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**Infant sleep and night feeding during later infancy: associations with infant weight,
breastfeeding and complementary food intake**

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Abstract

Infant sleep is a common concern for new parents. Although many expect a newborn infant to wake frequently, encouraging a baby to sleep through the night by a few months old is seen as both a developmental aim and parenting success. Many new mothers believe that their infants diet is related to their sleep; formula milk, or increased levels of solid food are often given in an attempt to promote sleep. However, the impact of these in later infancy is not understood. In the current study 756 mothers with an infant aged 6 – 12 months reported their infants typical night wakings and night feeds alongside any breastfeeding and frequency of solid meals. 78.1% of infants in this age range still regularly woke at least once a night with 59.9% receiving one or more milk feeds. Both night wakings and night feeds decreased with age. No difference in night wakings or night feeds was found between mothers who were currently breast or formula feeding. However, infants who received more milk or solid feeds during the day were less likely to feed at night but not less likely to wake. The findings have important implications for health professionals who support new mothers with infant sleep and diet in the first year. Increasing infant calories during the day may therefore reduce likelihood of night feeding but will not reduce need for parents to attend to the infant in the night. Breastfeeding has no impact on infant sleep in the second six months postpartum.

Introduction

Infant sleep, or lack of it, is a common concern of new parents. Although newborn infants are expected to wake frequently with a typical infant waking every two to three hours¹, Western nations in particular have a belief that infants should be encouraged to sleep through the night as soon as possible^{2,3}. A baby that sleeps well is perceived to be a sign of wellbeing and of good parenting^{4,5}.

Although sleep problems in later childhood are linked to behavioural, emotional and academic problems^{6,7}, waking during infancy is biologically normal. Infants have a biological predisposition to want to be close to their mothers and for frequent suckling^{8,9}. Moreover, due to the small size of a newborn infant's stomach and a need to build milk supply, frequent feeds and thus wakings are needed¹⁰. Lighter sleep may also be protective against sudden infant death syndrome in young infants¹¹.

Typically, by around three or four months of age, parents often believe that infants should be sleeping through the night¹², although the 1950s data that this is based on is out-dated¹³. Indeed, many studies show that for infants aged 6 – 12 months night waking is still common. Estimates of night waking range from around 30 – 60%¹⁴⁻¹⁸. Scher¹⁶ found the mean number of night wakings in this age group to be 1.77 and likewise nearly half of mothers with an infant aged 6 – 12 months old described their infant sleep as being problematic¹⁹.

Desire for the infant to sleep through the night is however often strong, with parents feeling that they have failed if their infant continues to wake¹². Parents may resort to letting their child 'cry it out' when they wake rather than responding to them^{2,18}, which may raise infant cortisol levels²⁰. Another common belief is that nutrition may affect infant sleep; mothers may stop breastfeeding as they believe it is contributing towards night wakings^{9,21,22}. Health professionals may also recommend mothers supplement with formula to get more sleep²³. These beliefs however are not well explored amongst older infants.

In early infancy, a link between increased night wakings and feeds and milk feeding method is apparent. Formula infants start to sleep for longer periods at an earlier age than breastfed infants²⁴⁻²⁶. This may be explained by the more difficult digestion of cow's milk leading to a greater feeling of fullness²⁷ and greater volume of consumption²⁸. Breastfed infants do receive more night feeds²⁹.

It is not clear however whether this relationship holds for older infant, despite belief that it does. Some studies find an association between breastfeeding and more frequent waking in later infancy^{30, 31} whereas others find no association^{32, 33} at eight months old. Other studies have found that although breastfed infants might wake more frequently, formula fed infants take longer to feed and settle, leading breastfeeding mothers to have more sleep overall^{34, 35}.

Mothers may also introduce solid foods at an early stage or encourage the infant to eat greater volumes during the day as they believe it will make the infant sleep for longer³⁶⁻³⁹. Despite this common perception, little research has examined solid food intake and sleep. One study showed that breastfed infants were more likely to sleep through the night at 9 months old if they had been introduced to solids before 12 weeks of age⁴⁰ although Nevarez, Rifas-Shiman, Kelinman, Gillman & Traveras³² found an early introduction of solids associated with less sleep at 12 months old. Moreover rice cereal added to a bottle had no impact on sleep at four months⁴¹.

Mothers may therefore be altering their infant feeding behaviour based on unclear, sparse and often out-dated evidence. Sleeping and feeding practices have changed considerably over the last thirty years⁹. The aim of the current study was to examine the issue of night waking and night feeds (and the distinction between them) in infants aged 6 – 12 months old, exploring the breastfeeding and solid food consumption.

Methodology

Participants

Approval for this study was granted by a Department of Psychology Research Ethics Committee. All participants gave informed consent prior to inclusion in the study. All aspects of this study have been performed in accordance with the ethical standards set out in the 1964 Declaration of Helsinki.

Mothers of an infant aged 6 – 12 months completed a self-report questionnaire. Exclusion criteria included a low birth weight (<2500g), premature birth (<37 weeks), inability to consent and infant / maternal health issues.

Mothers were recruited via local mother and baby groups based in South West Wales (UK) and through online parenting forums based in the UK. For the groups, contact was made with group leaders who distributed questionnaires to group members. Questionnaires were returned to the leader in a sealed envelope or via post to the researcher. In addition posters were placed in centres around the city asking participants to contact the researcher for further details via email, phone or post. Questionnaires had information letters attached with details of how to contact the researcher if further information was required. Study adverts were also placed on specific research request boards on online message boards on parenting forums based in the UK (e.g. www.mumsnet.com; www.bounty.com) with an online link to complete the questionnaire via survey monkey. All participants were however based in the UK. Details were given for how to contact the researcher if needed.

Participants completing the questionnaire via paper or online copy were given a written debrief at the end of the questionnaire and given researcher details to contact if they wanted further information. Consent was given via tick boxes for both methods. All participants were given instruction to contact their relevant health professional if completing the questionnaire had raised any questions or issues with regard to caring for their baby.

Data Collection

Mothers reported maternal demographic background (age, education, profession, marital status), infant birth weight, gender and age, and a series of questions regarding infant feeding and sleep including:

- Breastfeeding duration (initiation, age of infant when stopped if applicable and current feeding method).
- Infant age in weeks when complementary foods were introduced
- How frequently their infant consumed solid meals or snacks per day
- How frequently their infant received milk feeds per day
- Weaning method (how frequently they used spoon feeding and puree use to categorise mothers into baby-led weaning versus traditional spoon-feeding).
- How frequently on average their infant woke in the night (night defined as between the hours of 8pm and 6am)
- How frequently they gave their infants night feeds of milk or formula.

Data analysis

Data analyses were carried out using SPSS v20, SPSS UK Ltd.

Mothers were considered to be breastfeeding if they were doing so partially or exclusively. Infant feeding method at birth (breast or formula), current breastfeeding (yes/no) and breastfeeding duration were calculated. Infant birth and current weight were converted to z scores.

Pearson's correlations explored association between frequency of night wakings and night feeds with age of introduction of solids, frequency of milk feeds and frequency of solid feeds.

MANCOVA were used to examine differences in frequency of night wakings and night feedings by current breastfeeding status (yes/no), weaning reason (yes/no)

Maternal demographic background (age, education, marital status and occupation) and infant factors (age, gender, birth weight) were controlled for throughout where appropriate.

Results

Seven hundred and fifty six mothers completed the study. The mean age was 29.56 years, (range from 17 to 45) and the mean number of years in education was 14.87. 68.9% of mothers were primiparous. Mean age of infant was 8.34 months (range 6 – 12 months). For further demographic details please see table two.

Night wakings and night feeds

The mean number of times infants woke in the night was 1.77 (SD: 1.54) and the mean number of night feeds was 1.36 (SD: 1.55) for the sample as a whole. 21.1% of the sample did not wake at all and 40.9% did not feed at all. For both waking and feeding the frequency ranged from zero to seven occurrences with the most common occurrence being one or two for both waking (53.2%) and feeding (39.0%). Overall, both night wakings (Pearson's $r = -.152$, $p = .000$) and night feeds (Pearson's $r = -.255$, $p = .000$) decreased with infant age (see Table 2).

There was no significant difference in either night wakings [$t(754) = .633$, $p = .527$] or night feeds [$t(754) = 1.04$], $p = .298$] for infant gender. Similarly there was no significant association between night wakings (Pearson's $r = -.022$, $p = .271$) or night feeds (Pearson's $r = -.039$, $p = .144$) for infant current weight (once infant age was controlled for).

Milk feeding

An estimate of the number of milk feeds (breast or formula milk) given during the day was given. A mean number of 5.05 (SD: 2.12) feeds were given with a range from 1 – 9. 50.1% of mothers gave 3 – 5 feeds per day. Feeds decreased with age (Pearson's $r = -.270$, $p = .000$).

Frequency of milk feeds (breast or formula) during the day was significantly inversely associated with frequency of night feeds (Pearson's $r = .840$, $p = .000$) but not night wakings (Pearson's $r = .056$, $p = .063$).

Participants indicated whether they were currently breastfeeding. Two hundred and thirty four mothers (31.2%) were breastfeeding whilst 493 (68.8%) were not. Mothers who were breastfeeding gave significantly more day time feeds compared to those formula feeding independently of infant age [$f(1, 722) = 34.17$, $p = .000$]. Breastfeeding mothers gave an average of 5.69 feeds (SD: 2.18) compared to 4.24 (SD: 1.99) for formula feeding mothers. However there was no significant difference in night wakings [$t(725) = -1.182$, $p = .238$] or night feeds [$t(725) = -.217$, $p = .828$] between those currently breastfeeding or not [table three]

Complementary feeding

Timing of introduction to solid foods ranged from 8 to 32 weeks (mean 20.42, SD: 4.49). No significant association was found between age of introduction to solids and current night wakings (Pearson's $r = .010$, $p = .393$). However the older an infant was when it was introduced to solid foods, the more likely they were to feed in the night (Pearson's $r = .064$, $p = .039$) [both independent of infant age].

Participants estimated number of times infants received complementary foods meals during the day. The mean number of meals/snacks per day was with a range from 1 – 7 times. The majority of mothers gave two (25.7%), three (33.7%) or four (24.2%) meals with a minority giving 5 – 7 meals (4.8%) and 11.6% giving only one meal.

Number of complementary meals per day was not significantly associated with number of night wakings (Pearson's $r = -.038$, $p = .152$) but was significantly inversely associated with number of night feeds (Pearson's $r = -.153$, $p = .000$). The less solid meals the infant received, more night feeds were reported.

Total intake

Number of complementary feeds and milk feeds during the day were added together to give a total number of daytime feeds. Frequency ranged from 4 (2.0%) to 13 (2.2%) with a mean intake of 7.94 (SD: 2.26) feeds a day. Most mothers gave 7 – 9 feeds a day (50.0%).

Again no significant association was seen between number of feeds and night wakings (Pearson's $r = -.002$, $p = .481$) but significantly negatively associated with more frequent night feeds (Pearson's $r = -.099$, $p = .003$).

Discussion

This paper explored infant patterns of night waking and night feeding during the second six months postpartum. It showed that despite common beliefs that infants 'should' be sleeping through the night and not receiving night feeds, nearly three quarters of infants in this age range frequently woke at least once during the night with over half receiving at least one night time feed. Moreover, the data showed that breastfeeding, complementary feeding and infant weight were not associated with frequency of night waking, although an association with infant night feeding was found for lower frequency of intake.

The first issue raised by the findings is the issue of infant sleep. The data clearly showed that it is common for infants to wake and feed during the night in the second six months postpartum. Understanding normal patterns of sleep and waking for infants is important to supporting new mothers. Considerable pressure is put on mothers to have a 'good' baby who sleeps well and is seen to be contented. Infant night waking is associated with postnatal depression⁴². Although a large variance of this is likely to be due to exhaustion, it is also possible that perceptions of 'failure' are contributing to postnatal depression symptomology. These views may be exacerbated by the attitudes of others who believe that the infant should be sleeping and not waking. Greater awareness is needed of the normality of infant night waking and feeding so that expectations, understanding and support for new mothers can be greater.

Secondly, the findings challenge assumptions that breastfeeding is associated with more frequent night wakings^{43,44}. Breastfed infants did feed more frequently during the night than formula fed infants but they did not wake more. Formula fed infants continued to wake but were not fed. The study did not measure total sleep time but previous work has shown that mothers of breastfed infants get more sleep than formula fed infants overall³⁴, particularly if they co-sleep⁴⁵. This may be because feeding the infant soothes them back to sleep in a relatively quick period of time compared to settling an infant without a feed. Feeding is not simply nutrition for an infant; suckling is a natural act of comfort⁹ and breastfed babies in particular will

spend more time in sucking pauses where they are not consuming milk, but comforting themselves⁴⁶.

The findings also challenge the preconception that complementary foods will aid an infant to sleep through the exploration of reasons for introducing solid foods^{36, 37}. Again, intake of solids did not affect night wakings but it did affect whether the infant received a night feed; infants who consumed less in the day were more likely to have a night feed. This relationship also emerged for number of milk feeds in the day; infants who had more frequent feeds during the day, did feed less at night but it did not stop them waking. Moreover, later solid introduction was associated with more night feeding but not night waking (potentially due to having less solids in the day due to shorter experience). Due to the correlational relationship, it is not possible to be clear as to the relationship between this. One explanation is that mothers may be less likely to offer an infant a feed at night if they have consumed more during the day. Alternatively, 'filling an infant up' in the day with milk or solids may prevent night feeds due to lower hunger but it does not appear to prevent night waking. Infants continue to wake for reasons unrelated to hunger and there is a risk that encouraging an infant to consume more during the day, against its natural appetite may increase risk of the infant becoming overweight as they become less skilled regulating their intake according to need^{47, 48}.

The findings have important implications for health professionals and those working to support new mothers. Firstly, the normality of infant night waking and feeding needs to be more clearly publicised. Poor infant sleep is associated with increased risk of postnatal depression⁴⁹⁻⁵¹ and parenting stress⁵². Sleep deprivation may play a role in this but it is also possible that mothers may perceive themselves to be a failure if their infant is not sleeping through the night. Moreover, mothers who feel out of control and unsure of their parenting are more likely to experience depression⁵³. Understanding the normality of such night time behaviour may help increase maternal confidence and self esteem.

Linked to this, understanding that many infants wake frequently in the night may alter maternal behaviour. A belief that an infant 'should' be sleeping may lead the mother to feel that she must sleep train her infant. Allowing an infant to cry for long periods of time may negatively affect infant cortisol response²⁰ and brain development⁵⁴. Mothers may choose not to sleep train if they were more aware of the normality of infant behaviour.

There are important implications for infant feeding too. Stopping breastfeeding, or an early introduction of complementary foods, are both associated with a belief that this action will increase night time sleep and lead to more settled infant behaviour. These data suggest that these relationships do not hold true. A breastfed infant or one who consumes less solid food may feed more frequently at night but they are likely to continue to wake. Encouraging mothers to stop breastfeeding and increase solid intake could be detrimental to infant health with no clear benefit. An early introduction of solid foods is associated with poorer infant health outcomes⁵⁵ and overweight⁵⁶ whilst continued breastfeeding is recommended throughout the second year and beyond by the WHO⁵⁷. Pressurising an infant to consume solids foods may break down the natural ability of an infant to regulate their appetite, leading to potential overweight⁵⁸.

The research does have its limitations. Participants were self-selecting. Mothers were older, more educated with a higher percentage of professional occupations than average⁵⁹. The proportion of mothers who delayed solids until six months postpartum was higher than the UK average, as were levels of breastfeeding⁶⁰ suggesting that mothers more interested in infant feeding practices may have taken part. However, a range of demographic groups were included. Care should be taken however in generalising to a wider population.

Recruitment also used online methods of data collection. Although this method is now popular in health and social science research (e.g. Alcade & Cristina⁶¹; Hamilton, White & Cuddihy⁶²; Ferguson & Hansen⁶³), it may lead to a bias towards older, more educated, proactive participants⁶⁴. However, pregnant and new mothers are a well-

known user group of internet forums⁶⁵. Use tends to be inclusive of demographic groups⁶⁶ and allows cost effective access to a targeted sample⁶⁷.

Data was also self-report and based on average estimations of sleep and feeding. It is also recognised that intake of energy can only be approximated from frequency of feeds with the assumption that more feeds / meals equates to greater energy intake. Particularly for breastfeeding intake this may not be the case. However this was not the main variable analysed. Night time was also defined as from 8pm – 6am (as per previous studies such as Elias et al⁸) as this is a typical sleep period for infants this age. However it is recognised that some parents may not put an infant to sleep until later.

Limitations aside these findings are of interest because they both highlight the normality of infant night waking at 6 – 12 months old and illustrate that waking appears unrelated to night feedings. Breastfeeding should not be stopped, or solid intake increased in a belief that it will improve infant sleep. Instead more support is needed for mothers at this time to help them deal with their infants night waking, outside of recommendation to alter diet.

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Table 1. Sample distribution by Demographic Factors

Indicator	Group	N	%
Age	≤ 19	22	3.3
	20 – 24	90	13.6
	25 – 29	278	42.1
	30 – 34	194	29.4
	35 ≥	76	11.5
Education	School	113	17.1
	College	174	26.4
	Higher	373	56.5
Marital Status	Married	457	69.2
	Cohabiting	170	25.8
	Single	26	4.0
Home	Owned	425	64.5
	Rented	183	28.3
	Council	33	4.5
	Other	14	2.7
Maternal occupation	Professional & managerial	267	40.5
	Skilled	116	17.6

Unskilled	185	28.0
Other	48	7.3

Table two: Frequency of infants experiencing night wakings and night feeds

Frequency	Night wakings	Night feeds
None	160 (21.1%)	309 (40.9%)
One	218 (28.8%)	144 (19.0%)
Two	185 (24.5%)	151 (20.0%)
Three	97 (12.8%)	85 (11.2%)
Four	50 (6.6%)	37 (4.9%)
Five	25 (3.3%)	10 (1.3%)
Six	14 (1.9%)	12 (1.6%)
Seven	7 (.9%)	8 (1.1%)

Table three: Differences in night waking and night feeds for infants currently breast or formula fed by infant age in months

Age in months	Night waking			Night feeds		
	Whole sample	Breastfed	Not breastfed	Whole sample	Breastfed	Not breastfed
Six (n = 120)	2.06 (1.72)	1.94 (1.92)	2.12 (1.68)	1.80 (1.79)	1.75 (1.99)	1.86 (1.76)
		[F (118) = 1.24, p = .405]			[F (118) = .556, p = .163]	
Seven (n = 115)	2.05 (1.76)	2.35 (1.76)	1.88 (1.72)	1.72 (1.80)	2.00 (1.78)	1.56 (1.77)
		[F (113) = 2.25, p = .136]			[F (113) = 1.86, p = .175]	
Eight (n = 128)	1.59 (1.34)	1.11 (1.40)	1.71 (1.26)	1.11 (1.25)	1.09 (1.40)	1.12 (1.17)
		[F (126) = 4.31, p = .041]*			[F (126) = .014, p = .905]	
Nine (n = 93)	1.66 (1.26)	1.50 (1.17)	1.72 (1.29)	1.16 (1.23)	.96 (.91)	1.23 (1.33)
		[F (91) = .598, p = .441]			[F (91) = .909, p = .343]	
Ten (n = 85)	1.47 (1.21)	1.51 (1.15)	1.45 (1.26)	1.01 (1.16)	1.11 (1.10)	.94 (1.20)
		[F (83) = .077, p = .783]			[F (83) = .462, p = .499]	
Eleven (n = 110)	1.32 (1.10)	1.29 (1.08)	1.34 (1.21)	.89 (1.07)	.64 (1.00)	.96 (1.09)
		[F (108) = .934, p = .338]			[F (108) = 1.24, p = .415]	
Twelve (n = 105)	1.31 (1.64)	1.27 (1.41)	1.35 (1.03)	.60 (.97)	.57 (1.07)	.63 (.96)
		[F (103) = .593, p = .445]			[F (103) = .046, p = .831]	

*Shaded area = p < 0.05

Table Four: Association between frequency of complementary foods and night waking and feeding by infant age in months

Infant age		Night feeds	Night waking
Six	Frequency Complementary foods	$r = -.220, p = .001^{**}$	$r = .142, p = .088$
Seven		$r = -.166, p = .024^*$	$r = .056, p = .298$
Eight		$r = -.227, p = .003^{**}$	$r = -.146, p = .084$
Nine		$r = -.139, p = .090$	$r = -.052, p = .308$
Ten		$r = .042, p = .350$	$r = .069, p = .265$
Eleven		$r = -.371, p = .001^{**}$	$r = -.190, p = .002^{**}$
Twelve		$r = -.470, p = .000^{**}$	$r = -.268, p = .024^*$

* = $p < 0.05$; ** = $p < 0.01$