

REVIEW ARTICLE

A systematic review of prevention and treatment of infant behavioural sleep problems

Antonia Reuter¹ | Sven-Arne Silfverdal^{2,3} | Kristin Lindblom⁴ | Anders Hjern^{5,6,7} ¹Child and Youth Healthcare, Region Västra Götaland, Gothenburg, Sweden²Clinical Sciences, Pediatrics, Umeå University, Umeå, Sweden³Centre for Mother and Child Health Care, Umeå, Sweden⁴Child Health Services, Falun, Sweden⁵Sachs' Children and Youth hospital, Stockholm, Sweden⁶Department of Medicine, Clinical Epidemiology Unit, Karolinska Institutet, Stockholm, Sweden⁷CHESS, Centre for Health Equity Studies, Stockholm University and Karolinska Institutet, Stockholm, Sweden

Correspondence

Anders Hjern, Centre for Health Equity Studies, Karolinska Institutet/Stockholm University, 106 91 Stockholm, Sweden.
Email: anders.hjern@chess.su.se

Funding Information

This review was supported by a network grant from the Swedish Research Council for Health, Working Life and Welfare.

Abstract

Aim: The aim of this review was to evaluate the evidence for interventions for behavioural sleep problem in infants.**Methods:** Systematic review based on a search in MEDLINE, Web of Science and PsychINFO in December 2017 for articles published in English during 2007-2017 about preventive and treatment interventions for sleep problems in infants. The review included controlled trials and meta-analyses with at least 20 infants in study groups assessed according to the Grading of Recommendations Assessment, Development and Evaluation criteria.**Results:** Out of 476 original articles assessed for eligibility, 12 studies were included in the synthesis. Interventions with behavioural, educational and massage strategies were evaluated. No intervention was evaluated in more than one trial. Five interventions with behavioural methods for establishing consistent routines or controlled crying showed modest short-term effects, while the evidence for elements of education was inconsistent. Studies of massage were of poor quality. Knowledge gaps were identified regarding interventions in cross-cultural context, involving fathers, in children below six months of age, in high-risk populations and consequences of interventions that include extinction.**Conclusion:** Some support for short-term effects of behavioural treatment strategies was found, but more studies are needed to establish evidence.

KEYWORDS

behavioural intervention, infant, randomised controlled trials, sleep problem

1 | INTRODUCTION

The evolution of sleep-wake patterns from multiple sleep episodes to one main consolidated sleep episode at night is a complex developmental process substantially engaging and challenging the parents during the first years. Sleep behaviour problems are developmentally

normative; yet, parents who are able to attain appropriate strategies for settling their babies may decrease their child's risk for long-lasting problems. It is important to establish good sleep routines and gradually teach their baby to self-soothe. If parents do not have effective strategies for settling their baby, it can lead to ongoing adjustment problems for the baby.¹ Complaints about difficulty falling

Abbreviations: DSM-5, Diagnostic and Statistical Manual of Mental Disorders; GRADE, Grading of Recommendations Assessment, Development and Evaluation; ICSD, International Classification of Sleep Disorders.

This is an open access article under the terms of the Creative Commons Attribution-NonCommercial License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited and is not used for commercial purposes.

© 2020 The Authors. *Acta Paediatrica* published by John Wiley & Sons Ltd on behalf of Foundation Acta Paediatrica

asleep and multiple and prolonged night wakings are among the most common complaints to child health professionals from parents and often cause family distress.²

Sadeh and Anders have described the complex and bidirectional relationships between parenting and infant sleep in the context of a transactional model formulated by Sameroff³ (Figure 1). In this model, the sleep of the individual infant is influenced by maturational, intrinsic constitutional, biological, temperamental and medical factors which interact with parental influences and parental interactive behaviours. Parents' beliefs, expectations, emotions and behaviours related to infant sleep are influenced by their socio-cultural and environmental context, their own developmental history and memories, their personality and psychopathology, the infant's age, developmental characteristic and sleep patterns. Thus, children's sleep and sleep problem should be considered within the context of the family.

During the first year of life, sleep undergoes substantial developmental changes.² Most babies wake at night for feeding in the early weeks, and parents expect this awakening. Parents report that most babies begin to sleep through the night by about 12 weeks of age. The failure to achieve this milestone, so that an infant continues to settle poorly or wake the parents at night after 12 weeks, accounts for most infant sleep problems.⁴

There is no absolute definition of what constitutes a sleep problem. Sleep disorders refer to difficulties related to sleep, including difficulty falling or staying asleep, falling asleep at inappropriate times, excessive total sleep time and abnormal behaviours associated with sleep. The two most common sleep problems for children aged zero to five years are night waking and settling problems. Sleep problems are primarily defined by caregivers, are developmentally based and depend on cultural values.⁵

Different definitions have been created for use in clinical settings and in research. Within the clinical realm, the second revision of the *International Classification of Sleep Disorders* (ICSD) uses the clinical diagnostic category of Behavioural Insomnia of Childhood, which is further classified into sleep-onset association

Key notes

- The review found some support for short-term effects of behavioural treatment interventions for sleep problems in infants.
- Future studies are needed to disentangle which component/s in the interventions that are most effective.
- Knowledge gaps were found regarding the effectiveness of programmes in minorities with a Non-Western background; in high-risk populations; involving fathers; involving infants below six months of age; and consequences of behavioural interventions that include extinction.

type, limit-setting type or combined type.⁶ The latest renditions of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5)⁷ and the ICSD-3⁸ subsume paediatric insomnia under one umbrella diagnosis (DSM-5-Insomnia Disorder and ICSD-3-Chronic Insomnia Disorder), with both diagnoses taking developmental issues into consideration. From a clinical standpoint, these definitions also require that the symptoms must be frequent, be present for a specified time and result in some significant impairment in functioning in children, parents or in the family. Mild and transient symptoms should not be labelled a sleep disorder according to these manuals.²

It is important to make a distinction between the clinical diagnoses applicable to bedtime problems and night waking in children, and the research definitions used in studies of children with the problems. Essentially, no empirical studies of sleep problems in children have utilised the clinical definitions described above. In research, commonly used indicators of sleep are total sleep duration, number of awakenings at night and difficulties settling to sleep, often operationalised into scales recorded by parents.

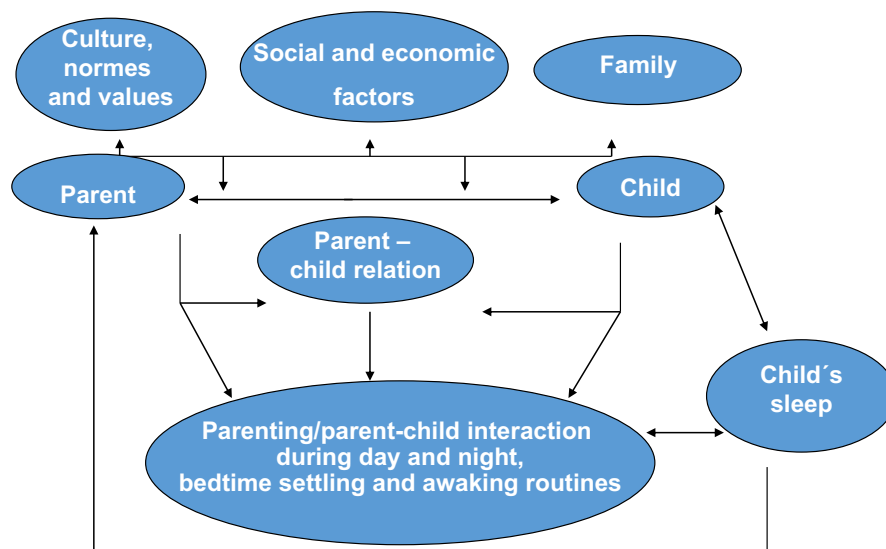


FIGURE 1 A transactional model of parenting and infant sleep³

Objective measurements with technical devices, such as actigraphs, have not been used much in studies of sleep problems in children.⁹

Sleep problems are common in children across development. Although definitions in terms of age, frequency, severity, and duration of symptoms and sample populations have varied, the prevalence of paediatric insomnia in children and adolescents ranges from 10% to as high as 80% in children with neurodevelopmental or psychiatric comorbidities.² The most common types of sleep problems include difficulties initiating sleep and maintaining sleep, in young children commonly referred to as bedtime problems and night waking.⁵

Disturbed sleep is a common problem in families with small children, and identified prevalence is remarkably similar across studies even when comparing studies across cultures. In the first six months of life, between 15% and 35% of parents report a problem with their infant's sleep, including difficulties settling their infant to sleep at the start of the night and resettling them over night.¹⁰ In a Swedish study, 30% of parents of infants aged six to 20 months reported problems with their children's night waking. In most cases (59%), the problems had lasted for more than three months.¹¹ These findings were rather consistent with an earlier Swedish study from the 1960s,¹² suggesting a quite stable prevalence over time.

Infant sleep problems are associated with adverse consequences for mothers including fatigue,¹³ postnatal depression and poorer general and mental health.¹⁴ Fathers also report poorer general health and greater psychological distress linked to infant sleep problems.¹⁵

The aim of this review was to evaluate the evidence for existing methods for the prevention and treatment of sleeping problems in infancy for use in Child Health Care, and to identify important knowledge gaps that need to be filled in future research.

2 | METHODS

We searched MEDLINE, Web of Science and PsychINFO in December 2017 for articles in English published during 2007-2017 about preventive and treatment interventions for behavioural sleep problems and crying or colic in children less than two 2 years (see ¹⁶ for search syntax). In total, 2070 unique records were found and screened through abstracts. It was soon realised that the literature on treatment for sleep disorders and infantile colic had minimal overlaps, and thus, we decided to separate sleep and colic interventions into two separate reviews. The general quality of studies was scrutinised with the Grading of Recommendations Assessment, Development and Evaluation, GRADE,¹⁷ operationalised into a checklist in Swedish by the Swedish Agency for Health Technology Assessment and Assessment of Social Services.¹⁸ We used the following criteria in the selection of articles for sleep problems: the article should include an original intervention study; sleep problems should be the target of the intervention; there should be a control group to the intervention group; the infant and parental outcomes

were accepted; the majority of the children in the study population should be under two years of age; and intervention and control groups should consist of at least 20 infants each.

The search flow is described in Figure 2. All articles were screened by two researchers and discussed until consensus was reached. There were 476 reports of original studies to be screened in full text, and 12 original articles described interventions for sleeping problems that fulfilled our criteria. We found 35 reviews to be of relevance and were taken aside and read separately. Three of these contained systematic reviews or meta-analyses that fulfilled our criteria and were included in the synthesis.

3 | RESULTS

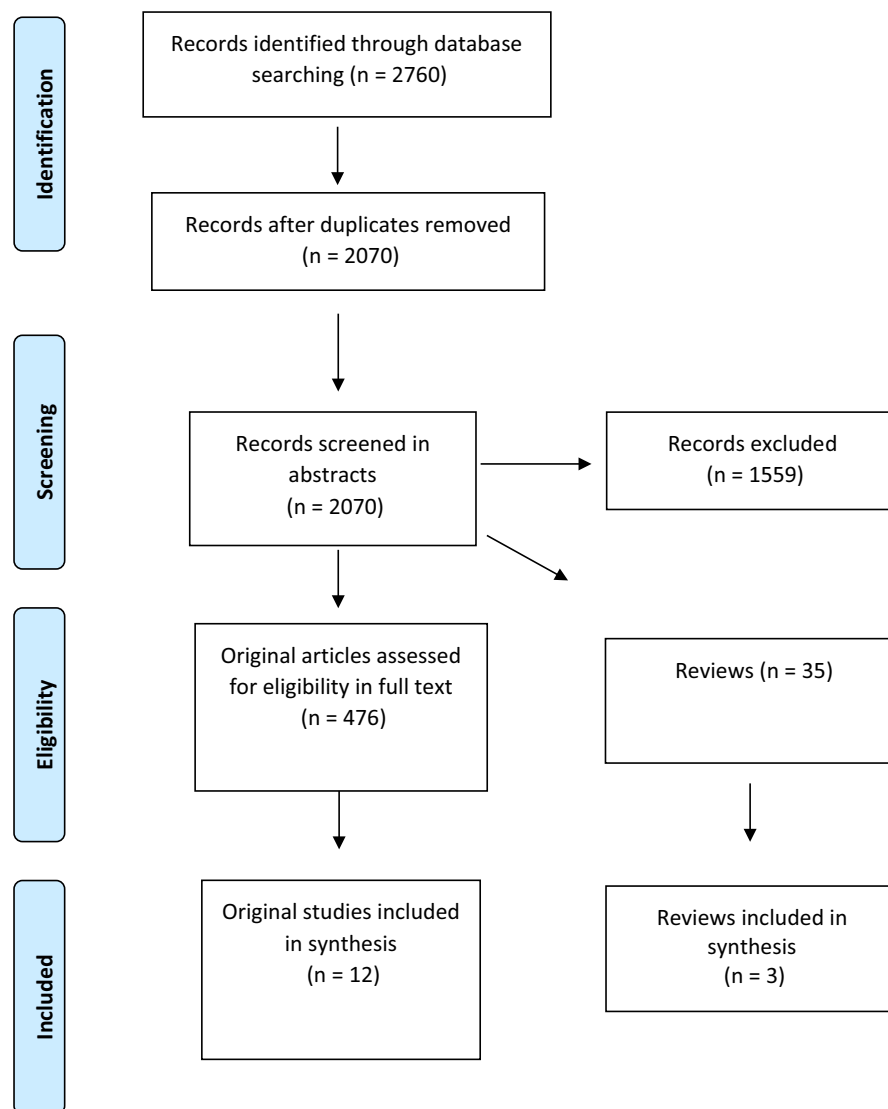
There were two main strategies for the prevention and treatment interventions for behavioural sleep problems in children in the retrieved literature.⁵ Behavioural strategies were the most common and were therefore referred to as behavioural interventions. Education is also often involved, often aiming to establish a bedtime routine. The studies in the review are heterogeneous in respect to the different strategies, and the interventions combined these strategies in different ways. The same elements were used with different purposes, either to prevent or to treat a sleep problem.

There were few studies of sleep interventions in study populations in the age up to 24 months. We have therefore also included studies which included older children, but where the majority of the children were in the age range up to 24 months. We did not find any individual method that had been used in more than one full-scale study, and therefore, no overall evaluation of effects according to GRADE was made. Original preventive studies are described in detail in Table 1 and original treatment studies in Table 2.

3.1 | Education

Educational programmes involved provision of information about normal sleep and crying patterns, signs or tiredness, and focus on early establishment of positive sleep habits. They may include individual and group sessions, a booklet, DVD and website with information about infant sleep and behavioural strategies to improve infant sleep problems, shape circadian rhythms and minimise the likelihood of bedtime settling problems. Several behavioural interventions have been incorporated as bedtime routines, including sleep location, parental handling during sleep initiation and parental response to night-time awakenings. Almost all programmes have incorporated the recommendation that babies should be put to bed drowsy but awake to help them develop independent sleep initiation skills at bedtime and enable them to return to sleep following naturally occurring night-time arousals without intervention. Parent education programmes have been delivered in both the prenatal period and the postnatal period. The behavioural intervention often involved educational components.⁵

FIGURE 2 Search flow



We found three studies with an educational strategy that showed positive effects on children's sleep habits in a short-term perspective. In a study without randomisation in Japan, mothers participated in a group presentation and received a 20-page booklet, named *Baby, Sleep Well at Night*, on sleep and a list of desirable and undesirable parental behaviours to promote infant sleep. A tendency towards less night waking was demonstrated at follow-up.¹⁹ In an RCT, *The Intervention Nurses Start Infants Growing on Healthy Trajectories*, education of developmentally appropriate messages about bedtime routines, sleep location and behaviours, and responses to waking were delivered at home visits including a follow-up after 52 weeks. Compared with controls, the intervention group infants were less likely to have prolonged bedtime routines and more likely to have earlier bedtimes at 16 and 40 weeks, were less likely to be fed immediately before bed and more likely to self-soothe to sleep. In the intervention group, nocturnal sleep duration was longer by 35, 25 and 22 minutes at 8, 16 and 40 weeks, respectively, while effects of the intervention had waned at follow-up at one year.²⁰ Hiscock et al²¹ performed an RCT at four weeks postpartum, sending a booklet and a DVD about infant sleep and crying and parental self-care by

mail. A telephone consultation was offered six to eight weeks postpartum and a group session at twelve weeks postpartum to discuss (infant) sleep problems and strategies. Intervention caregivers were less likely at six months to spend >20 minutes attending infant waking compared to caregivers receiving care as usual, but there were no differences between the groups in infant sleep, crying or feeding problems at either follow-up at four and six months. Among frequent feeders having 11 feeds or more per 24 hours, it was found at four months of age that infants in the intervention group had lower odds of having daytime sleep problems (OR 0.13, 95% confidence interval [CI] 0.03 to 0.54) and crying problems (OR 0.27, 95% CI 0.08 to 0.86) compared to the control group.

In studies with an educational strategy, the results are mixed or show no effects. One of these is *Tips for Infant and Parent Sleep*. The sleep intervention included a 45-minute meeting with a nurse to discuss sleep information and strategies, an 11-page booklet, and weekly phone contact to reinforce information and problem solving. In a pilot study, infants in the sleep intervention group had fewer night-time awakenings and a longer night-time sleep duration, but when the same researchers repeated the study with a larger sample,

TABLE 1 Overview of original articles included in the review—prevention

Authors Year	Sample	Setting & Delivery	Intervention details	Outcome	Was the programme effective?
Adachi et al (2009)	No RCT No randomisation Intervention and control groups recruited in January and February, respectively Intervention group n = 99 mothers and their 4-month-old infants recruited in January <i>Dropout</i> , n = 29 (29.3%) Control group n = 95 mothers and their 4-month-old infants recruited in February <i>Dropout</i> , n = 29 (30.5%)	Setting Health Centre and participants' homes in Fukuoka, Japan Who delivered the intervention? Professional at the health centre (questionnaire), first author (group session) How was the intervention programme delivered? Short group presentation, home visits and via mail	Intervention group Education Mothers were recruited at the health check-up session for their 4-month-old infants They received a booklet ('Baby, Sleep Well at Night') and participated in a group presentation on infant sleep. It contained background information and lists of desirable and undesirable parental behaviours to promote infant's sleep. They completed questionnaires on infant sleep patterns and sleep problems at baseline. Three months later, they received a follow-up questionnaire by mail Length —20-pages educational booklet and 10-minute group presentation Follow-up period —3 mo Control group —The control group received standard parenting educational information at the check-up session. They completed the questionnaires as above (at baseline and 3 mo later). When the follow-up was completed, they received the educational booklet	Both the intervention and the control group had significantly lower prevalence of infants with difficulties settling at follow-up. No differences between baseline and follow-up were found for the other sleep-related problems Compared to baseline the control group had significantly higher prevalence of infants who woke up more than once at night at follow-up ($P = .022$) Indicate prevention of night waking	Yes
Galland et al (2017)	RCT 802 families with mothers, partners and their babies born without congenital abnormalities at 36.5 wk' gestation or later were randomly allocated into one of four groups stratified on household deprivation and parity Intervention n = 593 Sleep: N = 192* FAB: N = 205* Combination: N = 196* Control n = 209 Missing data —all groups Actigraph, n = 304 (37.9%) Parental report, n = 295 (36.8%)	Setting Hospital (group session) and participants' homes in Dunedin, New Zealand Who delivered the intervention? Researcher (general home visits), lactation consultant (breastfeeding), local sports body (physical activity) How was the intervention programme delivered? Face-to-face	The aim to evaluate the effectiveness of sleep education antenatally and at 3 wk postpartum to prevent infant sleep problems Mothers were recruited at 28–30 wk' gestation. They were allocated to one of four groups: 1 (sleep intervention, 2) food, activity and breastfeeding (FAB) intervention, 3) combination of sleep and FAB intervention, or 4) control group, revealed after they consented to participate. All groups received standard maternity and <i>Well Child</i> care. The sleep group received a pre- birth group education on infant sleep, reinforced through an individual home visit 3 wk postpartum. The FAB group received education and support on breastfeeding pre-birth, 1 wk and 4 mo postpartum and on physical activity 3 mo postpartum. The combination group received all the above Questionnaires were completed pre-birth, and 4 and 6 mo postpartum. At 6 mo, accelerometers and parents' sleep diaries recorded the infants' activity/sleep for 48 h Length —1-hour pre-birth group education and home visit (sleep), four educational sessions (FAB) and all the above (combination) Follow-up period —6 mo Control group —Received standard maternity and <i>Well Child</i> care and completed the questionnaires pre-birth, 4 and 6 mo postpartum	No significant differences in infant sleep problems were found between the groups Linear or mixed linear regression models found no significant intervention effects on sleep outcomes, with 19.1% of mothers and 16.6% of partners reporting their infant's sleep a problem at 6 mo. Actigraphy-estimated the number of waking to be significantly reduced (8%) and the duration of daytime sleep increased (6 min) in those groups receiving the sleep intervention compared with those who did not. However, these small differences were not clinically significant and not observed in 24 h of infant sleep diary data	No

(Continues)

TABLE 1 (Continued)

Authors Year	Sample	Setting & Delivery	Intervention details	Outcome	Was the programme effective?
Hiscock et al (2014)	RCT 781 infants (from 770 families) born at 32 wk' gestation or later without a serious health concern and their primary caregiver were randomised Intervention N = 388 from 385 families Data available from 275 infants (273 families) Missing data n = 133 (29.1%) Control N = 393 from 385 families Data available from 279 infants (274 families) Missing data n = 114 (29%)	Setting Participants' homes and 42 well-child centres (group session) in Melbourne, Australia Who delivered the intervention? Trained health professional (nurse, psychologist) How was the intervention programme delivered? 4 wk postpartum a booklet and DVD via mail, at 6-8 wk telephone consultation, at 12 group session	The aim to evaluate a preventive programme. Caregivers were recruited at their first home visit by their maternal and child health nurse (day 7-10 postpartum) Educational material, telephone consultation and group session with focus on infants' night-time sleep problems, daytime sleep problem, sleep patterns and parental night attendances were measured with a postal survey at baseline, and 4 and 6 mo postpartum Length —27-page booklet, 23-minute DVD, telephone consultation, 1.5-hour group session Follow-up period —6 mo Control group —Received usual well-child care and completed the questionnaires at baseline, 4 and 6 mo postpartum	2014: Relative to control caregivers, intervention caregivers at 6 mo were less likely to spend >20 min attending infant waking (41% vs 51%, adjusted OR 0.66, 95% CI 0.46 to 0.95) No significant differences in infant sleep problems were found between the groups Infant frequent feeders (>11 feeds/24 h) in the intervention group were less likely to have daytime sleep (OR 0.13, 95% CI 0.03 to 0.54) or cry problems (OR 0.27, 95% CI 0.08 to 0.86) at 4 mo Frequent feeders at baseline had lower odds of daytime sleep problems in the intervention group compared with the control group at 4 mo The programme may be best targeted to frequent feeders	Partly, for frequent feeders
Paul I et al (2016)	RCT At 2 wk, 291 dyads of mother- newborn, full term, singletons, birth weight $\geq$ 2500 gm, were recruited to intervention or control group, stratified on birth weight, gestational age and intended feeding mode (breastfeeding or formula) Intervention N = 140 Missing data, n = 13 (10%) Controls N = 139 Missing data, n = 15 (10.7%) "90.7% completed visit at 1 y"	Setting: Participants home in Hershey, PA, USA, and at research centre Who delivered the intervention? Research nurses How was the intervention programme delivered? Material via mail-DVD or CD, and face to face	Primiparous mother-newborn dyads were randomised after childbirth, and research nurses delivered intervention content at home visits at infant ages 3, 16, 28 and 40 wk and at a research centre visit at 1 y The RP sleep component included developmentally appropriate messages about bedtime routines, sleep location and behaviours, and responses to wakings Portions of the Brief Infant Sleep Questionnaire were administered 2, 8 and 52 wk after birth with expanded sleep-related data collection at 16 and 40 wk	Compared with controls, intervention group infants were less likely to have prolonged bedtime routines >45 min and more likely to have earlier bedtimes at 16 and 40 wk, were less likely to be fed immediately before bed and more likely to self- soothe to sleep In intervention group nocturnal sleep duration was longer at 8, 18 and 40 wk by 35, 25 and 22 min, respectively ($P < .05$ for all) Sleep duration at 1 y was similar between groups	Yes

(Continues)

TABLE 1 (Continued)

Authors Year	Sample	Setting & Delivery	Intervention details	Outcome	Was the programme effective?
Stremmler et al (2013)	RCT—246 First-time mothers and their healthy singleton infants born at 37 wk' gestation or later were randomised to intervention or control group Intervention N = 123 n = 110 follow at 6 wk and/or 12 wk (109 at 6 wk, 103 at 12 wk) <i>Missing data</i> n = 14 at 6 wk (11%) n = 20 at 12 wk (16%) Control N = 123 N = 105 follow at 6 wk and/or 12 wk (103 at 6 wk, 102 at 12 wk) <i>Missing data</i> n = 20 at 6 wk (16%); n = 21 at 12 wk (17%)	Setting Hospital postpartum units and participants' homes in Toronto, Canada Who delivered the intervention? Nurse (intervention group), research assistant (controls) How was the intervention programme delivered? Educational session one to one (nurse); individual telephone consultations Control: care as usual, telephone contact by research assistant	Mothers were recruited from hospital postpartum units. Baseline data were collected from medical charts and a brief questionnaire. Before discharge, a nurse delivered an educational session on sleep issues and strategies to improve sleep, and a comprehensive educational booklet. 1, 2 and 4 wk after discharge, the same nurse provided telephone consultation on sleep-related issues The infant's longest nocturnal sleep period and night awakenings were measured by actigraphy at infant's age 6 and 12 wk (provided and collected by a research assistant) and supplemented by a sleep diary Length —45–60-minute educational session, 20-page booklet Follow-up period —12 wk Control group —Mother's received standard postpartum care. 1, 2 and 4 wk after discharge a nurse or research assistant telephoned mothers to increase compliance. The infant's longest nocturnal sleep period and night awakenings were measured as above	No significant differences in infant's longest nocturnal sleep period or number of night awakenings were found between the groups measured by actigraphy and/or sleep diary	No

no significant differences in infant's longest nocturnal sleep period or number of night awakenings were found between the groups.²² Hall et al²³ conducted an RCT based on a group teaching session on infant sleep and sleep-promoting behaviours, using video and hand-outs, reinforced by support the successive two weeks. At follow-up six weeks later, parents in the intervention group reported significantly less severe sleeping problems and a 30% reduction in night waking more than twice a night compared to the controls in parental reports. An analysis of objective actigraphic registered wakes or long wake episodes was performed, but no differences in mean change between the intervention and control groups were found. In an RCT, Galland et al²⁴ evaluated the effectiveness of sleep education antenatal and at 3 weeks postpartum to prevent infant sleep problems. Mothers were recruited at 28–30 weeks' gestation. They were randomly allocated to one of four groups with sleep intervention with a pre-birth group education on infant sleep, reinforced through an individual home visit 3 weeks postpartum, or food, activity and breastfeeding (FAB) intervention, or a combination of sleep and FAB intervention, or control group. No significant differences in infant sleep problems were found between the groups.

3.2 | Bedtime routine and other interventions based on behavioural principles

A common outcome in behavioural studies is the development of a positive bedtime routine. Mindell et al²⁵ studied in an RCT the effects of setting a bedtime routine including a bath, massage, quiet activities and lights out after 30 minutes. Results from questionnaire and sleep diaries showed that the bedtime routine resulted in moderate reductions in problematic sleep behaviours for infants and toddlers, latency to sleep onset and in number/duration of night wakings. In a later RCT by Mindell et al,²⁶ an algorithm-based customised sleep profile was provided for mothers through the internet, including a normative comparison of their child's sleep compared to other children, a rating of the child's sleep and customised evidence-based advice on how to promote better sleep for the child. It involved 264 mothers and their children (six to 36 months) randomised to either a programme focused on bedtime routine and changing responses to night wakes, or the three-step bedtime routine. Both programmes lasted for three weeks. The control group followed their usual bedtime practice. Significant improvement was found for both intervention groups. Follow-up data indicated maintenance of improvements one year after the intervention in both intervention groups.²⁷

In a third RCT, Mindell et al²⁸ examined the impact of a massage-based bedtime routine on infant sleep, maternal sleep and maternal mood. Mothers were instructed to use a two-step bedtime routine for two weeks, including a massage and quiet activities and no bath in this study. Infants aged between three and 18 months in the intervention group had a significant decrease in number of night wakings week 2 and week 3 of the study compared with baseline, while no decrease was found in the control group.

TABLE 2 Overview of original articles in the review—treatment interventions

Authors Year	Sample	Setting & Delivery	Intervention details
Hall et al (2015)	RCT with 235 single or two-parent families with a healthy 5.5-8 mo old infant with moderate behavioural sleep problems Intervention N = 117 parental report, n = 108 actigraph data, n = 96 <i>Missing data</i> parental report, n = 9(8%) actigraph data, n = 21 (18%) Control N = 118 parental report, n = 107 actigraph data, n = 96 <i>Missing data</i> parental report, n = 11 (9%) actigraph data, n = 22 (19%)	Setting Health units and participants' homes in Vancouver, Canada Who delivered the intervention? Nurses How was the intervention programme delivered? Groups teaching session with nurse and follow-up by telephone	During a group teaching session, they were taught on infant sleep and sleep-promoting behaviours, watched an illustrative video and received handouts (cognitive-behavioural group intervention) The successive two weeks they received reinforcing and supportive four follow-up calls Infant sleep disturbances were assessed the <i>Maternal (parental) Cognitions about Infant Sleep Questionnaire</i> (MCISQ), as well as parental sleep diaries and actigraphy for six successive days. All measures were taken before randomisation and at the 6-week follow-up Length —2-h teaching session and four telephone calls during a period of 3 wk Follow-up period —6 wk Control group —The control group were provided a teaching session on infant safety risks, which was reinforced by four telephone calls where nurses asked the same questions as to the intervention group. Infant sleep disturbances were assessed as above
Study 1 Hiscock et al (2007) Study 2 Hiscock et al (2008) Study 3 Price et al (2012)	Cluster RCT 328 mothers and their child born at 32 wk' gestation or later, with mother- reported sleep problems at age 7 mo but no significant sleep disorder Study 1 Intervention N = 174 <i>Missing data study 1</i> n = 11 at 8-10 mo (6%) n = 11 at 10-12 mo (6%) Included in analysis 168/174 (97%) Controls N = 154 <i>Missing data study 1</i> n = 7 at 8-10 mo (4,5%) n = 8 at 10-12 mo (5%) included in analysis 151/154 (98%) Study 2 at 2 years of age Intervention group n = 143 out of 174 <i>Missing data</i> , n = 31 (18%) Control group n = 129/154 <i>Missing data</i> , n = 25 (16%) Study 3 at 6 years of age Intervention n = 122/174 <i>Missing data</i> , n = 51 (29%) Control n = 103/154 <i>Missing data</i> , n = 50 (32%)	Setting Well-child clinic in Melbourne, Victoria, Australia Who delivered the intervention? Well-child nurses How was the intervention programme delivered? Individual structured nurse consultation at well-child clinic, followed- up appointment 2 wk later	Mothers were recruited at a four-month visit with their Maternal & Child Health (MCH) nurse. They received a tailored consultation, handouts, and the choice of two behavioural interventions ('controlled crying' or 'camping out') at child's age 8 mo In graduated extinction, parents respond to their infant's cry at increasing time intervals (ie, 2, 4, 6, 8, to 10 min), allowing an infant to learn to fall asleep by him or herself. Adult fading is an even more graduated approach to managing infant sleep problems, in which a parent sits with their infant until they fall asleep and slowly removes their parental presence over 2 to 3 wk They were asked to keep daily sleep diaries until the follow-up appointment two weeks later, where they based on the diaries discussed sleep improvements and future goals Mothers completed questionnaires at infant's age 10 and 12 mo measuring infant sleep problems using a single yes/ no item and infant temperament using the 5-point Global Infant Temperament Scale The 6-year follow-up study aimed to determine long-term harms and/or benefits of an infant behavioural sleep programme at age 6 y on (1) child, (2) child-parent and (3) maternal outcomes. The main outcomes measured were child mental health, sleep, psychosocial functioning, stress regulation; child-parent relationship; and maternal mental health and parenting styles Length : two structured 2.5-hour training sessions conducted by a paediatrician and a child psychologist, supported by a written manual Follow-up period : at 8-10 mo, 10-12 mo; at 2, and 6 y of age, respectively Control group —The control group received usual well-child care. The infants sleep problems and temperament were assessed as above

Outcome	Was the programme effective?
At six weeks, 4% of infants in the intervention group (n = 4) compared to 14% of infants in the control group (n = 15) had parental reports of severe sleep problem scores (relative risk of 0.26 [95% CI: 0.09, 0.77]); adjusting for baseline scores yielded an estimate of 0.30 (95% CI: 0.11, 0.84) and a risk difference of -10% (95% CI: -16.8-2.2) The intervention group had a 30% reduction in night waking ≥ 2 times/nights compared to the controls as reported by the parents At six weeks, there was no difference between the intervention and control groups for mean change in actigraphic wakes ≥ 2 times/nights or long wake episodes adjusted for baseline but there was a significant increase in longest sleep time in the intervention compared to control infants' Conclusion: The intervention improved caregivers' assessments of infant sleep problem severity compared with controls	Yes
Maternal depression symptoms (Edinburgh Postnatal Depression Scale); parenting practices (Parent Behavior Checklist); child mental health (Child Behavior Checklist); and maternal report of a sleep problem (yes or no) using written questionnaires when their child turned 10 mo, 12 mo and 2 y old. The intervention had a lasting impact on reducing maternal depression symptoms at 2 y Prevalence of infant sleep problems was lower in the intervention than control group at 10 mo (56% vs 68%; adjusted OR 0.58 (95% CI: 0.36 to 0.94)) and at 12 mo (39% vs 55%; adjusted OR 0.50 (0.31 to 0.80)). The association did not vary with the mother's depression score (high/low) at baseline. Infant temperament score at age 10 and 12 mo did not differ significantly between the intervention group and control group At 2 y, 27.3% (39 of 143) of mothers in the intervention group reported child sleep problems compared with 32.6% (42 of 129) of control mothers (adjusted OR: 0.83 [95% CI: 0.48 to 1.43]; $P = .49$). A smaller proportion of intervention rather than control mothers reported sleep problems that persisted throughout the entire study, that is, at all 3 of the 10-, 12- and 24-month assessment times (11.2% [16 of 142] vs 21.7% [28 of 129]; adjusted OR: 0.51 [95% CI: 0.25 to 1.03]; $P = .06$) No evidence of differences between intervention and control families for any outcome was found at 6 y age follow-up, including children's emotional and conduct behaviour scores, sleep problems, sleep habits score, parent- and child-reported psychosocial functioning, chronic stress; child-parent closeness and conflict, global relationship, disinhibited attachment; and parent depression, anxiety and stress scores or authoritative parenting	Yes, at first follow-up at 10-12 mo of age. At two years there was a tendency to less sleep problems in the intervention group Sleeping problem had mainly resolved at 2 y of age in both groups Behavioural sleep techniques have no marked long-lasting effects (positive or negative). Parents and health professionals can confidently use these techniques to reduce the short- to medium-term burden of infant sleep problems and maternal depression

(Continues)

TABLE 2 (Continued)

Authors Year	Sample	Setting & Delivery	Intervention details
Mindell et al (2009)	RCT 419 mothers and their child (209 infants aged 7-8 mo and 210 toddlers aged 18-36 mo) with mother-reported sleep problems but no significant sleep disorder were included and completed the study Intervention Infants: N = 134 Toddlers: N = 133 with complete data Control Infants: N = 72 Toddlers: N = 67 with complete data <i>Missing data</i> 3 in infant study (<1%) 11 in toddler study (5%)	Setting USA, screened by a market research firm by telephone or in-person. Lotion was sponsored, all families were paid 150-200US\$ Who delivered the intervention? Not specified How was the intervention programme delivered? Not specified	The aim to study efficacy of establishment of a consistent bedtime routine independent of behavioural intervention. Mothers were recruited by phone or in-person through an independent market research firm. First a week for baseline data on sleep routines. Starting week 2 of the study, they were instructed to use a 3-step bedtime routine for two weeks including a bath, massage (infants; 7-18 mo of age) or application of lotion (toddlers; 18-36 mo of age) and quiet activities with lights out before putting their child to bed as they normally did. Measures for infants and toddlers were slightly different and results were analysed separately. The child's sleep patterns (daytime and night-time) and sleep-related behaviours were assessed with an expanded version of the <i>Brief Infant Sleep Questionnaire</i> (BISQ) at day 8 (baseline), 15 and 22 of the study, and with a daily sleep diary. Parents were additionally asked to rate the ease of bedtime, how well the child slept the last night and the child's mood at wake-up, every day Length—1 instruction session Follow-up period—2 weeks Control group—The control groups were informed that the aim of the study was to study bedtime activities and sleep behaviour in children. They were instructed to follow usual bedtime practices throughout three weeks, and reported sleep-wake patterns for their child using BISQ (day 8, 15 and 22) and daily sleep diaries
Study 1 Mindell et al (2011a) Study 2 Mindell et al (2011b)	RCT Study 1: 272 families with mother-reported sleep problems but no significant sleep disorder at age 6-36 mo, were recruited and randomised after initial one-week baseline period, 264 with complete data were included Study 2: N = 171 of 264 with complete data participated in study 1 Intervention Study 1 CSP: N = 101 (96) CSP + routine: N = 86 (84) <i>Missing data:</i> 5 in CSP, 2 in CSP + routine Study 2 CSP: N = 62 CSP + routine: N = 52-55 Control Study 1 N = 85 <i>Missing data:</i> 1 Study 2 N = 57 Detailed distribution in numbers for each group is lacking for the follow-up study 2 but the groups had the same response rate (64, 65 and 66%, respectively)	Setting USA Who delivered the intervention? Algorithm-based How was the intervention programme delivered? Personal contact for informed consent, otherwise Internet-based Study supported by Johnson & Johnson Consumer Companies	Mother-infant pairs were recruited and screened by phone through an independent market research firm. An algorithm-based <i>Customized Sleep Profile</i> (CSP) was provided for mothers through the internet, including a normative comparison of their child's sleep compared to other children, a rating of the child's sleep and customised evidence-based advice on how to promote better sleep for the child. Mothers in a second group were additionally instructed to use a 3-step bedtime routine for two weeks including a bath, massage/application of lotion and quiet activities with lights out before putting their child to bed as they normally did The child's sleep patterns (daytime and night-time), sleep-related behaviours and maternal sleep-related perceptions were assessed with an expanded version of the <i>Brief Infant Sleep Questionnaire</i> (BISQ) Study 1 Mothers completed the expanded BISQ at day 8 (baseline), 15 and 22 of the study Study 2 A year after the intervention mothers were recruited to the follow-up study through an automated phone call and a subsequent email. A selection of items from the expanded BISQ was measured again, also this time through the internet Length—1 Internet-based intervention session Follow-up period—1 y Control group—The control group were instructed to follow usual bedtime practices throughout three weeks. They completed the expanded BISQ (as above) at day 8, 15, 22 of the study and 1 y later

Outcome	Was the programme effective?
The bedtime routine resulted in significant reductions in problematic sleep behaviours for infants and toddlers, latency to sleep onset and in number/duration of night waking, $P < .001$ No differences between baseline, week 2 and week 3 measures using BRIQ or sleep diaries were found in the control group with infants or the control group with toddlers <i>Infants</i> Results from BRIQ and/or the sleep diaries showed that infants in the intervention group had significantly shorter sleep latencies, fewer and shorter night waking, longer continuous sleep periods, less perceived sleep problems, better morning mood, longer total night-time sleep, easier bedtime and better sleep at week 2 and/or 3 of the study compared with baseline. <i>Toddlers</i> Toddlers in the intervention group had significantly shorter sleep latencies, fewer and shorter night waking, longer continuous sleep periods, less perceived sleep problems, better morning mood, fewer parent calls, fewer times out of the crib/bed, easier bedtime and better sleep at week 2 and/or 3 of the study compared with the baseline	Yes
Study 1 Children in all groups had significantly longer continuous sleep periods and less mother-perceived sleep problems at week 3 of the study compared with baseline and week 2 of the study Children in both intervention groups additionally had shorter sleep latencies, fewer and shorter night waking, longer total night-time sleep, better mood in the morning, fewer parent calls, easier bedtime and better sleep and week 3 of the study compared with baseline and/or week 2 of the study Children in the CSP only group had significantly earlier bedtime, and the CSP + routine group significantly later wake time at 3 wk compared to baseline and 2 wk For total naptime, number of times out of crib/bed and times the child wakes on its own, no significant differences over time were found in either group Sleep latencies, number and duration of night waking, continuous sleep periods and perceived sleep mother-perceived sleep problems varied significantly between groups over time Study 2 Infants in all groups had significantly fewer and shorter night waking, longer continuous sleep periods and fewer mothers considering sleep a problem at the 1-year follow-up compared with baseline and/or 3-week follow-up. ($P < .001$) Effect sizes were generally larger in the intervention groups than in the control group Infants in both intervention groups had significantly more ease of bedtime at the 1-year follow-up compared with baseline and 3-week follow-up Infants in the group who received the CSP intervention only had significantly shorter sleep latencies and shorter total naptime at the 1-year follow-up compared with baseline and/or 3-week follow-up No differences between baseline or 3-week follow-up, and the 1-year follow-up were found for total night-time sleep	Yes

TABLE 2 (Continued)

Authors Year	Sample	Setting & Delivery	Intervention details
Mindell et al (2018)	RCT with 123 mothers and their child with mother-reported sleep problems but no significant sleep disorder at age 3-18 mo Intervention N = 64 Control N = 59 <i>No information about dropouts or missing data</i>	Setting Clinical research centre, USA Families were paid for participation Industry-sponsored study Who delivered the intervention? Not specified How was the intervention programme delivered? Not specified	The purpose of the study was to examine the impact of a massage-based bedtime routine on infant sleep, maternal sleep and maternal mood. Mother-infant pairs were recruited and screened by phone and in-person through an independent clinical research organisation. Starting week two of the study, they were instructed to use a 2-step bedtime routine for two weeks, including a massage and quiet activities with lights out before putting their child to bed as they normally did The child's sleep patterns (daytime and night-time), sleep-related behaviours and maternal sleep-related perceptions were assessed with an expanded version of the <i>Brief Infant Sleep Questionnaire</i> (BISQ) at day 8 (baseline), 15 and 21 of the study, Length —1 instruction session Follow-up period —Two weeks Control group —The control group was told the aim of the study was to study children's sleep problems and asked to keep their usual bedtime practices for the three weeks. The

3.3 | Behavioural interventions based on extinction in different forms

Extinction-based behavioural interventions incorporate one or more of the following practices as delayed response to infant signals or cues using unmodified or graduated extinction methods including parental presence, regulation of feeding times, algorithms for sleep durations and bedtimes, and other strategies that aim to condition the infant to fall asleep in the absence of feeding or bodily contact.⁵ The treatment has two main components consisting of modifying parental cognitions about their child's sleep-related behaviours, and modifying parental behaviours and responses to the child to modify the child's sleep-related behaviours. Unmodified extinction, called cry-it-out method procedures for sleep problems, involves having the parents put the child to bed at a designated bedtime and then ignoring the child until a set time the next morning. Parents monitor for illness, injury, etc Behaviours that are ignored include crying, tantrums and calling for the parents. Unmodified extinction was not included in any of the interventions described in this review.

Graduated extinction or control crying and comforting are based on the same rationale of unmodified extinction and refers to a variety of techniques. The intervention allows parents to visit the child at certain intervals. The interval between check-ins with the child was often tailored to the child's age and temperament, and the parents' judgement of how long they can tolerate the child's crying. Parents can employ a fixed schedule, or they can wait progressively longer intervals (progressively increased intervals from two to ten minutes) before checking on their child. The checking procedure involves the parents comforting their child for a brief period and leaves the room. A more interactive model is staying with the child in their room and

gradually withdrawing parent presence, eventually leaving the room and then adopting the periodic checking paradigm, the camping out method. The behavioural intervention often involves educational components such as information about normal sleep and crying patterns, signs of tiredness and focus on establishment of positive sleep habits.

Hiscock et al^{29,30} performed a cluster randomised clinical trial with behavioural intervention for infants with sleeping problems recruited at seven months of age, delivered over one to three individual nurse consultations to parents of infants aged eight to ten months. This intervention was compared to usual care. The intervention involved controlled comforting and camping out for managing infant sleep. Parents in the intervention group reported fewer sleeping problems in the child at ten and 12 months, and a tendency to fewer sleeping problems at two years of age, 17 months after the intervention and lower rates of depression in mothers.²⁹ At a follow-up five years later, Price et al did find neither long-term harm nor benefit of the interventions on child mental health, sleep, psychosocial functioning, stress regulation, child-parent relationship, and maternal mental health and parenting styles.³¹

3.4 | Massage

In many regions of the world, especially in the African and Asian continents, indigenous South Pacific cultures and the former Soviet Union, infant massage is a traditional practice. Healthcare practitioners in Western cultures have become interested in infant massage primarily as an intervention for infants in neo-natal intensive care units where the environment is stressful and lacking in tactile stimulation. Massage is thought to benefit sleep, respiration,

Outcome	Was the programme effective?
Children in the intervention group had a significant decrease in number of night- wakings week 2 and week 3 of the study compared with baseline, which was not found in the control group ($P = .006$). Subsequent analyses indicated a significant reduction in number of night wakings for children in the intervention group, but not for those in the control group No other significant differences in sleep patterns (sleep latency, bedtime, duration of night wakings, longest continuous sleep period, total night-time sleep, number of naps, nap duration or total sleep across 24 h) were found over time or between the intervention group and control group Based on mother-ratings, children in the intervention group also had less bedtime difficulties, better sleep, better morning mood and less sleep problems between baseline and week 2 and 3 of the study. Except for child mood—where no significant interaction between the groups was found—the same improvements were not seen in the control group	Yes

elimination and the reduction of colic and wind as well as parent-infant interaction. Increasingly, parents/caregivers of low-risk babies in the Western world are being taught massage to promote infant development and improvements in sleep, elimination and the reduction of colic and wind.³²

In a first Cochrane's review, some evidence was found for the positive effect of infant massage on the mother-child interaction, sleep and crying, and the child's stress hormone profile.³² The effects were considered to be particularly important in families where infants are stressed and have sleep problems. A later Cochrane review by Bennet et al,³³ however, did not support the use of infant massage with low-risk groups parents and infants. Available evidence was judged to be of poor quality, and many studies did not address the biological plausibility of the outcomes being measured or the mechanisms by which change might be achieved. It should be noted, however, that Mindell et al had a massage component in two of their trials of bedtime routines, mentioned above with positive outcomes.^{26,28}

4 | DISCUSSION

In this systematic review of prevention and treatment of sleep problems in infants 0-24 months of age, we retrieved studies based on behavioural strategies, education and massage. The interventions evaluated typically included items from at least two, or even all three strategies. No single intervention was studied in more than one controlled study that fulfilled our criteria, which prevented us from drawing any firm conclusions about evidence according to the GRADE criteria used.¹⁷

All five studies of behavioural interventions for treatment of sleep problems demonstrated short-term effects on sleep problems. Two studies had interventions adapted to individual families that involved controlled crying or camping out along with written material

and follow-up sessions.^{23,30} Three studies showed positive effects of a consistent sleep routine, of which two included bathing, massage, quiet activities and extinguished light before the child was put to bed, and one of these methods was Internet-based.^{25,26,28}

The scientific support for preventing sleep problems in infants with education programmes before and/or after birth was inconsistent. Three RCT studies showed some positive effects of such programmes,¹⁹⁻²¹ while two studies did not show any significant protective effect.^{22,24} There are some indications in these studies that the timing of this information may be a decisive factor, where information given before delivery or soon thereafter does not have the same effect as information given when the first transition period is over, and follow-up contacts with parents.

Two Cochrane reviews^{32,33} evaluated massage as prevention and treatment for sleep problems in infants, concluding that the available evidence was of poor quality. In the absence of indications that such massage would be harmful, one could take this as support for the use of infant massage, especially in contexts where there is poor stimulation for infants. Future research should focus on the impact of infant massage in higher-risk groups (eg demographically and socially deprived parent-infant dyads), where there may be more potential for change.

4.1 | Negative consequences of behaviour-based interventions with sleep deprivation

Our review of behavioural sleep interventions includes extinction methods in which parents were asked to ignore their child's crying for a certain time. Many parents have difficulties with this, which contributes to abrasion, lack of conformity with the method and avoiding treatment. Why these methods are difficult

to implement has rarely been addressed in the literature, nor are the potentially negative consequences on parent-child interactions when parents are taught to avoid responding to children's signals.³⁴⁻³⁶ However, a study by Price et al did not find any negative effect of extinction on child health, child-parent relationship, maternal mental health and parenting styles five years after the intervention.³¹ As described above, there are alternatives to these treatment methods, which do not have these potentially negative consequences.

4.2 | Knowledge gaps

While many studies documented links between parenting and sleep problems in infants, most of these studies were focused on the mother/main caretaker, neglecting the significant role that fathers/the other caretaker may have on infant sleep development. This is surprising since many of the father-infant interactions occur around bedtime. The growing involvement of fathers in early childcare has been long identified and documented.³⁷ From a developmental systems perspective, there are good reasons to assume that paternal involvement should exert significant influence on the developing child as well as on the mother. Indeed, research on paternal involvement and infant sleep provided evidence regarding the role of the father in infant sleep development. Tikotzky³⁷ found that mothers were significantly more involved than fathers in daytime and night-time caregiving. A greater involvement of fathers in overall infant care predicted and was associated with fewer infant night wakings and with longer total sleep duration after controlling for breastfeeding. The findings highlight the importance of including fathers in developmental sleep research. Future studies should explore mechanisms underlying the relations between paternal involvement and infant sleep.³⁷

The ways in which culture and biology interact plays a major role in the establishment of sleep patterns and developmental norms and expectations regarding normal and problematic sleep. Cross-cultural research demonstrates differences between cultural contexts concerning how parents put their children to sleep and the concerns parents have about their children's sleep.

To a large degree, parental concern about infant night waking reflects Western cultural practices and norms.³⁸ This consideration does not downplay parental complaints, because parents who work Western office hours need to sleep at night themselves, and it is true that most Western infants over three months of age remain settled for long periods at night. Rather, the implication is that most infants who fail to develop this ability are in good health, so that the infant behaviour needs to be distinguished from the largely parental problem.⁵

Many parents in Scandinavia today have a background from outside of the Western world, which is where all studies in this review have been performed. Consequently, child health professionals are faced with families of widely differing cultural origins. Family and cultural attitudes and beliefs strongly influence whether sleeping behaviour is perceived as problematic or not, and may affect the effects

of interventions. Thus, further studies are needed to evaluate methods for sleep prevention and treatment in diverse cultural contexts.³⁸

Few randomised controlled trials have evaluated behavioural strategies to manage sleep problems in infants less than six months old. Behavioural sleep interventions in infants younger than 6 months have yielded mixed results. In a systematic review, Chrichton³⁹ concluded that educating parents about use of behavioural techniques can be effective in promoting infant sleep during the first six months. However, Stremler et al²² and Hiscock et al²¹ found no positive effect on infant night sleep of early preventive intervention. These results are partly consistent with the meta-analysis by Kempler et al,⁴⁰ reporting no significant effect of early behavioural sleep intervention in maternal report of infant nightly awakenings.

The maturation and consolidation of sleep-wake patterns during infancy are an important developmental task. The most rapid development in sleep organisation takes place during the infant's first months of life. During this time, the pattern of sleep and wakefulness is irregular. For most children, sleep begins to consolidate by six months, when they are establishing a circadian rhythm and no longer need night meals.⁴¹⁻⁴⁴ To intervene during this time can therefore be fraught with challenges. Unsettled behaviour in the first six months can emerge out of multiple interacting factors. Crying, feeding and sleep problems interact and co-evolve, particularly in the first neuro-developmentally sensitive four months.⁴⁵ James-Roberts discusses possible causes for few interventions during the first months, such as the human babies limit regulatory capacities or ability to learn, so that attempts to shape behaviour are less successful. Another aspect is the experience of parental unwillingness to participate in studies during the baby's first months. Parents are primarily concerned with their baby's well-being and growth at this age, and less inclined to introduce constraints.⁴⁵

4.3 | Methodological aspects

Although we have tried to base our review primarily on randomised clinical trials, there are weaknesses in many of these studies of methodologic origin as many intervention studies have used parental reports, questionnaires and diaries, and not objective measurements such as actigraphy data, as outcomes. As the study by Hall et al²³ described above, demonstrated, such objective methods do not always support the conclusions based on parental report. Lack of blinding and selection bias are other weaknesses which make it difficult to draw firm conclusions.⁴⁶

5 | CONCLUSIONS

The message from this review is that behavioural interventions seem to be a promising strategy for treatment of behavioural sleep

problems in infants above 6 months of age. However, the combination of several methods used in the reviewed interventions makes it impossible to disentangle exactly which component/s in the diverse interventions that are the most effective, and which interventions are more suitable for universal delivery and to families with greater needs. These are questions for further studies, which preferably should evaluate individual components in behavioural sleep interventions. Important knowledge gaps were found with regard to the effectiveness of treatment and prevention programmes in minorities with a Non-Western background, prevention in high-risk population, in treatment interventions involving fathers, treatment interventions in children below six months of age and negative consequences of behavioural interventions that include extinction.

ACKNOWLEDGEMENTS

We are grateful for the valuable comments on the first draft of this manuscript provided by professor emeritus Ian St James Roberts, University College, London, and the assistance in the literature search by Gun Brit Knutsson at the Karolinska University Library.

CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

ORCID

Anders Hjern  <https://orcid.org/0000-0002-1645-2058>

REFERENCES

- Crncec R, Matthey S, Nemeth D. Infant sleep problems and emotional health: a review of two behavioural approaches. *J Reprod Infant Psychol*. 2010;28(1):44-54.
- Meltzer LJ, Mindell JA. Sleep and sleep disorders in children and adolescents. *Psychiatr Clin North Am*. 2006;29(4):1059-1076; abstract x.
- Sadeh A, Anders T. Infant sleep problems: origins, assessment, interventions. *Infant Ment Health J*. 1993;14:17-34.
- St James-Roberts I. Helping parents to manage infant crying and sleeping: a review of the evidence and its implications for services. *Child Abuse Rev*. 2007;16(1):47-69.
- St James Robert I. *The Origins, Prevention and Treatment of Infant Crying and Sleeping Problems: An Evidence-Based Guide for Healthcare Professionals and the Families They Support*. Hove, East Sussex, UK: Routledge, Taylor & Francis Ltd, 2012.
- American Academy of Sleep Medicine. *International Classification of Sleep Disorders*, 2nd edn. Darien, Illinois, USA: American Academy of Sleep Medicine; 2005.
- American Psychiatric Association. *Diagnostic and Statistical Manual* 5th edn. Washington, D.C.: American Psychiatric Association; 2013.
- American Academy of Sleep Medicine. *International Classification of Sleep Disorders*, 3rd edn. Darien, Illinois, USA: American Academy of Sleep Medicine; 2014.
- Lewandowski AS, Toliver-Sokol M, Palermo TM. Evidence-based review of subjective pediatric sleep measures. *J Pediatr Psychol*. 2011;36(7):780-793.
- McLean K, Somers-Jones G, Molloy C, Aston R, Goldfeld S. Evidence-Based Interventions for Universal Child Health Services: Review of the Evidence. Melbourne, Australia: The Centre for Community and Child Health, Murdoch Children's Research Institute, and The Royal Children's Hospital. 2016.
- Thunstrom M. Severe sleep problems among infants in a normal population in Sweden: prevalence, severity and correlates. *Acta Paediatr*. 1999;88(12):1356-1363.
- Klackenberg G. The development of children in a Swedish urban community. A prospective longitudinal study. VI. The sleep behaviour of children up to three years of age. *Acta Paediatr Scand Suppl*. 1968;187:105-121.
- Giallo R, Rose N, Vittorino R, Fatigue VR. Fatigue, wellbeing and parenting in mothers of infants and toddlers with sleep problems. *J Reprod Infant Psychol*. 2011;29:236-249.
- Bayer JK, Hiscock H, Hampton A, Wake M. Sleep problems in young infants and maternal mental and physical health. *J Paediatr Child Health*. 2007;43(1-2):66-73.
- Martin J, Hiscock H, Hardy P, Davey B, Wake M. Adverse associations of infant and child sleep problems and parent health: an Australian population study. *Pediatrics*. 2007;119(5):947-955.
- Hjern A, Lindblom K, Reuter A, Silfverdal S-A. A systematic review of prevention and treatment of infantile colic. *Acta Paediatr*. 2020;109:1733-1744.
- Alonso-Coello P, Schunemann HJ, Moher J, et al. Evidence to Decision (EtD) frameworks: a systematic and transparent approach to making well informed healthcare choices. 1: Introduction. *BMJ*. 2016;353:i2016.
- SBU:s metodbok. Mall för randomiserade studier. <https://www.sbu.se/sv/var-metod/>.
- Adachi Y, Sato C, Nishino N, Ohryoji F, Hayama J, Yamagami T. A brief parental education for shaping sleep habits in 4-month-old infants. *Clin Med Res*. 2009;7(3):85-92.
- Paul IM, Savage JS, Anzman-Frasca S, Marini ME, Mindell JA, Birch LI. Responsive Parenting Intervention and Infant Sleep. *Pediatrics*. 2016;138(1):e20160762.
- Hiscock H, Cook F, Bayer J, et al. Preventing early infant sleep and crying problems and postnatal depression: a randomized trial. *Pediatrics*. 2014;133(2):e346-e354.
- Stremmler R, Hodnett E, Kenton L, et al. Effect of behavioural-educational intervention on sleep for primiparous women and their infants in early postpartum: multisite randomised controlled trial. *BMJ (Clinical research ed)*. 2013;346:f1164.
- Hall WA, Hutton E, Brant RF, et al. A randomized controlled trial of an intervention for infants' behavioral sleep problems. *BMC Pediatr*. 2015;15:181. <https://doi.org/10.1186/s12887-015-0492-7>.
- Galland BC, Sayers RM, Cameron SL, et al. Anticipatory guidance to prevent infant sleep problems within a randomised controlled trial: infant, maternal and partner outcomes at 6 months of age. *BMJ Open*. 2017;7(5):e014908.
- Mindell J, Telofski L, Wiegand B, Kurtz E. A nightly bedtime routine: impact on sleep in young children and maternal mood. *Sleep*. 2009;32(5):599-606.
- Mindell JA, Du Mond CE, Sadeh A, Telofski LS, Kulkarni N, Gunn E. Efficacy of an internet-based intervention for infant and toddler sleep disturbances. *Sleep*. 2011;34(4):451-458.
- Mindell JA, Du Mond CE, Sadeh A, Telofski LS, Kulkarni N, Gunn E. Long-term efficacy of an internet-based intervention for infant and toddler sleep disturbances: one year follow-up. *J Clin Sleep Med*. 2011;7(5):507-511.
- Mindell JA, Lee CI, Leichman ES, Rotella KN. Massage-based bedtime routine: impact on sleep and mood in infants and mothers. *Sleep Med*. 2018;41:51-57.
- Hiscock H, Bayer JK, Hampton A, Ukoumunne OC, Wake M. Long-term mother and child mental health effects of a population-based infant sleep intervention: cluster-randomized, controlled trial. *Pediatrics*. 2008;122(3):e621-e627.
- Hiscock H, Bayer J, Gold L, Hampton A, Ukoumunne OC, Wake M. Improving infant sleep and maternal mental health: a cluster randomised trial. *Arch Dis Child*. 2007;92(11):952-958.

31. Price AMH, Wake M, Ukoumunne OC, Hiscock H. Five-year follow-up of harms and benefits of behavioral infant sleep intervention: randomized trial. *Pediatrics*. 2012;130(4):643-651.
32. Underdown A, Barlow J, Stewart-Brown S. Tactile stimulation in physically healthy infants: results of a systematic review. *J Reprod Infant Psychol*. 2010;28:11-29.
33. Bennett C, Underdown A, Barlow J. Massage for promoting mental and physical health in typically developing infants under the age of six months. *Cochrane Database Syst Rev*. 2013;4:CD005038.
34. Blunden S, Etherton H, Hauck Y. Resistance to cry intensive sleep intervention in young children: are we ignoring children's cries or parental concerns? *Children*. 2016;3:2.
35. Byars KC, Simon SL. Behavioral treatment of pediatric sleep disturbance: Ethical considerations for pediatric psychology practice. *J Dev Behav Pediatr*. 2016;42:241-248.
36. Etherton H, Blunden S, Hauck Y. Discussion of Extinction-Based Behavioral Sleep Interventions for Young Children and Reasons Why Parents May Find Them Difficult. *J Clin Sleep Med*. 2016;12(11):1535-1543.
37. Tikotzky L. Parenting and sleep in early childhood. *Curr Op Psychol*. 2017;15:118-124.
38. Giannotti F, Cortesi F. Family and cultural influences on sleep development. *Child Adolesc Psychiatr Clin N Am*. 2009;18(4):849-861.
39. Crichton GE, Symon B. Behavioral management of sleep problems in infants under 6 months-what works? *J Dev Behav Pediatr*. 2016;37(2):164-171.
40. Kempler L, Sharpe L, Miller CB, Bartlett DJ. Do psychosocial sleep interventions improve infant sleep or maternal mood in the postnatal period? A systematic review and meta-analysis of randomised controlled trials. *Sleep Med Rev*. 2016;29:15-22.
41. Coons S. Development of sleep and wakefulness during the first 6 months of life. In: Guilleminault C, ed. *Sleep and its Disorders in Children*. New York: Raven Press; 1989:17-27.
42. Goodlin-Jones B-L, Burham MM, Gaylor E, Anders TF. Night waking, sleep-wake organization, and self-soothing in the first year of life. *J. Dev. Behav. Pediatr*. 2001;22:226-233.
43. Mirmiran M, Maas YGH, Arigno RL. Development of fetal and neonatal sleep and circadian rhythms. *Sleep Med. Rev*. 2003;31:321-334.
44. Douglas PS, Hill PS. Behavioral sleep interventions in the first six months of life do not improve outcomes for mothers or infants: a systematic review. *J Dev Behav Pediatr*. 2013;34:497-507.
45. St James-Roberts I, Sleep J, Morris S, Owen C, Gillham P. Use of a behavioural programme in the first 3 months to prevent infant crying and sleeping problems. *J Paediatr Child Health*. 2001;37:289-297.
46. Sadeh A, Mindell JA. Infant sleep interventions - Methodological and conceptual issues. *Sleep Med Rev*. 2016;29:123-125.

How to cite this article: Reuter A, Silfverdal S-A, Lindblom K, Hjern A. A systematic review of prevention and treatment of infant behavioural sleep problems. *Acta Paediatr*. 2020;109:1717-1732. <https://doi.org/10.1111/apa.15182>