived child sleep problems by mothers at 2 years) even after controlling for perinatal risks [28] and relevant mother and child confounders [35]. Additionally, in one of these studies, no association was found between maternal CB-PTSD(s) and a child's eating pattern [28]. The available research on the association between CB-PTSD(s) and the child's sleeping- and/or eating patterns is limited and suggests an association between CB-PTSD(s) and more problems in the child's sleeping pattern.

In a case-control study comparing a group of 50 premature children to 25 controls, the severity of maternal CB-PTSD(s) was associated with more eating/sleeping problems (aggregated index) and sleeping problems in children [28]. This association remained significant after controlling for perinatal risks, but the direct association with eating problems was not significant. More recently, Garthus-Niegel et al. [35] demonstrated small but significant associations between maternal CB-PTSD(s) at eight weeks postpartum and the number and duration of night awakenings, settling time, and perceived sleep problems of the two-year-old infant. This association remained significant after controlling for multiple relevant maternal and child confounders (i.e. maternal anxiety, maternal depression, age, educational level, breastfeeding, birth weight, and sleep variables at eight weeks postpartum).

3.6. Other developmental domains

The Ages and Stages Questionnaire (ASQ) and the Ages and Stages Questionnaire - Social-Emotional (ASQ:SE) were used to assess four

Table 8

Overview of the included articles investigating the association between maternal CB-PTSD(s) and eating and/or sleeping problems.

First author (date)	N child	Child outcome: instrument	Effect size (Association maternal CB-PTSD (s) and child outcome)	Quality assessment: overall appraisal
Garthus-Niegel S. (2018b) [35]	1480	BISQ	* Zero-order correlation: Nocturnal sleep duration: $r = -0.07, p < 0.1$ Total sleep duration: $r = -0.06, p < 0.05$ Night awakenings: $r = 0.12, p < 0.001$ Duration of wakefulness: $r = 0.10, p < 0.001$ Settling time: $r = 0.13, p < 0.001$ Perceived child sleep problems: $r = 0.13, p < 0.001$ * Multiple linear regression analysis: Night awakenings: $\beta = 0.11, 95\% \text{ CI } (0.01;0.02)$ Duration wakefulness: $\beta = 0.09, 95\% \text{ CI } (0.07;0.4)$ Settling time: $\beta = 0.09, 95\% \text{ CI } (0.07;0.39)$ Perceived child sleep problems: $\beta = 0.12, 95\% \text{ CI } (0.00;0.01)$	Moderate
Pierrehumbert B. (2003) [28]	75	The symptom checklist	* Analysis of variance: With aggregated index: $F(2,73) = 3.49, p = 0.03$ * Partial correlation coefficient (pcc), controlled for perinatal risk: Aggregated index: $pcc = 0.31, p < 0.01$ Sleeping problems: $pcc = 0.28, p < 0.05$	Moderate

BISQ: Brief Infant Sleep Questionnaire.

β : regression beta coefficient, d: day(s) Mo: month(s), F: regression F value, p: level of significance r: correlation coefficient, p: Spearman's rank correlation coefficient, SD: Standard deviation, W: week(s), Y: year(s).

domains of child development at two years in a large prospective cohort study involving 1472 mothers and their infants: gross motor development, fine motor development, communication, and social-emotional competence [33]. The results of this study showed a significant predictive effect of maternal CB-PTSD(s) at eight weeks postpartum on children's problems in social-emotional development at two years. This result remained significant after controlling for maternal mental health (depression, anxiety) and relevant child factors (sex, prematurity, temperament, health problems) (Table 9). Furthermore, in a group of 169 prematurely born infants in China, high maternal CB-PTSD(s) were associated with a higher risk of weight retardation at three months of

Table 9
overview of the included articles investigating the association between maternal CB-PTSD(s) and other developmental domains.

First author (date)	N child	Child outcome: instrument	Effect size (Association maternal CB-PTSD (s) and child outcome)	Quality assessment: overall appraisal
Garthus-Niegel S. (2017) [33]	1472	ASQ-3, ASQ:SE	* Socio-emotional development zero-order correlation: $r = 0.17, p < 0.001$ * Multivariate regression model: $\beta = 0.08, p < 0.01$	Moderate
Zhang T. (2020) [29]	169	Head circumference, weight, length	Prospective generalized linear mixed model: $\beta = 0.891, p < 0.023$	Moderate

ASQ:SE: Ages and Stages Questionnaire Social-Emotional, ASQ-3: Ages and Stages Questionnaire.

β : regression beta coefficient, d: day(s) Mo: month(s), F: regression F value, p: level of significance r: correlation coefficient, ρ : Spearman's rank correlation coefficient, SD: Standard deviation, W: week(s), Y: year(s).

corrected age [29] (Table 9).

3.7. Does treatment of maternal CB-PTSD affect the mother-child relationship and/or child developmental domains?

Two randomized controlled trials were identified that reported the possible influence of maternal CB-PTSD(s) treatment on the mother-child relationship (Table 10). The results suggested that early intervention (< 3 days postpartum) might be effective in reducing the symptom severity of maternal CB-PTSD(s) 2–3 months postpartum. However, results concerning the impact on the mother-child bond were contradictory.

Chiorino et al. [19] randomly assigned 37 women with CB-PTSD and their children into two groups: a treatment group ($n = 19$) and a control group ($n = 18$). Women in the treatment group received a 90-minute EMDR session in a period of 1–3 days after childbirth, following the EMDR Recent Birth Trauma Protocol. By contrast, the control group received treatment as usual (TAU); i.e. a supportive psychological session at the maternity ward. In both groups, CB-PTSD(s) were reduced, but the reduction was more significant in the treatment group.

Table 10
Overview of the included articles investigating the association between maternal CB-PTSD(s) treatment and child outcome.

First author (date)	N child	Child outcome: instrument	Mean difference in child outcome score in treatment vs control group	Quality assessment: overall appraisal
Bahari S. (2021) [22]	165	PBQ	MD = -7.82 95 % CI (-9.11 ; -6.53), $p < 0.001$	Good
Chiorino V. (2019) [19]	37	MIBS	At 6 wk.: MD = -0.322 , 95 % CI: (-1.095 ; 0.452), $p = 0.404$ At 12 wk.: MD = -0.357 , 95 % CI: (-1.103 ; 0.390), $p = 0.339$	Moderate

MIBS: Mother-to-Infant Bonding Scale self-report version, PBQ: Postpartum Bonding Questionnaire.

β : regression beta coefficient, d: day(s) Mo: month(s), F: regression F value, p: level of significance r: correlation coefficient, ρ : Spearman's rank correlation coefficient, SD: Standard deviation, W: week(s), Y: year(s).

Additionally, both groups showed improvement in mother-child bonding, but no significant differences were observed between groups. This indicated that significant improvement of CB-PTSD(s) severity after early EMDR in the treatment group compared to the control group did not coincide with significant improvement of the mother-child bond in the treatment group compared to the control group. In another recent study, by Bahari et al. [22], individual counseling was given to 83 women in the intervention group compared to treatment as usual for 83 women in the control group. The first session of treatment was given almost immediately after birth (24–48 h). This was followed by a second session 10 to 15 days after delivery and a telephone contact 4 to 6 weeks postpartum. At two months postpartum, both the CB-PTSD(s) severity and mother-infant bond improved significantly in the intervention group compared to the control group.

4. Discussion

In this systematic review, we aimed to summarize the research describing the association between untreated and treated maternal CB-PTSD(s) and the mother-child relationship and/or early child development. To the knowledge of the authors, this is the first systematic review to consider maternal postpartum PTSD symptoms specifically associated with childbirth and their association with various child outcomes.

4.1. Maternal CB-PTSD(s) and mother-child relationship and/or infant development

Our results suggest a significant negative association between maternal CB-PTSD(s) and some important aspects of the mother-child relationship and early child development. This observation is in line with two systematic reviews evaluating the impact of parental PTSD (nonspecific to childbirth) on parenting and child development [4,56]. Similar results regarding the association with maternal postnatal PTSD, specific and non-specific to childbirth, contribute to the knowledge that childbirth may be considered a traumatic event. Regardless of the traumatic event type, common etiological factors (i.e., personal characteristics, trauma severity, social support, and experienced life stress after the traumatic event) may lead to PTSD development [57]. Evidence for a common pathway to the development of PTSD was found in a diathesis-stress model [58]. In this model, a person's vulnerability (ecological and biological) interacts with triggering and sustaining stress factors and may lead to the development of PTSD. The model has also been shown to fit etiologic pathways for CB-PTSD [59].

The majority of the included research focused on the association between maternal CB-PTSD(s) and the mother-child relationship. These results are important since the mother-child relationship has been shown to be one of the keystone determinants of child development [5,7]. The association found between maternal CB-PTSD(s) and mother-child attachment was more robust compared to mother-child bonding or mother's object relation. However, confounding variables may also be important explanatory factors. A possible explanation for the association between maternal CB-PTSD(s) and the mother-child relationship may be that mothers with PTSD are less able to provide sensitive and qualitative responses, which are a key feature of mother-child attachment [60,61]. Since PTSD is associated with persistent negative cognitive and mood alterations (criterion D, DSM-5 [9]), this might also impact the mother's thoughts and emotions towards her child, which, in turn, is a key feature of mother-infant bonding and mother's object relation. However, our results were inconsistent in showing a negative association between maternal CB-PTSD(s) and the mother-infant bond and mother's object relation. Tedeschi et al. [62] introduced the possibility of posttraumatic growth after a stressful and challenging situation. Traumatic childbirth experiences have also been linked to such positive changes in thoughts, emotions, and behavior [63,64]. Positive changes may therefore positively impact mother-child bonding and mother's object relation as well, explaining the inconsistent results.

Furthermore, our review suggests a significant association between the severity of maternal CB-PTSD(s) and more challenging child behavior and temperament, with maternal depressive symptoms as a possible explanatory factor. Previous research examining the impact of maternal PTSD (not specific to childbirth) on child internalizing and externalizing behavior as well as child emotion regulation [65], socio-emotional difficulties, and behavioral problems [66] has shown similar results. Mothers with PTSD(s) experience one or more symptoms of avoidance, hypervigilance, intrusions, and negative mood and cognition alterations [9]. This may lead to emotion regulation problems such as irritability, sudden mood changes, or emotional numbing. Problems in maternal emotion regulation have been associated with problems in child adjustment and behavior [67]. The maternal behavioral and emotional changes due to emotion regulation problems related to CB-PTSD(s) may be learned and internalized by the young child, resulting in more behavioral and temperamental problems. On the other hand, children may change their behavior to activate their mother's responses, which are less sensitive and responsive due to emotion regulation problems.

Results suggesting a negative association between maternal CB-PTSD (s) and early breastfeeding outcomes (initiating breastfeeding and continuous breastfeeding at 2–4 months) are limited. However, these results are in line with a previously found association of general maternal PTSD(s) in the postpartum period with not exclusively breastfeeding at 1 month postpartum and not breastfeeding as long as wanted [68]. Beck et al. [69] found that a range of possible aspects of a traumatic birth experience may explain breastfeeding problems in mothers with CB-PTSD(s): intruding flashbacks, feeling violated, disturbing detachment, enduring physical pain, and insufficient milk supply.

Our results also contribute to the knowledge that maternal mental health might be associated with the child's sleep pattern [4,8,70,71]. However, these results are based upon two studies only, using different assessment tools, with small to medium effect sizes, and both being of moderate quality [28,35]. We should therefore interpret this possible association with care.

Although a direct association between maternal CB-PTSD(s) and child outcome measures (as explained above) is plausible, we should also consider possible indirect pathways. Several risk factors have previously been associated with maternal CB-PTSD(s) development [13,59]. Maternal vulnerability factors (i.e. depression in pregnancy, history of PTSD and/or other psychopathology, and fear of childbirth), factors related to birth (i.e. birth experience, operative birth, support during birth, and infant complications), and postnatal factors (i.e. postpartum depression, maternal stress, and coping) impact maternal responses to childbirth and, therefore, the possibility of maternal CB-PTSD(s) development. Several of these risk factors have been shown to have a direct impact on child outcomes [72,73]. To ensure measurement of the direct association of maternal CB-PTSD(s) with child outcome, outcome data should have been controlled for these risk factors and other possible confounding variables. Only fourteen out of thirty-five included studies controlled their data for confounding variables, and in only four of these studies, a significant association between maternal CB-PTSD(s) and all child outcomes remained after controlling for pre-morbid maternal factors [44,51], relevant maternal and child factors [33], and perinatal risks [28]. In 6 out of fourteen studies, at least some of the investigated child outcomes were better explained by maternal mind-mindedness [38], maternal depressive symptoms [43], maternal sleep [45], parenting stress [37], and several pre-morbid maternal factors [34,35]. All of the remaining four studies found an indirect relationship between CB-PTSD and child outcomes via maternal depressive symptoms [21,52], unknown mediators other than maternal depressive symptoms [32], and psychological distress at 1 month postpartum [41]. The majority of the included research did, however, not control data for confounding variables and most confounders were only controlled for in one study. Therefore, the question remains whether the reported

associations between maternal CB-PTSD(s) and child outcomes are directly attributable to maternal CB-PTSD(s) or indirectly through other associated factors.

Caution is also advised in interpreting the direction of the association. The abovementioned explanations—indicating that maternal CB-PTSD(s) and other risk factors affect child outcomes—are only one way of understanding the association. Child outcome parameters may reciprocally affect maternal CB-PTSD(s), as has been proven for the association between maternal postpartum depression and child behavior problems at ages 3 to 5 [74]. Thirteen included studies used a longitudinal or prospective design, giving more insight into change over time, but the majority of research used a cross-sectional study design. In our results, there was no obvious difference between associations found in cross-sectional or longitudinally designed studies.

Furthermore, twelve out of thirty-five studies examined high-risk samples that are not representative of the general population. More negative associations would be expected in high-risk samples. Indeed, a higher rate of negative associations between maternal CB-PTSD(s) and child outcomes in high-risk samples (10/12 studies; 83 %) was found compared to negative associations in general-risk samples (10/19 studies; 52 %), limiting the generalizability of our results to the population level. Additionally, twenty-six papers used a convenience sample, which has the inherent bias of being unlikely to be representative of the study population.

Inconsistencies and contradictory results in the association between maternal CB-PTSD(s) and the mother-child relationship and child developmental domains might also be attributable to other methodological issues. Firstly, a great variety of instruments and clinical cut-off scores were used to define maternal CB-PTSD(s). This revealed a broad CB-PTSD(s) prevalence range (1.2 % and 59.8 %), not in line with the results from a large systematic review and meta-analysis reporting estimated CB-PTSD mean prevalence to be 4.7 % [10]. Not using diagnostic cut-off scores may limit the comparability of the study results. Secondly, self-report questionnaires were most frequently used for measuring both mother and child variables. Self-report questionnaires are subject to self-report bias because a mother's own mental health problems might influence the perception of the child. Thirdly, the use of various assessment tools evaluating child outcomes limits the comparison of results between studies. Also, not all these measurement tools were well validated. Mother-infant relationship measurement tools were mostly validated [55,75–77], except for the self-report version of the BMIS and Still Face Paradigm. Child behavior/temperament was investigated by validated instruments [46,77–79]. Child eating and sleeping pattern and breastfeeding were mostly investigated by non-validated questionnaires, except from the Breast-Feeding Self-Efficacy Scale [80].

4.2. Treatment of maternal CB-PTSD(s) and mother-child relationship and/or infant development

Very limited research was found examining the effects of maternal treatment for CB-PTSD(s) and its association with change in the mother-child relationship and/or child development. Research that did investigate such an effect focused on early interventions (< 3 days postpartum) and showed a reduction of maternal PTSD symptoms but showed contradictory results regarding the change in mother-child bonding [19,22]. Indeed, previous research suggests the effectiveness of early interventions in preventing and treating maternal PTSD in the postpartum period [81]. However, according to DSM-5 criteria, a formal diagnosis of PTSD can only be made if symptoms persist for 4 weeks after the traumatic event [9]. No research was found that considered treatment of maternal CB-PTSD(s) after four weeks postpartum and its effect on child development. According to the findings of a systematic review and meta-analysis, trauma-focused psychotherapy may be effective in reducing general maternal postpartum PTSD symptoms in the short term (3 months after delivery) and the medium term (3–6 months after

delivery) [14,15]. We can speculate that earlier interventions might be of more interest since this reduces the period in which the child is exposed to maternal stress symptoms.

4.3. Strengths, limitations, and recommendations

To our knowledge, this is the first systematic review that examines the relation between maternal childbirth-related PTSD symptoms and their impact on the young child. A thorough search was conducted in three relevant databases, and all evidence was evaluated by two separate reviewers, contributing to a secure data presentation.

Several methodological issues have been discussed in this paper. Additionally, the moderate to poor quality of available research reduces the validity of our conclusions. Furthermore, limited evidence was found in several outcome measures (breastfeeding, child sleep and/or eating pattern, and other developmental domains and treatment of maternal CB-PTSD(s)), therefore limiting the robustness of the results. Results were available for child outcomes up to two years of age (infants), and the impact on further child development has to be further explored. Finally, little is known about the clinical impact of the associations found.

Future research should focus on longitudinal study designs, including large samples representative of the maternal population. In addition, results should be controlled for relevant confounders such as maternal depressive symptoms. The use of standardized measures for evaluating both mother and child outcomes will further contribute to the comparability of studies and the generalizability of results.

Furthermore, future research should focus on the effects of maternal PTSD treatment on different domains of child development. Research on this topic, however, is scarce and future research could contribute to more robust evidence on the effect of maternal PTSD on child development.

4.4. Clinical implications

Our results suggest that maternal CB-PTSD may be associated with less favorable mother-child attachment and child development. Therefore, prevention of and screening for maternal CB-PTSD(s) may contribute to a better prognosis for both mother and child. Health workers who are in contact with women who recently gave birth (e.g. gynecologists, midwives, maternity personnel, NICU personnel, pediatricians, general practitioners, and preventive youth health care) can play a significant role in its implementation in routine care. The findings of our review support that multidisciplinary collaboration should become standard care for families in the peripartum period.

5. Conclusion

We used a rigorous systematic review approach to evaluate the possible impact of maternal CB-PTSD(s) on the mother-child relationship and child development. The findings suggest an association between the severity of maternal CB-PTSD(s) and mother-child attachment and child behavior. However, confounding variables (for example maternal depressive symptoms) and methodological issues influenced these results. Results reporting the effects on breastfeeding, sleeping/eating patterns, and other developmental areas should be interpreted with caution since limited evidence was available. We also evaluated whether maternal trauma-focused treatment beneficially impacted child development, but research was scarce, of low quality, and contradictory. The possible negative association of maternal CB-PTSD(s) with child development supports a multidisciplinary approach to identify young families at risk and provide early prevention and screening of the maternal mental health state.

Declaration of competing interest

None.

Acknowledgments

None.

Appendix. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.earlhumdev.2022.105667>.

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