



# Quality of Preterm Infants' Night Sleep: and Online Community-Based Survey of Maternal Factors and Perceptions of Infants' Nighttime Awakenings and Sleep Problems

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## Abstract

**Background:** Between one-quarter and one-third of infants aged six months to five years have sleeping problems. Infants' night sleep patterns, in particular problematic night waking with crying, are a common concern for parents. Many factors can influence the development of infants' night sleep patterns and sleep problems, including parental interaction.

**Objectives:** To examine the associations between premature infants' nighttime awakening, mothers' reports of sleep problem severity, and maternal factors, including mothers' styles of attachment and behaviors used to settle their infants to sleep.

**Method:** The cross sectional survey study used a web-based questionnaire to collect data from a community-based sample of 105 mothers of singleton premature infants aged 5-6 months (corrected age) across a number of English speaking countries. The main outcome measures were mothers' perceptions of infants' nighttime awakenings (frequency and duration) and presence of infant sleep problems.

**Results:** Of the 55% of mothers who reported that their infants had sleep problems, 17% described the problem as serious. The majority of infants woke 2.1 times per night for an average of 45.7 minutes per night. Mothers' style of attachment and personal history of sleep problems predicted the duration of the infants' nighttime awakening, whereas maternal active physical comforting predicted the frequency of nighttime awakenings.

**Conclusions:** The findings can guide healthcare providers to screen mothers for an anxious style of attachment, perceptions of infant sleep problems, and use of active physical comforting strategies for bedtime settling when assessing premature infants' sleep problems.

**Keywords:** Maternal Attachment, Nighttime Awakenings, Premature Infant, Settling Strategies, Sleep Problem

## 1. Introduction

Between one-quarter and one-third of infants and young children experience sleep problems (Mindell et al., 2006). The most commonly reported problems are settling difficulties at bedtime and nighttime awakening with signaling (crying) (Goodlin-Jones et al., 2001). Persistent sleep problems during childhood have been associated with attention deficit disorder, impulsivity, aggression, obesity, and poor health-related quality of life (Hiscock et al., 2007; Simola et al., 2012; Taveras et al., 2008; Touchette et al., 2009). Persistent alterations in sleep-wake states may have cumulative and long-term neurodevelopmental effects, especially for preterm infants (Holditch-Davis, 2010). At four months of age, most preterm infants (without neurological complications) are expected to sleep relatively long stretches during the night (approximately six hours) and soothe themselves to sleep following nighttime arousals (Henderson et al., 2011).

Maternal factors including depression, (Lam et al., 2003;), quality of sleep, poor daily functioning (Fiese et al., 2007; Hall et al., 2006; Meltzer & Mindell, 2007), and style of attachment (Benoit et al., 1992) have been linked with children sleep problems. Maternal bedtime behaviors, in particular active physical involvement to settle infants to sleep, e.g. rocking, has been linked to frequent nighttime awakenings (Sadeh et al., 2009; Morrell & Cortina-

Borja, 2002; Touchette et al., 2005). Because preterm infants represent an understudied population in the community it is important to understand contributions of maternal factors to the quality of premature infants' nighttime sleep.

Preterm infants' responses to everyday stimuli are highly variable, which likely affects maternal interactions (Als, 1982). Differences in the care-giving behaviors of mothers of full-term and mothers of preterm infants have been documented (Feldman & Eidelman, 2006; Forcada-Guex et al., 2006). Mothers have been more controlling and distant, and less sensitive and synchronized during interactions with their infants (Feldman & Eidelman, 2006; Forcada-Guex et al., 2006; Muller-Nix et al., 2004). Such behavior has been linked to insecure (anxious) adult attachment styles (Magai et al., 2000).

France and Blampied's (1999) theoretical framework situates infants' nighttime awakening and signaling in the context of anxious mother-infant attachment relationships. They hypothesize that anxiously attached mothers might have intensive or active involvement with their infants at bedtime and in response to their infants' signaled nighttime awakenings. Mothers' over-involvement behaviors (i.e., active physical comforting) to settle their infants may disrupt infants' sleep regulatory abilities and increase problematic nighttime awakening because infants are unable to develop skills in initiating sleep independently (self-soothing).

No published work describes links between mothers' anxious style of attachment, settling behaviors, and perceptions of premature infants' nighttime sleep quality. We aimed to explore the association between mothers' anxious style of attachment, use of active physical comforting strategies to settle their infants, and perceptions of infant sleep problems. Two research questions were explicitly posed:

- a) Is maternal bedtime settling behavior, in particular the use of active physical comforting strategies, associated with mothers' reports of sleep problems in their premature infants at five to six months corrected age?
- b) Is there an association between mothers' anxious style of attachment and perception of the frequency and duration of premature infants' nighttime awakenings at five to six months corrected age?

## 2. Methods

### 2.1. Subjects

Mothers of premature infants between 5-6 months of age (corrected age) were recruited from the community. The mothers were not receiving therapy for mental health problems. Eligible infants were born between 26 and 36+ 6 weeks gestational age, had birth weights of greater than 1,000 grams, and lived at home. Infants receiving behavioral intervention for sleep problems from healthcare providers or with medical diagnoses of congenital abnormalities or developmental delays were excluded. In total, 105 mothers completed the survey.

### 2.2. Procedure

Ethics approval was obtained from the applicable university, infant development program, and health authority. Recruitment for the online web-based survey occurred through advertising in a local newspaper, on relevant websites, and during health fairs between July 2008 and December 2009.

### 2.3. Measures

#### 2.3.1. Background information

The infants' demographic information, including current feeding type, and infant health problems, was collected. Mothers' demographic information, mood, history of sleep problems, and experience with older children with sleep problems were incorporated in the questionnaire.

#### 2.3.2. The mother's perception of the infant's nighttime awakening and infant's sleep problems

The Brief Infant Sleep Questionnaire (BISQ) (Sadeh, 2004) measured maternal perceptions of infants' night waking and severity of their infants' sleep problems. Test-retest reliability of the BISQ has been reported as .82-.95 and the tool has correlated with other sleep measures (i.e., actigraphic records and daily sleep logs) (Sadeh, 2004). Nighttime awakening was defined as occurring between one hour after the child's bedtime and the start of the next day. Mothers reported the average number of infants' nighttime awakenings (FNW) per night and the total duration of nighttime awakening (DNW) per night during the last typical week. The mothers indicated whether they perceived their infants' sleep as being: "no problem at all," or "a problem (small/ serious)."

#### 2.3.3. Mothers' bedtime behavior to settle infants

The Active Physical Comforting (APC) subscale of the Parental Interactive Bedtime Behavior Scale (PIBBS) measured mothers' intense activities to settle their infants (e.g., "rocking," "cuddle," "settle in the parents' bed") (Morrell & Cortina-Borja, 2002). The APC consists of 6 items, with responses rated on a 5-point scale

ranging from 0 (0 = "never") to 4 (4 = "very often"). Higher scores indicated more active comforting. Settling in the parents' bed has been significantly correlated with infants' sleeping problems (Morrell & Cortina-Borja, 2002). In the present study, Cronbach's alpha for the subscale was .75.

#### 2.3.4. Mothers' anxious attachment style

The Attachment Style Questionnaire (ASQ), developed by Feeney et al. (1994), measured mothers' styles of attachment. The ASQ scale consists of 40 items, with responses ranging from 1 to 6, where 1 = "totally disagree" and 6 = "totally agree." Thirteen ASQ items that delineated an anxious style of attachment were used for this analysis. The literature provides evidence for the internal consistency of the scale (Alexander et al., 2001 & Feeney, 2003). In a study of 76 couples' attachment, Feeney (2003) reported that the subscale had an alpha coefficient of .86, for both men and women. In the present study, the Cronbach's alpha for the subscale was .88.

#### 2.3.5. Other study variables

The exploration of maternal perceptions of length and duration of infants' nighttime awakenings occurred after controlling for family functioning and maternal happiness. The General Functioning (GF) 12-item subscale of the McMaster Family Assessment Device was used to assess family functioning (Epstein et al., 1983). The item response options include: "strongly agree," "agree," "disagree," and "strongly disagree;" six items describe healthy functioning and six items describe unhealthy (pathological) functioning. A higher total score indicates greater family pathology. The internal consistency of the GF has been satisfactory in community samples (Byles et al., 1988 & Georgiades et al., 2008). For the current study, the Cronbach's alpha was .91.

Maternal overall happiness was assessed using four items from Canada's Health Promotion Survey (Stephens & Graham, 1993): feelings of being "cheerful and light hearted," "loved and wanted," "downhearted and blue (reverse-scored)," and "lonely (reverse-scored)." The items are scaled from 1 (never) to 4 (always), with higher scores indicating more happiness. The composite scale of these four items has demonstrated acceptable internal consistency (Johnson et al., 2000). In the current study, the Cronbach's alpha was .75.

### 2.4. Analysis

All statistical analyses were conducted using SPSS for Windows 17 and p values (two-sided) of < 0.05 were considered statistically significant. Scaled variables had acceptable distributions; no multi-collinearity between variables was evident.

Pairs of variables with correlation coefficients < .20 were not considered for further analysis. Mann Whitney nonparametric statistics were used to explore the relationships between mothers' use of APC to settle their infants and their perceptions of infants' sleep problems. Hierarchical regression analysis was used to examine relationships between maternal factors, such as mothers' anxious style of attachment and use of active physical comforting strategies, and infants' nighttime awakening. Two separate models were estimated. In the first model, the premature infants' FNW was the outcome variable; infant birth order, family functioning, mothers' use of APC strategies, and maternal style of attachment was predictor variables. In the second regression model, DNW was the outcome variable; family functioning, and maternal history of sleep problems, happiness, use of APC and anxious style of attachment were predictor variables.

## 3. Results

Table 1 provides a summary of the characteristics of the study participants. The majority of infants (86.7%) had an appropriate birth weight for their gestational age, 62.9% were first-born, and

the mean age of infants was 5.5 months corrected. The majority of the mothers was Caucasian (82%), well-educated and married. About half of the mothers (55.2%) reported that their infants had sleep problems; 17.2% rated the problem as serious (Table 2). The means of the number and duration of nighttime awakenings were 2.1(times per night) and 45.7 (minutes per night), respectively. The number of nighttime awakenings ranged from 0-10 times/night and duration from 0-240 minutes/night. The wide range is due to four infants waking 6- 10 times per night, with 120-240 minutes of nighttime awakening per night. Further analysis of the subgroup of infants with severe nighttime awakenings was not possible due to limited numbers. The Mahalanobis distances analysis showed those data points did not influence the regression model (Huber, 1981).

**Table 1: Infant and Maternal Characteristics**

Demographic and Health Characteristics	
Infant Characteristics	Percentage (n) N=105
Gender	
Male	61.0 (64)
Type of Birth (%)	
Vaginal	41.0 (43)
Cesarean	49.5 (52)
Vacuum/Forceps	8.6 (9)
Gestational age (weeks) (%) <sup>a</sup>	
26.5 - 30.6	9.5 (10)
31.1 - 34.0	21.9 (23)
34.1 - 36.6	68.6 (72)
Multiples (%)	
Singleton	96.2 (101)
Twins	3.8 (4)
Birth Order (%)	
First born	62.9 (66)
Later born	37.1 (39)
Feeding Methods (%) <sup>b</sup>	
Exclusive breast feeding	19.0 (20)
Other	81.0 (84)
Health problems (%)	
None	60.0 (63)
Reflux	27.6 (29)
Allergy	4.8 (5)
Transient health problems <sup>c</sup>	7.6 (8)
Maternal Characteristics	Percentage (n)
Ethnicity/Race (%)	
White	81.9 (86)
Other	18.1 (19)
Marital Status (%)	
Married/Cohabiting	93.3 (98)
No Spouse	6.7 (7)
Education (%)	
Less than high school	1.0 (1)
High school	14.3 (15)
College	24.8 (26)
Bachelor's degree	40.0 (42)
Graduate degree	19.0 (20)
Household Income (CDN\$) (%)	
Under \$25,941	6.7 (7)
\$25,941 - \$44,196	13.3 (14)
\$44,197 - \$67,211	15.2 (16)
\$67,212 - \$98,000	16.2 (17)
Over \$98,000	40.0 (42)
Declined	8.6 (9)
Paid work (%)	
Engaged in paid work	36.2 (38)
Country of Residence (%)	
Canada	40.0 (42)
USA	43.8 (46)
Australia	4.8 (5)
UK	4.8 (5)
New Zealand	6.7 (7)
Maternal History of Sleep Problems (%)	
Sleep Problems	24.8 (26)
Previous experience with infant sleep problems (%)	
No	18.1 (19)
Yes	19.0 (20)
Not applicable (first born infant)	62.1 (66)
Age (mean (SD))	31.5 (5.4)

A One hundred and five mother- premature infant dyads were in the study; of this sample only two were extremely premature infants (less than 28 weeks of gestation).

B One missing case for feeding method

C Includes ear infection, flu, cough, or stomach upset.

Correlations among predictor variables were in the expected direction. The correlation between mothers' anxious style of attachment and their use of APC during bedtime interactions was very small ( $r = .09$ ). Infants' birth order was the only confounding variable that met the inclusion criteria for the first regression model with FNW as the criterion. Mothers' histories of sleep problems had a significant positive correlation with infants' duration of nighttime awakening. Mothers reporting a history of sleep problems were more likely to report infant sleep problems compared with mothers with no sleep problem history (73.1% versus 49.4%,  $\phi = .21$ ,  $p < .03$ ;  $\chi^2 = 3.54$ ,  $p < .05$ ). Although 19.0% of the infants were exclusively breastfed, our analysis showed no significant associations between exclusive breastfeeding and outcome variables.

The first research question focused on the relationship between mothers' use of APC and reports of infant sleep problems (sleep problem vs. no sleep problem). Mothers who reported infant sleep problems used more "active physical comforting" strategies (median = 62.5) compared with mothers who had infants with no reported sleep problems (median = 45.8).

The second research question focused on the association between mothers' anxious style of attachment and the FNW and DNW of premature infants.

In the first regression model, infant birth order, family functioning, APC, and mothers' anxious attachment style accounted for 14.4% of the variance in the FNW (Table 3). Two variables made a statistically significant contribution when other predictors were held constant: infant's birth order ( $\beta = -.25$ ) and the mother's use of active physical comforting ( $\beta = .24$ ). The first-born infants had fewer awakenings, on average. For every standard deviation increase in the mother's use of APC strategies, there was a 0.24 of a standard deviation increase in the FNW.

**Table 2: Infants' Sleep-Wake Patterns**

Variable	Range	Mean (SD)	Median	25 <sup>th</sup> Percentile	75 <sup>th</sup> Percentile
Number of nighttime awakenings	0-10	2.1 (1.6)	2.0	1.0	3.0
Duration of nighttime awakenings (minutes)	0-240	45.7 (50.8)	30.0	15.0	60.0
Sleep latency (minutes)	0-180	33.1 (31.0)	20.0		
Total daytime naps (hours)	1.5-8.0	3.5 (1.5)	3.0		
Total nighttime sleep (hours)	2-12	9.2 (1.9)	10.0		
Total sleep in 24 hours (hours)	5.0-18.5	12.7 (2.5)	13.0		
Consider sleep a problem (n (%)):		58 (55.2)			
Have a problem		48 (82.7)			
Small problem		10			
Serious problem		17.3			
No problem		47 (44.8)			

Note. N for all variables = 105 except for the infant sleep position variable = 103 (two missing values).

In the second regression model, family functioning, and mothers' happiness, history of sleep problems, anxious style of attachment, and use of APC strategies explained 24.2% of the total variance in the DNW (Table 4). Only maternal history of sleep problems ( $\beta = .29$ ) and anxious style of attachment ( $\beta = .24$ ) were significantly associated with DNW. For every standard deviation increase in maternal anxious style of attachment, infants' DNW increased by 0.24 of a standard deviation. Mothers with a history of sleep problems had infants with night waking lasting about one half hour longer, on average, compared with the infants of mothers without sleep problem histories.

**Table 3:** Frequency of Nighttime Awakening Regressed on Family Functioning, Birth Order, Mothers' Active Physical Comforting and Anxious Style of Attachment

Regression Results	Predictors	Coefficients B	Standardized Beta	SE	Adjusted R <sup>2</sup>	R <sup>2</sup> Change
Step 1	Birth Order	-0.75*	-.22*	.32	.08 P = .005	.10 P = .005
	Family Functioning(unhealthy)	0.52	.77	.29		
Step 2	Birth Order	-0.80*	-.24*	.31	.13 P = .001	.05 P = .012
	Family Functioning(unhealthy)	0.36	.12	.29		
	Active Physical Comforting	0.02	.24*	.01		
Step 3	Birth Order	-0.82*	-.25*	.31	.14 P = .001	.02 P = .094
	Family Functioning(unhealthy)	0.03	.01	.35		
	Active Physical Comforting	0.02*	.24*	.01		
	Anxious Style of Attachment	0.03	.19	.02		

Note. \*p < .05. Birth order coded as first born = 1 and second and later born = 0. N = 105

**Table 4:** Duration of Nighttime Awakening Regressed On Family Functioning, Mothers' Happiness, History of Sleep Problems, Use of Active Physical Comforting, And Anxious Style of Attachment

Regression Results	Predictors	Coefficients B	Standardized Beta	SE	Adjusted R <sup>2</sup>	R <sup>2</sup> Change
Step 1	Family Functioning(unhealthy)	20.47	0.22	10.29	.20 P < .001	.23 P < .001
	Mother's History of Sleep Problem	40.23**	0.34**	10.82		
	Mother's Happiness	-3.60	-.03	11.12		
Step 2	Family Functioning(unhealthy)	16.90	0.18	10.46	.21 P < .001	.02 P < .001
	Mother's History of Sleep Problem	35.99**	0.31**	11.06		
	Mother's Happiness	-7.03	-.07	11.25		
	Active Physical Comforting	0.33	0.15	0.21		
Step 3	Family Functioning(unhealthy)	9.33	0.10	10.88	.24 P < .001	.03 P < .001
	Mother's History of Sleep Problem	34.03**	0.29**	10.91		
	Mother's Happiness	-2.39	0.02	11.91		
	Active Physical Comforting	0.32	0.14	0.20		
	Anxious Style of Attachment	1.13*	0.24*	0.53		

Note. \*p < .05; \*\*p < .01. N = 105. Mother with sleep problem = 1; without = 0

## 4. Discussion

In our study, mothers using more APC strategies were more likely to report that their premature infants had sleep problems. This finding is consistent with other studies demonstrating associations between infants' sleep problems and mothers' intense settling strategies (Morrell & Steele, 2003; Sadeh et al., 2009; Touchette et al., 2005). The small proportion of variance in FNW, explained by mothers' use of APC strategies, may reflect mothers' inconsistent use of APC. The APC mean was 53.8 (possible range 0-100) which implies mothers' settling behaviors were inconsistent. The subscale items may have failed to capture all aspects of mothers' intense involvement at bedtime. Although we controlled for important variables, variables other than those we examined may contribute to premature infants' sleep problems.

In this sample, APC was not a predictor of the duration of infants' nighttime awakenings. Including mothers' histories of sleep problems in the model may have reduced the contribution of APC because mothers with sleep difficulties may have kept their infants awake for longer periods. Our result is the first examination of this variable within the context of maternal sleep quality and sleep problems in community-based preterm infants.

Maternal mood previously identified as problematic, was not significantly associated with maternal perceptions of premature in-

fants' sleep problems and nighttime awakening. The association between maternal depression and infant night waking is well documented in the literature (Armitage et al., 2009; Hiscock et al., 2008). Our measure may have been inadequate to capture maternal emotional health. Teti and Crosby (2012) reported that videotapes of mothers with depressed mood indicated maternal difficulties with setting sleep limits for infants; the mothers intervened even when their infants were not distressed. Future studies should measure maternal mental health using validated measures, such as the Center for Epidemiologic Studies-Depression Scale (Radloff, 1977), which has been used to measure maternal depressive symptoms when caring for premature infants (Shaha et al., 2013). Almost half of the mothers in our study practiced "co-sleeping" with their infants either in the same room or in the same bed; however, co-sleeping was not significantly associated with mothers' perceptions of the presence of a sleep problem. Ramos et al. (2007) reported that mothers who chose to "co-sleep" with their infants rated fewer poor infant sleep behaviors than mothers who "co-slept" with their infants in response to their poor sleep behaviors. We did not examine mothers' reasons for co-sleeping. It is possible that mothers of premature infants anticipated co-sleeping as more necessary to settle their infants.

Our findings support theoretically hypothesized associations between mothers' anxious style of attachment and premature infants' nighttime awakenings. In full term populations, infants' insecure attachment has been linked with maternal reports of infant sleep problems (Morrell & Steele, 2003; Scher, 2001). Benoit et al.'s

(1992) study of 41 full-term children with diagnosed sleep disorders found that 100% of mothers with infants in the sleep problem group were insecurely attached compared with 57% of the mothers in the group without sleep problems.

Mothers' anxious style of attachment explained only 3.3% of the variance in premature infants' duration of awakening. Our modest finding supports France and Blampied's (1999) theory that mothers' style of attachment is associated with the interaction between mothers and infants' night waking.

The lack of association between a mother's style of attachment and her use of APC settling strategies is not congruent with France and Blampied's (1999) theory that mothers' attachment styles are linked to intense involvement in settling their infants, hindering infants' development of sleep self-initiation skills. The APC subscale may have been inadequate to capture all dimensions of mothers' intense involvement in their infants' settling or the association between maternal use of APC and her style of attachment may have been attenuated by another variable, such as consistency in using comforting strategies. In a study linking infants' sleeping arrangements and mother-infant interaction, consistency in sleep arrangements was associated with more positive mother-infant interaction (Taylor et al., 2008).

We found that infants with pre-existing siblings had more awakenings in a night than first-born infants; however, there was no significant association between birth order and the mothers' report of the presence of infant sleep problems. Other studies have reported that mothers' caretaking interactions have varied in response to full-term infants' birth order (Dunn et al., 1986; Sigman et al., 1981). Mothers with more than one child may be more sensitive to infants' night behavior. The lack of a significant relationship between birth order and the length of night waking may indicate experienced mothers settle their infants more efficiently.

In our study, mothers with histories of sleep problems reported longer infant waking duration and were more likely to identify infant sleep problems. Earlier studies linked poor maternal sleep quality with infant sleep problems (Bayer et al., 2007; Loutzenhiser et al., 2011). We did not collect data on mothers' current sleep problems; however, historical problems may have persisted in this group.

Using a web-based approach increased the recruitment of community-based mothers from several countries; however, the convenience sample limited the generalizability of the study. Most mothers had relatively high socioeconomic status, self-identified as Caucasian and were well educated. Many mothers located the study through a website devoted to helping parents handle infant sleep problems, which may have introduced sampling bias. The cross-sectional study design prevents any claims about cause and effect. Reliance on a subjective sleep measure (maternal self-report) to determine presence of infants' sleep problems is a limitation.

The study findings have the potential to increase healthcare providers' awareness of active physical comforting strategies, mothers' sleep quality and mothers' attachment style when assessing and treating sleep problems in premature infants. Detailed assessments can help nurses and other healthcare practitioners identify infants at risk of developing sleep problems.

## 5. Conclusion

To our knowledge this is the first study to investigate the relationship between mothers' anxious attachment style and premature infant sleep problems. Mothers' anxious style of attachment was associated with longer duration of infants' nighttime awakenings. The study findings add information about the association between mothers' use of active physical comforting strategies and maternal identification of sleep problems in premature infants. Our findings shift the focus to maternal factors, such as sleep quality and style of attachment, when assessing premature infant sleep problems.

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