

REVIEW ARTICLE

Early Intervention Strategies for Enhancing Attachment and Interaction in Families with Premature Infants: A Systematic Literature Review

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Introduction: Preterm birth poses significant risks to neonatal health and development, impacting parental roles and early bonding.

Aim: Our systematic review explores recent interventions aimed at enhancing parent-premature infant interactions and attachment, particularly in NICU settings.

Methods: Following PRISMA guidelines, articles published between 2010 and 2024 were searched across major databases. 19 English-language studies assessing interventions to promote bonding, attachment, and interaction with preterm infants met the final inclusion criteria for the systematic review after rigorous screening and bias assessment.

Results: The reviewed studies presented diverse interventions targeting parent-infant relationship. The interventions included kangaroo care, parent education, and psychological support, conducted predominantly in hospital settings. Positive outcomes were consistently reported in enhancing attachment, improving parental sensitivity, and reducing maternal anxiety and depression. Father involvement also showed beneficial impacts on attachment outcomes.

Conclusion: Early interventions can mitigate the risks threatening the development of prematurely born infants by fostering secure parent-infant attachments and enhancing parental competence. The findings underscore the clinical significance of integrating bonding-focused interventions into routine NICU care, emphasizing the role of both parents in supporting infant development. Future healthcare strategies should prioritize the early comprehensive support to optimize the long-term developmental outcomes in preterm infants.

Keywords: preterm infants, parent-infant interaction, attachment, early intervention, NICU

Introduction

Preterm birth is a prevalent perinatal risk, affecting about 13.4 million premature infants annually (Ohuma et al., 2023). According to the World Health Organization, a premature infant is defined as any newborn delivered before the completion of 37 weeks of gestation (World Health Organization, 2023). Prematurity and its complications are responsible for over a third of neonatal deaths (World Health Organization, 2023).

Premature birth presents challenges and risks for both the newborns and their families. From the infant's perspective, the immature organism is forced to exist in an inadequate extrauterine environment; therefore, its survival often depends on medical support. Perinatal complications such as intraventricular haemorrhage (IVH), periventricular leukomalacia (PVL), bronchopulmonary dysplasia (BPD), and retinopathy of prematurity (ROP) are frequent (Ding et al., 2025; García et al., 2024; Yan et al., 2024). The untimely termination of intrauterine growth and the exposure of the immature central nervous system to the external world involve risks for the child's later development, potentially affecting cognitive (Arhan et al., 2017; Behboodi et al., 2025; Doyle et al., 2015; O'Meagher et al., 2017; Potharst et al., 2012), language (Breeman et al., 2015; Jurišová et al., 2025; Reis et al., 2012), and motor skills (Behrman & Butler, 2007; Jurišová et al., 2025).

The implications of prematurity for mental development have generated a wealth of research since the mid-20th century (Behrman & Butler, 2007). For decades the developmental impairments related to preterm birth had been conceptualized as the consequences of purely medical hazards (Aylward et al., 1989; Hadders-Algra, 2005). However, as the first follow-up studies reached the children's higher ages it became clear that even the most complex medical risk scales could reliably predict the developmental outcomes merely for the first years of life (Hadders-Algra, 2005). The failures of prediction from medical variables have directed the researchers' interest toward the potential role of the caretaking environment. More recent studies similarly highlight that neurodevelopmental outcomes are influenced by a wide range of medical and psychosocial risk factors (Axford et al., 2025). In addition, children born preterm may be particularly susceptible to environmental quality and caregiving (Jaekel et al., 2015; Lionetti et al., 2025).

A preterm delivery is a highly stressful life event for the whole family. The sight of the tiny, fragile infant is shocking, and anxiety over the infant's survival and health (Hendy et al., 2024) as well as feelings of guilt for failing to carry the pregnancy to term (Behrman & Butler, 2007) aggravate the stress. The relationship between mother and infant often begins with weeks or even months of separation if the infant needs to be placed in a Neonatal Intensive Care Unit (NICU). Premature infants may remain different from their full-term counterparts for a long time. They are often less responsive to the developmentally relevant (including social) stimuli but at the same time get easily overstimulated. Their state-regulation is poor, making them difficult to soothe, and their signals are less readable and interpretable (Als & Brazelton, 1981; Bozzette, 2007). For these reasons, mothers may struggle to understand and attune to their infant, a challenge intensified by their own anxiety (Ionio et al., 2024; Shaw et al., 2023). All these inevitably have impacts on the parent-infant interactions and consequently on bonding or attachment¹ which plays a crucial role in the child's later social and emotional growth (Posada & Kaloustian, 2010; Shaw et al., 2023). Therefore, fostering the development of a harmonious relationship between premature infants and their primary caregivers is vital for the child's development.

How parents cope with the atypical beginning is highly variable. The parental behaviour is inevitably moderated by the untimely delivery and the atypical infant, but it may either be adaptive or become a source of further risks (Sameroff, 2009). Research findings on the attachment between premature infants and their mothers are inconsistent (Shaw et al., 2023). The review by Korja et al. (2012) suggests no greater likelihood of insecure attachment; however, Wolke et al. (2014) found higher occurrence of disorganized attachment in high-risk preterm infants, and an earlier review (Bozzette, 2007) concluded that perturbed conditions for mothers to interact with their preterm infants were typical. Maternal behaviour during the first six months proved to be more influential on attachment quality than the infant's characteristics (Korja et al., 2012), which is particularly notable in light of the elevated risk in preterm mothers for depression and anxiety (Brandon et al., 2011; Pace

1 Both the term "bonding" and that of "attachment" refer to the early relationship between the parents and their infants. The two concepts in developmental science originate from different theoretical and methodological backgrounds. Central to both theories is the reciprocity of parent-infant relationship, yet the two terms are not synonyms as they cover distinct processes of the early relationship formation. The concept of bonding applies to the very early stage (directly post-birth and the subsequent weeks), and focuses on the caregiver's emotions, cognitions, behaviours, and the physical proximity of the dyad (Klaus & Kennel, 1976). Attachment theory interprets the relationship as a result of gradual building-up processes and internal representations over an extended period of the child's development and emphasizes the role of the caregiver's sensitivity (Bowlby, 1969; Ainsworth, 1979). Despite all this, confusion and inconsistencies frequently occur even in the scientific literature (Ettenberger et al., 2021; Kim et al., 2020).

et al., 2016; Treyvaud, 2014) as well as symptoms of posttraumatic stress (Gondwe & Holditch-Davis, 2015). The coping resources of parents depend on a host of background variables, including the availability of social and psycho-educational support (Halford & Petch, 2010). Participation in parenting intervention may well be one of the factors explaining the diversity in parental adjustment to the preterm infants' specific needs, thence the variety in the attachment quality in preterm infants.

Publications on intervention efforts to help parents of preterm infants have been available since the 1980s. Evans et al. (2014) reviewed controlled studies published until 2013 on parenting intervention aiming to improve the quality of the relationship between mothers and preterm infants. Out of 536 studies 17 met their rather strict selection criteria and of those, only eight demonstrated the effectiveness of the intervention. Recent reviews, however, suggest that attachment- and relationship-based interventions in NICU settings significantly improve mother–preterm infant interactions (Kim & Kim, 2022; Siva et al., 2025). All of these interventions share the facilitation of the parents' involved interactions with their infants as their core component while varying in terms of complexity, the personnel in contact with the parents, the parents' role in the sessions, the intensity, and the duration. In the Family-Centered Care Interventions (Evans et al., 2014; Kim & Kim, 2022; Siva et al., 2025), parents are encouraged to participate in the care of the infant while in the NICU and provided with education on the prematurity-related specific tasks. In the Video Interaction Guidance Interventions (Kim & Kim, 2022; Siva et al., 2025) parents watch a video on newborn interaction and discuss it with professionals, or the parents' interaction with their own infant is videotaped and subsequently discussed. The Kangaroo Mother Care Interventions (Evans et al., 2014; Kim & Kim, 2022; Siva et al., 2025) which may also be included in the more complex programs are based on the beneficial effects of skin-to-skin contact and ensure a quiet intimate dyadic situation with the high-risk infant with whom more active interactions are not yet feasible. The Infant Massage and Multisensory Interventions (Siva et al., 2025) encourage and teach parents how to use proper and sensitive stimulation.

Objectives

The risks threatening the parental role of the mothers and fathers of preterm infants on the one hand and the preterm infants' increased need of sensitive parenting on the other hand underscore the importance of early support for the parent-premature infant dyads. In recent years a rapid growth of the number and the variety of interventions offered to the families with preterm infants could be witnessed. The objective of this systematic review was to explore recent interventions aimed at enhancing parent–preterm infant bonding, attachment, and interaction.

The recent reviews of the published interventions are selective in that Kim and Kim (2022) included only studies using randomized controlled trials (RCT), while Siva et al. (2025) focused exclusively on the mother-infant relationship, and both of them covered solely NICU-based interventions. Our intention was to gain a wide overview of the present state of the art in the field, including not only NICU-based studies but also those conducted in the home of the families or by phone and the interventions involving fathers. We paid specific attention to the methodological challenges of the intervention effect research, such as the characteristics of samples, timing of assessments, measures of outcome, mediating, and moderating factors.

Methods

The protocol for this review adhered to the PRISMA Guidelines and Checklist. The review was not pre-registered at PROSPERO.

Eligibility Criteria and Search Strategy

The literature search was conducted between March 1 and March 31, 2024. Peer-reviewed articles published between January 2010 and March 2024 were reviewed, restricted to those published in English. Database searches were conducted through Web of Science, EMBASE, Medline, Pubmed, PsycInfo, EBSCO, and Cochrane databases. Only full-text articles with results presented were considered. Inclusion criteria applied to the sample (parent – preterm infant dyads or triads) and the focus of intervention (parent-infant interactions, bonding, or attachment). Search terms, exclusion, and inclusion criteria are presented in Table 1.

Article selection was completed by the research team. The steps of selection were as follows: With the use of the search terms (Table 1) 10,162 publications appeared which were screened for duplicates, and subsequently the inclusion and exclusion criteria were applied. After screening by title 242 articles remained; having examined the abstracts, 41 were picked out, and on the basis of the full texts, 19 studies were selected for final assessment (Figure 1). The 19 articles were published in 17 journals.

Assessment of Risk of Bias

The risk of bias was assessed using the Cochrane Risk of Bias Tools (2019) by the first and second authors (Anett Nagy and Magda Kalmár). Categories included randomization, deviation from intended interventions, missing outcome data, outcome measurement, and selection of reported results. The overall bias assessment was defined as follows: low risk of bias meant that the study was judged to have a low risk of bias in all domains; some concerns were noted if at least one category raised concerns; and high risk of bias was assigned if the study had a high risk in at least one category or concerns in more than one category. Disagreements were resolved by consensus discussion.

Results

Description of the Studies

The characteristics of the 19 selected studies are summarized in Table 2, with the following distribution by country: five (26.3%) from Iran, two (10.5%) from the United States, two (10.5%) from the Netherlands, two (10.5%) from Turkey, and one (5.2%) each from Japan, South Korea, Finland, Norway, Ireland, Hong Kong, and India. One study (5.2%) involved multiple countries: Argentina, Colombia, Israel, Norway, and Poland. The studies were published between 2010 and 2024, with two published in 2013, 2018, 2019, 2022, and 2024, one in 2010, 2011, 2015, 2017, 2020, and 2023, and three in 2021. The average number of clinical centers involved in the studies was 1.67 ($SD = 1.49$, range = 1–7). In terms of research design, 18 studies used experimental design (94.8%), of which 13 studies (68.4%) were randomized controlled trials (RCT), while the remaining one study (5.2%) was quasi-experimental.

Samples

In 16 studies the mother, in one study the father, and in two studies both parents participated. The samples altogether consisted of 1445 premature infants ($M = 80.28$, $SD = 44.57$, range = 30–186) and their parents. The total number of mothers was 1295 (18 studies; $M = 76.18$, $SD = 35.33$, range = 36–150); the total number of fathers was 242 (3 studies; $M = 80.67$, $SD = 62.14$, range = 30–150).

Designs

The typical design (in all studies except for two) was between-group comparison, with intervention groups compared to standard-care groups. Two studies (Chavan et al., 2024; Ghetti et al., 2023) used within-group design with pre- and post-intervention assessments in the target groups. The composition of the samples is shown in Table 2.

The target and the comparison groups were matched for gestational age and birth weight in all studies and in 11 also for parental education (mother: Cho et al., 2013; Jafarzadeh et al., 2019; Kadiroğlu & Güdücü Tüfekci, 2022; Khoramirad et al., 2024; Meijssen et al., 2010; Vahdati et al., 2017; father: Ravn et al., 2011; both parents: Heo & Oh, 2019; Hoffenkamp et al., 2015; Shoghi et al., 2018; Yu et al., 2022).

Table 1. Search Terms, Inclusion and Exclusion Criteria

Search terms, keywords	preterm OR prematur* OR „early delivery” OR „early onset of labour” AND mother OR father OR parent* OR family AND intervention OR attachment OR bond OR care OR interaction* OR parenting OR education* OR support* OR relation* OR NICU
Inclusion criteria	English language articles published between January 2010 and March 2024 Type of the article: full text, peer reviewed article Qualitative or quantitative methods Results presented Participants: parent-infant dyads Infants were born preterm with no congenital abnormalities Parents had no diagnosed mental disorders Intervention focused on parent-infant interactions, bonding or attachment
Exclusion criteria	Type of the article: review, pilot study or theoretical articles Duplicate articles Focus on medication, effect of COVID Interventions not aiming to enhance the interaction, bonding or attachment of parents-preterm infants The lack of the parents’ competence in the language of intervention High Risk of Bias according to Cochrane Risk of Bias Tools

Figure 1. Flow Diagram for Study Selection (PRISMA)

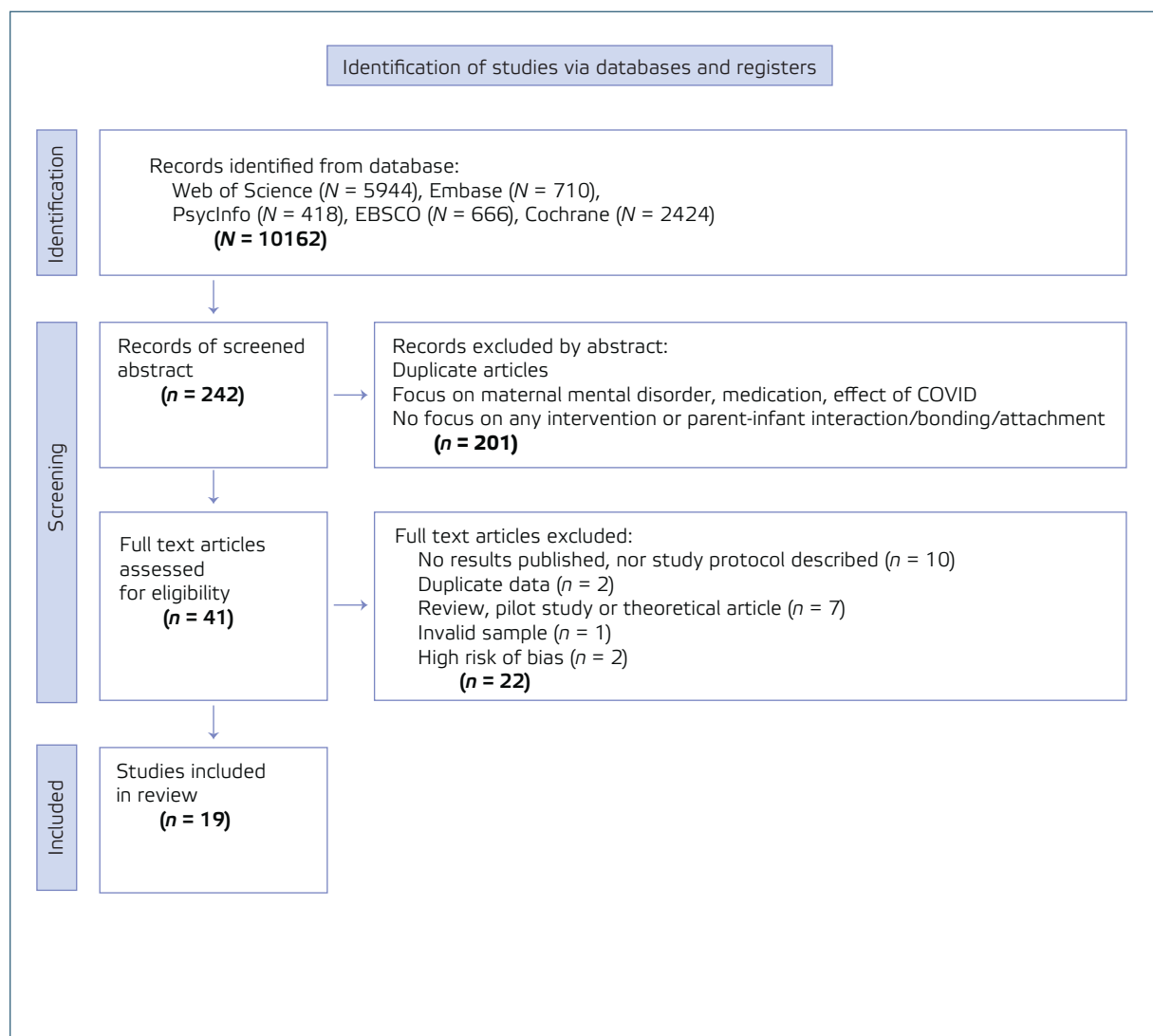


Table 2. Evaluation of Studies (N = 19)

First Author(s) (year)	Study design	Risk of bias	Country of study	C (N)	Inf (N)	Parents (N)	Groups		Gestational Age (weeks) Mean (SD) or range		Birth Weight (grams) Mean (SD)		Follow-up: duration / timing (corrected ages)
							IG	CG	IG	CG	IG	CG	
Beebe et al., 2018	RCT	low	United States	1	71	71 M	39	32	26-34	26-34			4 m
Chavan et al., 2024	exp	low	India	1	30	30 F	30	-	32.13 (2.36)	-	1270.27 (162.76)	-	3 m
Cho et al., 2013	quasi-exp	some concerns	Japan	3	43	43 M	23	20	29.51 (3.97)	30.76 (3.74)	1377.57 (624.6)	1451.5 (644.06)	12 m
Ghetti et al., 2023	RCT	low	Argentina, Colombia, Israel, Norway, Poland		186	186 M	103	102	30.2 (2.6)	30.69 (2.7)	1391.3 (420.9)	1423.45 (446.15)	12 m
Heo & Oh, 2019	RCT	low	South Korea	1	62	62 M-F	30	32	28.42 (2.67)	29.75 (3.19)	1139.6 (424.32)	1228.13 (441.79)	2 w
Hoffenkamp et al., 2015	RCT	low	The Nether- lands	7	150	150 M-F	75	75	32 (3.1)	32 (3.1)	1828 (735)	1770 (663)	1 d - 6 d -1 m - 6 m (post-par- tum)
Jafarzadeh et al., 2019	exp	some concerns	Iran	1	50	50 M	25	25	34.33 (1.11)	34.34 (1.05)	2178.6 (104.52)	2192.61 (363.82)	1 w after discharge
Kadiroğlu & Güdücü Tüfekci, 2022	exp	some concerns	Turkey	1	63	63 M	30	33	34-36	34-36			1 m
Khoramirad et al., 2024	exp	low	Iran	2	123	123 M	34+39	50	IG1: 30.7 (2.6); IG2: 31.5 (2.1)	31 (2.7)	IG1: Mean rank = 34(51) IG2: Mean rank = 57.5(48)	Mean rank = 62.4(33)	min 4, max 10 d
Kostilainen et al., 2020	mixed- method; RCT	low	Finland	3	36	36 M	24	12	30.2 (24.7-33.3)	30 (27.1-33.3)	1522 (900-2800)	1314 (925-2000)	40 gw
Kurt et al., 2020	quasi-exp	some concerns	Turkey	1	60	60 M	30	30	32.97 (2.47)	32.77 (2.65)	1985.83 (501.14)	2028.83 542.89)	5 d

(continued on the next page)

Table 2. (continued)

First Author(s) (year)	Study design	Risk of bias	Country of study	C (N)	Inf (N)	Parents (N)	Groups		Gestational Age (weeks) Mean (SD) or range		Birth Weight (grams) Mean (SD)	Follow-up: duration / timing (corrected ages)
							IG	CG	IG	CG		
Meijssen et al., 2010	RCT	low	The Netherlands	1	112	112 M	57	55	29.5 (2.1)	30.1 (1.9)	1246 (356)	6 m
Ravn et al., 2011	RCT	low	Norway	1	93	93 M	46	47	33.3 (1.4)	33.2 (1.3)	1935 (361)	12 m
Seiiedi-Biarag et al., 2021	RCT	low	Iran	1	66	66 M	34	32	31.53 (1.76)	31.29 (1.97)		8 w
Shoghi et al., 2018	RCT	some concerns	Iran	1	40	40 M	20	20	34-37	34-37	2500 >	5 d
Twohig et al., 2021	RCT	low	Ireland	1	72	72 M	37	35	28.4 (2.5)	28.3 (2.4)	1179 (475)	9 m (6 and 12 m developmental assessment)
Vahdati et al., 2017	RCT	some concerns	Iran	1	64	64 M	32	32	32.74 (1.81)	33.04 (1.98)	1673.90 (503.94)	mean 5.9 (SD 4.21) d
White-Traut et al., 2013	RCT	low	United States	2	142	142 M	66	76	32.2 (1.7)	32.5 (1.6)	1816 (374)	6 w
Yu et al., 2022	RCT	low	Hong Kong	1	48	48 M ¹	27	21	32.2 (2.7)	31.9 (2.8)	1700 (600)	3 w - 3 m - 6 m (9 m - 12 m developmental assessment)

Notes. IG = intervention group; CG = control group; RCT = randomized controlled trial; Exp = experimental; C = centers; Inf = Infants; M = mothers; F = fathers; M-F = mothers and fathers; CA = corrected age; gw = gestational week; d = day; w = week; m = month; Empty cells indicate that no data were reported.

Interventions

The direct targets of interventions were promoting parent-preterm dyad attachment, enhancing psychological and social relationships, improving parental sensitivity, fostering the newborn's self-regulation, and reducing socio-emotional disorders. Indirectly, the interventions aimed to reduce maternal stress, anxiety, and depression, while promoting maternal competence and mental health. The interventions are listed in [Table 3](#).

Most of the interventions involved the parent - newborn dyad, with both the parent and infant actively participating, such as in kangaroo care or infant massage (13 studies, 68.4%). We regarded parent-focused interventions those in which the parent received education or psychological support while the preterm infant was passively present, such as discussing videotaped sessions or involving the parents in the care of the infant in the hospital. In three studies (15.8%) the target was the mother, in two (10.5%) both parents, while in one (5.3%) the father.

The professionals implementing the interventions, in addition to the authors, included nurses, psychologists, psychologist assistants, paediatric physical therapists, and in one case a music therapist. The interventions can be sorted into seven categories:

1. Comprehensive programs of parental education (including video recordings), aiming at enhancing the engagement in care, promoting breastfeeding, skin-to-skin contact, and other bonding activities such as singing (eight studies);
2. Skin-to-skin interventions: kangaroo care (two studies) or infant massage (one study);
3. Music therapy (one study), singing or listening to music during kangaroo care (one study each);
4. Mindfulness-based neurodevelopmental care with the mother (one study);
5. Discussing video recordings of parent-child interaction (one study);
6. Hospital-based group or individual counselling (one study each);
7. Providing information via a phone app (one study).

The interventions were predominantly conducted in hospital settings (18 studies, 94.7%), with six studies continuing at home via home visits or ongoing therapy (Cho et al., 2013; Ghetti et al., 2023; Jafarzadeh et al., 2019; Kadiroğlu & Gündüç Tüfekci, 2022; Ravn et al., 2011; White-Traut et al., 2013), and one study (5.3%) was exclusively home-based (Meijssen et al., 2010).

Assessment of Outcomes

The majority of the studies followed up the subjects for periods ranging from a few days to a maximum of the child's corrected age of 12 months. In two studies (Jafarzadeh et al., 2019; Vahdati et al., 2017) post-tests were administered only immediately after completion of the intervention (see [Table 2](#) for details).

The instruments used in the studies are summarized in [Table 3](#). The studies employed a range of assessment techniques: Eight studies (42.1%) video-recorded mother-preterm dyad activities, though the coding used for analysis differed across studies. Trained professionals conducted the coding in all cases. In addition to behaviour coding, questionnaires were used to assess mother/father-infant bonding or attachment, maternal mental health, maternal competence, and infant behaviour. With respect to attachment outcomes, some studies focused on bonding, while others on attachment, typically reflecting the measures employed. However, conceptual distinctions were rarely discussed; in the papers by Kurt et al. (2020) and Shoghi et al. (2018), the two terms were even used interchangeably. In one study mothers were instructed to keep a diary, which was later analysed.

Statistical Analysis

The data analysis in the reviewed studies included t-test, ANOVA, ANCOVA, repeated measure analysis, linear regression, and mixed-effect model. Evaluation of the results was mainly based on the *p* values; effect sizes were reported only in five studies. The Cohen *d*'s were typically moderate (0.5; Kurt et al., 2020; Twohig et al., 2021; Yu et al., 2022). The *d* values were higher (0.5–0.8) in Cho et al. (2013), and lower (0.3–0.5) in Hoffenkamp et al. (2015).

Table 3. Studies According to Interventions, Outcomes and Effectiveness (N = 19)

Intervention	Data collection tools	Outcome variable(s)	Intervention effective	Preterm sample	First author(s) (year)
Family Nurture Intervention (FNI) Involving the mother in the care of the infant in the NICU	Demographic data Observation (video recording, coded)	Interaction	Yes	extremely preterms; very preterms; moderate to late preterms	Beebe et al., 2018
Kangaroo Father Care (KFC)	Postpartum Bonding Questionnaire (PBQ)	Bonding	Yes	very preterms; moderate to late preterms	Chavan et al., 2024
Japanese Infant Mental Health Program (JIMHP) Involving the mother in the care of the infant in the hospital	Demographic data Center of Epidemiologic Studies Depression Scale (CES-D) Nursing Child Assessment Feeding Scale (NCAFS) Social Support Scale (SSS) Parenting Stress Index (JPSI) Kyoto Scale of Psychological Development (KSPD)	Interaction Maternal mental health	Yes Yes	extremely preterms; very preterms; moderate to late preterms	Cho et al., 2013
Music therapy (MT) Individualized MT with a high level of parental involvement, provided in the NICU and at home during the first three months following discharge	Postpartum Bonding Questionnaire (PBQ) Edinburgh Postnatal Depression Scale (EPDS) Generalized Anxiety Disorder tool (GAD-7) Parental Stress Scale (PSS) Ages and Stages Questionnaire (ASQ)	Bonding Maternal mental health	No No	very preterms; moderate to late preterms	Ghetti et al., 2023
Parent Participation Improvement Program Involving the parents in the care of the infant in the hospital	Demographic data Pediatric Nurse-Parent Partnership Scale (PNPPS) Maternal Attachment Inventory (MAI)	Attachment	Yes	extremely preterms; very preterms; moderate to late preterms	Heo & Oh, 2019
Hospital-based video interaction guidance (HbVIG)	Demographic data Observation of parent-infant interaction (video recording, coded) Postpartum Bonding Questionnaire (PBQ) My Baby and I Questionnaire (MBI) Yale Inventory of Parental Thoughts and Actions (YIPTA) Parental Stress Scale: Neonatal Intensive Care Unit (PSS:NICU) Edinburgh Postnatal Depression Scale (EPDS) State-Trait Anxiety Inventory (STAI-State) State-Trait Anger Expression Inventory (STAXI2-State) Traumatic Event Scale (TES)	Interaction Bonding Maternal mental health	Yes Yes No	very preterms; moderate to late preterms	Hoffenkamp et al., 2015
Telenursing Consultation service by phone	Demographic data Parent Stressor Scale: Neonatal Intensive Care Unit (PSS-NICU) Maternal Postnatal Attachment (MPA)	Attachment Maternal mental health	Yes Yes	moderate to late preterms	Jafarzadeh et al., 2019
Infant Care Training (ICT) Involving the mother in the care of the infant in the hospital	Demographic data Maternal Bonding Scale (MBS) Perceived Maternal Parenting Self-Efficacy Scale (PMP-SE) Pharis Self-Confidence Scale (PSCS)	Bonding	Yes	moderate to late preterms	Kadiroğlu & Güdücü Tüfekci, 2022

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Table 3. (continued)

Intervention	Data collection tools	Outcome variable(s)	Intervention effective	Preterm sample	First author(s) (year)
Mindfulness based neurodevelopmental care	Demographic data Parental Stressor Scale: NICU (PSS: NICU) Mother-to-Infant Bonding Scale (MIBS)	Bonding Maternal mental health	Yes Yes	very preterms; moderate to late preterms	Khoramirad et al., 2024
Singing during Kangaroo Care	Demographic data State-Trait Anxiety Inventory (STAI) Parent diary Singing Experience Questionnaire (SEQ)	Interaction Maternal mental health	Yes Yes	extremely preterms; very preterms; moderate to late preterms	Kostilainen et al., 2020
Kangaroo Care	Demographic data Maternal Attachment Scale (MAS)	Attachment	Yes	very preterms; moderate to late preterms	Kurt et al., 2020
Infant Behavioral Assessment and Intervention Program (IBAIIP) Education of parents	Demographic data Still-face procedure – video recording Infant and Caregiver Engagement Phases (ICEP) Maternal Sensitivity and Responsivity Scales (MSRS)	Interaction	Yes	very preterms and/or very low birth weight	Meijssen et al., 2010
The Mother Infant Transaction Program (MITP) Involving the mother in the care of the infant in the hospital Education of parents	Demographic data Observation of mother-infant free play and semistructured play (video recording, coded) Qualitative Ratings for Parent-Child Interaction	Interaction	Yes	very preterms; moderate to late preterms	Ravn et al., 2011
Supportive counselling on mental health in parent groups	Demographic data General Health Questionnaire (GHQ) Postpartum Bonding Questionnaire (PBQ)	Bonding	Yes	very preterms	Seiiedi-Biarag et al., 2021
Infant massage by mothers	Demographic data Maternal Attachment Behaviors Scale (MABS)	Attachment	Yes	moderate-to late preterms	Shoghi et al., 2018
Preterm infant-parent programme for attachment (PIPPA study)	Demographic data Observation (video recording, coded) Child Adult Relationship Evaluation (CARE)-Index The Ages and Stages Questionnaire-Social-Emotional Development version (ASQ-SE)	Interaction	Yes	extremely preterms; very preterms	Twohig et al., 2021
Music during Kangaroo Care	Demographic data Video recording Avant's Maternal Attachment Assessment Scale (AMAAS)	Attachment	Yes	very preterms; moderate to late preterms	Vahdati et al., 2017
Hospital to Home: Optimizing the Infant's Environment (H-HOPE) Infant-directed: stimulation Mother-directed: education and social support	Demographic data Observation (video recording, coded) Nursing Child Assessment Satellite Training – Feeding Scale (NCAST-Feeding) Dyadic Mutuality Code (DMC)	Interaction	Yes	very preterms; moderate to late preterms	White-Traut et al., 2013
Mother-Infant Transaction Program (MITP) – modified version Individual coaching	Demographic data Observation (video recording, coded) Parenting Stress Index-Short Form (PSI-SF) Edinburgh Postnatal Depression Scale (EPDS) Infant Behavior Questionnaire (IBQ) Merrill-Palmer-Revised Scales of Development (MPR)	Interaction Maternal mental health	Yes Yes	very preterms; moderate to late preterms	Yu et al., 2022

Synthesis of the Outcomes

Parent-Infant Bonding and Attachment

As mentioned earlier, the studies employed a wide range of self-report questionnaires and rating scales to assess bonding or attachment (Table 3), covering parental attitudes, feelings, and behaviours. None of the studies measured attachment from the infant's perspective.

All but one of the 11 studies which assessed parental bonding or attachment reported positive impact of the intervention in comparing the target and the control groups (Heo & Oh, 2019; Hoffenkamp et al., 2015; Jafarzadeh et al., 2019; Kadiroğlu & Güdücü Tüfekci, 2022; Khoramirad et al., 2024; Kurt et al., 2020; Seiedi-Biarag et al., 2021; Shoghi et al., 2018; Vahdati et al., 2017) or between the pre- and the post-intervention results (Chavan et al., 2024). The only exception was the music therapy intervention (Ghetti et al., 2023) which had no effect on bonding. Kadiroğlu & Güdücü Tüfekci (2022), who measured both within-group and between-group changes, found significant improvement of bonding between the pretest and the posttest in both groups; however, the changes were more marked in the intervention group.

The two studies in which both mothers and fathers participated led to interesting results in that while the intervention had beneficial effects on bonding (Hoffenkamp et al., 2015) and attachment (Heo and Oh, 2019) in both parents, the improvement of fathers was particularly pronounced.

Parent-Infant Interaction

In all of the nine studies in which mother-infant interactions were observed, the interactions became more favourable following the intervention. The mothers became more sensitive (Beebe et al., 2018; Meijssen et al., 2010; Yu et al., 2022) and more involved (Cho et al., 2013). They were more likely to maintain positive contact using touch and vocalizations (Beebe et al., 2018), found it easier to connect with the infant (Kostilainen et al., 2020), and felt more responsive (White-Traut et al., 2013). Meijssen et al. (2010) reported that mothers in the intervention group showed more positive behaviours and were less controlling than the control mothers. In the study of Hoffenkamp et al. (2015), which covered both maternal and paternal interactions, the intervention led to an increase in sensitivity in both parents and a decrement in withdrawal behaviour in the mothers.

Mental Health and Maternal Competence

The studies which included maternal mental health measures reported promising results: Depression (Cho et al., 2013; Hoffenkamp et al., 2015; Yu et al., 2022), anxiety (Hoffenkamp et al., 2015; Kostilainen et al., 2020), and stress (Cho et al., 2013; Hoffenkamp et al., 2015; Jafarzadeh et al., 2019; Khoramirad et al., 2024; Yu et al., 2022) decreased in the mothers following the intervention. Kadiroğlu & Güdücü Tüfekci (2022), who measured maternal self-confidence, found positive changes between the pretest and the posttest in both groups; however, the improvement was more pronounced in the intervention mothers.

Discussion

Our systematic review aimed to explore intervention techniques aiming to facilitate high-quality attachment between parents and premature infants, as well as to promote harmonious interactions during the early postnatal period. 19 studies published between 2010 and 2024 from a range of countries, including the USA, Argentina, Colombia, Israel, Turkey, Iran, India, Japan, Hong Kong, South Korea, and several European countries (the Netherlands, Finland, Norway, Ireland, and Poland) were processed.

Statistically significant results of all but one (Ghetti et al., 2023) of the reviewed studies indicated that the interventions were successful in improving the quality of interactions and fostering the development of secure attachment. Various types of intervention were represented in the studies; with one exception all were based on the parent-infant dyadic context. Eight studies implemented comprehensive programs of parental education, comprising parent-infant interaction in various ways: involving the parents in the infant care in the NICU (Beebe et al., 2018; Cho et al., 2013; Heo & Oh, 2019; Ravn et al., 2011), after-discharge individual developmental care and assessment sessions (Meijssen et al., 2010), observing and discussing mother-infant interactions (Twohig et al., 2021; Yu et al., 2022), and multiple-modality infant stimulation (White-Traut et al.,

2013). Further interventions included parental education in less complex forms: video interaction guidance (Hoffenkamp et al., 2015), infant care training (Kadiroğlu & Güdücü Tüfekci, 2022), and „telenursing” by phone app (Jafarzadeh et al., 2019). Khoramirad et al. (2024) provided mindfulness-based neurodevelopmental care; Shoghi et al. (2018) trained the parents to use infant massage. Two studies implemented Kangaroo Care. The results of Kurt et al. (2020) are somewhat questionable since the potential influence of maternal education was not controlled for, although it was higher in the Kangaroo group and also had a significant effect on the outcome measure. The favourable findings of Chavan et al. (2024) are notable because the subjects were fathers, even though this study had a between-subject design with no control group. In two studies the basic condition for both the target and the control groups was Kangaroo Care, and music was used as intervention (singing: Kostilainen et al., 2020; listening: Vahdati et al., 2017). In the single exclusively parent-focused program (Seiiedi-Biarag et al., 2021) the mothers participated in group counselling on mental health.

The reviewed studies reflect a broad range of the methodological challenges of the field of intervention impact research, from the target samples and the duration of follow-up to the handling of the mediator and moderator factors.

As far as the subjects are concerned, these studies shared a common methodological shortcoming of prematurity research in that the subjects represent a wide range of preterm infants, hence hampering the generalization of the findings. The practical implication of this is a compelling need to tailor the interventions to the specific needs of individual premature infants, especially those in severe medical conditions whose needs might be obscured in such mixed samples. Most of the studies were conducted with very to moderately preterm infants. There was a notable lack of interventions specifically targeting extremely premature (i.e., born before 28 weeks of gestation) or extremely low birth weight (ELBW; i.e., birth weight of less than 1000 g) infants, despite this group being at the highest risk for attachment difficulties (Yerlikaya Oral & Karaçetin, 2024). The scarcity of interventions for ELBW infants may be explained by recruiting obstacles due to their critical health status and longer stays in the NICU.

In all but three studies parents were represented only by the mothers. The difficulty of recruiting fathers for such kinds of research is well-known and is unfortunate in light of the increasingly acknowledged importance of the fathers' role (e.g., Bakermans-Kranenburg et al., 2019; Brown et al., 2012; Lamb, 2002) as well as the psychological challenges and feelings of isolation fathers are exposed to when their infant is born prematurely (Baldoni et al., 2021). The findings by Chavan et al. (2024), Heo and Oh (2019), and Hoffenkamp et al. (2015), suggesting that the father's bonding to the infant improved owing to the intervention (even more than the mother's, in the study of Hoffenkamp et al. [2015]), are particularly noteworthy.

A typical methodological difficulty of longitudinal research pertains to the duration of the follow-up, which is also clearly represented in the reviewed studies. Five studies followed the samples until the infants reached 12 months of corrected age (Cho et al., 2013; Ghetti et al., 2023; Ravn et al., 2011; Twohig et al., 2021; Yu et al., 2022), while the rest did so only for a few months or weeks. The lack of the longer-term follow-ups is particularly regrettable in light of the fact that attachment stability may not fully develop before the infant reaches one year of age.

Only two studies included multiple outcome measurement points (Hoffenkamp et al., 2015; Yu et al., 2022), and in both the interventions effects tended to fade (although remained significant) over the 6-month period following the termination of the treatment.

As far as the instruments measuring the outcome are concerned, there was a variety to assess interactions (coded observation and rating scales); however, for attachment it was restricted to the use of parental self-report questionnaires and rating scales. Observational data, particularly such covering the infant's behaviour, would have increased the validity of attachment measurement.

The review cannot answer the question as to which types of interventions might be more valuable than the others. In addition to the heterogeneity of subjects, duration, and assessment tools and measures, the lack of reporting of the effect sizes in the majority of studies prevents the quantitative comparison of the intervention effects. In addition, it is hard to rule out that involving the parents in intervention may be beneficial in itself, regardless of the actual components of the program.

Several interventions were complex, consisting of various components (parental counselling, video recordings, singing, skin-to-skin contact, etc). As far as research is concerned, it becomes a shortcoming since in case the program proves to be successful, it is impossible to identify to what extent each of the components contributed to the results. It is quite likely that decision makers could more easily be persuaded to finance such intervention programs if there were clear-cut evidences of the power of the various activities. On the other hand, a combination of different types of support to the parents of high-risk infants may be natural in the clinical practice, and the use of any techniques for which competent providers are available can be recommended.

The variances in the impact of intervention on the participating parents are considerable. Parental and infant characteristics as well as external circumstances may well influence the action mechanisms. Potential moderator effects

were investigated in several studies; however, significant results were reported only in three. In the study of Hoffenkamp et al. (2015), the subset of mothers who experienced the preterm birth as traumatic benefited more from the intervention both in interactive behaviour and bonding. Ravn et al. (2011) found that being a first-time mother enhanced the effects of the intervention on sensitivity, responsiveness, and dyadic synchrony. Infant variable was detected to have an effect only by Beebe et al. (2018): Gaze interactive contingency improved only in mothers of male infants.

Inclusion of potential mediators (e.g., the infants' medical status, available social support, the setting - hospital vs. home, provision of conditions) and sophisticated multivariate statistical analyses could ensure deeper understanding of what factors the impacts of a particular intervention may have depended on and why it turned out more effective in some dyads than in others.

Strengths and Limitations

Whereas this review provides insights into the interventions which appear to promote bonding and attachment between parents and premature infants, several limitations should be noted.

Although a meta-analysis might have provided an even more informative overview of the studies available in the field, in this case it was not feasible due to the lack of homogeneity of the preterm infant groups in perinatal status (gestational age and medical conditions) as well as the diversity in other aspects of methodology (assessment instruments, intensity and duration of intervention, statistical analysis). The methodological heterogeneity cautions against the generalization of findings.

The studies primarily focused on very to moderate preterm infants. The research interest in the extremely immature or extremely low birth weight (ELBW) infants seems to be rather limited, which is unfortunate since this group is at the highest risk in every respect, including the attachment difficulties. Although it is explained by the much greater proportion of moderate and very preterms, as well as the difficulty of working with the most fragile infants, designing and testing interventions tailored specifically for ELBW infants would be desperately needed, given the increasing survival rates of the latter group owing to the rapid advances in neonatal care.

With respect to the theoretical foundations of the studies, the lack of clear distinction between the concepts „bonding” and „attachment” as the target of intervention (hence in the choice of outcome measures) renders the comparability of studies questionable (Ettenberger et al., 2021) and hampers the interpretation of the results (Kim et al., 2020).

Conclusion, Implications, and Future Directions

Taking into consideration the methodological challenges of the intervention effect research, the results of the reviewed studies mainly suggest that the successes of the programs are noteworthy.

The major message to be inferred from the reported findings is that early intervention may counteract the risks threatening the parent–preterm infant interactions and attachment by enhancing parental sensitivity and reducing parental anxiety, depression, and stress. Most of the interventions focused on maternal-infant bonding, while some also covered paternal involvement, which proved to be particularly efficient. A wide range of techniques were implemented in the intervention programmes from medium-intensity ones such as telenursing or group activities to high-intensity individual counselling and therapy, with all appearing beneficial.

The few studies involving fathers suggest a promising new direction of research. A further recommendation for future research is that in order to understand the variation of outcomes and design interventions to fulfil the specific needs of preterm infants and their families, more attention should be paid to the potential moderator and mediator factors.

Even though the duration is a common challenge of longitudinal studies, researchers should make all efforts to extend the follow-up to reach the age when attachment is stabilized to make it feasible to assess the long-term effects of early interventions.

The implications of these findings for clinical practice are that early intervention targeting the parent–infant interactions and bonding should be included in the routine care provided to families with preterm infants. The intervention, preferably beginning in the Neonatal Intensive Care Units (NICUs), may include kangaroo care, skin-to-skin contact, and parental education, counselling, or therapy. The involvement of both parents, especially the fathers, may strengthen the family unit and promote secure attachment in both the mother-infant and the father-infant relationships. Healthcare professionals should be trained to support parents in bonding with their premature newborns, including providing emotional and psychological support throughout the NICU stay and beyond.

GLOSSARY OF ABBREVIATIONS

AMAAS – Avant’s Maternal Attachment Assessment Scale
ASQ – Ages and Stages Questionnaire
ASQ-SE – Ages and Stages Questionnaire-Social–Emotional Development version
BPD – Bronchopulmonary Dysplasia
CA – Corrected Age
CARE – Child–Adult Relationship Evaluation
CES-D – Center for Epidemiologic Studies-Depression Scale
CG – Control Group
COVID – Coronavirus Disease
DMC – Dyadic Mutuality Code
ELBW – Extremely Low Birth Weight
EPDS – Edinburgh Postnatal Depression Scale
FNI – Family Nurture Intervention
GAD – Generalized Anxiety Disorder (scale)
GHQ – General Health Questionnaire
HOPE – Hospital to Home: Optimizing the Infant’s Environment
IBAIP – Infant Behavioral Assessment and Intervention Program
IBQ – Infant Behavior Questionnaire
ICEP – Infant and Caregiver Engagement Phases
ICT – Infant Care Training
IG – Intervention Group
IVH – Intraventricular Haemorrhage
JIMHP – Japanese Infant Mental Health Program
JPSI – Japanese Parenting Stress Index
KFC – Kangaroo Father Care
KSPD – Kyoto Scale of Psychological Development
MABS – Maternal Attachment Behaviors Scale
MAI – Maternal Attachment Inventory
MAS – Maternal Attachment Scale
MBI – My Infant and I Questionnaire
MBS – Maternal Bonding Scale
MIBS – Mother-to-Infant Bonding Scale
MITP – Mother–Infant Transaction Program
MPA – Maternal Postnatal Attachment
MPR – Merrill–Palmer–Revised Scales of Development
MSRS – Maternal Sensitivity and Responsivity Scales
MT – Music Therapy
NCAFS – Nursing Child Assessment Feeding Scale
NCAS – Nursing Child Assessment Satellite Training
NIC – Neonatal Intensive Care (used as short form)
NICU – Neonatal Intensive Care Unit
PBQ – Postpartum Bonding Questionnaire
PIPPA – Preterm Infant–Parent Programme for Attachment
PMP – Perceived Maternal Parenting (e.g., PMP-SE)
PNPPS – Pediatric Nurse–Parent Partnership Scale
PSCS – Pharis Self-Confidence Scale
PSI-FS – Parenting Stress Index-Short Form
PSS – Parental Stress Scale (or NICU version: PSS:NICU)
PVL – Periventricular Leukomalacia
RCT – Randomized Controlled Trial
ROP – Retinopathy of Prematurity

SEQ – Singing Experience Questionnaire
SSS – Social Support Scale
STAI – State–Trait Anxiety Inventory
TES – Traumatic Event Scale
WHO – World Health Organization
YIPTA – Yale Inventory of Parental Thoughts and Actions

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References

- Ainsworth, M. D. S. (1979). Infant–mother attachment. *American Psychologist*, 34(10), 932–937.
<https://doi.org/10.1037/0003-066X.34.10.932>
- Als, H., & Brazelton, T. B. (1981). A new model of assessing behavioral organization in preterm and fullterm infants. *Journal of the American Academy of Child Psychiatry*, 20(2), 239–263.
[https://doi.org/10.1016/S0002-7138\(09\)60987-0](https://doi.org/10.1016/S0002-7138(09)60987-0)
- Arhan, E., Gücüyener, K., Soysal, Ş., Şalvarlı, Ş., Gürses, M. A., Serdaroglu, A., Demir, E., Ergenekon, E., Türkyılmaz, C., Önal, E., Koç, E., & Atalay, Y. (2017). Regional brain volume reduction and cognitive outcomes in preterm children at low risk at 9 years of age. *Child's Nervous System*, 33, 1317–1326.
<https://doi.org/10.1007/s00381-017-3421-2>

- Axford, S. B., Burnett, A. C., Seid, A. M., Anderson, P. J., Waterland, J. L., Gilchrist, C. P., Olsen, J. E., Nguyen, T.-N.-N., Doyle, L. W., & Cheong, J. L. Y. (2025). Risk factor effects on neurodevelopment at 2 years in very preterm children: A systematic review. *Pediatrics*, 155(6), Article e2024069565.
<https://doi.org/10.1542/peds.2024-069565>
- Aylward, G. P., Pfeiffer, S. I., Wright, A., & Verhulst, S. J. (1989). Outcome studies of low birth weight infants published in the last decade: A metaanalysis. *The Journal of Pediatrics*, 115(4), 515–520.
[https://doi.org/10.1016/S0022-3476\(89\)80273-2](https://doi.org/10.1016/S0022-3476(89)80273-2)
- Bakermans-Kranenburg, M. J., Lotz, A., Alyousefi-van Dijk, K., & van IJzendoorn, M. (2019). Birth of a father: Fathering in the first 1,000 days. *Child Development Perspectives*, 13(4), 247–253.
<https://doi.org/10.1111/cdep.12347>
- Baldoni, F., Ancora, G., & Latour, J. M. (2021). Being the father of a preterm-born child: Contemporary research and recommendations for NICU staff. *Frontiers in Pediatrics*, 9, Article 724992.
<https://doi.org/10.3389/fped.2021.724992>
- Beebe, B., Myers, M. M., Lee, S. H., Lange, A., Ewing, J., Rubinchik, N., Andrews, H., Austin, J., Hane, A., Margolis, A. E., Hofer, M., Ludwig, R. J., & Welch, M. G. (2018). Family nurture intervention for preterm infants facilitates positive mother–infant face-to-face engagement at 4 months. *Developmental Psychology*, 54(11), 2016–2031.
<https://doi.org/10.1037/dev0000557>
- Behboodi, S., Chaimani, A., Benhammou, V., Twilhaar, E. S., Johnson, S., Zeitlin, J., & Sentenac, M. (2025). Trends over time in cognitive outcomes of children born very preterm: A systematic review and meta-analysis. *JAMA Pediatrics*, 179(10), 1074–1081.
<https://doi.org/10.1001/jamapediatrics.2025.2221>
- Behrman, R. E., & Butler, A. S. (Eds.). (2007). *Preterm birth: Causes, consequences, and prevention*. Institute of Medicine (US) Committee on Understanding Premature Birth and Assuring Healthy Outcomes; National Academies Press.
- Bowlby, J. (1969). *Attachment and loss: Vol. 1. Attachment*. Basic Books.
- Bozzette, M. (2007). A review of research on premature infant–mother interaction. *Newborn and Infant Nursing Reviews*, 7(1), 49–55.
<https://doi.org/10.1053/j.nainr.2006.12.002>
- Brandon, D. H., Tully, K. P., Silva, S. G., Malcolm, W. F., Murtha, A. P., Turner, B. S., & Holditch-Davis, D. (2011). Emotional responses of mothers of late-preterm and term infants. *Journal of Obstetric, Gynecologic, & Neonatal Nursing*, 40(6), 719–731.
<https://doi.org/10.1111/j.1552-6909.2011.01290.x>
- Breeman, L. D., Jackel, J., Baumann, N., Bartmann, P., & Wolke, D. (2015). Preterm cognitive function into adulthood. *Pediatrics*, 136(3), 415–423.
<https://doi.org/10.1542/peds.2015-0608>
- Brown, G. L., Mangelsdorf, S. C., & Neff, C. (2012). Father involvement, paternal sensitivity, and father–child attachment security in the first three years. *Journal of Family Psychology*, 26(3), 421–430.
<https://doi.org/10.1037/a0027836>
- Chavan, A., Paul, N., Manerkar, S., Krishna DSN, A., Gupta, A., Sahu, T. K., Kalathingal, T., Krishna, V. V., & Mondkar, J. (2024). Impact of kangaroo father care in stable very low birth weight infants on father–infant bonding. *Journal of Neonatal Nursing*, 30(3), 293–296.
<https://doi.org/10.1016/j.jnn.2023.10.012>
- Cho, Y., Hirose, T., Tomita, N., Shirakawa, S., Murase, K., Komoto, K., Nagayoshi, M., Okamitsu, M., & Omori, T. (2013). Infant mental health intervention for preterm infants in Japan: Promotions of maternal mental health, mother–infant interactions, and social support by providing continuous home visits until the corrected infant age of 12 months. *Infant Mental Health Journal*, 34(1), 47–59.
<https://doi.org/10.1002/imhj.21352>
- Ding, L., Huang, J., Yan, X., Zhong, G., Yu, Z., Liu, D., & Wu, B. (2025). A comprehensive benchmark of very preterm and extremely preterm infant care in Shenzhen: Insights from the triple aim framework. *Italian Journal of Pediatrics*, 51, Article 186.
<https://doi.org/10.1186/s13052-025-02043-2>
- Doyle, L. W., Cheong, J. L. Y., Burnett, A., Roberts, G., Lee, K. J., Anderson, P. J., & Victorian Infant Collaborative Study Group. (2015). Biological and social influences on outcomes of extreme-preterm/low-birth weight adolescents. *Pediatrics*, 136(6), e1513–e1520.
<https://doi.org/10.1542/peds.2015-2006>
- Ettenberger, M., Bieleninik, L., Epstein, S., & Elefant, C. (2021). Defining attachment and bonding: Overlaps, differences and implications for music therapy clinical practice and research in the neonatal intensive care unit (NICU). *International Journal of Environmental Research and Public Health*, 18(4), Article 1733.
<https://doi.org/10.3390/ijerph18041733>
- Evans, T., Whittingham, K., Sanders, M., Colditz, P., & Boyd, R. N. (2014). Are parenting interventions effective in improving the relationship between mothers and their preterm infants? *Infant Behavior and Development*, 37(2), 131–154.
<https://doi.org/10.1016/j.infbeh.2013.12.009>
- García, H., Villasis-Keever, M. A., Zavala-Vargas, G., Bravo-Ortiz, J. C., Pérez-Méndez, A., & Escamilla-Núñez, A. (2024). Global prevalence and severity of retinopathy of prematurity over the last four decades (1985–2021): A systematic review and meta-analysis. *Archives of Medical Research*, 55(2), Article 102967.
<https://doi.org/10.1016/j.arcmed.2024.102967>
- Ghetti, C. M., Gaden, T. S., Bieleninik, Ł., Kvestad, I., Assmus, J., Stordal, A. S., Aristizabal Sanchez, L. F., Arnon, S., Dulsrud, J., Elefant, C., Epstein, S., Ettenberger, M., Glosli, H., Konieczna-Nowak, L., Lichtensztein, M., Lindvall, M. W., Mangersnes, J., Murcia Fernández, L. D., Røed, C. J., ... Gold, C. (2023). Effect of music therapy on parent–infant bonding among infants born preterm: A randomized clinical trial. *JAMA Network Open*, 6(5), Article e2315750.
<https://doi.org/10.1001/jamanetworkopen.2023.15750>
- Gondwe, K. W., & Holditch-Davis, D. (2015). Posttraumatic stress symptoms in mothers of preterm infants. *International Journal of Africa Nursing Sciences*, 3, 8–17.
<https://doi.org/10.1016/j.ijans.2015.05.002>
- Hadders-Algra, M. (2005). Prematurity and low birthweight. In B. Hopkins (Ed.), *The Cambridge encyclopedia of child development* (pp. 442–447). Cambridge University Press.

- Halford, W. K., & Petch, J. (2010). Couple psychoeducation for new parents: Observed and potential effects on parenting. *Clinical Child and Family Psychology Review*, 13, 164–180. <https://doi.org/10.1007/s10567-010-0066-z>
- Hendy, A., El-Sayed, S., Bakry, S., Mohammed, S. M., Mohamed, H., Abdelkawy, A., Hassani, R., Abouelela, M. A., & Sayed, S. (2024). The stress levels of premature infants' parents and related factors in NICU. *SAGE Open Nursing*, 10, Article 23779608241231172. <https://doi.org/10.1177/23779608241231172>
- Heo, Y. J., & Oh, W.-O. (2019). The effectiveness of a parent participation improvement program for parents on partnership, attachment, and infant growth in a neonatal intensive care unit: A randomized controlled trial. *International Journal of Nursing Studies*, 95, 19–27. <https://doi.org/10.1016/j.ijnurstu.2019.03.018>
- Hoffenkamp, H. N., Tooten, A., Hall, R. A. S., Braeken, J., Eliëns, M. P. J., Vingerhoets, A. J. J. M., & van Bakel, H. J. A. (2015). Effectiveness of hospital-based video interaction guidance on parental interactive behavior, bonding, and stress after preterm birth: A randomized controlled trial. *Journal of Consulting and Clinical Psychology*, 83(2), 416–429. <https://doi.org/10.1037/a0038401>
- Ionio, C., Ciuffo, G., Colombo, C., Melani, O., Figliano, M. F., Landoni, M., Castoldi, F., Cavigioli, F., & Lista, G. (2024). Preterm birth and maternal mood states: What is the impact on bonding? *Pediatric Reports*, 16(1), 35–45. <https://doi.org/10.3390/pediatric16010004>
- Jaekel, J., Pluess, M., Belsky, J., & Wolke, D. (2015). Effects of maternal sensitivity on low birth weight children's academic achievement: A test of differential susceptibility versus diathesis stress. *Journal of Child Psychology and Psychiatry*, 56(6), 693–701. <https://doi.org/10.1111/jcpp.12331>
- Jafarzadeh, Z. A., Maghsoudi, J., Barekatain, B., & Marofi, M. (2019). Effect of telenursing on attachment and stress in mothers of preterm infants. *Iranian Journal of Neonatology*, 10(1), 65–71. <https://doi.org/10.22038/ijn.2018.29890.1406>
- Jurišová, E., Ráčková, L., Začková, M., & Romanová, M. (2025). Cognitive, language, and motor developmental patterns of extremely preterm children up to 2 years of age: A descriptive approach. *Frontiers in Psychology*, 16, Article 1599390. <https://doi.org/10.3389/fpsyg.2025.1599390>
- Kadiroğlu, T., & Gülüçü Tüfekci, F. (2022). Effect of infant care training on maternal bonding, motherhood self-efficacy, and self-confidence in mothers of preterm newborns. *Maternal and Child Health Journal*, 26, 131–138. <https://doi.org/10.1007/s10995-021-03287-0>
- Khoramirad, A., Taheri, L., Eskandari, N., & Abedini, Z. (2024). Effect of mindfulness-based neurodevelopmental care on infant outcomes in NICU. *Journal of Neonatal Nursing*, 30(3), 237–242. <https://doi.org/10.1016/j.jnn.2023.10.001>
- Kim, A. R., Kim, S.-Y., & Yun, J. E. (2020). Attachment and relationship-based interventions for families during neonatal intensive care hospitalization: A study protocol for a systematic review and meta-analysis. *Systematic Reviews*, 9, Article 61. <https://doi.org/10.1186/s13643-020-01331-8>
- Kim, S.-Y., & Kim, A. R. (2022). Attachment- and relationship-based interventions during NICU hospitalization for families with preterm/low-birth weight infants: A systematic review of RCT data. *International Journal of Environmental Research and Public Health*, 19(3), Article 1126. <https://doi.org/10.3390/ijerph19031126>
- Klaus, M. H., & Kennell, J. H. (1976). *Maternal-infant bonding: The impact of early separation or loss on family development*. Mosby.
- Korja, R., Latva, R., & Lehtonen, L. (2012). The effects of preterm birth on mother–infant interaction and attachment during the infant's first two years. *Acta Obstetrica et Gynecologica Scandinavica*, 91(2), 164–173. <https://doi.org/10.1111/j.1600-0412.2011.01304.x>
- Kostilainen, K., Mikkola, K., Erkkilä, J., & Huottilainen, M. (2020). Effects of maternal singing during kangaroo care on maternal anxiety, wellbeing, and mother–infant relationship after preterm birth: A mixed methods study. *Nordic Journal of Music Therapy*, 30(4), 357–376. <https://doi.org/10.1080/08098131.2020.1837210>
- Kurt, F. Y., Kucukoglu, S., Ozdemir, A. A., & Ozcan, Z. (2020). The effect of kangaroo care on maternal attachment in preterm infants. *Nigerian Journal of Clinical Practice*, 23(1), 26–32. https://doi.org/10.4103/njcp.njcp_143_18
- Lamb, M. E. (2002). Infant–father attachments and their impact on child development. In N. J. Cabrera, C.S. Tamis-LeMonda (Eds.), *Handbook of father involvement*. Routledge.
- Lionetti, F., Sperati, A., Spinelli, M., Dellagiulia, A., Fasolo, M., & Pluess, M. (2025). Exploring preterm birth and low birth weight as environmental sensitivity factors: A scoping review of socio-emotional and cognitive developmental outcomes. *Neuroscience & Biobehavioral Reviews*, 175, Article 106216. <https://doi.org/10.1016/j.neubiorev.2025.106216>
- Meijssen, D., Wolf, M.-J., Koldewijn, K., Houtzager, B. A., van Wassenae, A., Tronick, E., Kok, J., & van Baar, A. (2010). The effect of the Infant Behavioral Assessment and Intervention Program on mother–infant interaction after very preterm birth. *Journal of Child Psychology and Psychiatry*, 51(11), 1287–1295. <https://doi.org/10.1111/j.1469-7610.2010.02237.x>
- Ohuma, E. O., Moller, A.-B., Bradley, E., Chakwera, S., Hussain-Alkhateeb, L., Lewin, A., Okwaraji, Y. B., Mahanani, W. R., White Johansson, E., Lavin, T., Estevez Fernandez, D., Gatica Domínguez, G., de Costa, A., Cresswell, J. A., Krasevec, J., Lawn, J. E., Blencowe, H., Requejo, J., & Moran, A. C. (2023). National, regional, and global estimates of preterm birth in 2020, with trends from 2010: A systematic analysis. *The Lancet*, 402(10409), 1261–1271. [https://doi.org/10.1016/S0140-6736\(23\)00878-4](https://doi.org/10.1016/S0140-6736(23)00878-4)
- O'Meagher, S., Kemp, N., Norris, K., Anderson, P., & Skilbeck, C. (2017). Risk factors for executive function difficulties in preschool and early school-age preterm children. *Acta Paediatrica*, 106(9), 1468–1473. <https://doi.org/10.1111/apa.13915>
- Pace, C. C., Spittle, A. J., Molesworth, C. M.-L., Lee, K. J., Northam, E. A., Cheong, J. L. Y., Davis, P. G., Doyle, L. W., Treyvaud, K., & Anderson, P. J. (2016). Evolution of depression and anxiety symptoms in parents of very preterm infants during the newborn period. *JAMA Pediatrics*, 170(9), 863–870. <https://doi.org/10.1001/jamapediatrics.2016.0810>
- Posada, G., & Kaloustian, G. (2010). Attachment in infancy. In J. G. Bremner & T. D. Wachs (Eds.), *The Wiley-Blackwell handbook of infant development: Vol.1*. (2nd ed., pp. 483–509). Blackwell Publishing. <https://doi.org/10.1002/9781444327564.ch16>

- Potharst, E. S., Houtzager, B. A., van Sonderen, L., Tamminga, P., Kok, J. H., Last, B. F., & van Wassenae, A. G. (2012). Prediction of cognitive abilities at the age of 5 years using developmental follow-up assessments at the age of 2 and 3 years in very preterm children. *Developmental Medicine and Child Neurology*, 54(3), 240–246.
<https://doi.org/10.1111/j.1469-8749.2011.04181.x>
- Ravn, I. H., Smith, L., Lindemann, R., Smeby, N. A., Kyno, N. M., Bunch, E. H., & Sandvik, L. (2011). Effect of early intervention on social interaction between mothers and preterm infants at 12 months of age: A randomized controlled trial. *Infant Behavior and Development*, 34(2), 215–225.
<https://doi.org/10.1016/j.infbeh.2010.11.004>
- Reis, A. B. R., de Mello, R. R., Morsch, D. S., Meio, M. D. B. B., & da Silva, K. S. (2012). Mental performance of very low birth weight preterm infants: Assessment of stability in the first two years of life and factors associated with mental performance. *Revista Brasileira de Epidemiologia*, 15(1), 13–24.
<https://doi.org/10.1590/s1415-790x2012000100002>
- Sameroff, A. (2009). The transactional model. In A. Sameroff (Ed.), *The transactional model of development: How children and contexts shape each other* (pp. 3–21). American Psychological Association.
<https://doi.org/10.1037/11877-001>
- Seiiedi-Biarag, L., Mirghafourvand, M., Esmailpour, K., & Hasanpour, S. (2021). A randomized controlled clinical trial of the effect of supportive counseling on mental health in Iranian mothers of premature infants. *BMC Pregnancy and Childbirth*, 21, Article 6.
<https://doi.org/10.1186/s12884-020-03502-w>
- Shaw, R. J., Givrad, S., Poe, C., Loi, E. C., Hoge, M. K., & Scala, M. (2023). Neurodevelopmental, mental health, and parenting issues in preterm infants. *Children*, 10(9), Article 1565.
<https://doi.org/10.3390/children10091565>
- Shoghi, M., Sohrabi, S., & Rasouli, M. (2018). The effects of massage by mothers on mother-infant attachment. *Alternative Therapies in Health and Medicine*, 24(3), 34–39.
- Siva, N., Nayak, B. S., Lewis, L. E. S., Velayudhan, B., & Noronha, J. A. (2025). Intervention strategies to enhance early mother-infant interaction at NICU: A systematic review. *Journal of Neonatal Nursing*, 31(3), Article 101671.
<https://doi.org/10.1016/j.jnn.2025.101671>
- Treyvaud, K. (2014). Parent and family outcomes following very preterm or very low birth weight birth: A review. *Seminars in Fetal and Neonatal Medicine*, 19(2), 131–135.
<https://doi.org/10.1016/j.siny.2013.10.008>
- Twohig, A., Murphy, J. F., McCarthy, A., Segurado, R., Underdown, A., Smyke, A., McNicholas, F., & Molloy, E. J. (2021). The preterm infant–parent programme for attachment—PIPPA study: A randomised controlled trial. *Pediatric Research*, 90, 617–624.
<https://doi.org/10.1038/s41390-020-01262-z>
- Vahdati, M., Mohammadzadeh, M., & Talakoub, S. (2017). Effect of kangaroo care combined with music on the mother–premature neonate attachment: A randomized controlled trial. *Iranian Journal of Nursing and Midwifery Research*, 22(5), 403–407.
https://doi.org/10.4103/ijnmr.IJNMR_50_16
- White-Traut, R., Norr, K. F., Fabiyi, C., Rankin, K. M., Li, Z., & Liu, L. (2013). Mother–infant interaction improves with a developmental intervention for mother–preterm infant dyads. *Infant Behavior and Development*, 36(4), 694–706.
<https://doi.org/10.1016/j.infbeh.2013.07.004>
- Wolke, D., Eryigit-Madzwamuse, S., & Gutbrod, T. (2014). Very preterm/very low birthweight infants' attachment: Infant and maternal characteristics. *Archives of Disease in Childhood – Fetal and Neonatal Edition*, 99, F70–F75.
<https://doi.org/10.1136/archdischild-2013-303788>
- World Health Organization. (2023). *Born too soon: Decade of action on preterm birth* (1st ed.). World Health Organization.
- Yan, C., Gong, X., Luo, H., Liu, Y., Lin, Y., Weng, B., & Cai, C. (2024). Impact of implementation of 2019 European respiratory distress syndrome guidelines on bronchopulmonary dysplasia in very preterm infants. *Italian Journal of Pediatrics*, 50, Article 178.
<https://doi.org/10.1186/s13052-024-01752-4>
- Yerlikaya Oral, E., & Karaçetin, G. (2024). Preterm birth's effects on attachment. *Cam and Sakura Medical Journal*, 4(2), 39–47.
<https://doi.org/10.4274/csmedj.galenos.2024.2024-7-1>
- Yu, N. K. K., Shum, K. K.-M., Lam, Y. Y., Kwan, Q. K. L., Ng, S. Y. P., & Chan, N. T. T. (2022). Sensitivity training for mothers with premature infants: A randomized controlled trial. *Journal of Pediatric Psychology*, 47(10), 1167–1184.
<https://doi.org/10.1093/jpepsy/jsac051>