



ORIGINAL ARTICLE

Effect of current breastfeeding on sleep patterns in infants from Asia-Pacific regionMahesh Babu Ramamurthy,¹ Rini Sekartini,² Nichara Ruangdaraganon,³ Duy Hong T Huynh,⁴ Avi Sadeh⁵ and Jodi A Mindell⁶

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Aim: The aim of this study was to assess the relationship between breastfeeding and sleep patterns in infants from Asia-Pacific region.

Methods: Parents of 10 321 infants (0–11 months) from Australia, China, Hong Kong, India, Indonesia, Korea, Japan, Malaysia, New Zealand, the Philippines, Singapore, Taiwan, Thailand and Vietnam completed an expanded version of the Brief Infant Sleep Questionnaire.

Results: Overall, 4714 (45.72%) were currently being breastfed; 61.3% of those between 0 and 5 months and 36.6% of those between 6 and 11 months. Currently breastfed infants, when compared with not currently breastfed infants, had a significant increase in the number and duration of night-time wakings and less consolidated sleep. Interestingly, currently breastfed infants less than 6 months also showed longer duration of daytime sleep and obtained more sleep overall. Of note, of those who were currently breastfed, those infants who were nursed back to sleep during night, woke up more often at night (2.41 vs. 1.67 times) and had shorter continuous night-time sleep period (5.58 vs. 6.88 h; $P < 0.001$). There was no significant difference between breastfeeding and non-breastfeeding infants in the number of night wakings, when the nursing to sleep variable was controlled for in the analysis of variance.

Conclusion: Breastfeeding is associated with reduced sleep consolidation in infants. This relationship, however, may be moderated by parenting practices of nursing to sleep and back to sleep during the night. Thus, parents of infants with night waking problems should be encouraged to limit the association between nursing and falling to sleep, to improve sleep while maintaining breastfeeding.

Key words: breastfeeding; parenting practices; sleep patterns.

What is already known in this topic

- 1 Breastfeeding is associated with less consolidated nocturnal sleep.
- 2 Parental behaviours at bedtime and in response to nocturnal awakenings impact sleep.
- 3 Infants who fall asleep independently at bedtime have longer sustained sleep periods.

What this paper adds

- 1 The relationship between breastfeeding and reduced sleep consolidation is moderated by parenting practices of nursing to sleep and back to sleep during the night.
- 2 Parents who breastfeed are less likely to perceive their child's sleep as being problematic
- 3 In infants less than 6 months of age, total sleep time is greater in breastfed infants as a result of increased daytime sleep, with no differences in sleep time in older infants who are breastfed

Background

Sleep-related problems are one of the most prevalent complaints that parents report to paediatricians.¹ Multiple studies have found that between a quarter and a third of children between the ages of 6 months and 5 years have difficulties going to bed, falling

asleep or sleeping through the night.^{2–4} There are several factors that can influence sleep characteristics of infants, including infant characteristics (e.g. sex, prematurity, temperament of the baby), parent characteristics (e.g. income, feelings of depression in mother, mother's feeling of efficacy), infant–parent interaction at bedtime (e.g. lulling the child to sleep/staying until the infant is asleep, breastfeeding after awakening, rocking the baby to sleep after awakening) and co-sleeping.^{5,6} One sleep-related factor that has received limited attention is breastfeeding.

The benefits of breastfeeding are myriad. The greatest and most obvious benefits of breastfeeding are for the immediate

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health and survival of the infant. Rates of diarrhoea, respiratory tract infections, otitis media and other infections, as well as deaths due to these diseases, are all lower in breastfed than in non-breastfed infants.⁷ Furthermore, many studies confirm that children who are breastfed do better on tests of intellectual and motor development than children who are not breastfed.⁸

One area of limited research is the impact of breastfeeding on the sleeping patterns of infants. In one prospective study of 132 infants (1 month–1 year) in a predominantly Caucasian population, infants who were breastfed or were breastfed plus bottle-fed were found to be more likely to wake at night throughout the first year. Interestingly, in this study, social class, parity of the mother and weight gain of the infant were not related to wakefulness, with feeding method the only factor found to impact sleep.⁹ Other studies have also found that breastfeeding is associated with increased night-time awakenings when compared with bottle-fed infants, as well as sleeping in shorter bouts.^{10,11} On the other hand, breastfeeding has been found to be associated with decreases in other sleep problems. For example, it has been shown that children who were fed breast milk have significantly fewer symptoms of sleep-disordered breathing, as indicated by a lower apnoea-hypopnoea index, as explained by lesser infections in breastfed babies, leading to lesser adenoidal hypertrophy.¹²

To date, the limited studies conducted on the relationship between breastfeeding and sleep have primarily focused exclusively at night-time awakenings and have been primarily conducted in Caucasian samples. Thus, the purpose of the current study is to analyse the relationship between current breastfeeding and both sleep patterns and sleep problems in infants in the Asia-Pacific region (incorporating both Asian and Caucasian samples).

Method

This study is part of a larger cross-cultural study.¹³

Participants

This study included 4602 primary care givers (mostly mothers) of infants (birth to 12 months of age), of which 4089 were from predominantly Asian countries/regions (China, Hong Kong, India, Indonesia, Japan, South Korea, Malaysia, the Philippines, Singapore, Taiwan, Thailand and Vietnam) and 513 from predominantly Caucasian countries (the USA, Canada, the UK, Australia, New Zealand).

Procedure

All participants completed an expanded version of the Brief Infant Sleep Questionnaire (BISQ), which is fully described in the referred article¹⁴ The BISQ includes questions about infants' daytime and night-time sleep patterns, as well as sleep-related behaviours including sleeping arrangements, bedtime routines and parents perception of sleep problems. All questionnaires were completed online, except for Thailand and Vietnam, in which a paper version was completed face-to-face with a researcher. In eight countries/regions (Australia, China, India, Malaysia, Singapore, the Philippines, the UK, the USA), the

questionnaire was set as a pop-up screen at a popular parenting website (BabyCenter) and invited parents to complete a sleep survey for children ages birth to 36 months. All other countries/regions utilised a free-standing website for the survey. Recruitment in these areas was conducted via email utilising mailing lists obtained from local marketing firms.

Statistical analyses

The variables of interest in this study were the infant's bedtime, number of night wakings, duration of night wakings, duration of night sleep, numbers of naps, duration of daytime sleep, total sleep time and sleep latency over 30 min, as well as parents' perception of bedtime difficulties and overall sleep problems. Continuous variables were analysed using analysis of variance with Cohen's *d* utilised for effect sizes. Categorical variables were analysed utilising χ^2 . Effect sizes reported for χ^2 analyses are phi (ϕ). Because of the large cohort size and the multiple analyses, findings were considered significant if $P < 0.001$. Data were analysed using SAS version 9.2 (SAS Institute Inc., Cary, NC, USA).

Results

Table 1 presents the total number/percentage of children currently breastfed by country in infants less than 6 months of age and infants 6–12 months. Overall, almost two-thirds of infants less than 6 months of age are currently breastfed, with a decrease to 36.6% in those 6–12 months of age, with wide variability across countries from a low of 27.7% (Hong Kong) to a high of 82.3% (Vietnam) in the younger infants, and a range of 5.9 (Hong Kong) to 66.7% (Japan) in older infants. In both age groups, there are more children who are currently

Table 1 Prevalence of currently breastfeeding

Country	Age < 6 months		Age > 6 months	
	<i>n</i>	%	<i>n</i>	%
Australia	308	62.0	352	50.6
China	1304	47.9	1920	27.2
Hong Kong	220	27.7	287	5.9
Indonesia	179	68.2	236	36.0
India	923	71.5	890	54.2
Japan	73	82.2	162	66.7
Korea	116	67.2	236	50.0
Malaysia	239	46.0	250	24.4
New Zealand	205	65.9	270	44.4
Philippines	239	41.0	184	27.2
Singapore	226	54.4	231	35.1
Thailand	153	56.9	182	23.1
Taiwan	180	42.8	257	23.3
Vietnam	237	82.3	262	64.1
Predominantly Asian	4089	56.1	5097	35.2
Predominantly Caucasian	513	63.5	622	47.9
Entire sample	4602	61.3	5719	36.6

Table 2 Night-time sleep variables across breastfeeding status for <6 months

	Currently breastfeeding (<i>n</i> = 2621)	Not currently breastfeeding (<i>n</i> = 1981)	F or χ^2	Effect size
Bedtime	21.31 (1.57)	21.16 (1.58)	10.30*	0.10
Number of wakings	2.28 (1.35)	1.91 (1.40)	80.89**	0.27
Duration of wakings (hours)	0.95 (1.00)	0.80 (0.93)	26.42**	0.16
Longest sleep (hours)	5.37 (2.58)	6.33 (2.85)	141.20**	0.36
Rise time	6.63 (1.33)	6.63 (1.35)	0.02	
Night-time sleep (hours)	8.90 (1.92)	8.92 (1.98)	0.13	
Number of naps	3.46 (1.19)	3.19 (1.18)	59.81**	0.23
Daytime sleep (hours)	4.82 (2.25)	4.27 (2.10)	71.98**	0.25
Total sleep time (hours)	13.72 (2.87)	13.19 (2.76)	40.08**	0.19
Sleep latency (>30 min)	19.18%	17.01%	3.48	
Bedtime difficulty	24.42%	24.33%	0.00	
Sleeps well	58.57%	59.72%	0.62	
Sleep problem	56.34%	45.75%	50.61**	0.10

* $P < 0.001$; ** $P < 0.0001$. The effect size is based on Cohen's *d*.

Table 3 Night-time sleep variables across breastfeeding status for 6–12 months

	Currently breastfeeding (<i>n</i> = 2093)	Not currently breastfeeding (<i>n</i> = 3626)	F or χ^2	Effect size
Bedtime	21.12 (1.43)	21.06 (1.39)	2.35	
Number of wakings	2.37 (1.52)	1.72 (1.37)	277.84**	0.46
Duration of wakings (hours)	0.57 (0.73)	0.51 (0.74)	8.33	
Longest sleep (hours)	6.09 (2.93)	7.34 (2.90)	246.55**	0.43
Rise time	6.93 (1.18)	6.83 (1.19)	0.02	
Night-time sleep (hours)	9.32 (1.54)	9.34 (1.54)	0.31	
Number of naps	2.60 (0.92)	2.49 (0.88)	18.82**	0.12
Daytime sleep (hours)	3.18 (1.43)	3.20 (1.48)	0.16	
Total sleep time	12.50 (2.02)	12.54 (2.01)	8.58	
Sleep latency (>30 min)	14.34%	12.88%	2.42	
Bedtime difficulty	21.17%	20.57%	0.28	
Sleeps well	53.03%	53.50%	0.11	
Sleep problem	50.98%	56.62%	17.02**	0.05

* $P < 0.001$; ** $P < 0.0001$. The effect size is based on Cohen's *d*.

breastfeeding in predominantly Caucasian countries than those in predominantly Asian countries/regions, $P < 0.01$

Significant differences in sleep patterns and sleep problems were found comparing those who are currently breastfed to those who are not currently breastfed. In those below 6 months of age (see Table 2), infants who are currently breastfed have significantly more awakenings during the night and of longer duration. The longest uninterrupted sleep period was also significantly shorter in the currently breastfed group. In contrast to night-time parameters, during the day, infants who are currently breastfed have a higher number of daytime naps and significantly longer daytime sleep compared with the non-breastfed group. In fact, the increase in daytime sleep in this breastfed group results in more total sleep time (sum of both

daytime and night-time sleep). Furthermore, sleep problems, as perceived by the care giver, was lower in the non-breastfed group.

Sleep differences were also found across breastfeeding status in 6- to 12-month olds (see Table 3). Currently breastfed in this age group also demonstrated a significant increase in the number of night-time awakenings and a decrease in the average longest uninterrupted sleep compared with the non-breastfed group. Daytime naps were also significantly longer in the currently breastfed group. However, in this age group duration of daytime sleep and total sleep time were not different between the two groups. Similar to the younger infants, parental perception of sleep problems was lower in the non-breastfed group; although, sleep was actually more disrupted.

To further elucidate the possible mechanism for sleep differences associated with breastfeeding, breastfeeding back to sleep was more closely examined, as parental behaviours associated with falling asleep have been indicated as a primary influence on sleep disruption in young children. We compared breastfeeding back to sleep with bottle-feeding and no feeding back to sleep. As seen in Table 4, breastfed infants were more likely to be solely nursed back to sleep during the night (3623 = 76% of the currently breastfed infants). Infants who are nursed back to sleep at night (with or without the inclusion of bottle-feeding) have significantly more night wakings during the night. Infants who are fed back to sleep have shorter consolidated sleep periods in comparison with currently breastfed infants who are not fed back to sleep. However, there were no other consistent or systematic differences associated only with nursing back to sleep at night.

Discussion

As indicated by such organisations as the World Health Organization, exclusive breastfeeding is recommended for the first 6 months, and complementary breastfeeding until at least the age of 12 months. As noted, breastfeeding results in a myriad of physical and psychological benefits.^{8,15} The current study investigated the relationship of sleep to breastfeeding and found that infants who are currently breastfed had more night wakings with shorter sleep periods between night wakings, primarily in those under the age of 6 months.

Sleep disruption associated with breastfeeding has been observed in other studies as well.¹¹ Various reasons have been cited for this finding, including that infants seem to digest breast milk more rapidly than formula milk, which could account for the shorter period of satiety and sleep in breastfed infants.¹⁶ Studies have also shown that by stretching the time before feeding when the infant awakens, breastfed babies can learn to sleep longer intervals, suggesting that it was the closer temporal relationship between demand and response in breastfed babies that is the cause for frequent awakenings.¹⁷

Despite the widely recognised advantages of human milk for the young infant, in our study, as well as in other studies, it is clear that breastfed babies have more fragmented sleep at night. It is possible that mothers' need for uninterrupted nights' sleep may be promoting early cessation of breastfeeding. In this context, it is very gratifying to note the result in our study that within the group of breastfed babies, the subgroup of infants who were not nursed back to sleep (and likely not nursed to sleep at bedtime) had significantly less awakenings when compared with infants who were nursed back to sleep. This finding suggests that breastfeeding *per se* may not disrupt sleep. Rather, among the various factors studied, parental behaviours at bedtime and in response to nocturnal awakening are more significant. Parent-child bedtime interactions have been reported as the best predictors of sleep problems in early childhood.^{5,18,19} It is also known that children who learn to fall asleep on their own at bedtime have longer sustained sleep periods than those who do not.^{20,21} Thus, breastfed infants may learn to associate nursing with falling asleep and therefore require their mother to feed them before they are able to fall asleep following night waking.²²

Table 4 Night-time sleep variables for currently breastfeeding infants comparing the use of bottle-feeding and nursing with resume sleep following night wakings

	No nursing or bottle-feeding (n = 468)	Bottle-feeding only (n = 275)	Nursing only (n = 3623)	Nursing and bottle-feeding (n = 348)	F	Effect size, partial η^2
Bedtime	21.93 (1.67)†	21.20 (1.41)†§	21.25 (1.50)†§	21.42 (1.44)§	8.42**	0.005
Number of wakings	1.52 (1.62)†	2.07 (1.31)†	2.42 (1.37)§	2.52 (1.41)§	64.6**	0.040
Duration of wakings	0.65 (0.97)†	0.95 (1.00)†	0.76 (0.88)†	1.02 (1.07)†	16.23**	0.010
Longest sleep	7.40 (3.02)†	5.66 (2.66)†	5.50 (2.65)†	5.43 (2.77)†	73.7**	0.045
Rise time	6.75 (1.16)†	6.69 (1.32)†	6.80 (1.28)†	6.47 (1.35)†	7.20**	0.005
Night-time sleep	9.21 (2.15)†	9.02 (1.97)†	9.12 (1.65)†	8.62 (2.12)†	10.13**	0.006
Number of naps	2.78 (1.21)†	3.18 (1.24)†	3.07 (1.14)†	3.47 (1.28)†	29.57**	0.018
Daytime sleep	3.79 (1.89)†	4.67 (2.47)†	4.02 (2.04)†	4.72 (2.35)†	28.62**	0.018
Total sleep time	13.01 (2.80)†	13.69 (3.11)†	13.15 (2.48)†	13.33 (3.08)†	5.26*	0.003

* $P < 0.005$; ** $P < 0.0001$. †§Means with no overlapping letters are significantly different in post hoc Duncan analysis.

Studies have demonstrated that a combination of interventions such as teaching the infant to fall asleep without external help, reducing or eliminating unnecessary night-time feedings and forming a stable sleep wake cycle is successful in reducing night awakening in infants.²³ Another study¹⁷ showed that breastfeeding need not be associated with night-time awakenings and that breastfed babies can be behaviourally entrained to sleep through the night. The results of their study suggests that teaching parents to stretch the time between feedings when the infant awakens – by providing opportunities for self soothing – is the most important factor in facilitating to sleep through the night. It is also clear from that study that breastfed babies adapt themselves to the long interval in the night without feeds by taking a large feed in the early morning, hence, parents can be reassured that the infants intake will not be compromised by missing a feed.

There were other additional interesting findings in this study. Firstly, although sleep was more disrupted in infants who were breastfed, parents were less likely to perceive their child's sleep as being problematic. It is unclear what accounts for this discrepancy in parental perception. It may be simply that parents who breastfeed have an overall more positive view of their child or it may be that there is a greater expectation that their infant will wake at night, and thus fragmented sleep is perceived as less problematic. Another possibility is that nursing during the night is less disruptive to parents' sleep than bottle-feeding. This latter explanation is supported by a study indicating that parents of infants who are breastfed at 3 months post-partum actually get 40–45 min more sleep at night compared with non-breastfeeding mothers.²⁴ These parents also reported fewer sleep problems than parents of formula-fed infants. Another interesting finding was that in younger infants, total sleep time was greater in breastfed infants as a result of increased daytime sleep. In older infants, there were no differences in total sleep time across breastfeeding status, which indicates that although sleep may be more fragmented in infants who are breastfed, there may not be any consequences of sleep deprivation.

A primary strength of our study is in the number of infants who have been included and the wide representation from different countries. However, there are limitations, including being an Internet-based study, hence, the respondents are probably the more educated class who have access to Internet. Additional limitations include the cultural differences between countries, which may lead to differences in perceptions and reporting of infant sleep problems.¹³ Overall, the number of infants who slept in their parent's bed (50.7%) and the number of infants who slept in their parents' room (80.7%) were consistently high in predominantly Asian countries.

Conclusions

Overall, we found that breastfeeding is associated with increased night-time wakings and decreased sleep consolidation in infants. However, parental response to nocturnal awakenings (nursing back to sleep) is highly associated with infants' sleep consolidation. That is, this relationship between sleep fragmentation and nursing may be moderated by parenting practices of nursing to sleep and back to sleep during the night. Thus, parents of infants with night waking problems should be

encouraged to limit the association between nursing and falling to sleep, to help decrease sleep issues while maintaining breastfeeding.

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References

- Mindell J, Kuhn B, Lewin D, Meltzer L, Sadeh A, Medicine AAO. Behavioral treatment of bedtime problems and night wakings in infants and young children. *Pediatrics* 2006; **29**: 1263–76.
- Armstrong K, Quinn R, Dadds M. The sleep patterns of normal children. *Pediatrics* 1994; **161**: 202–6.
- Mindell J, Meltzer L, Carskadon M, Chervin R. Developmental aspects of sleep hygiene: findings from the 2004 National Sleep Foundation Sleep in America Poll. *Pediatrics* 2009; **10**: 771–9.
- Sheldon SH, Ferber R, Kryger MH, eds. *Principles and Practice of Pediatric Sleep Medicine*. Philadelphia, PA: WB Saunders Co, 2005.
- Sadeh A, Tikotzky L, Scher A. Parenting and infant sleep. *Pediatrics* 2010; **14**: 89–96.
- Touchette E, Petit D, Paquet J *et al.* Factors associated with fragmented sleep at night across early childhood. *Arch. Pediatr. Adolesc. Med.* 2005; **159**: 242–9.
- Bartick M, Reinhold A. The burden of suboptimal breastfeeding in the United States: a pediatric cost analysis. *Pediatrics* 2010; **125**: e1048–56.
- Floreyc C, Leech A, Blackhall A. Infant feeding and mental and motor development at 18 months of age in first born singletons. *Pediatrics* 1995; **24** (Suppl. 1): S21–6.
- Eaton-Evans J, Dugdale AE. Sleep patterns of infants in the first year of life. *Arch. Dis. Child.* 1988; **63**: 647–9.
- Carey W. Letter: breast feeding and night waking. *Pediatrics* 1975; **87**: 327.
- Elias MF, Nicolson NA, Bora C, Johnston J. Sleep/wake patterns of breast-fed infants in the first 2 years of life. *Pediatrics* 1986; **77**: 322–9.
- Montgomery-Downs HE, Crabtree VM, Sans Capdevila O, Gozal D. Infant-feeding methods and childhood sleep-disordered breathing. *Pediatrics* 2007; **120**: 1030–5.
- Mindell J, Sadeh A, Wiegand B, How T, Goh D. Cross-cultural differences in infant and toddler sleep. *Pediatrics* 2010; **11**: 274–80.
- Sadeh A, Mindell J, Luedtke K, Wiegand B. Sleep and sleep ecology in the first 3 years: a web-based study. *Pediatrics* 2009; **18**: 60–73.
- Vestergaard M, Obel C, Henriksen TB, Sørensen HT, Skajaa E, Ostergaard J. Duration of breastfeeding and developmental milestones during the latter half of infancy. *Acta Paediatr.* 1999; **88**: 1327–32.
- Burness N. Infant feeding. In: Vaughan VC, McKay RJ, Behrman RE, eds. *Nelson Textbook of Pediatrics*. Philadelphia, PA: WB Saunders Co, 1979.
- Pinilla T, Birch LL. Help me make it through the night: behavioral entrainment of breast-fed infants' sleep patterns. *Pediatrics* 1993; **91**: 436–44.
- Van Tassel E. The relative influence of child and environmental characteristics on sleep disturbances in the first and second years of life. *Pediatrics* 1985; **6**: 81–6.

- 19 Mindell JA, Sadeh A, Kohyama J, How TH. Parental behaviors and sleep outcomes in infants and toddlers: a cross-cultural comparison. *Pediatrics* 2010; **11**: 393–9.
- 20 Anders T, Halpern L, Hua J. Sleeping through the night: a developmental perspective. *Pediatrics* 1992; **90**: 554–60.
- 21 Adair R, Bauchner H, Philipp B, Levenson S, Zuckerman B. Night waking during infancy: role of parental presence at bedtime. *Pediatrics* 1991; **87**: 500–4.
- 22 DeLeon C, Karraker K. Intrinsic and extrinsic factors associated with night waking in 9-month-old infants. *Pediatrics* 2007; **30**: 596–605.
- 23 Schaefer CE. Treatment of night wakings in early childhood: maintenance of effects. *Percept. Mot. Skills* 1990; **70**: 561–2.
- 24 Doan T, Gardiner A, Gay C, Lee K. Breast-feeding increases sleep duration of new parents. *Pediatrics* 2007; **21**: 200–6.