

BMJ Open Effects of parenting interventions for at-risk parents with infants: a systematic review and meta-analyses

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ABSTRACT

Objectives Infancy is a critical stage of life, and a secure relationship with caring and responsive caregivers is crucial for healthy infant development. Early parenting interventions aim to support families in which infants are at risk of developmental harm. Our objective is to systematically review the effects of parenting interventions on child development and on parent–child relationship for at-risk families with infants aged 0–12 months.

Design This is a systematic review and meta-analyses. We extracted publications from 10 databases in June 2013, January 2015 and June 2016, and supplemented with grey literature and hand search. We assessed risk of bias, calculated effect sizes and conducted meta-analyses.

Inclusion criteria (1) Randomised controlled trials of structured psychosocial interventions offered to at-risk families with infants aged 0–12 months in Western Organisation for Economic Co-operation and Development (OECD) countries, (2) interventions with a minimum of three sessions and at least half of these delivered postnatally and (3) outcomes reported for child development or parent–child relationship.

Results Sixteen studies were included. Meta-analyses were conducted on seven outcomes represented in 13 studies. Parenting interventions significantly improved child behaviour ($d=0.14$; 95% CI 0.03 to 0.26), parent–child relationship ($d=0.44$; 95% CI 0.09 to 0.80) and maternal sensitivity ($d=0.46$; 95% CI 0.26 to 0.65) postintervention. There were no significant effects on cognitive development ($d=0.13$; 95% CI -0.08 to 0.41), internalising behaviour ($d=0.16$; 95% CI -0.03 to 0.33) or externalising behaviour ($d=0.16$; 95% CI -0.01 to 0.30) post-intervention. At long-term follow-up we found no significant effect on child behaviour ($d=0.15$; 95% CI -0.03 to 0.31).

Conclusions Interventions offered to at-risk families in the first year of the child's life appear to improve child behaviour, parent–child relationship and maternal sensitivity post-intervention, but not child cognitive development and internalising or externalising behaviour. Future studies should incorporate follow-up assessments to examine long-term effects of early interventions.

INTRODUCTION

The first year of a child's life is characterised by rapid development that forms the foundation for lifelong developmental trajectories.

Strengths and limitations of this study

- Comprehensive search strategy and screening procedure.
- Evaluation of child development and parent–child relationship outcomes.
- Meta-analyses conducted on seven outcomes.
- Few studies provide follow-up data.
- Limited information on intervention implementation.

A healthy environment is crucial for infants' emotional well-being and future physical and mental health.^{1,2} Experiencing severe adversity early in life can alter a child's development and lead to toxic stress responses, impairing brain chemistry and neuronal architecture.³ For infants, severe adversity typically takes the form of caregiver neglect and physical or emotional abuse. The highest rates of child neglect and violent abuse occur for children younger than 5,^{4,5} with the most severe cases, which involve injury or death, occurring predominantly to children under the age of 1.⁶

Mental health problems are common in infants, but symptoms are often less intrusive and less distinctly identifiable than for older children.^{7–12} The Copenhagen Child Cohort 2000 study found a prevalence rate of 18% for axis I diagnoses (according to Diagnostic Classification (DC): 0–3) in children aged 18 months, with regulatory disorders and disturbances in parent child–relationships being the most frequent mental health diagnoses.⁸ The high prevalence in mental health diagnoses is important to note, as early onset of behavioural or emotional problems and adverse environmental factors increases the risk for negative outcomes later in life, such as substance abuse, delinquency, violence, teen pregnancy, school dropout, continued mental health problems and long-term unemployment.^{1,2,8,13–18}

Becoming a parent can be stressful and challenging,^{19–21} particularly for parents who have experienced trauma, abuse, poverty or other stressors.²² Early-intervention parenting programmes aim to assist parents with the challenges they experience. Most of these interventions teach caregivers specific strategies and skills that foster healthy child development with an emphasis on promoting warm and responsive caregiving.²³

Existing systematic reviews of the effects of parenting interventions offered to families with young children have shown mixed results.^{14 24–29} In a review of 78 studies aimed at families with children aged 0–5 years, Piquero *et al*¹⁴ found an average effect size (*g*) of 0.37 for decreased antisocial behaviour and delinquency for intervention children. Based on 22 studies, Barlow *et al*²⁸ concluded that there is tentative support for the effect of group-based interventions on emotional and behavioural adjustment in children aged 0–3 years. MacBeth *et al*²⁴ found medium effect sizes for child or parent outcomes in a review of the Mellow Parenting intervention for families with children aged 0–8 years. Barlow *et al*²⁶ found some evidence suggesting that parenting programmes for teenage parents may improve parent–child interaction. Barlow *et al*²⁷ reviewed parent–infant psychotherapy for high-risk families with infants aged 0–24 months; they found that infant attachment improved, but they found no effects on other outcomes. Reviewing interventions offered to a universal group of parents of infants aged 0–1 year, Pontoppidan *et al*²⁵ found mixed and inconclusive results for child development and parent–child relationship outcomes. Peacock *et al*³⁰ examined the effects of home visits for disadvantaged families with children aged 0–6 years and found improved child development outcomes when the intervention was implemented early.

The existing reviews include very few studies of interventions for at-risk parents that are initiated within the first year of the infants' life. Therefore, we do not know if early preventive parenting interventions are effective in improving child development or parent–child relationship outcomes. The aim of this review was to systematically review the effects of parenting interventions offered to at-risk families with infants aged 0–12 months. We included randomised controlled trials of parenting interventions reporting child development or parent–child relationship outcomes at postintervention or follow-up.

METHODS

Search strategy

This review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses. We did not register a protocol. The database searches were performed in June 2013 and were updated in January 2015 and June 2016. We searched 10 international bibliographical databases: Campbell Library, Cochrane Library, CRD (Centre for Reviews and Dissemination), ERIC, PsycINFO, PubMed, Science Citation Index Expanded, Social Care Online, Social Science

Citation Index and SocINDEX. Operational definitions were determined for each database separately. The main search was made up of combinations of the following terms: infant*, neonat*, parent*, mother*, father*, child*, relation*, attach*, behavi*, psychotherap*, therap*, intervention*, train*, interaction, parenting, learning and education. The searches included Medical Subject Headings, Boolean operators and filters. Publication year was not a restriction. Furthermore, we searched for grey literature, hand-searched four journals and snowballed for relevant references.

Eligibility criteria and study selection

We screened all publications based on title and abstract. Publications that could not be excluded were screened based on the full-text version. Table 1 shows the inclusion and exclusion criteria.

We excluded studies that examined parenting interventions aimed at specific risk groups such as teen mothers; parents with severe mental health problems; or parents with children born preterm, at low birth weight or with congenital diseases. Families experiencing difficulties such as these have specific needs, and interventions aimed at these groups may be more targeted when compared with parenting interventions aimed at broader, at-risk groups of parents. Since our focus was parenting interventions aimed at at-risk parents in general, we excluded studies developed for specific risk groups.

Each publication was screened by two research assistants under close supervision by MP and SBR. Uncertainties regarding inclusion were discussed with MP and SBR. Screening was performed in Eppi-Reviewer V.4.³¹

Data extraction and risk of bias assessment

We developed a data extraction tool for the descriptive coding and extracted information on (1) study design, (2) sample characteristics, (3) setting, (4) intervention details, (5) outcome measures and (6) child age at postintervention and at follow-up. Information was extracted by one research assistant and subsequently checked by another reviewer. Disagreements were discussed with MP or SBR. Primary outcomes were child behaviour and the parent–child relationship. Secondary outcomes were other child development markers such as cognitive development, language/communication, psychomotor development, parent sensitivity and attachment classification. When reported, both total scores and subscale scores were extracted.

Numeric coding of outcome data was conducted by ISR and checked by MP or SBR. We resolved disagreements by consulting a third reviewer. Risk of bias was assessed separately for each relevant outcome for all studies based on a risk-of-bias model developed by Professor Barnaby Reeves and the Cochrane Non-Randomized Studies Method Group (BC Reeves, JJ Deeks, JPT Higgins and GA Wells, unpublished data, 2011). This extended model is organised and follows the same steps as the existing risk-of-bias model presented in the Cochrane Handbook, chapter

Table 1 Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
Population	
At-risk population of parents of infants 0–12 months old in western Organisation for Economic Co-operation and Development countries	Studies including specific groups such as young mothers (mean age <20 years), divorced parents, parents with mental health problems such as schizophrenia and abuse, and children born preterm, at low birth weight or with congenital diseases
Intervention	
Structured psychosocial parenting intervention consisting of at least three sessions and initiated either antenatal or during the child's first year of life with at least half of the sessions delivered postnatally	Interventions not focusing specifically on parenting (eg, baby massage, reading sessions with child or breastfeeding interventions), and unstructured interventions (eg, home visits not offered in a structured format)
Control group	
No restrictions were imposed. All services or comparison interventions received or provided to the control group were allowed.	
Outcome	
Child development and/or parent–child relationship outcomes	Studies reporting only physical development or health outcomes such as height, weight, duration of breastfeeding and hospitalisation Papers with insufficient quantitative outcome data to generate standardised mean differences (Cohen's <i>d</i>), ORs and CI
Design	
Randomised controlled trials (RCT) or quasi-RCTs	Other study designs such as case control, cohort, cross-sectional and systematic reviews
Publication type	
Studies presented in peer-reviewed journals, dissertations, books or scientific reports	Abstracts or conference papers; studies published in languages other than English, German or the Scandinavian languages (Danish, Swedish and Norwegian)

8.³² The assessment was conducted by ISR and SBR. Any doubts were discussed with a third reviewer.

Analyses

We calculated effect sizes for all relevant outcomes for which sufficient data were provided. Effect sizes were reported using standardised mean differences (Cohen's *d*) with 95% CIs for continuous outcomes. Data included post-intervention and follow-up means, raw SD and sample size. Alternatively, *t*-values, *F*-tests, X^2 , *p* values, mean differences, eta-squared and β coefficients were used. For dichotomous outcomes, we used ORs with 95% CIs as the effect size metric when presenting the effects of the individual studies. When used in meta-analyses, ORs were converted to *d* using the method presented in Chinn.³³ The data used to calculate ORs were number of events and sample sizes. We contacted the corresponding author for more information if a paper presented insufficient information regarding numeric outcomes. When available, we used data from adjusted analyses to calculate effect sizes. When using the adjusted mean difference, we used the unadjusted SD in order to be able to compare the effect sizes calculated from unadjusted and adjusted means, respectively. To calculate effect sizes, we used the Practical Meta-Analysis Effect Size Calculator developed by David B Wilson at George Mason University and provided by the Campbell Collaboration.³⁴

Meta-analysis was performed when the intervention outcome and the time of assessment were comparable. If a single study provided more than one relevant measure or only subscales for a given meta-analysis, then the effect sizes of the respective measures were pooled into a combined measure.

Random effects inverse variance weighted mean effect sizes were applied and 95% CIs were reported. Studies with larger sample sizes were therefore given more weight, all else being equal. Due to the relatively small number of studies and an assumption of between-study heterogeneity, we chose a random-effects model using the profile-likelihood estimator as suggested in Cornell.³⁵ Variation in standardised mean difference that was attributable to heterogeneity was assessed with the I^2 . The estimated variance of the true effect sizes was assessed by the Tau² statistic. When indication of high heterogeneity ($I^2 > 75\%$) was found, sensitivity analyses were conducted, removing one study at a time in order to identify a potential source of heterogeneity. The small number of studies in the respective meta-analyses did not allow for subgroup analyses. Results were summarised for child development (behaviour, cognitive development, psychomotor development and communication/language) and parent–child relationship (relationship, sensitivity and attachment

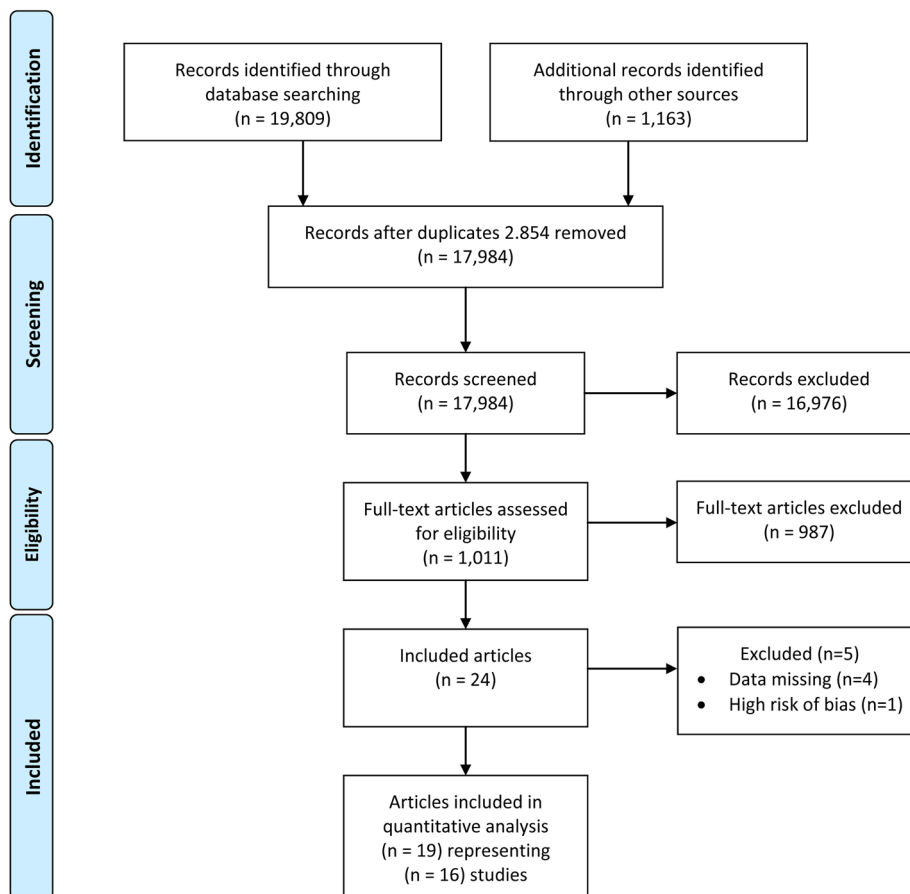


Figure 1 Flow diagram for study selection process.

classification) outcomes for the following assessment times: postintervention (PI—immediately after intervention ending), short-term (ST—less than 6 months after intervention ending), medium-term (MT—7–12 months after intervention ending) and long-term (LT—more than 12 months after intervention ending) follow-up.

RESULTS

Description of studies

The literature search identified 17 984 articles after the removal of duplicates. A flow diagram for the process of study inclusion is illustrated in [figure 1](#). Nineteen papers representing 16 individual studies were included.³⁶ Kaminski *et al*³⁶ represented two trials (Los Angeles and Miami) and are handled as two studies when reporting results. Four studies were excluded, as they provided insufficient numeric data to calculate effects sizes and CIs.^{37–40} One study was excluded due to unacceptably high risk of bias.⁴¹

Included studies

Except for one study,⁴² which compared a group-based intervention with an individual-based intervention, all studies compared interventions with a no-intervention control or with treatment as usual. A few studies offered minor interventions such as psychoeducation and social worker contact to the control group.^{43–46} Eight studies

were American,^{36 42–44 46–48} two were conducted in the Netherlands,^{49–51} and one study each was from Sweden,^{52–54} Germany,⁵⁵ Italy,⁵⁶ New Zealand,^{57 58} Norway⁴⁵ and the UK.⁵⁹ The oldest study was published in 1981⁴⁷ and the most recent studies were published in 2015.^{45 53–55} Sample size ranged from 40 participants⁴³ to 755.⁵⁵

Participant characteristics

[Table 2](#) shows study participant characteristics. All families exhibited at least one risk factor such as poverty, low education or living in deprived areas. Some samples were further characterised by, for example, insecure attachment, risk of developmental delay, or having a difficult or irritable infant. We did not include studies targeting families with more severe problems such as drug abuse, incarceration or chronic diseases.

Mothers' mean age ranged from 21 to 33 years. Four studies recruited primiparous mothers,^{44 49–51 55} five studies also included mothers with more than one child^{43 45 46 48 52–54} and seven studies did not report parity.^{36 42 47 56–59}

Interventions

[Table 3](#) presents the intervention details. Eight studies offered individual home visits,^{44–46 49–51 55–59} three studies offered individual sessions (outside the home),^{47 48 52–54} one study offered group sessions,⁴² one study offered web coaching,⁴³ two studies combined individual sessions and group sessions,³⁶ and one study combined home visits

Table 2 Participant characteristics

Study	Country	Risk	Mother mean age at start, in years	Child age at start, in months	Primiparous %	Intervention, n	Control, n
Ammaniti <i>et al</i> ⁵⁶	Italy	Depressive or psychosocial risk	33	Third trimester	Not reported	47	44
Baggett <i>et al</i> ⁴³	USA	Low income	Intervention: 25; control: 27	~4	Mean number of children: 1.75	20	20
Barlow <i>et al</i> ⁵⁹	UK	Vulnerable	<17 years: intervention—17.9%; control—22.2%	Second trimester	Not reported	68	63
Bridgeman <i>et al</i> ⁴⁷	USA	Low income	17–35	2	Not reported	Unclear*	Unclear*
Cassidy <i>et al</i> ⁴⁴	USA	NBAS or low income	24	6.5–9	100	85	84
Fergusson <i>et al</i> ^{57, 58}	New Zealand	Two or more risk factors present	Mother: intervention—24; control—24 Father: intervention—27; control—27	Not reported (recruited within 3 months of birth)	Not reported	206	221
Høivik <i>et al</i> ⁴⁵	Norway	Interactional problems	30	7.3	72	88	70
Kaminski <i>et al</i> ³⁶	USA	Low income	24	Prenatally (LA), at birth (Miami)	Not reported	338	236
Katz <i>et al</i> ⁴⁶	USA	African-American with inadequate prenatal care	25	0	Mean number of children: 2.9	146	140
Mendelsohn <i>et al</i> ⁴⁸	USA	Low-educated Latina mothers	Intervention: 30; control: 30	0.5	Intervention: 77 control: 36.2	77	73
Salomonsson <i>et al</i> ^{52, 53, 54}	Sweden	Worried mothers	Intervention: ~34; control: ~32	Intervention: 4.4; control: 5.9	Intervention: 81; control: 78	40	40
Sierau <i>et al</i> ⁵⁵	Germany	Economic and social risk factors	Intervention: 21; control: 22	Third trimester	100	394	361
Taylor <i>et al</i> ⁴²	USA	Poverty, single marital status, low education, age <20, previous substance abuse or a history of abuse	Intervention (n): <20: 44; 20–30: 122; >30: 34; control: <20: 58; 20–30: 108; >30: 34	3	Not reported	50	50
van den Boom <i>et al</i> ^{49, 50}	The Netherlands	Lower class mothers with irritable infants	Mother: 25 Father: intervention—28; control—29	6	100	50	50
Klein Velderman <i>et al</i> ⁵¹	The Netherlands	Insecure attachment	28	~7	100	54	27

*The study only reported number of participants in each analysis. NBAS, Neonatal Behavioural Assessment Scale.

Table 3 Intervention characteristics

Study	Name of intervention	N	Intervention			Outcome			
			Begins	Intensity	Format	Ends/duration	Control	Measure	Child age
Ammaniti <i>et al</i> ⁵⁶	Home Visiting Programme	91	8 months pregnant	Weekly and every second week; ~36 sessions	Home visits	Ends: 12 months of age	No intervention	Parent-child relationship	12 months
Baggett <i>et al</i> ⁴³	Infant net	40	3–8 months of age	10 online sessions + 1 read to me session + weekly coach calls	Web coaching	Duration: 6 months	TAU + provided computer and internet technology	Parent-child relationship	~10 months
Barlow <i>et al</i> ⁵⁹	Intervention based on the Family Partnership Model	131	6 months antenatal	Weekly (mean sessions 41.2)	Home visits	Duration: 18 months	TAU	Parent-child relationship Child development	12 months
Bridgeman <i>et al</i> ⁴⁷	Parent Child Development Center	Unclear*	2 months of age	Twice a week for a total of 6 hours	Individual sessions	Ends: 36 months of age	No intervention	Parent-child relationship Child development†	36 months
Cassidy <i>et al</i> ⁴⁴	Circle of security, home visiting	174	6.5–9 months of age	1 hour every 3 weeks	Home visits	Duration: 3 months	Psychoeducational sessions (3 times 1 hour)	Parent-child relationship†	12 months
Fergusson <i>et al</i> ^{57, 58}	Early start (2 levels of intensity)	443	Recruited within 3 months of birth	Varied; low level: up to 2.5 hours per 3 months	Home visits	Duration 36 months	No intervention	Child development	~36 months ~9 years
Høivik <i>et al</i> ⁴⁵	Video feedback, Marte Meo	158	Varies, between 0–24 months of age ~7.3 months of age	8 sessions, 9–13 months (mean 11.5 months)	Home visits	Duration: 9–13 months	TAU + health centre nurses if needed	Parent-child relationship Child development	~9–10 months ~15–16 months
Kaminski <i>et al</i> ⁶⁶	Legacy for children	574	Prenatal in LA	Weekly (2.5 hour) for 3 years in LA	Group sessions and individual sessions	Duration: 3 years in LA	No intervention	Child development	~36 months ~48 months ~60 months
Kaminski <i>et al</i> ⁶⁶	Legacy for children		At birth in Miami	Weekly (1.5 hour) for 5 years in Miami	Group sessions and individual sessions	Ends: 5 years of age in Miami	No intervention	Child development	~60 months

Continued

Table 3 Continued

Study	Name of intervention	N	Intervention			Outcome			
			Begins	Intensity	Format	Ends/duration	Control	Measure	Child age
Katz <i>et al</i> ⁴⁶	Pride in Parenting Programme	286	At birth	Weekly from birth through 4 months and biweekly from 5 to 12 months	Home visits + groups sessions	Ends: 12 months of age	TAU + monthly contacts from a hospital-based social worker	Child development	12 months
Mendelsohn <i>et al</i> ⁴⁸	Video Interaction Project	150	2 weeks postpartum	12 sessions (30–45 min each)	Individual sessions	Ends: 36 months of age	TAU	Child development	33 months
Salomonsson <i>et al</i> ^{52 53 54}	Psychoanalytic treatment	80	Varied: infants below 1½ years, mean age <6 months	23 session (median), 2–3 hours per week	Individual sessions	Duration: unclear, assumingly 6 months	TAU	Parent–child relationship Child development	4½ years ~11 months ~54 months
Sierau <i>et al</i> ⁵⁵	Pro Kind	755	36 gestational weeks (assumingly)	Weekly (first 4 weeks after programme intake and 4 weeks after birth), biweekly and monthly (last half year of treatment)	Home visits	Ends: 24 months old (assumingly)	TAU	Parent–child relationship Child development	24 months
Taylor <i>et al</i> ⁴²	Group well child care	220	3 months of age	7 sessions (45–60 min) up to 15 months	Group sessions	Ends: ~15 months of age	Individual well child care†	Parent–child relationship† Child development†	~15 months
van den Boom ^{5 49}	—	100	6 months of age (baseline 10 days after birth)	1 session (2 hours) every 3 weeks for 3 months	Home visits	Ends: 9 months of child's age	No intervention	Parent–child relationship	9 months 12 months 18 months
Klein Velderman <i>et al</i> ⁶¹	1. VIPP 2. VIPP-R	81	~7 months of age	4 visits (1.5–3 hours) over 9–12 weeks	Home visits	Duration: 9–12 weeks	No intervention	Parent–child relationship	11– 13 months 13 months

*Study only reported number of participants in each analysis.

†Outcome(s) not included in meta-analysis.

‡Two active intervention groups, no control group.

TAU, treatment as usual; VIPP, Video Feedback Intervention to Promote Positive Parenting; VIPP-R, Video Feedback Intervention to Promote Positive Parenting with Discussions on the Representational Level.

and group sessions.⁴⁶ Intervention was initiated prenatally in four studies,^{36 55 56 59} and 12 studies initiated intervention after the child was born.^{36 42–54 57 58} The duration of the interventions varied from relatively short interventions (≤ 6 months)^{43 44 49–54} to medium-length interventions (7–12 months)^{42 45 46 56 59} to long interventions (≥ 24 months).^{36 47 48 55 57 58}

Outcomes

Child development and the parent–child relationship were measured based on parent-report questionnaires, teacher-report questionnaires, structured interviews and videos. Five studies reported only child development outcomes,^{36 46 48 57 58} five reported only parent–child relationship outcomes^{43 44 49–51 56} and six reported both.^{42 45 47 52–55 59} Timing of assessment was divided into four assessment times: (1) postintervention follow-up, (2) short-term follow-up, (3) medium-term follow-up and (4) long-term follow-up.

All studies reported a postintervention outcome. Two studies reported an outcome at short-term follow-up,^{45 49 50} two at medium-term follow-up^{36 49} and three at long-term follow-up.^{36 52–54 57 58}

Risk of bias

The risk of bias assessments are shown in online supplementary table 1 and are divided into child development outcomes and parent–child relationship outcomes. Many studies provided insufficient information for at least two domains, thereby hindering a clear judgement for risk of bias. Risk of bias generally ranged between low and medium. However, three studies had outcomes where one or two domains had a moderate risk of bias.^{45–47} Two studies had outcomes with high risk of bias in one domain.^{45 47} Based on an overall judgement across risk-of-bias domains, two outcomes (Comprehensive Test of Basic Skills Form (CTBS) math and reading scores)⁴⁷ and one study⁴¹ were excluded from the review. The reasons were, on the one hand, high risk of bias in relation to ‘incomplete data addressed’ combined with unclear risk of bias judgements in all other domains,⁴⁷ and on the other hand the pronounced baseline imbalance not being addressed.⁴¹

The outcomes included in the child development meta-analyses were characterised by low-to-medium and unclear risk-of-bias domains, whereas the meta-analyses on parent–child relationship outcomes primarily included outcomes with a relatively low or unclear risk of bias. Two studies represented in the meta-analyses of both child development and parent–child relationship outcomes had domains assessed as having moderate or high risk of bias.^{45 47}

Child development outcomes post-intervention

Table 4 presents the study outcomes for the individual studies.

Meta-analysis of the primary outcome is reported in figure 2, and the secondary outcomes are reported in online supplementary figures.

Behaviour

The meta-analysis of parent-reported child behaviour shown in figure 2 included eight studies.^{36 45 48 52 55 58 59} The analysis showed a small but significant effect on child behaviour ($d=0.14$; 95% CI 0.03 to 0.26) favouring the intervention group. One study that offered a considerably longer intervention than the rest was removed for a sensitivity analysis, which found that the results were not substantially affected by removing the study.³⁶ The study was therefore kept in the analysis. For the internalising and externalising subscales, no significant difference between intervention and control group was found (see online supplementary figures 2 and 3). None of the behavioural outcomes that were not included in a meta-analysis showed statistically significant differences between intervention and control group.^{46 55 59}

Three studies reported observer-rated child behaviour using the behavioural rating scale (BRS) from Bayley II.^{46 55 59} One study used a dichotomised version of BRS,⁴⁶ which may not have been able to detect changes in this population since all but one (intervention) and three (control) children were rated as unproblematic. Meta-analysis was therefore not conducted. None of the studies found statistically significant effects.

Cognitive development

The meta-analysis on cognitive development included five studies (online supplementary figure 3).^{27 46–48 55} There was no significant difference between intervention and control groups ($d=0.13$; 95% CI -0.08 to 0.41). A sensitivity analysis was conducted in which the one study that did not apply the Mental Developmental Index was removed,⁴⁷ and the analysis found that the effect size decreased ($d=0.03$) but remained insignificant (95% CI -0.12 to 0.21).

Psychomotor development

We could not perform meta-analysis for psychomotor development outcomes, as one study provided data comparing two active interventions.⁴² Of the three studies that included psychomotor development, none of them found significant effects.^{42 46 55}

Communication/language development

We could not perform meta-analysis for communication/language outcomes, as the measures varied considerably. Two studies found no significant effect on communication/language development,^{48 55} whereas one found significantly improved communication/language development for the intervention group ($d=0.72$; 95% CI 0.24 to 1.20).⁴⁷

Child development outcomes at follow-up

Because few studies reported child development outcomes at follow-up, we were only able to conduct a meta-analysis for one of the follow-up outcomes.

Child behaviour

The meta-analysis of parent-rated child behaviour at long-term follow-up, as shown in online supplementary figure 4,

Table 4 Child development outcomes as reported across studies included in the systematic review

Study	Measure	Assessment	Child age in months		Intervention		Control		Cohen's d	Other statistics
			n	Mean	n	Mean	n	Mean		
PI	Behaviour									
Barlow <i>et al</i> ⁵⁹	Total problem score BITSEA*	Q	55	33.52	38.81	49	35.55	39.63	0.05 (-0.33; 0.44)	
	Competence BITSEA	Q	53	14.06	3.65	43	13.37	3.53	0.19 (-0.21; 0.60)	
	BRS	O	62	38.37	5.71	59	38.69	5.5	-0.06 (-0.41; 0.30)	
Heivik <i>et al</i> ⁴⁵	Total score ASQ:SE	Q	~9-10			27			0.40 (-0.10; 0.90)	$\beta = -7.22$, SD of DV=18.51†
Salomonsson and Sandell ⁵²	Total score ASQ:SE*	Q	~11	1.00	0.72	37	1.14	0.70	0.20 (-0.26; 0.65)	Becker's $\delta = 0.25$ (adjusted for baseline ASQ:SE)
Sierau <i>et al</i> ⁶⁵	Internalising CBCL*	Q	24	9.51	5.95	159	9.94	5.65	0.07 (-0.14; 0.29)	
	Externalising CBCL*	Q	24	15.93	7.56	164	15.34	7.23	0.08 (-0.13; 0.29)	
	BRS	O	24	53.10	26.74	142	57.13	27.79	-0.15 (-0.37; 0.08)	
Fergusson <i>et al</i> ⁶⁷	Externalising ITSEA (short)	Q	~36			207			0.19 (-0.01; 0.39)	Cohen's d provided in paper
	Internalising ITSEA (short)	Q	~36			207			0.26 (0.06; 0.47)	Cohen's d provided in paper
	Total problem score ITSEA (50 items)	Q	~36			207			0.24 (0.04; 0.44)	Cohen's d provided in paper
Kaminski <i>et al</i> ⁶⁶	DECA behavioural concerns	Q	36			126			-0.12 (-0.48; 0.25) †	OR=0.81 (0.42; 1.56)
	DECA socioemotional problems	Q	36			127			-0.04 (-0.49; 0.43) †	OR=0.93 (0.41; 2.17)
Kaminski <i>et al</i> ⁶⁶	DECA behavioural concerns	Q	60			121			0.32 (-0.07; 0.7) †	OR=1.78 (0.88; 3.57)
	DECA socioemotional problems	Q	60			122			0.00 (-0.48; 0.49) †	OR=1.00 (0.42; 2.44)
	SDQ conduct problems	Q	60			122			0.18 (-0.14; 0.52) †	OR=1.39 (0.77; 2.56)
	SDQ hyperactivity ₁	Q	60			121			0.31 (-0.21; 0.84) †	OR=1.75 (0.69; 4.55)
	SDQ peer problems	Q	60			121			-0.14 (-0.52; 0.24) †	OR=0.78 (0.39; 1.54)
Mendelsohn <i>et al</i> ⁴⁸	Total problem score CBCL*	Q	33	50.2	10.0	47	53.2	9.7	0.30 (-0.09; 0.70)	
	Externalising CBCL*	Q	33	50.0	9.8	47	51.8	9.4	0.19 (-0.21; 0.58)	
	Internalising CBCL*	Q	33	52.9	9.9	47	53.8	9.3	0.09 (-0.30; 0.49)	
Katz <i>et al</i> ⁶⁶	BRS	O	12			73			0.83 (-0.43; 2.09) †	Normal/non-optimal: intervention -72/1; control -48/3; OR=4.5 (0.45; 44.55)
PI	Cognitive development									
Barlow <i>et al</i> ⁵⁹	MDI	O	12	93.74	10.98	62	93.03	10.89	0.06 (-0.29; 0.42)	

Continued

Table 4 Continued

Study	Measure	Assessment	Child age in months		Intervention			Control			Cohen's <i>d</i>	Other statistics
			n	Mean	n	Mean	SD	n	Mean	SD		
Katz <i>et al</i> ⁴⁶	MDI	O	12	101.0	73	101.0	12.4	51	101.4	17.3	-0.03 (-0.39; 0.33)	
Taylor <i>et al</i> ⁴²	MDI	O	~15	99.3	50	99.3	14.8	50	100.4	14.3	-0.08 (-0.47; 0.32)§	
Sierau <i>et al</i> ⁶⁵	MDI	O	24	87.37	180	87.37	14.74	167	87.64	14.74	-0.02 (-0.23; 0.19)	
Bridgeman <i>et al</i> ⁴⁷	Intelligence Stanford-Binet	O	36	104.22	46	104.22	10.36	52	96.69	12.20	0.66 (0.25; 1.07)	R=0.49 (including all independent variables)
Mendelsohn <i>et al</i> ⁴⁸	MDI	O	33	86.1	52	86.1	7.5	45	83.9	9.7	0.26 (-0.14; 0.66)	
PI	Psychomotor development											
Katz <i>et al</i> ⁴⁶	PDI	O	12	95.1	73	95.1	13.6	51	93.1	11.9	0.15 (-0.20; 0.51)	
Taylor <i>et al</i> ⁴²	PDI	O	~15	103.6	50	103.6	11.5	50	100	12.4	0.30 (-0.09; 0.70)§	
Sierau <i>et al</i> ⁶⁵	PDI	O	24	92.86	180	92.86	15.08	167	92.81	14.10	0.00 (-0.21; 0.21)	
PI	Communication/language											
Bridgeman <i>et al</i> ⁴⁷ , 1981, New Orleans, Louisiana	Ammons	O	36	13.44	34	13.44	3.38	38	11.11	3.09	0.72 (0.24; 1.20)	
Mendelsohn <i>et al</i> ⁴⁸	PLS-3	O	33	80.7	52	80.7	10.2	45	81.1	10.6	-0.04 (-0.44; 0.36)	
Sierau <i>et al</i> ⁶⁵	ELFRA	O	24	102.64	169	102.64	64.69	161	107.84	66.63	-0.08 (-0.30; 0.14)	
	SETK-2	O	24	0.78	141	0.78	0.58	128	0.80	0.61	-0.03 (-0.27; 0.21)	
SF	Behaviour											
Høvik <i>et al</i> 2015 ⁴⁵	ASQ:SE	Q	~15-16		26			27			1.05 (0.47; 1.62)	β=-13.79, SD of DV=15.02†
MF	Behaviour											
Kaminski <i>et al</i> ⁶⁶	DECA behavioural concerns	Q	48		124			78			0.26 (-0.14; 0.66)‡	OR=1.61 (0.78; 333)
	DECA socioemotional problems	Q	48		124			78			0.00 (-0.55; 0.55)‡	OR=1.00 (0.37; 2.70)
	SDQ conduct problems	Q	48		124			78			0.18 (-0.14; 0.51)‡	OR=1.39 (0.77; 2.5)
	SDQ hyperactivity ₁	Q	48		124			78			-0.37(-0.01; 0.26) ‡	OR=0.51 (0.16; 1.61)
	SDQ peer problems	Q	48		124			78			-0.12(-0.49; 0.26) ‡	OR=0.81 (0.41; 1.61)
LF	Behaviour											
Fergusson <i>et al</i> ⁶⁸	SDQ*	Q	~108		199		0.91	171	10.08	1.06	0.17 (-0.03; 0.38)	

Continued

Table 4 Continued

Study	Measure	Assessment	Child age in months		Intervention		Control		Cohen's d	Other statistics
			n	Mean	n	Mean	n	Mean		
Kaminski <i>et al</i> ³⁶	DECA behavioural concerns	Q	116		71		0.27 (-0.21; 0.72)†	OR=1.62 (0.69; 3.70)		
	DECA socioemotional problems	Q	117		73		0.49 (0.05; 1.01)†	OR= 2.44 (1.10; 6.25)		
	SDQ conduct problems	Q	116		71		-0.03(-0.39; 0.33) ‡	OR=0.94 (0.49; 1.82)		
	SDQ hyperactivity ₁	Q	116		71		0.17 (-0.37; 0.7)†	OR=1.35 (0.51; 3.57)		
	SDQ peer problems	Q	116		71		0.17 (-0.24; 0.58) ‡	OR=1.37 (0.65; 2.86)		
Salomonsson <i>et al</i> ⁵³	ASQ:SE	Q	32	0.98	32	0.88	0.13 (-0.37; 0.62)			
	SDQ	Q _{parent}	32	8.17	31	7.39	0.15 (-0.35; 0.64)			
	SDQ	Q _{teacher}	24	5.71	27	6.59	-0.18 (-0.73; 0.37)			
	CGAS functioning	Q	31	78.39	30	68.87	0.69 (0.17; 1.21)			

Significant effect sizes are marked with bold.

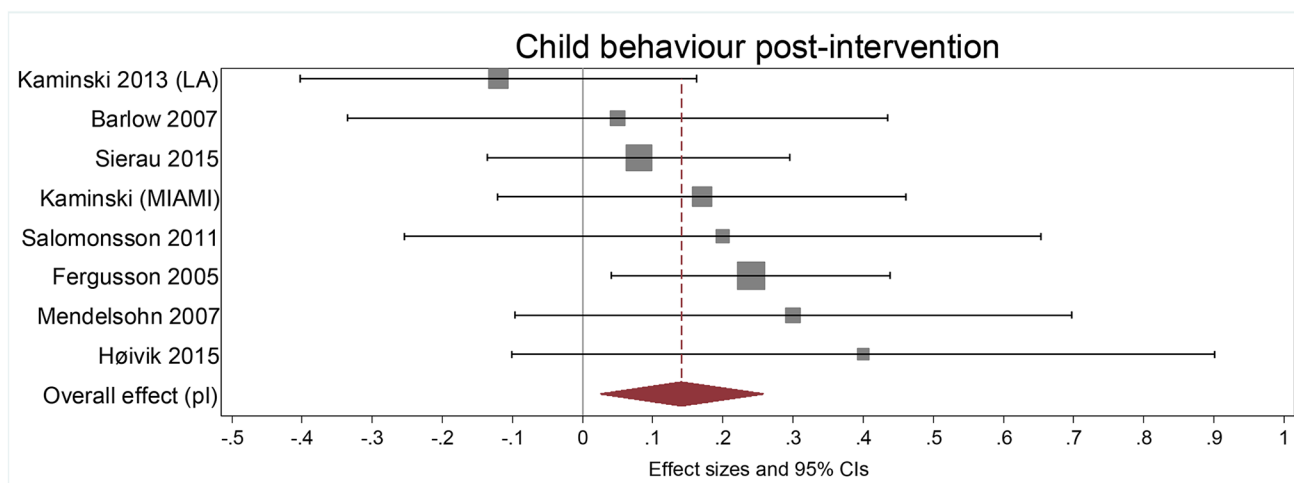
*Reverse scoring—high score is negative.

†Adjusted for ASQ baseline score.

‡Calculation based on dichotomous outcome.

§No control group. Two interventions were compared.

ASQ:SE, Ages and Stages Questionnaires: Social-Emotional; BITSEA, Brief Infant Toddler Social Emotional Assessment; BRS, Behavioural Rating Scale; CBCL, Child Behaviour Checklist; CFI, Concept Familiarity Index; CGAS, Children's Global Assessment Scale; DECA, Devereux Early Childhood Assessment; DV, dependent variable; ELFRA, Elternfragebögen für die Früherkennung von Risikokindern; ITSEA, Infant Toddler Social Emotional Assessment; LF, long-term follow-up (>12 months postintervention); MDI, Mental Developmental Index; MF, mid-term follow-up (7–12 months); O, observation; PDI, Psychomotor Development Index; PI, postintervention; PLS-3, Preschool Language Scale; Q, questionnaire; SDQ, Strengths and Difficulties Questionnaires; SETK-2, Sprachentwicklungstest für zweijährige Kinder; SF, short-term follow-up (≤6 months postintervention); U, unadjusted.



Study	Intervention (n)	Control (n)	Effect (d)	Random effect 95% CI	% Weight
Kaminski 2013 (LA)	126	78	-0.12	-0.40 0.16	13.45
Barlow 2007	55	49	0.05	-0.34 0.44	7.25
Sierau 2015	170	162	0.08	-0.14 0.30	23.12
Kaminski 2013 (Miami)	121	73	0.17	-0.12 0.46	12.71
Salomonsson 2011	38	37	0.20	-0.25 0.65	5.22
Fergusson 2005	207	184	0.24	0.04 0.44	27.15
Mendelsohn 2007	52	47	0.30	-0.10 0.70	6.82
Høivik 2015	37	27	0.40	-0.10 0.90	4.28
Overall effect	806	657	0.14	0.026 0.26	100.00
Heterogeneity	$I^2=0.00$ and $\text{Tau}^2=0.00$ (95% CI: 0.00 to 0.04)				

♦ Tau^2 using Maximum likelihood was negative and set to zero. The Profile likelihood method successfully converged for CI limits.

Figure 2 Meta-analysis of studies reporting child behaviour outcomes at postintervention. ML, maximum likelihood.

included child behaviour scores (Strengths and Difficulties Questionnaires (SDQ)) from three studies.^{36 53 58} No significant effect was found ($d=0.15$; 95% CI -0.03 to 0.31).

At short-term follow-up, one study found a significant positive effect on child behaviour ($d=1.05$; 95% CI 0.47 to 1.62).⁴⁵ At medium-term follow-up, one study found no significant effects on behavioural concerns, conduct problems, hyperactivity or peer problems.³⁶ At long-term follow-up, one study found a significant positive effect on child functioning (Children's Global Assessment Scale) ($d=0.69$; 95% CI 0.17 to 1.21),⁵³ and one study found a significant positive effect on child socioemotional development (Devereux Early Childhood Assessment) (OR=2.44; 95% CI 1.10 to 6.25).³⁶

No studies reported follow-up data on cognitive development, communication/language or psychomotor development.

Parent-child relationship postintervention

Table 5 presents the study outcomes for the individual studies.

Meta-analysis of the primary outcome is reported in figure 3, and the secondary outcomes are reported in online supplementary figures.

Parent-child relationship

The meta-analysis of the overall parent-child relationship included nine studies and is presented in

figure 3.^{43 45 47 49 51 54-56 59} The parent-child relationship was significantly better in the intervention group as compared with the control group ($d=0.44$; 95% CI 0.09 to 0.80). The measures reported in the studies vary to some degree, which could be a source of heterogeneity. I^2 was 81, indicating that a large proportion of the observed variance in effect sizes may be attributable to heterogeneity rather than to sampling error.

Maternal sensitivity

We performed a separate meta-analysis on maternal sensitivity, which is a central component in the parent-child relationship. The meta-analysis included five studies (online supplementary figure 5) and showed a significant effect favouring the intervention group ($d=0.46$; 95% CI 0.26 to 0.65).^{47 51 54 56 59}

Attachment

Two studies reported attachment classification.^{44 51} They found no significant effects of the intervention.

Parent-child relationship at follow-up

Because few studies reported parent-child relationship outcomes at follow-up, we could not conduct meta-analyses for any parent-child relationship follow-up outcomes.

At short-term follow-up, one study found no significant effect on the parent-child relationship.⁴⁵ At medium-term

Table 5 Parent-child relationship outcomes as reported across studies included in the systematic review

Study	Measure	Assessment	Child age (months)		Intervention		Control		Cohen's d	Other statistics	
			n	Mean	SD	n	Mean	SD			
Ammaniti <i>et al</i> ⁵⁶	Sensitivity (M) SMIS	V	12	45	7.25	1.06	37	6.67	1.31	0.49 (0.05; 0.93)	
	Cooperation (D) SMIS	V	12	45	8.11	0.94	37	7.67	1.19	0.42 (-0.02; 0.85)	
	Interference (M) SMIS*	V	12	45	1.36	0.81	37	1.52	0.80	0.20 (-0.24; 0.63)	
	Affective state (M) SMIS*	V	12	45	1.15	0.44	37	1.39	0.66	0.44 (-0.00; 0.88)	
	Self-regulative behaviours (C) SMIS	V	12	45	1.92	0.95	37	1.96	0.99	-0.04 (-0.48; 0.39)	
	Positive behaviours (C) Landry	V	~10	20			20			0.69 (0.05; 1.33)	Eta ² =0.107
Baggett <i>et al</i> ⁴³	Positive behaviours (P) Landry	V	~10	20			20			0.45 (-0.17; 1.08)	Eta ² =0.049
	Sensitivity (M) CARE-index	V	12	62	9.27	2.67	59	8.2	3.26	0.36 (0.00; 0.72)	
Barlow <i>et al</i> ⁵⁹	Cooperativeness (C) CARE-index	V	12	62	9.35	3.08	59	7.92	3.7	0.42 (0.06; 0.78)	
	Positive Language (M) (in-house)	V	36	42	30.26	27.07	31	7.24	39.93	0.70 (0.22; 1.17)	
Bridgeman <i>et al</i> ⁴⁷	Sensitivity (M) Ainsworth's Rating Scale	V	36	42	6.29	1.62	31	5.19	2.30	0.57 (0.09; 1.04)	
	Acceptance (M) Ainsworth's Rating Scale	V	36	42	6.87	1.31	31	6.52	1.55	0.25 (-0.22; 0.71)	
	Cooperation (M) Ainsworth's Rating Scale	V	36	42	6.03	1.96	31	5.48	1.98	0.28 (-0.19; 0.75)	
Høivik <i>et al</i> ⁴⁵	EAS*	V	-9-10	73	151.90	19.6	52	145.84	29.24	0.25 (-0.11; 0.61)	

Continued

Table 5 Continued

Study	Measure	Assessment	Child age		Intervention		Control		Cohen's <i>d</i>	Other statistics
			(months)	n	Mean	SD	n	Mean		
Salomonsson <i>et al</i> ⁵⁴	Sensitivity (M) EAS	V	~11	38	0.64	0.13	37	0.57	0.17	0.46 (0.00; 0.92)
	Structuring (M) EAS	V	~11	38	0.71	0.12	37	0.68	0.16	0.21 (-0.24; 0.67)
	No intrusiveness (M) EAS	V	~11	38	0.78	0.16	37	0.73	0.23	0.25 (-0.20; 0.71)
	Responsiveness (C) EAS	V	~11	38	0.70	0.13	37	0.67	0.20	0.18 (-0.28; 0.63)
	Involvement (C) EAS	V	~11	38	0.69	0.14	37	0.66	0.19	0.18 (-0.27; 0.63)
van den Boom ⁴⁹	Interactive behaviour (M) (in-house)	V	9	~47			~47			1.78 (1.30; 2.26)
	Interactive behaviour (C) (in-house)	V*	9	~47			~48			1.54 (1.08; 2.00)
Klein Velderman <i>et al</i> ⁶¹	Sensitivity (M) Ainsworth's Rating Scale	V	11-13	54			27			0.48 (0.02; 0.95) †
Sierau <i>et al</i> ⁵⁵	Affectivity (D) MBRS-R	V	24	146	3.16	0.61	142	3.35	0.63	-0.31 (-0.54; -0.07)
	Responsiveness (D) MBRS-R		24	145	3.38	0.70	140	3.54	0.68	-0.23 (-0.46; 0.00)
Taylor <i>et al</i> ⁴²	NCATS	V	~15	50	59.5	6.1	50	59.4	6.0	0.00 (-0.39; 0.39)‡
SF	Parent-child relationship									
Høivik <i>et al</i> ⁴⁵	EAS*	V	~15-16	63	153.40	22.33	47	156.15	19.25	0.13 (-0.25; 0.51)
MF	Parent-child relationship									

Continued

Table 5 Continued

Study	Measure	Assessment	Child age (months)		Intervention		Control		Cohen's d	Other statistics			
			n	Mean	SD	n	Mean	SD					
van den Boom ⁵⁰	Acceptance (M) based on Ainsworth	V	18	6.86	1.19	43	6.86	1.19	39	5.95	1.88	0.58 (0.14; 1.03)	F=7.04
	Accessibility (M) based on Ainsworth	V	18	6.88	1.50	43	6.88	1.50	39	5.87	1.89	0.60 (0.15; 1.04)	F=7.26
	Cooperation (M) based on Ainsworth	V	18	6.70	1.68	43	6.70	1.68	39	5.18	1.65	0.91 (0.46; 1.37)	F=16.92
	Sensitivity (M) based on Ainsworth	V	18	6.70	1.42	43	6.70	1.42	39	5.26	1.92	0.86 (0.41; 1.31)	F=15.14
LF	Parent-child relationship												
Salomonsson <i>et al.</i> ⁵⁴	Sensitivity (M) EAS	V	54	0.68	0.12	33	0.68	0.12	33	0.67	0.16	0.07 (-0.41; 0.55)	
	Structuring (M) EAS	V	54	0.66	0.12	33	0.66	0.12	33	0.69	0.13	-0.24 (-0.72; 0.24)	
	No intrusiveness (M) EAS	V	54	0.82	0.12	33	0.82	0.12	33	0.81	0.14	0.08 (-0.406; 0.56)	
	Responsiveness (C) EAS	V	54	0.69	0.19	33	0.69	0.19	33	0.74	0.15	-0.29 (-0.78; 0.19)	
	Involvement (C) EAS	V	54	0.67	0.13	33	0.67	0.13	33	0.72	0.16	-0.34 (-0.83; 0.14)	
PI	Attachment												
Cassidy <i>et al.</i> ⁴⁴	Attachment SSP	V	12			85			84			0.30 (-0.06; 0.66)§	B=0.54 (SE=0.33), OR=1.72 (0.90; 3.28)¶
Klein Velderman <i>et al.</i> ⁵¹	Attachment SSP	V	13			54			27			0.22 (-0.22; 0.66)	
SF	Attachment												
van den Boom ⁴⁹	Attachment SSP	V	12			50			50			0.97 (0.48; 1.45)§	Secure/insecure: intervention — 31/19; control — 11/39 OR=5.78 (2.40; 13.94); L ² (1)=16.96
MF	Attachment												
van den Boom ⁵⁰	Attachment SSP	V	18			43			39			1.07 (0.58; 1.57)§	χ ² =18.35
LF	Attachment												

Continued

Table 5 Continued

Study	Measure	Assessment	Child age		Intervention		Control		Cohen's <i>d</i>	Other statistics
			(months)	n	Mean	SD	n	Mean		
Salomonsson <i>et al</i> ⁵³	Secure attachment SSAP	V	54	31	2.22	1.05	30	2.32	1.33	-0.08 (-0.59; 0.42)
	Avoidant attachment SSAP*	V	54	31	1.05	0.48	30	1.16	0.52	0.22 (-0.28; 0.72)
	Ambivalent attachment SSAP*	V	54	31	0.96	0.73	30	0.84	0.61	-0.18 (-0.68; 0.32)
	Disorganised attachment SSAP*	V	54	31	0.80	0.84	30	0.63	0.58	-0.23 (-0.74; 0.27)

Significant effect sizes are marked with bold.

*Reverse scoring—high score is negative.

†Adjusted for pretest sensitivity.

‡No control group. Two interventions were compared.

§Calculation based on dichotomous outcome

¶Adjusted for income, infant sex and irritability.

C: child; CARE, Child-Adult Relationship Experimental; EAS, Emotional Availability Scales; LF, long-term follow-up (>12 months postintervention); M, mother; MBRS-R, Maternal Behaviour Rating Scale-Revised; MF, mid-term follow-up (7–12 months); NCATS, Nursing Child Assessment Teaching Scale; O, observation; P, parent; PI, postintervention; Q, questionnaire; SF, short-term follow-up (≤6 months postintervention); SMILS, Scales of Mother-Infant Interactional System; SSAP, Story Stem Assessment Profile; SSP, Strange Situation Procedure; U, unadjusted; V, video.

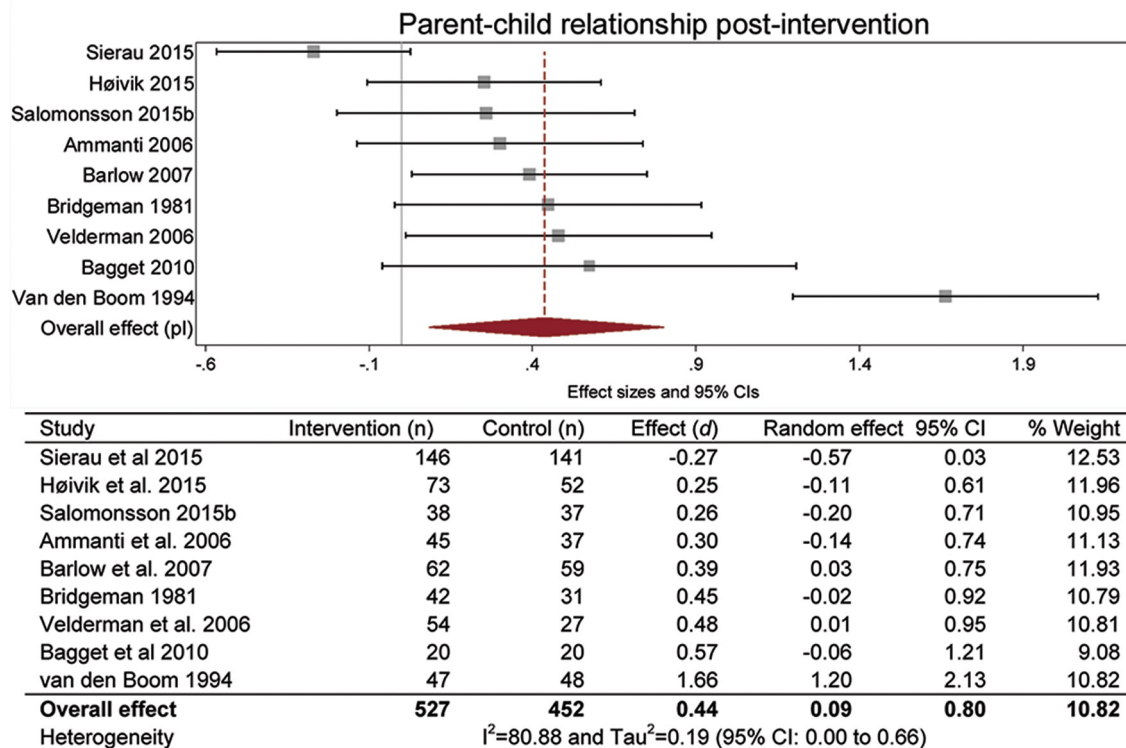


Figure 3 Meta-analysis of studies reporting parent-child relationship outcomes at postintervention.

follow-up, one study found significant positive effects on maternal acceptance ($d=0.58$; 95% CI 0.14 to 1.03), accessibility ($d=0.60$; 95% CI 0.15 to 1.04) and cooperation ($d=0.91$; 95% CI 0.46 to 1.37).⁵⁰ At long-term follow-up, one study did not find a significant effect on the parent-child relationship.⁵⁴

Maternal sensitivity

At medium-term follow-up, one study found a significant positive effect on maternal sensitivity ($d=0.86$; 95% CI 0.41 to 1.31).⁵⁰ At long-term follow-up, one study found no significant effect on maternal sensitivity.⁵⁴

Attachment

At short-term and medium-term follow-up, one study found a significant positive effect on attachment at both the 12-month follow-up ($d=0.97$; 95% CI 0.48 to 1.45) and the 18-month follow-up ($d=1.07$; 95% CI 0.58 to 1.57).^{49 50} At long-term follow-up, one study did not find a significant effect on attachment.⁵³

Sensitivity analyses

The meta-analysis on the parent-child relationship indicated that substantial heterogeneity may be present. Sensitivity analyses showed that one study in particular contributed to the high I^2 value.⁴⁹ When this study was removed from the analysis, I^2 decreased from 81 to 46. Tau^2 decreased from 0.19 (95% CI 0.00 to 0.66) to 0.04 (95% CI 0.00 to 0.19). The effect size decreased to 0.26 (95% CI 0.05 to 0.50).

Two of the studies included in the meta-analyses had outcomes with domains at moderate to high risk of

bias.^{45 47} Removing Bridgeman *et al* from the meta-analysis on child behaviour did not alter the results considerably ($d=0.12$; 95% CI 0.01 to 0.25). When removed from the analysis on cognitive development, the effect decreased but remained insignificant ($d=0.03$; 95% CI -0.03 to 0.21). For the parent-child relationship the effect was almost unchanged when Bridgeman *et al* and Høivik *et al* were removed, but the CI widened ($d=0.47$; 95% CI 0.00 to 0.95). The effect on maternal sensitivity ($d=0.44$; 95% CI 0.22 to 0.65) was not altered considerably by removing Bridgeman *et al*.

Relative effects

One study compared two active interventions: group and individual.⁴² The authors found no difference between the two interventions on cognitive development, psychomotor development or the parent-child relationship.

DISCUSSION

We identified 19 papers representing 16 trials that investigated the effects of parenting interventions delivered to at-risk parents of infants aged 0–12 months. Due to the variety of outcome measures applied, not all of the 16 included studies were included in the meta-analyses. At postintervention, we found a small but significant positive effect on overall child behaviour, but no significant effects on child cognitive behaviour or the child behaviour subscales internalising or externalising. We found a medium-sized effect on overall parent-child relationship and maternal sensitivity. Most of the findings from studies that

were not represented in the meta-analyses were not statistically significant.

The meta-analyses showed the most pronounced effect sizes for parent–child interaction and maternal sensitivity, whereas the effects on child behaviour and cognitive development were either small or not significant; however, small effect sizes can have meaningful impact on population-level outcomes.⁶⁰ The non-significant outcomes for internalising and externalising behaviours were also small, but may be clinically relevant for large, at-risk populations. Most interventions provided direct support for how to improve maternal sensitivity and the relationship between parent and child (eg, Circle of Security⁶¹ and Video feedback Intervention to promote Positive Parenting⁶²). Therefore, it seems reasonable that the parent–child relationship and maternal sensitivity can be improved within a relatively short time period, whereas the effects of the interventions on child development may take longer to emerge.⁶³

The tests for the child behaviour subscales internalising and externalising narrowly included the 0 value within the 95% CIs (−0.03 to 0.33 and 0.00 to 0.30, respectively). These values suggest that similar studies to those in this review would likely produce small but positive effects. Because these analyses are based on three studies, there is a certain degree of uncertainty regarding the CIs reported. A larger sample of studies may be necessary to conclusively determine the significance of these results.

Two studies represented in the meta-analyses were assessed as having a moderate to high risk of bias in one⁴⁷ or two⁴⁵ domains. As this could potentially affect the credibility of the results, we conducted sensitivity analyses to investigate these studies' contribution to the effect sizes. However, removing these studies from the analyses did not substantially alter the effects.

The outcomes applied in the individual studies vary and most meta-analyses are based on heterogeneous measures. Although the measures vary, they do measure the same underlying construct and can therefore be meaningfully combined in the meta-analyses.

The meta-analyses of parent–child relationship and maternal sensitivity included in-house measures, that is, measures developed by the evaluators that have, to our knowledge, not been formally validated. This could potentially affect the results; however, sensitivity analyses showed that removing these outcomes from the analyses did not substantially alter the results, therefore we kept the outcomes in the analyses.

The number of studies in the meta-analyses ranged from three to nine. While a meta-analysis on nine studies is fairly reliable, a meta-analysis including only three studies may provide a less accurate estimate of the overall effect.⁶⁴ We therefore applied the random-effects model using the profile-likelihood estimator. This has been recommended for meta-analyses with a small number of studies, because it generates wider CIs than the frequently applied DerSimonian-Laird estimator.³⁵ The results of the

meta-analyses including fewer studies should still be interpreted with some caution.

This review focuses on interventions for adult mothers; studies with young mothers were excluded, including central studies such as the Olds *et al*⁶³ studies of Nurse Family Partnership. Although teen mothers are an at-risk group due to their age, and they often face additional risk factors such as poverty, low education and single parenthood, we have not included them in this review. We believe this is the appropriate method because teen mothers are a distinct group requiring targeted care that is developmentally appropriate for their stage in life. We consider the narrower focus on adult mothers to be a strength, because the interventions aimed at adult mothers most often differ considerably from interventions for teen mothers; this specificity reduces heterogeneity in study outcomes that are often present between the teen and adult interventions.

The included studies were conducted in countries with different levels of service for families with infants; therefore, it may not be possible to reproduce effects in other contexts. The interventions examined in the studies also varied according to approach, intensity and duration. Both short and extensive interventions were included in all meta-analyses, and we found no apparent tendencies in the results. Due to the relatively low number of studies in the meta-analyses, we could not conduct subgroup analyses. Subgroup analyses are important as they provide information about whether the effect of an intervention is modified by certain circumstances or characteristics of the participants. Eight of the included studies reported some kind of subgroup or moderator analyses.^{44–49 51 56}

Most of the studies did not address implementation in their design. This presents challenges with regard to assessing outcomes, as results may have been moderated, both positively and negatively, by implementation quality. Of the 16 studies reviewed, four provided information about efforts to support implementation, such as strategies to reduce participant attrition,⁴⁶ information about variability in the number of intervention sessions that some families received,^{43 46 55} and information on the intervention.^{49 50 55} All of the studies could have included more information about the implementation context and the possible moderating factors associated with different strategies. Without more extensive implementation information, replicability remains problematic, particularly in circumstances where implementation supports were not well documented.

A further limitation of the study is that although many studies reported outcomes during the intervention period and postintervention, only a few reported follow-up data. We were able to perform meta-analysis for one long-term outcome: child behaviour measured by the SDQ. The analysis included three studies and found no significant difference between intervention and control groups. Individual study results at different follow-up times were mixed and therefore inconclusive for both child development and the parent–child relationship at long-term follow-up.

It is problematic that the studies did not assess long-term outcomes because it makes it impossible to evaluate the short-term, medium-term and long-term effects of the interventions. Conclusions based on postintervention assessments may be insufficient to draw firm conclusions about the effectiveness of parenting interventions.

CONCLUSION

This review identified 16 studies that evaluated the effects of parenting interventions for at-risk caregivers with infants aged 0–12 months on child development and parent–child relationship. Meta-analyses revealed a small but statistically significant positive effect of the interventions on child behaviour as well as moderate effects on the parent–child relationship and maternal sensitivity. There were no statistically significant effects on child cognitive development, internalising behaviour or externalising behaviour at post-intervention; however, internalising and externalising behaviours were marginally significant and may have reached statistical significance with a larger sample. Similarly, the effect on child behaviour at long-term follow-up was not significant, but approaching statistical significance. Parenting interventions initiated in the child's first year of life appear to have the potential to improve child behaviour and the parent–child relationship post-intervention.

Few studies assessed child development and parent–child relationship outcomes at follow-up; therefore, it remains unclear whether parenting interventions delivered in this population will have lasting effects. Future studies should incorporate follow-up assessments to examine the long-term effects of early interventions for at-risk families.

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