

Behavioral Sleep Interventions in the First Six Months of Life Do not Improve Outcomes for Mothers or Infants: A Systematic Review

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ABSTRACT: *Objective:* The United Kingdom's National Institute for Health Research has recently invited proposals for the design of a multicomponent primary care package of behavioral interventions to reduce parental distress caused by excessive infant crying in the first 6 months of life. A systematic review was performed to determine whether behavioral interventions for sleep, when applied by parents to infants younger than 6 months, improve maternal and infant outcomes. *Methods:* Searches of PubMed, CINAHL, and Cochrane Database of Systematic Reviews were conducted to identify systematic reviews, meta-analyses, clinical trials, and cohort studies investigating the effects of behavioral sleep interventions in infants younger than 6 months (January 1993–August 2013). The evidence is critically analyzed, according to PRISMA guidelines. *Results:* Cry-fuss, feeding, and sleep problems emerge out of multiple dynamically interacting and co-evolving variables in early life and are for this reason generically referred to as regulatory problems. Studies that link behavioral interventions for sleep in the first 6 months with positive effects on maternal and infant health demonstrate 3 methodological constraints. They fail to identify and control for feeding difficulties, fail to distinguish between the neurodevelopmentally different first and second halves of the first year of life, and apply reductive analyses to evaluations of complex interventions. Despite substantial investment in recent years in implementation and evaluation of behavioral interventions for infant sleep in the first 6 months, these strategies have not been shown to decrease infant crying, prevent sleep and behavioral problems in later childhood, or protect against postnatal depression. In addition, behavioral interventions for infant sleep, applied as a population strategy of prevention from the first weeks and months, risk unintended outcomes, including increased amounts of problem crying, premature cessation of breastfeeding, worsened maternal anxiety, and, if the infant is required to sleep either day or night in a room separate from the caregiver, an increased risk of Sudden Infant Death Syndrome. *Conclusion:* The belief that behavioral intervention for sleep in the first 6 months of life improves outcomes for mothers and babies is historically constructed, overlooks feeding problems, and biases interpretation of data.

(*J Dev Behav Pediatr* 34:497–507, 2013) **Index terms:** infant sleep, behavioral intervention, maternal anxiety, breastfeeding, postnatal depression, infant crying.

MULTIPLE INTERACTING AND CO-EVOLVING FACTORS AFFECT MATERNAL-INFANT SLEEP

In the first few months, excessive infant crying is reported by 1 in 5 new parents.¹ Many more cite unsettled behavior as the reason for commencing formula feeds, with crying, fussing, and frequent night waking perceived to signal inadequate breastmilk.^{2–4}

Parents are more likely to report that their baby has cry-fuss problems in the first 3 months and sleep problems after 3 months of age, and infants with problem crying and fussing in the first 3 months of life do not wake more than other babies on average.⁵ Nevertheless, crying, feeding, and sleep problems interact and co-evolve, particularly in the first neurodevelopmentally sensitive 4 months.⁶ Although unsettled babies may not wake more often at night, they may cry and be difficult to settle for longer periods in the night, and infants with feeding problems often wake excessively, both day and night. Because of this dynamic interaction, crying, feeding, and sleep problems may be generically defined as regulatory problems.⁷ From about 4 months of age, sleep is consolidated in the nighttime, although normal babies still wake up to 3 times nightly, and waking is consolidated in the daytime, except for 1 to 4 brief daytime naps.^{8,9} After the first neurodevelopmentally sensitive 3 to 4 months, regulatory problems have settled for most, but the 6% who persist are at risk of long-term behavioral problems, including feeding problems.^{10,11}

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Although underlying biological processes are dominant, maternal-infant sleep is most appropriately conceptualized as a complex adaptive system, in which there is a dynamic and co-evolving interplay between cultural, psychosocial, temperamental, environmental, and biological factors.^{6,12} A significant role for the relative neurodevelopmental maturity of any individual is suggested by the finding that high levels of quiet sleep at birth predict more self-settling in later infancy.¹³

Definitions

Parents use “unsettled” as a nonspecific term referring to a baby’s crying, fussing, and frequent waking from sleep in the first months of life, and this article uses the terms unsettled behavior, cry-fuss behavior, and excessive crying interchangeably. Clinically, an infant is regarded as unsettled or crying excessively if parents report a problem.¹⁴ But the term “unsettled” is now commonly used by health professionals to specifically denote a baby’s inability to “self-settle” or “self-soothe,” that is, to transition into sleep in a separate sleeping place without parental intervention. Parental complaints of “unsettled” infant behavior from the first weeks and months postbirth commonly elicit education from the health professional about how to apply behavioral interventions.^{15–17} This article defines a “behavioral intervention for infant sleep” as a parental practice or infant-care method that aims to entrain the infant’s neurobiological characteristics so that nocturnal self-settling episodes are more common. Behavioral interventions incorporate 1 or more of the following practices: delayed response to infant signals or cues (i.e., unmodified or graduated extinction methods, including parental presence), regulation of feed 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 with the carer.

Neuroscientists are increasingly elucidating the neurocorrelates of postnatal depression, which, untreated, may result in poorer cognitive and psychological outcomes for the infant life-long. Observational, neurohormonal, and neuroimaging studies demonstrate that postnatal depression is characterized by decreased maternal sensitivity to infant cues, which disrupts maternal-infant neuroendocrine and neurobehavioral synchronies, including of feeds and sleep, and permanently changes the infant’s brain architecture. Cue-based care, however, denotes a sensible care-giver responsiveness to infant cues and promotes neuroendocrine and neurobehavioral synchronies, including of feed and sleep, between mother and infant.^{18–23} By dampening down negative feedback loops between caregiver and baby in the first neurodevelopmentally sensitive months of life, cue-based care stabilizes the complex adaptive system of the mother and baby and helps prevent unpredictable amplification of problems.⁶ Sensible cue-based care is different to anxious hypervigilance, which has been linked with increased infant waking.¹³ In the first weeks and months of life, cue-based care is responsive parent-infant co-regulation and is

not consistent with behavioral interventions, which aim to entrain neurobiological characteristics by delaying responses to pre-cry and cry cues.

Aim

The United Kingdom’s National Institute for Health Research has recently invited proposals for the design of a multicomponent primary care package of behavioral interventions to reduce parental distress caused by excessive infant crying in the first 6 months of life.²⁴ Behavioral interventions for infant sleep are widely recommended by health professionals when parents present with cry-fuss, feeding, and sleep problems in the first months of life and are also popularly promoted in the community.²⁵ It is claimed that these interventions prevent the development of “bad habits,” postnatal depression, and infant behavioral problems in later childhood. Some health professionals, however, disagree with this interpretation of the evidence, and families receive conflicting advice about unsettled infant behavior. This problem of discipline-specific advice substantially contributes to costly duplication of services and recourse to multiple service providers, including Emergency Departments.^{26,27} We undertake a systematic review of studies concerning behavioral interventions for infant sleep in the first 6 months to determine whether maternal and infant outcomes are improved.

METHODS

Our review followed PRISMA guidelines.²⁸ We searched the databases of PubMed, CINAHL, and the Cochrane Database of Systematic Reviews (January 1993 to August 2013). Search terms included infant, sleep, night waking, unsettled, and behavioural or behavioral. The combined lists were screened for relevant titles, and abstracts of all marginally relevant titles were examined. Studies were included if they considered the effects of behavioral intervention (as defined above) on infant sleep, were published in a peer-reviewed English language publication, and if participants were parents and their typically developing infants with an upper age limit of 6 months. Meta-analyses and systematic reviews were included with cohort studies and randomized controlled trials. We identified other pertinent studies through citation tracking, review of reference lists of retrieved articles, and our knowledge of the literature. Because studies measure multiple aspects of unsettled infant behavior and sleep, multiple parent and infant outcomes, and multiple variations of behavioral interventions, data pooling, and statistical analysis for comparisons across studies were not viable or meaningful. Our findings were synthesized and narratively described. (See Fig. 1 for a flow diagram of studies reviewed for inclusion and Table 1 for details of selected key studies.)

RESULTS

Methodological Constraints

Significant methodological issues arise in the design and evaluation of interventions for complex problems,

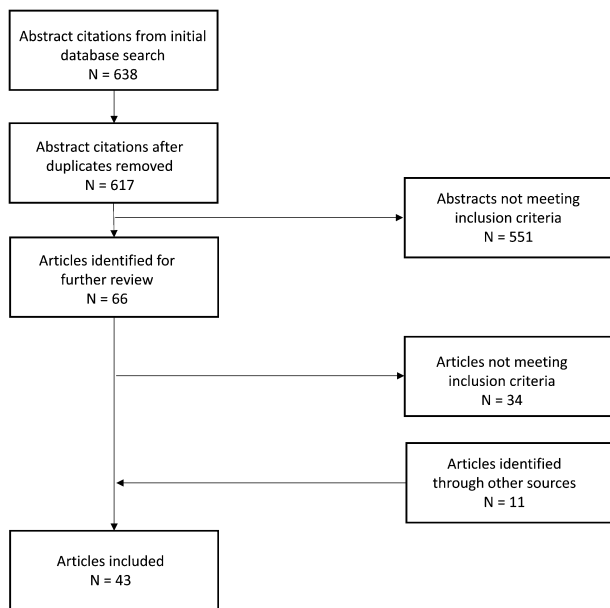


Figure 1. Flow diagram of studies reviewed for inclusion.

such as unsettled infant behavior.⁴⁸⁻⁵² We identify 3 main methodological problems complicating interpretation of evidence concerning behavioral interventions for infant sleep younger than 6 months.

First, although feeding and sleep problems interact and co-evolve in this population, unidentified and unmanaged feeding problems confound almost all studies concerning unsettled infant behavior in the first months of life.^{6,53-57} Many studies also fail to control for the effects of method of infant feeding.³⁰ Latch and positional instability problems, anatomic abnormalities, functional lactose overload, and scheduled or spaced feeds may cause poor satiety, crying, and frequent waking both day and night in the first few weeks and months.^{54,58-63} Yet doctors, child health nurses, midwives, and researchers are inadequately trained in the identification and management of feeding problems.⁶⁴⁻⁶⁷ This important translational gap explains the increased incidence of cry-fuss problems found in breastfeeding babies and also unsettled babies' increased risk of premature breastfeeding cessation.^{68,69} The failure to identify and control for feeding problems is important not just because of the effect of unidentified feeding problems on night waking, or the increased risk of premature breastfeeding cessation, but because the maternal anxiety and disrupted maternal-infant relations that arise from undetected feeding problems in infants with regulatory problems may persist long term, regardless of feeding method.^{7,10,11,70-72}

Second, although neurodevelopmental differences between the first 6 months and second 6 months of an infant's life are profound, we find that evaluations of interventions with behavioral components commonly fail to differentiate between these different neurodevelopmental stages. Behavioral interventions for sleep have been evaluated in pediatric populations with an age

range from birth to 12 months or more. Positive findings from studies on infants with a mean age of 6 months or older are extrapolated back to assert that programs with a behavioral intervention component will be beneficial if applied to parents and their babies from the first weeks and months of life.^{16,39,73,74}

Third, in evaluations of complex interventions that include a behavioral intervention component, correlations are commonly interpreted as causal. In particular, positive outcomes on maternal mood symptom scores are often attributed to a single component of the intervention, that is, the education about behavioral intervention, when the positive effect is likely to be explained by multiple covariates.^{41,75}

No Improvement in Maternal or Infant Outcomes

A well-conducted randomized controlled trial of a behavioral educational intervention in 246 primiparous mothers and their infants, delivered in hospital with an education session and booklet, and with phone support at 1, 2, and 4 weeks postpartum, demonstrates no differences between the control and intervention groups on any outcomes, including maternal and infant nocturnal sleep durations, number of night wakings, and the Edinburgh Postnatal Depression Scale.²⁹ We contend that the lack of evidence demonstrating improved maternal and infant outcomes is explained by behavioral interventions' failure to identify and repair underlying disruptions of maternal-infant neurobehavioral synchronies, including feeding problems, out of which unsettled infant behavior may emerge.⁵³⁻⁵⁷

Two meta-analyses conclude that both the longest sustained sleep period, during which an infant does not wake, and the longest self-regulated sleep period, during which an infant may wake but goes back to sleep without disturbing the parents, increase rapidly within the first 4 months of life, and particularly between 1 and 3 months postbirth.^{8,9} These data are interpreted as evidence that introducing behavioral interventions during this period of acute neuroplasticity will prevent unsettled infant behavior, behavioral and sleep problems in later childhood, and postnatal depression.^{9,15,17,40,74} Application of behavioral methods from the first weeks of life increases self-regulated sleep periods and increases total 24-hour duration of time spent in the cot without signaling by 29 minutes.^{76,77} However, decreased episodes of night-waking or longer infant sleep durations do not inevitably improve outcomes for mothers and their infants, as is often assumed.^{78,79}

Infant Outcomes

Two randomized controlled trials, 1 in the United Kingdom of 610 families and 1 in Australia of 268 families, found that parent delivery of a behavioral sleep intervention in the first 12 weeks increases sleep duration but does not decrease infant crying, which is parents' primary concern in this age group.^{76,77} Another randomized controlled trial of 111 families with babies between the ages of 2 and 6 weeks who cried excessively investigated the effects of a behavioral intervention

Table 1. Key Studies

Authors	Study Design	Sample	Relevant Outcomes
Stremler et al ²⁹	Multi-site randomized	246 Canadian mother-child pairs, intervention group educated in behavioral sleep intervention by 45-min hospital session postpartum; booklet; phone support at 1, 2, 4 wk postpartum	No significant differences between control and intervention groups on any outcomes at 6 and 12 wk, including actigraphy of maternal and infant nighttime awakenings, Edinburgh Postnatal Depression Scale, and general sleep disturbance scale
Galland et al ⁸	Systematic review	22 studies of normal infant and child sleep duration (0–12 yr) from different countries and cultures to establish global norms	Normal range of total hours sleep over 24-hr period: 0–2 mo = 9.3–20.0 3 mo = 9.4–17.8 6 mo = 8.8–17.0 Lower and upper limits to range of times infant wakes at night: 0–2 mo = 0–3.4 3–6 mo = 0–3.0 Notes that almost all infant studies do not control for infant feeding despite well-known effect on infant sleep
Galbally et al ³⁰	Longitudinal	4,507 Australian mothers in The Longitudinal Study of Australian Children, nationally representative study of growth and development of children	Breastfeeding associated with increased night waking and not sleeping alone at 6 months of age, but not with other nocturnal unsettled behaviors such as infant restlessness or problems getting back to sleep
Price et al ³¹	Longitudinal	225 Australian mothers recruited by community maternal and child health nurses at infant age 7 mo for sleep study	Infant sleep problems identified at single or multiple points at 4, 8, 10, 12, and 24 mo not associated with any differences at 6 yr in child, maternal or child-parent outcomes
Iacovou and Sevilla ³²	Longitudinal	10,419 UK mothers enrolled in pregnancy in Avon Longitudinal Study of Parents and Children	Mothers who scheduled feeds at infant age 4 wk are not protected against postnatal depression at 8 wk or 33 mo. Their children have poorer cognitive and academic outcomes at ages 5, 7, 11, and 14 compared with those who receive cue-based care in early infancy
Hyde et al ³³	Longitudinal	3,558 Australian mother-child pairs enrolled in Mater-University of Queensland Study of Pregnancy	Infant regulatory problems at 6 mo are a risk factor for maternal-reported behavior concerns at 5 and 14 yr, but are unrelated to young adults' mental health at 21 yr
Sirvinskiene et al ³⁴	Longitudinal	189 Lithuanian mothers recruited in hospital postpartum studied to 6 mo	Infants of mothers expressing more parent-centered and rigid attitudes toward infant-rearing at 3 mo have nearly 3 times greater risk for continuation of behavioral difficulties at 6 mo
Kendall-Tackett et al ³⁵	Cross-sectional	6,410 mothers of infants 0–12 mo who participated in survey of mothers' sleep and fatigue representing 59 countries (formula = 176; mixed = 1,125; exclusively breastfeeding = 4,774)	Breastfeeding mothers report longer total sleep time, more daily energy, and lower rates of depression than their mixed or formula feeding counterparts

(Table continues)

Table 1. Continued

Authors	Study Design	Sample	Relevant Outcomes
Bryanton and Beck ³⁶	Cochrane review	4 trials on postnatal education of behavioral sleep interventions had useable data	<p>Infant crying measured in 2 studies (St James-Roberts 2001; Symon 2005) in 7 ways with no effects found</p> <p>Infant sleeping measured in 4 studies (St James-Roberts 2001; Stremler 2006³⁷; Symons 2005; Wolfson 1992³⁸) in a total of 16 different ways. Only 1 significant positive outcome: behavioral intervention increased duration of infant sleep without disturbing parents an average of 29 min in 24 hr</p> <p>Concludes that no recommendations for practice change can be made because there exists insufficient evidence to determine the effects of postnatal parental education for optimizing infant general health and parent-infant relationships</p>
Phillips et al ³⁹	Cohort	251 Australian mothers with infants 0–12 mo of age admitted to residential parenting center, average infant age 5.44 mo	<p>Multifaceted residential intervention that includes behavioral sleep interventions</p> <p>Improved maternal mood and less unsettled infant behaviors at 1 and 3 mo after discharge</p>
Henderson et al ⁴⁰	Systematic review	26 studies of normal sleep development in the first 12 mo	<p>% who sleep for 8 hr without waking parents 5 of 6 nights:</p> <p>1 mo: 0%</p> <p>3 mo: 37%</p> <p>6 mo: 53%</p> <p>The most marked changes in longest self-regulated sleep period occur in the first 4 mo, particularly ages 1 and 2 mo</p> <p>Concludes that “1 non-contentious implication is for the timing of prevention, as early as the first months of life.”</p>
Schmid et al ¹¹	Longitudinal	4,427 German parents of newborns admitted to neonatal care within 10 d after birth, assessed at 5, 20, and 56 mo	Parent-reported sleep problems at 5 mo tended to persist at 20 mo but had resolved by school-age
Fisher et al ⁴¹	Controlled study	364 Australian parents, control group 2006, intervention group 2007	<p>Half day group program at 4 wk post-birth including behavioral intervention for infant sleep and psycho-education to enhance relationship with spouse/partner</p> <p>Decreased diagnosis with depression or anxiety or adjustment disorder in the intervention group at 6 mo</p>
Dorheim et al ⁴²	Cross-sectional	2,830 all Norwegian women who delivered at Stavanger University Hospital posted a questionnaire at 7 wk postpartum	<p>Improvements in infant sleep do not improve Edinburgh Postnatal Depression Scale score</p> <p>No differences in sleep (onset, duration, efficiency, number of awakenings, or subjective quality) between depressed and non-depressed women</p>

(Table continues)

Table 1. Continued

Authors	Study Design	Sample	Relevant Outcomes
			Mothers not exclusively breastfeeding are at increased risk for both sleep problems and postpartum depression
			Duration of sleep and sleep efficiency not associated with depression, but subjective reports of sleep quality and disturbance are associated with depression
			Breastfeeding mothers' global sleep quality was better than that of mothers who partially bottle-fed their infants, but not better than mothers who did not breastfeed at all
Goyal et al ⁴³	Randomized clinical trial	112 US mothers recruited from childbirth education classes and participated to 3 mo postpartum	Mothers who were awake for more than 2 hr between midnight and 6 AM, who napped <60 min during the day, and who had difficulty going back to sleep when woken were at increased risk for depression at 3 mo postpartum
			Infant temperament and number of times infant woke during night was not a predictor of depressive symptoms
			Maternal ratings of infant temperament account for less than 1% of variance in postpartum depressive symptoms
Doan et al ⁴⁴	Randomized clinical trial	133 UK mother-baby pairs recruited during pregnancy	Parents of infants who were breastfed in the evening and/or at night slept an average of 40–45 min more than parents of infants given formula
			Parents of infants who received formula at night reported more sleep disturbance
Smart et al ⁴⁵	Pre-post intervention	59 mothers and 52 fathers of Australian infants referred to tertiary pediatric clinic for unsettled babies, age range 2 weeks to 7 months, average 14.9 weeks	Decreased Edinburgh Postnatal Depression Scores and parent-reported decrease in presenting problem (either crying or sleeping) three to four weeks later; 94% of mothers found talking about the baby helpful, 86% found learning that baby is well helpful, 46% found putting baby to bed awake and learning about settling techniques helpful
Warren et al ⁴⁶	Longitudinal	1,222 US mother-baby pairs studied between 1 and 36 mo	Child awakenings do not contribute to maternal depressive symptoms but maternal depressive symptoms contribute to the duration of nocturnal child awakenings across time
St James-Roberts et al ⁴⁷	Comparative cohorts	193 Three cohorts of mother-baby pairs studied at 10 d, 5 wk and 12 wk post-birth, from Copenhagen, from London, and from mothers who identified as practicing proximal care or "attachment parenting"	Londoners, who are more likely to use behavioral interventions, less likely to breastfeed, and have less physical contact with their babies, have infants who cry 45 min more a day at 5 wk than Danish parents, who are twice as likely to breastfeed at 12 wk, have more physical contact (average 10 hr daily in total, including feeding and sleeping) and practice sensible cue-based care
			Proximal care had the same effect on crying amounts as the moderate parenting style of the Copenhagen group

during weekly home visits by pediatric nurse specialists over a 4-week period compared with usual care. The intervention group showed decreased crying, but the data are not included in the 2010 Cochrane analysis of postnatal parent education because of selective reporting.^{36,80}

Excessive crying in the first few months has been linked with increased risk of behavioral problems, including feeding disorders in later childhood, particularly in the 6% for whom problem crying persists at 5 months and in families with multiple risk factors.^{10,11} Behavioral sleep interventions in the first 6 months, however, are not protective. In a community-based randomized trial of 225 pairs, infant sleep problems at 1 or multiple points in time from 4 months of age had no long-term negative outcomes on child, maternal, or maternal-child relationship outcomes at 6 years of age.³¹ The more frequent signaling during the night by breastfed babies is not associated with long-term sleep or behavioral problems.⁷ A prospective cohort of 2,308 pairs shows that if regulatory problems persist at 6 months, mothers are more likely to report anxiety about that child's behavior throughout childhood, yet measures of that child's mental health in young adulthood are normal.³³ Studies demonstrating that behavioral sleep interventions may help prevent disturbances in later infancy or childhood apply to parents who report sleep problems in older infants, not babies younger than 6 months.^{16,81,82}

Maternal Outcomes

Cry-fuss problems in the first 3 to 4 months correlate with increased symptom scores on maternal depression and anxiety scales. However, behavioral sleep interventions in the first 6 months have not been shown to decrease rates of postnatal depression.²⁹ Increased depression and anxiety symptom scores are linked to problems of maternal sleep efficiency, or difficulty initiating and falling back to sleep, not to the length of the infant's self-regulated sleep periods. Poor maternal sleep efficiency results from elevated sympathetic nervous system arousal, or anxiety, not the number of times the mother wakes to the baby's signals during the night.^{42,43} A birth cohort study of 1,222 mother-infant pairs demonstrates that maternal depressive symptoms at 1 month postbirth predict increased duration of child awakenings over time, but an increased duration of child awakenings does not predict maternal depressive symptoms; consistent findings were not identified in either direction for frequency of child awakenings.⁴⁶ Even though exclusively breastfeeding mothers wake more often to their infant's nighttime signals, they have improved quality and duration of sleep and decreased incidence of postnatal depression.^{35,44,83} Strategies demonstrated to be effective for prevention of postnatal depression include optimizing support for breastfeeding and applying relaxation techniques to improve sleep efficiency.⁸⁴

Parenting programs that include behavioral sleep interventions for babies younger than 6 months report decreased maternal depression and anxiety symptom

scores but are complex interventions with multiple covariates. The positive effects on maternal mood cannot be reductively attributed to the behavioral component. Caring therapeutic relationships and group support have positive effects on maternal mental health, regardless of the specific intervention delivered.^{41,73,75,85,86} Hiscock et al⁸¹ showed that teaching mothers to implement behavioral interventions if they report a sleep problem when their baby is 7 months of age improves maternal depressive and anxiety symptom scores, sustained until 2 years of age, but also warn that their findings should not be extrapolated back to the first 6 months.⁸⁷

Unintended Outcomes

Cry-fuss and sleep problems emerge out of the complex and dynamic system of the mother and infant and often cannot be traced back linearly to any single causative factor. Similarly, behavioral interventions that aim to manipulate a single variable, for example, the longest self-regulated infant sleep period, risk the emergence of unpredictable feedback loops and unintended outcomes in the maternal-infant complex adaptive system.⁶

Behavioral interventions use a range of techniques to extinguish infant signals or cries on waking during the night or when laid awake in a separate room for sleep during the day.^{16,78} Four commonly used techniques are feed-play-sleep cycles, sleep algorithms, decreased daytime stimulation, and identification of "tired cues."^{41,73} We contend that each of these strategies lacks a logical biological rationale, locates authority in the expert, and undermines parental confidence in their capacity to read their infant's cues.⁸⁴

Proponents of feed-play-sleep cycles claim that this strategy prevents excessive feeding or overfeeding.⁸⁸ However, overly frequent or prolonged breastfeeding are signs of underlying feeding problems, which require appropriate identification and management. Feed-spacing is associated with increased risk of lactation failure in this age group; paced bottle-feeding is the most appropriate technique to mitigate the risks of overfeeding in formula-fed babies.^{53,89-92} Feed spacing does not protect against postnatal depression.³² Feed-play-sleep cycles also aim to condition the baby to self-settle when laid down in a solitary sleeping environment, by decoupling sleep from feeds and bodily contact. But postprandial somnolence is an innate neurobehavior, or infant cue, resulting from the effects of parasympathetic nervous system activation, elevated oxytocin, and elevated plasma cholecystokinin. A prospective birth cohort study of 189 mother-infant pairs found that more rigid, routinized care at 3 months is associated with 3 times the incidence of infant behavioral problems at 6 months, compared with more flexible cue-based care.³⁴ London infants, whose parents are less likely to offer cue-based care, cry 50% more at 2 and 5 weeks of age and are about half as likely to be breastfed at 12 weeks compared with Copenhagen infants, whose parents offer more cue-based care and physical contact.⁴⁷ These findings suggest that premature cessation of breastfeeding and

increased crying are unintended outcomes of behavioral interventions when adopted as population strategies for prevention.

Sleep algorithms are numerical guides detailing average duration of awake times during the day before a sleep is needed and the estimated length of time the baby should sleep, day and night. These algorithms teach parents that they need to watch for “tired cues,” and parents are taught to interpret cry-fuss behavior or the inability to self-settle in the cot as “overtiredness.” But variability is the most prominent feature of infant sleep in the first 6 months.^{8,40,93} For example, a systematic review of 22 studies of normal infant sleep concludes that at 2 months of age, the amount of sleep taken in a 24-hour period varies between 9.3 and 20 hours. Similarly, at 3 and 6 months of age, the normal total amounts vary by a difference of over 8 hours.⁸ There is also a very wide variation in each baby’s individual total sleeping times from day to day.⁹⁴ Many babies need much less sleep than is algorithmically prescribed.⁹⁵

Regularly placing an infant in a quiet darkened room during the day in the belief that he or she is crying and unsettled due to “overstimulation” and “overtiredness” inhibits consolidation of sleep at night. This practice also increases the risk of Sudden Infant Death Syndrome because the safest place to sleep an infant day or night is supine in the same room^{96,97} and limits the caregiver’s ability to develop a healthy daytime biopsychosocial rhythm, which protects maternal mental health.^{84,98} Diverse sensory stimulation not only optimizes infant neurodevelopment but is associated with more settled infant behavior when combined with cue-based care.^{47,99} An adequate sensory diet is achieved by having the infant in proximity as the caregiver enjoys activities outside the home, either outdoors or in physically or socially active contexts, and by sensible amounts of physical contact.⁴⁷

Parents learn to make sense of his or her baby’s cues through experimentation, familiarity with context, and pattern recognition, but prescriptive lists of “tired cues” teach parents to read their babies through a “tired” filter.^{18,22} These “tired cues” often signal problems other than tiredness, for example, a need for more varied sensory experience.

Up to half of all adults complain of at least 1 symptom of insomnia a few nights a week or more, with significant discrepancies between subjective feelings of sleep deprivation and objective measures.^{100,101} Adult sleep research demonstrates that cognitive behavioral therapy is the most effective intervention for adult sleep problems. Cognitive behavioral therapy addresses tendencies to harbor unrealistic expectations about amounts that comprise enough sleep, to overestimate how little sleep has been had, and to overemphasize the consequences in daily life.¹⁰² Behavioral interventions for infant sleep, applied as a population strategy of prevention in the first 6 months, teach parents to focus on infant sleep frequency and duration, on the number of times of waking in the night, and on potential negative effects upon their

life and the infant’s life. Significantly, these are the same cognitions that have been demonstrated to reinforce adult sleep anxiety, worsen sleep efficiency, and worsen subjective feelings of sleep deprivation.¹⁰²

Less than 1 in 5 families in the first 6 months report infant sleep problems for which they want help.^{1,103} Studies of behavioral sleep interventions typically have significant recruitment problems and high drop-out rates, indicating that many families who identify sleep problems do not wish to engage behavioral programs.^{81,104} Yet the results of behavioral interventions for sleep in infants older than 6 months are interpreted as evidence of the need to advocate population strategies of prevention in the first weeks and months.^{40,74} Clinically, we observe that the widespread promotion of behavioral interventions as preventive strategies creates unnecessary anxiety for many families. This is corroborated by evidence that societies in which behavioral approaches to infant care are promoted in the first weeks and months postbirth demonstrate paradoxically high levels of parental anxiety concerning infant sleep.¹⁰⁵

DISCUSSION AND CONCLUSION

From the 1920s, in the context of medicalization and the associated disruption of traditional social behaviors that support innate maternal-infant neurobehaviors, health professionals in the West were trained to recommend Dr Truby King’s method of infant care, also known as “scientific mothering.” Scientific mothering promoted measurement, expert supervision of the mother, and clock-based regulation of infant feeds and sleep, and was reinforced from the 1950s by the early findings of behavioral psychology. The current dominance of behavioral approaches to infant sleep in Western societies is a direct continuation of these historical antecedents.^{78,95,106,107} Critics argue that infant sleep data continue to be interpreted through the lens of the historical belief that early behavioral intervention serves the best interests of mothers and babies; more broadly, critics of reductionist epistemology argue that unexamined assumptions are reinforced in research and therefore clinical practice because of the effects of citation networks, persuasive rhetoric, and publication and funding biases.¹⁰⁸⁻¹¹¹

Contemporary mothers have complex identities and responsibilities and are vulnerable to high levels of fatigue in the first months post-birth, made worse if the new baby has cry-fuss or sleep problems. Parents with unsettled babies in the first weeks and months of life demonstrate an urgent desire for health professional support. Behavioral intervention for infant sleep, as both a population strategy of prevention and clinical intervention, is a dominant health professional response. But our analysis demonstrates that despite substantial investment in implementation and evaluation of behavioral interventions for infant sleep in recent years, behavioral interventions in the first 6 months do not decrease infant crying, prevent sleep and

behavioral problems in later childhood, or protect against postnatal depression. In addition, behavioral sleep interventions risk unintended outcomes, including increased incidence of problem crying, premature cessation of breastfeeding, worsened maternal anxiety, and, if the infant is required to sleep either day or night in a room separate from the caregiver, an increased risk of Sudden Infant Death Syndrome.

Unsettled behavior in the first 6 months of life emerges out of multiple interacting factors, including maternal mental health and maternal-infant feeding problems, and early intervention is important. Our holistic, evidence-based clinical approach to unsettled infant behavior in the first months of life, which has been developed, published, and preliminarily evaluated elsewhere, systematically addresses the 5 domains of baby's health, mother's health, feeds, sensation, and sleep ("The Possums Approach").^{54,56,112-114} An evidence-based approach to sleep problems in the first 6 months avoids behavioral interventions, including extinction and graduated extinction; feed-play-sleep cycles; and education about "tired cues," sleep algorithms, or "overstimulation." Parental empowerment is supported by education about sensible, cue-based care; about healthy daytime biopsychosocial rhythms; by addressing parental sleep anxiety, safe sleep, and normal crying; and by prevention of and early intervention for the heterogenous problems, including feeding difficulties and psychosocial risk factors, which are linked to the emergence of unsettled infant behavior.

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