# Patterns of Developmental Change in Infants' Nighttime Sleep Awakenings From Six through 36 Months of Age

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The data used in this study were collected as part of the NICHD Study of Early Child Care and Youth Development (SECCYD). The NICHD-SECCYD was directed by a steering committee and supported by NICHD through a cooperative agreement (5U10HD025460-18; 5U10HD025447-18; 5U10HD025420-19; 5U10HD025456-18; 5U10HD025445-19; 5U01HD033343-14; 5U10HD025451-19; 5U10HD025430-18; 5U10HD025449-18; 5U10HD027040-18; and 5U10HD025455-18) that called for scientific collaboration between the grantees and NICHD staff. We thank the PI's and families of the NICHD-SECCYD. The content is solely the responsibility of the authors and does not necessarily reflect the views of the NICHD or the NICHD Early Child Care Research Network.

Key terms: Infant sleep awakenings, sleep problems, breastfeeding, temperament, maternal sensitivity

December 31, 2010

Abstract

Nighttime sleep awakenings, infant and family characteristics, and infant experiences were measured longitudinally in a diverse sample of more than 1,200 infants 6, 15, 24, and 36 months of age. Using growth mixture modeling, two developmental patterns were identified. One group, *SLEEPERS*, 66% of the children, showed a flat trajectory of sleep awakenings, with mothers reporting about one night of sleep awakening per week. The second group, *BECOMING SLEEPERS*, about 34% of the infants, had 7 nights of awakenings per week at 6 months, dropping down to 2 nights per week at 15 months, and down to 1 night per week by 24 months. Compared with Sleepers, Becoming Sleepers were more likely to be breastfed, to score higher on difficult temperament at the 6-month assessment, to come from a large family, to have a slightly more depressed mother, to have a mother with no spouse or partner, and to be in child care fewer hours per week at 9 months of age. These findings suggest that different *patterns* of sleep awakenings over the first three years can be identified. Using two group structural equation modeling, individual differences were examined at different points on the individual infants' sleep trajectories. Early in the first year, more sleep awakenings were associated with difficult temperament, breastfeeding, infant illness, maternal depression, and greater maternal sensitivity. At 21 months, sleep awakenings were no longer related to infant temperament. At 36 months, only child illnesses, maternal depression, and greater maternal sensitivity were associated with more sleep awakenings. Attachment measures at 15 months of age were not related to sleep awakenings. The findings, taken together, suggest that individual differences in sleep awakenings *early* in the first three years of life may be largely affected by infant temperament, breastfeeding, illnesses, and parent responsiveness; sleep awakenings *later* in infancy may be related to illnesses and parent responsiveness.

December 31, 2010

**Patterns of Developmental Change in Infant's Nighttime Sleep Awakenings**

**From Six through Thirty-Six Months of Age**

Nighttime sleep awakenings are normative during infancy. Healthy babies cycle through sleep stages, waking several times during the night. Generally, babies soothe themselves and return to sleep (Goodlin-Jones, Burnham, Gaylor, & Anders, 2001). When babies are not able to return to sleep on their own, their waking is disruptive to parents and may be reported to pediatricians as a sleep problem. A significant minority of children have problems with awakenings during the night at some time in the first four years of life, with estimates ranging from 15% to 46% (Gaylor, Goodlin-Jones, & Anders 2001; Hiscock & Wake, 2001; Kataria, Swanson, & Trevathan, 1987; Pollock, 1992; Sadeh & Anders, 1993). Indeed, the most commonly diagnosed disorders in pediatric practices are those relating to initiating and maintaining sleep (Anders, Halpern, & Hua, 1992; Anders & Eiben, 1997; Dollinger, 1982). For pediatricians and developmental psychologists, sleep disturbances and their trajectories are of interest because sleep problems can be disruptive to the emotional life and schedules of parents and siblings. Research suggests that difficulties with sleep awakenings may foreshadow later problems with physiological, emotional, and behavioral self-regulation (Dahl, 1996; Dearing, Taylor, & McCartney, 2004; Gregory, Caspi, Eley, Moffitt, O'Connor, & Poulton, 2005; Lozoff, Wolf, & Davis, 1984; Richman, 1981; Frank, Issa, & Stryker, 2001; Thunstrom, 2002).

Previous studies have reported that the percentage of infants with excessive sleep awakenings declines over the first few years of life (Goodlin-Jones, et al., 2001; Lozoff, et al., 1985; Richman, 1981; Scher, 1991; Scher, Zukerman, & Epstein 2005; Thome & Skuladottir, 2005; Touchette, et al., 2005; Zuckerman, Stevenson, & Bailey, 1987). However, not all infants show this characteristic decline. For example, Scher (1991) reported that regular night waking was not uncommon throughout the first year, with some infants showing increased sleep awakenings around nine months. In an internet questionnaire study, Sadeh (2004) found non-linear age-related trends in parent reports of night waking, with as many as 30% of infants and toddlers continuing to have multiple or prolonged night awakenings. Research has also pointed to groups of children for whom sleep problems continue through early childhood or for whom problems recur even after intervention (Thome & Skuladottir, 2005; Lam, Hiscock, & Wake, 2003; Wolke, Meyer, Ohrt, & Riegel, 1995).

Most of the research on predictors of sleep has examined individual differences in infant sleep at particular ages, rather than individual differences in patterns of sleep over time. Although it is generally assumed that sleep awakenings tend to decrease over the first three years of life, focusing on measures of central tendency at any given age may give only a “partial picture” of infant/toddler sleep. Burnham & Gaylor (2008) suggest that variability in sleep patterns across time needs to be acknowledged and understood in order to fully assess and diagnose sleep disorders. To do this, longitudinal data from large, normative samples are needed.

Several heuristic models have been offered for understanding individual and developmental differences in sleep awakenings. Using a systems perspective, Sadeh and Anders (1993) proposed a transactional model of sleep-wake regulation that acknowledges the role of the distal extrinsic context, including cultural norms, family socioeconomic factors, and experiences in the caretaking environment. Their model also takes into account the role of the proximal extrinsic context (parental emotional characteristics), intrinsic infant characteristics (health, temperament, and developmental factors), and the parent-child relationship and interactions. Similarly, Beebe (2008) proposes a heuristic model that assumes both bidirectional and mediational relations among intrinsic and extrinsic child factors. In both models, the child's physical characteristics, parental behaviors and characteristics, and the child's relationships with others are assumed to affect sleep awakenings.

Although the contemporary literature implicates both biological and environmental factors in sleep awakenings, the underlying causes of infant sleep awakenings are not well understood. The capacity and propensity for self-soothing in particular, and self-regulation more generally, appear central. The mechanisms promoting and/or interfering with these processes in regards to sleep remain largely undetermined. Most children awaken several times during the night and return to sleep on their own. Early on, some infants may be more likely to awaken than others. When parents respond to infant normative sleep awakenings, they may interfere with the infant's developing ability to self-soothe and return to sleep independently (Goodlin-Jones et al., 2001; Touchette et al., 2005; Warren, Howe, Simmens, & Dahl, 2006). At the same time, pre-existing infant problems with self-soothing (Burnham, Goodlin-Jones, & Gaylor, 2002) and possibly self-regulation in general (Dahl, 1996) may elicit more solicitous parenting behavior. Unfortunately, these efforts to provide assistance may contribute to continuing sleep and bedtime issues. A negative circular pattern can arise when well-intended or exhausted parents attempt to intervene on behalf of infants who struggle to soothe themselves back to sleep. Infant difficulties in self-soothing may elicit parental responsiveness to awakenings, which in turn delays infants' abilities to self soothe and return to sleep. Mothers who are more sensitive may have children with more awakenings because they respond more quickly to their children's awakenings, and their children fail to learn self-soothing.

In particular, babies who are breastfed may find it difficult to soothe themselves and return to sleep because they have become accustomed to falling asleep while nursing. Very early in infancy, breastfed babies may awaken more frequently throughout the night because they do not get as many calories per feeding; later in infancy, they awaken more frequently, not because they do not get enough calories, but because they have difficulty returning to sleep without the customary nursing.

As capacity for self-regulation in the second and third years of life increases, most children resolve their early difficulties with sleep awakening (Bronson, 2000). However, the normal capacity for self-soothing may be challenged in infants with temperamental difficulties, unusual health problems such as normative or excessive ear or respiratory infections, marked instabilities in the family situation, irregular sleep routines, household chaos, maternal depression or parental behavior marked by either harshness and inconsistency or over-solicitous responsiveness. For these infants, regulation around sleep may not develop, and this lack of physical self-regulation may have implications for subsequent health as well as emotional, social, and cognitive development.

In this report, we examine whether different prototypic patterns of sleep awakening can be identified over the course of infancy, and whether specific child, family, and environmental factors are associated with these prototypic sleep patterns. We also examine individual differences in sleep awakenings at specific points across infancy, trying to understand not only patterns of sleep but also individual differences that may illuminate developmental changes in processes related to infant sleep regulation. The identification of patterns of sleep behavior over time may help inform pediatric practice, provide useful guidance to parents, and provide insight into the origins of sleep/wake regulation.

*Child variables related to night awakenings*

Gender. Gender does not appear to play a consistent role in sleep problems (e.g. Burnham, Gaylor, Williamson & Wei, 2009; Germo, Goldberg & Keller; Iglowstein, Jenni, Molinari, & Largo, 2003; Touchette, et al, 2005). The gender differences that have been reported may be culture specific. In Israel, girls were reported to have more problems than boys (Scher, Tirosh, Jaffe, Rubin, Sadeh, & Lavie, 1995); in the U.S., boys have been reported to have more problems than girls (Goodlin-Jones et al., 2001). Even though research does not show a clear role for gender in early sleep problems, it seems premature not to examine sex differences in infancy as a possible entry into maladaptive sleep patterns.

Breastfeeding. A number of studies have associated problems with sleep awakenings to factors related to breastfeeding – being nursed to sleep, parental presence until sleep onset, or being fed on awakening (Touchette et al., 2005; Lam et al., 2003). Elias, Nicholson, Bora & Johnston (1986), following babies for two years, reported that sleep awakenings were common in breastfed infants throughout the first two years of life.

Temperament. Sleep problems appear related to difficult temperament (Jimmerson, 1991; Morrell & Steele, 2003; Scher et al., 2005; Touchette et al., 2005). According to Sadeh & Anders (1993), infants who are irritable, hypersensitive, and have lower sensory thresholds may sleep for shorter periods and nap irregularly. Longitudinal studies have shown positive associations between behaviorally assessed temperament and subsequent sleep problems (Keefe, Kotzer, Froese-Gretz, & Curtin; Snow, Jacklin & Maccoby, 1980) but not between maternal perception of temperament and later sleep problems (Halpern, Anders, Garcia-Coll, & Hua, 1994). Morrell and Steele (2003) suggest that difficult infants may elicit more active parent comforting which may perpetuate night awakenings.

Attachment. Sadeh & Anders (1993) suggested that examining the association between the parent-child attachment system and sleep disturbances might be especially fruitful. Because going to bed can be a time of "heightened anxiety and uncertainty" (p. 28), children with a secure attachment to a parent might be less likely to have sleep problems. Evidence that attachment might be related to sleep disruptions has been accumulating. McNamara, Belsky, & Fearon (2003) found that 15 month-old infants with ambivalent attachments were reported to have more awakenings than infants with avoidant attachments and later showed more clinical sleep problems than infants with an avoidant attachment profile. Morrell and Steele (2003) found that ambivalent attachment was associated with sleep problems at 12 months and predicted persistent problems at two years. However, Morrell and Steele emphasize that this association is still in question for two reasons. First, the association observed in their study was quite small. Second, the researchers noted that the majority of infants with persistent sleep problems did not show ambivalent attachment. Thus, it is not entirely surprising that in their analysis of data from more than 10,000 infants in the Early Childhood Longitudinal Study - Birth Cohort (ECLS-B), Burnham, Gaylor, Williamson, & Wei (2009), found that infants with frequent night-waking at nine months were more likely to be rated as *securely* attached at two years of age than infants not rated as secure. The relations between sleep awakenings and attachment require further investigation.

*Maternal and environmental variables related to night awakenings*

Maternal sensitivity. Although parental sensitivity is generally related to all things optimal in infants (e.g. Davis & Logsdon, in press), it is not clear that maternal sensitivity (as typically measured) reduces sleep problems. Indeed, there is reason to suspect that parental sensitivity to infant awakenings may be related to more sleep awakenings and later sleep problems (Keller, Buckhalt, & El-Sheikh (2008). Specifically, rather than allow infants to self-soothe and return to sleep on their own, parents who respond to awakenings with attempts to comfort or feed may interfere with their infant's growing ability to self soothe and return to sleep independently. Findings support this notion. According to Touchette et al (2005), feeding after an awakening was the factor most strongly associated with infants not sleeping through the night at 5 months, and parental presence until sleep onset was the factor most strongly associated with sleep awakening at 17 and 29 months of age. At later ages, issues related to parental limit setting may be more predictive of sleep awakenings and persistent sleep problems than parental sensitivity (Touchette, et al, 2005). The success of interventions aimed at limiting parental responsiveness to infant calls for attention around bedtime and awakenings (e.g. Ferber, 1985) suggest that parental efforts to comfort and placate young children who struggle with going to sleep may contribute to sleep difficulties through the second year of infancy.

A recent study supports the importance of mothers' emotionally sensitive attempts at limit setting behavior during bedtime. Teti, Kim, Mayer, & Countermine (2010) showed that mothers' *emotional availability* at bedtime positively predicted infants' sleep quality. Emotionally available mothers were those "who prepared their infants for bed using positive, quiet, soothing bedtime routines that gently guided infant toward sleep". Although highly sensitive, these mothers were careful not to initiate new interactions and avoided high-volume, intrusive talk. In their rating scheme for sensitive mothers, Teti, et al allowed the highly sensitive mother category to include those mothers who did *not* respond to their infant's calls after being put down to sleep or who delayed as much as one minute before responding to distress cries, since the goal of the bedtime interaction was to gently guide the child to sleep.

Maternal depression. Maternal depression has also been associated with infant sleep problems (Hiscock & Wake, 2001; Lam et al., 2003; Lozoff, et al., 1985; Richman, 1981, Zuckerman, et al., 1987). To untangle the nature of the relation between infant sleep and maternal depression, Warren, Howe, Simmens, and Dahl (2006) examined the relation between maternal depressive symptoms and duration and frequency of infant sleep awakenings using longitudinal data from the National Institute of Child Health and Human Development Study of Early Child Care and Youth Development (NICHD SECCYD). They found that child awakenings did not predict maternal depressive symptoms, but higher maternal depressive symptoms predicted increased duration, but not frequency, of child awakenings across the 15 to 24 and 24 to 36 month periods.

*Environmental variables related to night awakenings*

Father's presence. No studies have focused on the father's direct role in sleep problems, but fathers' presence may affect the mother's responsiveness and emotions about sleep awakenings. Sadeh, et al (2007) reported that fathers were more likely than mothers to endorse imposing bedtime limits on infants. To the extent that a partner in the home objects to interruptions caused by awakenings and encourages the mother's limit setting, infants in two parent households may be less likely to experience multiple sleep awakenings.

Childcare. There is only limited evidence that sleep problems are related to childcare attendance (Jimmerson, 1991) and birth order (Scher et al., 1995). Childcare may affect children in a number of ways. It could increase children's tolerance for environmental interruptions during sleep. Alternatively, childcare may increase sleep disturbance by making children more vigilant and stressed at bedtime.

In this study, we examined some of the child, parent, and environmental factors that have been implicated in the developmental course of sleep awakenings, focusing on those factors that may place children at risk for later sleep problems. We considered child characteristics (e.g., health problems, difficult temperament, and attachment to the mother), maternal characteristics (e.g., depression, health problems), and maternal caregiving experiences (e.g., breastfeeding, sensitivity). Finally, we considered variables relating to family environmental risk factors such as family poverty, presence of a spouse or partner in the household, and nonmaternal childcare.

With a large and diverse sample of families from ten different locations across the U.S., the NICHD SECCYD longitudinal data set is ideal to examine changes from six to 36 months in infant sleep awakenings and their relations to family experiences. Using these data, two other sets of researchers have provided some interesting findings regarding correlates of sleep awakenings at particular ages. Warren, et al (2006) examined the relations between maternal depressive symptoms and duration and frequency of infant sleep awakenings over the first three years of infancy, and McNamara, et al (2003) compared anxious and avoidant attached infants' sleep at 15 and 24 month of age. In this report, we modeled individual differences in infant sleep trajectories over the entire first three years of infancy, and we examined the factors that may account for individual differences in these patterns that may be related, not only to maternal depression and infant attachment, but also to other variables concerning family health and family risk.

We had three aims. The first was to estimate the developmental trajectories of children's sleep awakenings. Cross-sectional studies and the theoretical literature suggested that a small number of developmental patterns characterize the large majority of infants between 6 and 36 months of age. Because sleep is critical for good health and normal development, it seemed likely that the largest group of children would show very low levels of sleep problems throughout this period. At the same time, because there are numerous conditions that could disrupt sleep, we expected to identify a second group of infants who would show early sleep difficulties but whose sleep problems would abate with time and with the increasing capacity for self-regulation. We also considered the possibility that there could be a third and relatively small group of infants for whom sleep awakenings would continue and possibly increase over time. These babies, we hypothesized, might have constitutional problems with self-soothing that are aggravated by environmental conditions or health problems.

The second aim was to identify important variables associated with the developmental trajectories by examining relations of the trajectories with temperament, breastfeeding experiences, attachment security, health problems during infancy, and familial and environmental risk factors. Previous research suggested that early in infancy, infants with difficult temperament and infants who were breastfed might have more awakenings than other infants. Later in infancy, separation distress, insecure attachment, and infant respiratory, ear, and intestinal illnesses might account for variation in sleep awakenings in children. Children with the most sleep awakenings, we hypothesized, would reside with a mother with high levels of depressive symptoms, as Warren et al. (2006) had reported. It also seemed that children with high levels of sleep awakening might have a mother with who is highly responsive to their distress. In addition, we examined possible associations between infant sleep awakenings and child gender, birth weight, and the quantity of nonmaternal childcare children experienced.

A third aim was to examine individual differences in sleep awakenings at specific points across infancy. Examining individual differences in addition to patterns may help illuminate developmental changes in processes related to infant sleep regulation.

# Method

*Sample*

Participants for the study were recruited in 1991 from hospitals at 10 data collection sites: Little Rock, AR; Irvine, CA; Lawrence, KS; Boston, MA; Philadelphia and Pittsburgh, PA; Charlottesville, VA; Seattle, WA; Hickory and Morganton, NC; and Madison, WI. 1,364 families with healthy newborns were enrolled. Recruitment and selection procedures are described in detail in several publications (NICHD Early Child Care Research Network [ECCRN], 1994; 1996.) Of the initial pool of eligible mothers contacted for participation, 1,364 completed the one-month home visit and became study participants. These 1,364 families were very similar to the eligible hospital sample on major demographic characteristics (years of maternal education, ethnicity, and presence of partner in home). The resulting sample was diverse, including 24% ethnic minority children, 11% mothers who had not completed high school, and 14% single-parent mothers (percentages not mutually exclusive). Mothers had an average of 14.4 years of education ($SD$ = 2.49 years), and 51.7% of the children were boys. Eligibility requirements specified that mothers be 18 years or older, speak English, plan to be in the geographic area for the next three years, and not have known or acknowledged substance abuse, and that infants not be hospitalized at birth for more than seven days and not have any obvious disabilities. This had the effect of screening out very low birth weight, severely premature or sick infants from the study. The sample was not designed to be nationally representative. However, the sample was similar to families in the census tract records and the nation as a whole on key demographic variables (household income and ethnicity).

Data from each subject were considered complete if data from at least two assessment points was available. With this criterion, complete sleep data were available from more than 88%

of the initial sample: 1,276 mothers and their infants at 6 months, 1,243 at 15 months, 1,206 at 24 months, and 1,215 at 36 months. The sample was approximately half male at each age. Compared with children for whom we had insufficient sleep data for analyses, children with sleep data at two or more of the assessment points appeared to be less likely to be from a minority ethnic group (analysis sample: 23%; excluded sample: 35%, $p = .44$), and have more educated mothers (14.29 vs. 13.15 years of education, $p = .34$), but these differences were not significant.

Mothers included in these analyses had an average of 14.3 years of education (*SD* = 2.49 years), and 13.3% were single parents. Although average family income was 3.66 times the poverty threshold (*SD* = 3.10), 31% of the infants were from low income families (Federal income-to-needs level 2 or below), and no more than 81% of the children were non-Hispanic white.

*Procedure*

Mothers and children were visited at home when the children were 1, 6, 15, 24, and 36 months old. Telephone contacts were made at intervening three-month intervals. At each face-to-face visit, mothers completed questionnaires about themselves, the child, and their family, and responded to a standardized demographic interview. Children and their mothers came to the university laboratories when children were 15, 24, and 36 months old. At these visits, standardized assessments were administered to the children, and mothers and children were observed playing together. When the infants were 15 months of age, they were videotaped in the Strange Situation.

*Measures*

*Nighttime sleep awakenings*. During a standardized interview, mothers were asked five questions about their child's nighttime sleep in the previous week. These questions, listed in Table 1, were selected to mirror the most common measures of infant problems in use at the time data collection for the NICHD SECCYD began (Richman, 1981; Lozoff et al., 1985; Zuckerman et al., 1987). The number of nights with sleep awakenings after sleep onset (NIGHTS SA) in the preceding week was used as the main sleep measure when the infants were 6, 15, 24 and 36 months old. This measure is comparable to the measures of fragmented sleep that have been collected in more recent longitudinal studies of sleep (e.g. Touchette et al., 2005). The distribution of infants with sleep awakenings for one through seven nights at each age are presented in Table 2.

*Standardized report of sleep problems.* When the children were 24 and 36 months of age, mothers completed the Child Behavior Checklist (CBCL 2-3; Achenbach, 1992), a widely used screening checklist with demonstrated test-retest validity as well as concurrent and predictive validity. The CBCL asked mothers to answer "Not True," "Somewhat or Sometimes True," or "Very True or Often True" for each of 100 behavioral items. Included among these 100 items were the following eight items concerning the child's sleep: 1. Doesn't want to sleep alone, 2. Has trouble getting to sleep, 3. Has nightmares, 4. Resists going to bed at night, 5. Is overtired, 6. Sleeps less than most children during day and/or night, 7. Talks or cries out in sleep, and, 8. Wakes up often at night. Because the CBCL was available only when the infants were 2 and 3 years of age, it was used to provide validity to the NIGHTS SA scores collected at those points.

*Child gender and birth weight.* Child gender, birth order, and birth weight were obtained from interviews with the mother when the infant was one month old.

*Difficult temperament.* A measure of difficult infant temperament was based on 39 6-point items selected from the 55 items on the Infant Temperament Questionnaire (Medoff-Cooper, Carey, & McDevitt, 1993) completed by mothers at the 6-month home visit. A composite score representing difficult temperament was formed from the mean of items from the Approach, Activity, Intensity, Mood, and Adaptability subscales (with appropriate items reflected). Higher scores represented more difficult temperament (e.g., "My baby is fussy or cries during the physical examination by the doctor."). Cronbach's alpha for the items administered to this sample was .81.

*Breastfeeding.* Mothers reported whether or not their infant was breastfeeding at the six and 15-month assessment periods.

*Attachment*. The Strange Situation was administered when the infants were 15 months old according to standard procedures (Ainsworth, Blehar, Waters, & Wall, 1978) by research assistants who had been trained and certified according to *a priori* criteria to assure that the assessments were very high quality. Videotapes of the Strange Situation episodes from all sites were shipped to a central location and rated by a team of experienced, certified coders. Three measures related to the child's attachment to the mother were used for this study. The first is secure/insecure attachment. Infants were judged as securely attached if they sought comfort from their mothers when they were distressed or greeted their mothers without ambivalence when they were reunited. The second was type of secure attachment coded—secure, avoidant, ambivalent-resistant, and disorganized (Main & Solomon, 1990). The third measure was the extent of the child's distress during Episode 6 of the Strange Situation when the child was left alone in the strange situation room. Details of the coding and characteristics of infant attachment security in the sample are described in NICHD ECCRN (1997, 2006).

*Child illnesses*. When the infants were 6, 15, 24, and 36 months old, mothers reported whether or not in the preceding three months their child had any of the following health problems: respiratory illnesses, ear infections, and intestinal illnesses. Scores were summed over illnesses and could range from 0 (no illnesses) to 3 at each time period.

*Maternal depression*. When the infants were 6, 15, 24, and 36 months of age, mothers completed the Center for Epidemiological Studies Depression Scale (CES-D, Radloff, 1977). Cronbach's alphas for the CES-D across the five data collection points ranged from .88 to .91. The depression scores were moderately stable over time (r's = .46 to .58).

*Maternal sensitivity*. Mother-child interaction was videotaped in semi-structured 15-minute observations at each age. The observation task at six months had two components. In the first seven minutes, mothers were asked to play with her child using any toy or object available in the home or none at all; for the remaining eight minutes, mothers were given a standard set of toys they could use in play with their infants. When the infants were 15, 24, and 36 months, the observation procedures followed a three boxes procedure in which mothers showed their children age-appropriate toys in three containers in a set order. The mother was instructed to have her child play with the toys in each of the three containers and to do so in the order specified. Independent coders rated maternal-child interactions from video tapes. Details of the procedure, coding, and reliability are described in NICHD ECCRN (1999, 2001, and 2006).

At each age, a maternal sensitivity composite was constructed based on three of the ratings. At 6, 15 and 24 months it comprised the sum of three 4-point ratings, sensitivity to nondistress, positive regard, and intrusiveness (reversed). At 36 months, three 7-point ratings were composited: supportive presence, respect for autonomy, and hostility (reversed). Inter-coder reliability on the composite was .87 at 6 months, .83 at 15 months, .85 at 24 months, and

.84 at 36 months. Internal consistency was .75, .70, .79, and .78, respectively. The composite scores were moderately stable across time (r's ranged from .39 to .48). Composites across age periods (6 to 36 months and 24 to 36 months) were computed by standardizing the scores at each age, and averaging them across time.

*Maternal health.* When the infants were 6, 15, 24, and 36 months of age, mothers were asked to describe their health compared to other women their age on a 4-point Likert scale ranging from poor (1) to excellent (4).

*Second parent in the home.* When the infants were 6, 15, 24, and 36 months of age, mothers reported whether or not there was a second parent or maternal partner in the home.

*Poverty.* Using the mothers' reported family income when the infant was 6, 15, 24, and 36 months of age, an income-to-need ratio was computed between the parents' family income and the U.S. census poverty levels at the time of the measurement. Families with income ratios below 2 were considered poor or near poor.

*Childcare.* The quantity of care was examined at each assessment point. To measure *quantity* of nonmaternal childcare, the mother reported the number of hours per week that her child was cared for on a regular basis by someone other than herself when the infant was aged 5, 9, 21, and 33 months. Detailed information on this childcare measure can be obtained from NICHD ECCRN (1997, 2002).

*Data Analyses*

To examine whether nighttime sleep awakenings (NIGHTS SA) was a good indicator of sleep problems in infancy, the relations among NIGHTS SA scores, maternal report of infant sleep problems, and CBCL sleep scores at each assessment time were examined with Pearson Product Moment Correlation coefficients. To identify developmental trajectories of sleep problems, we applied growth mixture modeling using an unconditional growth model across the study period. Mixture model estimation methods can sometimes lead to local maxima instead of to the global maximum. Multiple random start values were used in this analysis to assure a global maximum was reached. The mixture groups uncovered by this analysis were validated by examining group differences across a wide variety of covariates with a series of t-tests. In addition, to identify variables (child, mother, and family characteristics) that are associated with individual differences in NIGHTS SA over time and at each age, we used multiple group structural equation modeling.

All data manipulation and descriptive statistics were conducted using SAS® version 9 (SAS Institute Inc., 2010). The growth model and structural equation models fit in this analysis were estimated using MPlus version 6 (Muthén and Muthén, 1998-2010) using maximum likelihood methods for missing data (Allison, 1987; Muthén et al., 1987; Little & Rubin, 1987). This method yields unbiased estimates assuming any missing dependent variable data is either missing completely at random (MCAR) or simply at random (MAR). Missing exogenous covariate data leads to list-wise deletion. However, by including the covariate estimation in the model, this ML missing data approach that keeps all the data in the modeling regardless of some missing dependent variable data, can be extended to the covariates as well. We used this approach for four covariates (separation distress, breastfeeding, difficult temperament, and maternal sensitivity at 6 months) that had higher rates of missing data and which otherwise would have resulted in the exclusion of more cases from the analysis.

## Results

### *Descriptive Data*

Table 3 presents the means and standard deviations for each sleep measure and the intercorrelations among each measure.

NIGHTS SA scores were correlated over age, with Pearson Product Moment correlations ranging from .15 (6 month and 36 month scores) to .34 (24 and 36 month scores). NIGHTS SA scores were significantly correlated with maternal ratings of how much of a problem the child's sleep was for the mother and the family within all ages ($r$ = .28 NIGHTS SA at 6 months, $r$ = .29 NIGHTS SA at 15 months, and .37 at both 24 and 36 months). CBCL sleep scores at 24 and 36 months were correlated with each other ($r$ = .58), and correlated with corresponding NIGHTS SA scores ($r$ = .47 at 24 months and $r$ = .34 at 36 months). These results indicate that the NIGHTS SA measure is associated with maternal perceptions of sleep waking as a problem for her or the family and with maternal reports of sleep problems on the standardized child behavior checklist, lending validity to our use of NIGHTS SA scores as a measure of sleep problems. Subsequent analyses are performed only on the NIGHTS SA scores.

*Modeling Developmental Change*

The model to determine the developmental trajectory of our sleep awakening variable across the period of 6 to 36 months of age featured a simple polynomial growth model across four time points for which we had sleep awakening data: 6, 15, 24, and 36 months of age. We included a random intercept and linear slope with a fixed quadratic term. The latter term was held fixed to identify the model and make it estimable. The mixture component of the growth mixture model allowed us to estimate a given number of latent classes, each with their own mean latent growth models with individual random variation around them.

The growth mixture model does not automatically return a single solution, but estimates the number of components of the mixture dictated by the analyst. Solutions with increasing numbers of latent classes are obtained and evaluated relative to each other using multiple criteria that help in the determination of how best to represent the data. The suggested method for determining the number of latent classes in the mixture model (Nyland, Asparouhov, & Muthén, 2007) is one of finding the convergence of several sources of evaluation including BIC statistics, likelihood ratio tests, solution quality, and substantive interpretability. Table 4 provides several of these pieces of information for the one, two, and three class solutions, where it becomes clear that the majority of these items identify the two class solution of the growth mixture model. This solution had the lowest BIC statistic and is indicated by the Lo, Mendell & Rubin ( 2001) and bootstrap-nested likelihood ratio test (McLachlan and Peel, 2000) results for the three class solution both of which found that the addition of a third class did not result in an appreciably better model of the data.

The quality of the two class solution, indicated by two quality indicators is not high. The entropy is a very low .383, and the posterior probabilities are .73 for the smaller class and .85 for the larger class. However, the three class solution with better entropy does not improve on the posterior probabilities and is substantively uninterpretable. Moreover, the third solution adds a class characterizing less than 1% of the sample in it. On balance, the two class solution seems to be the better choice. Table 5 contains some descriptive information by the two class solution, and Figure 1 presents the mean trajectories for the two groups.[1]

Infants in Class 1 (Sleepers), comprising 67% of the sample, had a flat trajectory of awakenings, with approximately one awakening per week from 6 through 36 months. We use the label *Sleepers* because this group has relatively few nights of awakenings. For infants in Class 2

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[1] When the sample is constrained to two classes, the 1% variation attributed to the third class is incorporated into the other two classes.

(*Becoming Sleepers*), awakenings at 6 months are high-- seven nights of the week-- and then decline to only one awakening per week by 18 months of age. This group comprised the remaining 33% of the sample. We use the label *Becoming Sleepers* because at 18 months of age, they became indistinguishable from Class 1, the *Sleepers*.

*Factors Differentiating the Two Trajectory Groups*

To examine factors related to the trajectory groups and establish the validity of the two groups, we tested group differences between the Sleepers and Becoming Sleepers mixture groups with regard to infant gender, birth weight, parity, difficult temperament, breastfeeding, separation distress, attachment security, attachment style, child health, maternal depression, maternal sensitivity, maternal and partner health, partner presence in the home, poverty, child care hours, , minority status, family size, maternal education, and childcare hours. On average, compared to the Sleepers, the Becoming Sleepers are more likely male ($F= 9.20$, $p \leq .00$), to be breastfed at 6 ($F= 33.01$, $p \leq .00$) and breastfed at 15 months ($F= 19.21$, $p \leq .00$), to have higher scores on difficult temperament at the 6 month assessment ($F= 6.47$, $p \leq .01$), to come from a large family ($F= 7.20$, $p \leq .01$), to have a mother with a higher depression score ($F= 7.83$, $p \leq .01$), to have a mother with no spouse or partner at 6 months ($F=4.86, p<.03$), 24 months ($F=9.79, p<.00$), and 36 months ($F=5.88, p<.02$), and to be in child care fewer hours per week at 9 months of age ($F=5.13$, $p<.03$). As Figure 1 shows, the sleep awakening trajectories for the two groups differ primarily in the first year and a half of infancy, coming to nearly identical trajectories in the third year of life, so it is not surprising that most of the variables on which the two mixture classes differ represent characteristics of or circumstances occurring early in life.

*Identifying Associates of Individual Differences in Sleep Awakenings over Time*

Having established group-level differences, we also sought to examine the relationship between the covariates and children's individual sleep trajectories. We tested a two-group structural equation model that maintained the distinction between Sleepers and Becoming Sleepers; this allowed us to formally test whether the covariates of interest operated differently within these two groups. We tested the effects of both time invariant (i.e., child sex, poverty, difficult temperament, breastfeeding, and attachment or separation distress) and time varying (i.e., child illness, maternal depression, maternal sensitivity, maternal health, hours in nonmaternal care, and presence of a partner in the home) covariates on children's sleep awakening intercepts and linear slopes. We initially estimated separate growth models for each time varying covariate and output individuals' estimated intercepts and linear slopes for these variables. These estimates were then used as covariates to predict the sleep awakening growth parameters; initial findings were null for the prediction of sleep awakening intercepts and linear slopes from covariate slopes, so these paths were removed from the final model. Finally, since the sleep awakenings growth models contained a (fixed) quadratic term, the effects of the covariates on the intercept and linear slope could vary depending on how time was coded in the model. We chose to specifically examine the effects of the covariates with the intercept set at 6-months (the beginning of our window), 21-months (the center of our window), and 36-months (the end of our window). Furthermore, when time was coded with the intercept set at 36-months, the associations between the covariates and sleep awakening linear slopes were uninterpretable (and are not reported) because the linear slopes were approaching a lower asymptote.

The results for the SEM models with the sleep awakenings intercepts set at 6-months, 21-months, and 36-months are found in Table 6. We used a nested likelihood test to determine whether we could impose equality constraints on the regression relationships from the covariates to the sleep awakening growth model parameters for our two groups (Sleepers and Becoming Sleepers). The constrained model fit the data adequately for all three intercept models (6 mo. $p=.16$, 21 mo. $p=.95$, 36 mo. $p=.92$), indicating that the covariate effects were the same in the two groups. The top of Table 6 provides the constrained multiple regression estimates for the two groups; the bottom provides the unconstrained estimated growth model means, variances and covariances.

These results show that 6-month breastfeeding and difficult temperament were associated with more sleep awakenings through the middle of the study period (i.e., 21-months); at the beginning of the study period (i.e., 6-months), children who were breastfed or had a difficult temperament also had sleep awakening linear slopes that were decreasing faster. Throughout the study period, children who experienced more illness, or had mothers with more depression or sensitivity also experienced greater sleep awakenings; at 6-months, these effects were also associated with sleep awakenings that were decreasing faster. Maternal health and childcare hours had isolated instances of association. R2 values for the two growth parameter outcomes show that the models predict 5-8% of the variance in random intercepts of Sleepers and 4-5% of Becoming Sleepers across the three time points tested. The models do slightly less well accounting for variance among the random slopes, accounting for 2-5% of Sleepers' variance in slopes, and 3-5% of the Becoming Sleepers' slope variances. Effect sizes were calculated for the covariates using a t-statistic to Cohen's d transformation. Significant effects on the random intercepts were generally in the .2 to .4 range. The effects of covariates measured earlier (i.e., difficult temperament and breastfeeding both at 6 month) tended to decrease over time.

## Discussion

In this report, we identified two distinct patterns of sleep awakenings over the first three years of life for children who participated in the NICHD SECCYD. The majority of these generally healthy children, those we identified as Sleepers, showed little evidence of elevated sleep awakenings at any point from six months through age three years. About one third of the children, those we called Becoming Sleepers, showed early difficulties with sleep awakenings. However, by 36 months of age, most of the Becoming Sleeper children had about the same low levels of awakenings as did children in the Sleeper group.

The two groups of children identified in this study appear to represent meaningful and distinct longitudinal patterns with regard to the developmental course of sleep. Not only were the patterns of sleep awakenings empirically distinctive, but membership in the groups was predictable from child and family characteristics. Children in the Becoming Sleepers group were more likely to be male, have a difficult temperament, be breastfeeding at 6 and 15 months, have a mother with a slightly higher depression score, have a partner in the home at 6, 24 and 36 months, have fewer family members, and have fewer hours in child care at 9 months of age. In our sample, we did not have enough children with persistent sleep problems to constitute a definable group. The findings pertaining to difficult temperament and breastfeeding replicate findings of other studies. More importantly, they suggest that sleep awakenings early in infancy are affected by internal difficulties in self-soothing and internal cues to hunger. As infants mature, sleep on any given night becomes predictable by more situational factors and family circumstances.

Infants who experienced more hours of child care were in the group of children who had fewer awakenings early in infancy. It may be that these infants in more hours of child care became accustomed to sleeping despite ambient environmental stimulation and so were less likely to awaken, or perhaps, they were more tired from spending the day in activities away from their parents. In any case, the effects of child care were restricted to child care at 9 months of age.

Our findings, like the findings of others, indicate that sleep and sleep problems have a developmental course. Findings using growth mixture modeling suggest that sleep awakenings diminish in a non-linear fashion, with rate of sleep awakenings declining more strikingly in the period between 6 and 21 months of age. In addition, the factors most strongly connected to early differences in sleep patterns are not the same as the factors most strongly connected to later sleep difficulties. Early on, sleep awakenings are related to children's difficult temperament, breastfeeding experiences, and child illnesses as well as to mothers' depression and sensitivity. However, over time, the effects of infant temperament and breastfeeding appear to recede, and other variables become prominent as predictors of individual differences in sleep awakenings. Factors that determine whether the older infant and toddler will awaken during the night are illnesses, such as ear aches, respiratory infections and gastrointestinal illnesses, experiences that lead adults as well as infants to have difficulties maintaining sleep. Also important later in infancy may be the behavioral contingencies related to their awakenings. Infants whose mothers display sensitivity during play and structured interactions are more likely to continue to awaken more frequently than infants whose mothers are less responsive, perhaps because these generally sensitive mothers are also more inclined to intervene when the infant shows signs of struggling with sleep. Because developing capacities for self-soothing seem important for regular sleep, the tendency of mothers to intervene may have the unintended consequence of slowing the child's progression in the area of self-soothing. Our data do not allow us to determine this interpretation with certainty; but it suggests the importance of follow-up research targeted to the issue.

These findings, while far from definitive, suggest several things about the developmental course of sleep awakenings. First, genetic or constitutional factors such as those that might be reflected in difficult temperament appear to be implicated in early sleep problems during infancy. These temperament-based factors may make boys more reactive to internal and external stimuli and make it more difficult for them to develop sufficient capacities for self-soothing to avoid awakening early on. Second, family contextual factors and parenting practices also appear implicated in sleep awakenings. Some of the findings pertaining to maternal sensitivity suggest that instrumental learning mechanisms may account for sleep difficulties; that is, as mothers attempt to assist their children in getting to sleep that may actually reinforce behaviors in the child that run counter to self-soothing and self-regulation. Family adversity related to low income, single-parent status, poor parental general health, maternal depression do not seem to be related to sleep awakenings, at least not in this group of approximately 1200 infants drawn from across the country. Maternal depression, however, appears to be related to sleep awakenings, but the exact mechanism by which this operates appears yet to be defined. New evidence is emerging that maternal depression may affect infants prenatally, via the mother's HPA system (Field, in press).

The absence of associations between sleep problems and variables related to infant-mother attachment are of greater concern because of the failure of our study to replicate those of other researchers, even those using subject children from the same data set. McNamara, Belsky, and Fearon (2003) reported that infants with insecure-resistant attachments had significantly greater numbers of night awakenings and longer mean duration of night-awaking episodes than insecure-avoidant infants. However, their analyses included only insecure-resistant and insecure-avoidant infants. Including secure attachment types, we did not find any differences across the sample in sleep awakenings despite our attempt to use measures of attachment security and separation distress.

Our findings further suggest that using the measure of the number of nights per week in which infants awakened after sleep onset may be a useful indicator of individual differences in infant sleep patterns. It is an easy measure to collect and correlates well with maternal reports of difficulties around sleep. This measure also correlates with the sleep factor score from the Child Behavior Checklist, another more standardized measure of sleep problems that was obtained later in the infancy period.

*Limitations*

Findings from this study are limited by their heavy reliance on data obtained using maternal report. We have no independent measures of infants' sleep (e.g. polysomnography or observation) other than maternal report. In addition, we did not have direct measures of sleep routines. Although other research suggests that maternal report is reasonably reliable and correlated with laboratory observations of infant sleep (Sadeh, Lavie, Scher, Tirosh, & Epstein, 1991), our findings regarding the relations among variables may be confounded by the shared variance attributable to maternal report.

It has been suggested that maternal reports of infant temperament and sleep awakenings are themselves related. Infants with many sleep awakenings could have been perceived as having difficult temperament. However, of the 39 items on the temperament measure used in this study, none addressed the issue of sleep awakenings.

The findings are also somewhat limited by the restricted sample recruited for the NICHD study. These findings are based on a sample that was composed of children all healthy at birth. No premature infants, twins, or low-birth weight infants were included in the initial sample.

Although the incidence of maternal reported sleep problems was low, they were similar to those of earlier researchers studying normal populations (e.g. Zuckerman, et al., 1987; Richman. 1981).

Readers may also be aware of problems inherent to trajectory modeling (Bauer & Curran, 2004; Sampson & Laub, 2005). The groups we identified may be relatively unstable and will need to show replication within other samples and validation over time. Because the sample is large—many of the findings, though significant, are modest in magnitude.

Finally, as this is a correlational study, issues of cause and effect are difficult to untangle. It is possible that sleep awakenings are responsible for mothers rating children as having difficult temperament and may even contribute to continued breastfeeding. Warren, et al. (2007) noted that depression contributed to child awakenings, and not vice versa. Similar analyses would have to be undertaken to resolve many of the correlational findings in this report.

*Implications for Handling Sleep Problems*

These findings suggest that primary health care providers should be aware that some children who are generally healthy and typically developing might still have sleep problems that extend over time. Those infants more pre-disposed to early sleep problems are those who are male, have difficult temperaments according to their mothers' experience, and are breastfeeding. For the majority of these infants, sleep awakenings tend to abate.

These findings also lend further support to expert recommendations for optimal infant sleep patterns concerning greater bedtime ritualization, discouragement of parental intrusion and encouragement of infant self-soothing to promote sleep that is more continuous. The data presented here suggest that with careful management of sleep-time routines and the family environment more generally, it is likely that children will reduce their sleep awakenings over time. Our findings lend support to behavioral interventions that are based on reducing over-solicitous behavior on the part of parents whose infants display nighttime awakenings and bedtime oppositional behaviors. Interventions aimed at helping parents establish more nuanced, carefully targeted routines to help babies with self-soothing might be useful adjuncts to current pediatric guidance. Given that mothers described infants with many awakenings per week as creating problems for themselves and other family members, parents might also be encouraged to seek occasional respite either in the form of enlisting outside support or in the form of more orchestrated co-parenting (e.g., shift taking). Finally, future research should be directed to exploring the continuing significance of these early patterns of sleep disruptions for cognitive and social developments that require self regulation.

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Table 1

*Sleep Questions Mothers Answered at the 6, 15, 24 and 36 infant month assessments*

| |
|---|
| Has your child wakened you during the night in the last week? |
| How many nights during the last week? |
| How many times each night did your child awaken you? |
| If so, for how long was your child awake? |
| How much of a problem was this for you and your family (Rated on a 1-3 scale from “Not much” to “Quite a bit”) |

Table 2.

Percentage of infants at each age awakening 1 to 7 nights per week.

| AGE | **6 mo** | **15 mo** | **24 mo** | **36 mo** |
|---|---|---|---|---|
| **Nights/week** | **% (N)** | **% (N)** | **% (N)** | **% (N)** |
| 0 | 29.58 (378) | 33.07 (411) | 35.57 (429) | 37.94 (461) |
| 1 | 13.54 (173) | 17.94 (223) | 19.49 (235) | 21.48 (261) |
| 2 | 15.02 (192) | 16.81 (209) | 17.08 (206) | 14.98 (182) |
| 3 | 5.95 (76) | 10.46 (130) | 9.37 (113) | 8.81 (107) |
| 4 | 4.15 (53) | 3.94 (49) | 4.31 (52) | 4.53 (55) |
| 5 | 3.99 (51) | 2.98 (37) | 3.23 (39) | 4.12 (50) |
| 6 | 3.29 (42) | 2.74 (34) | 1.99 (24) | 1.73 (21) |
| 7 | 24.49 (313) | 12.07 (150) | 8.96 (108) | 6.42 (78) |
| missing | 86 | 121 | 158 | 149 |

Table 3.
Means and correlations among Sleep Measures from 6 months through 36 months

| | Mean | Stan.Dev. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. timwek06 | 2.89 | 2.79 | | | | | | | | | |
| 2. timwek15 | 2.14 | 2.34 | 0.33** | | | | | | | | |
| 3. timwek24 | 1.90 | 2.17 | 0.23** | 0.28** | | | | | | | |
| 4. timwek36 | 1.72 | 2.04 | 0.15** | 0.19** | 0.34** | | | | | | |
| 5. problm06 | 1.32 | 0.55 | 0.28** | 0.1** | 0.07 | 0.06 | | | | | |
| 6. problm15 | 1.30 | 0.55 | 0.15** | 0.29** | 0.14** | 0.1** | 0.31** | | | | |
| 7. problm24 | 1.31 | 0.57 | 0.08 | 0.07 | 0.37** | 0.11** | 0.18** | 0.25** | | | |
| 8. problm36 | 1.34 | 0.59 | 0.03 | 0.04 | 0.12** | 0.37** | 0.11** | 0.27** | 0.29** | | |
| 9. CBCL24 | 3.24 | 2.71 | 0.17** | 0.22** | 0.47** | 0.22** | 0.03 | 0.12** | 0.39** | 0.11** | |
| 10. CBCL36 | 3.68 | 2.60 | 0.09** | 0.12** | 0.29** | 0.34** | 0.04 | 0.14** | 0.25** | 0.21** | 0.58** |

N's for each correlation varied from 1278-544 depending on the non-missing data available for each pair.

* $p \leq .05$; ** $p \leq .01$.

Table 4.

Growth Mixture Model Fit and Model Quality Statistics for 1, 2, and 3 Latent Classes.

| No. of latent classes | Lo, Mendell & Rubin nested LR test P-value | Bootstrap LR test P-value | BIC | Smallest Class size | Entropy | Posterior Probability Range |
|---|---|---|---|---|---|---|
| 1 | | | 15977 | -- | -- | -- |
| 2 | <.00005 | <.00005 | 15905 | 34% | .383 | .73-.85 |
| 3 | .1110 | 1.0000 | 15913 | <1% | .620 | .58-.85 |

Table 5.

Means and Standard Deviations for Number of Nights per Week with Awakenings at the Four Ages, Broken Down by the Two Latent Class Groups and the Full Data Set

| | Sleepers | | | Becoming Sleepers | | | Full Data Set | | |
|---|---|---|---|---|---|---|---|---|---|
| Child age | N | Mean | Std Dev | N | Mean | Std Dev | N | Mean | Std Dev |
| 6 mo | 842 | 1.3 | 1.6 | 436 | 6.0 | 1.9 | 1278 | 2.9 | 2.8 |
| 15 mo | 818 | 1.9 | 2.1 | 425 | 2.7 | 2.7 | 1243 | 2.1 | 2.3 |
| 24 mo | 800 | 1.9 | 2.1 | 406 | 1.9 | 2.4 | 1206 | 1.9 | 2.2 |
| 36 mo | 806 | 1.8 | 2.0 | 409 | 1.7 | 2.1 | 1215 | 1.7 | 2.0 |

Table 6.
Multiple Group SEM Estimates and Effect Sizes for Models Fit at Ages 6, 21, and 36 Month

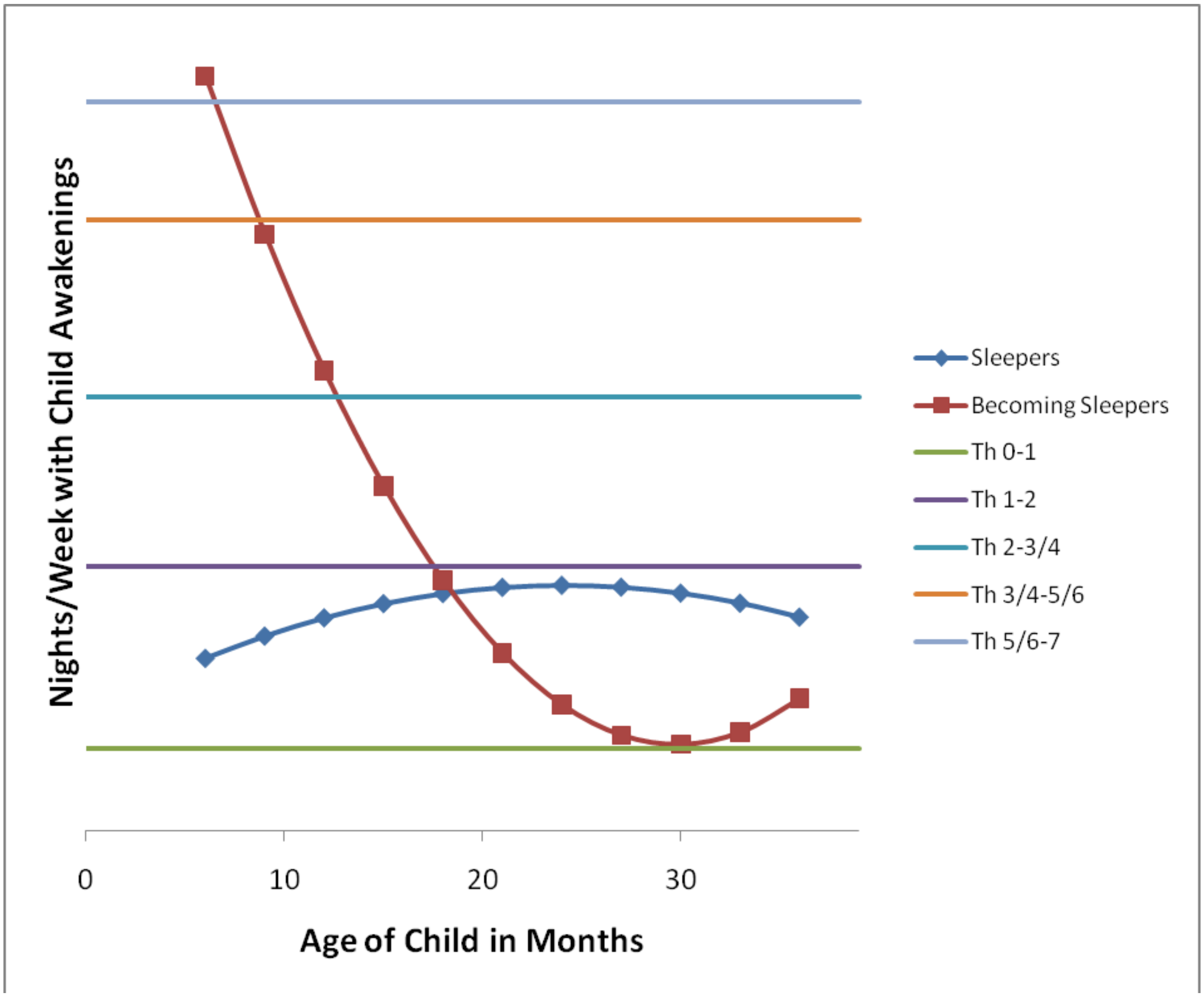
| | Dependent Variable (Nights SA Growth Model) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 6 mo | | | | 21 mo | | | | 36 mo | |
| Sleepers & Becoming Sleepers | Random Intercept | ES – S[a] ES-BS[b] | Random Slope | ES – S[a] ES-BS[b] | Random Intercept | ES – S[a] ES-BS[b] | Random Slope | ES – S[a] ES-BS[b] | Random Intercept | ES – S[a] ES-BS[b] |
| **Structural Regression Coefficients** | | | | | | | | | | |
| Gender (Male) | 0.02 | 0.08 | -0.01 | -0.06 | 0.02 | 0.08 | -0.00 | -0.01 | 0.02 | 0.07 |
| | | 0.12 | | -0.09 | | 0.12 | | -0.01 | | 0.10 |
| Difficult Temperament | 0.08** | 0.21 | -0.03** | -0.25 | 0.05* | 0.15 | -0.01 | -0.08 | 0.04 | 0.08 |
| | | 0.3 | | -0.35 | | 0.22 | | -0.11 | | 0.12 |
| Breastfeeding 6 mo | 0.09** | 0.26 | -0.03** | -0.28 | 0.06** | 0.21 | -0.02 | -0.14 | 0.03 | 0.07 |
| | | 0.38 | | -0.40 | | 0.31 | | -0.20 | | 0.10 |
| Separation Distress | 0.02 | 0.07 | -0.01 | -0.08 | 0.02 | 0.07 | 0.00 | 0.00 | 0.02 | 0.05 |
| | | 0.10 | | -0.11 | | 0.1 | | 0.00 | | 0.07 |
| Child Illness 6, 21, 36 | 0.19** | 0.29 | -0.05** | -0.25 | 0.16** | 0.38 | 0.01 | 0.05 | 0.12** | 0.29 |
| | | 0.42 | | -0.36 | | 0.54 | | 0.07 | | 0.42 |
| Maternal Depression 6, 21, 36 | 0.06** | 0.26 | -0.02** | -0.27 | 0.05** | 0.24 | 0.01 | 0.11 | 0.08** | 0.24 |
| | | 0.37 | | -0.39 | | 0.35 | | 0.15 | | 0.34 |
| Maternal Sensitivity 6, 21, 36 | 0.07** | 0.26 | -0.02** | -0.21 | 0.05** | 0.21 | 0.01 | 0.07 | 0.09** | 0.2 |
| | | 0.37 | | -0.31 | | 0.3 | | 0.10 | | 0.28 |
| Maternal Health 6, 21, 36 | 0.01 | 0.02 | -0.01* | -0.14 | -0.00 | -0.01 | 0.01 | 0.10 | 0.02 | 0.05 |
| | | 0.03 | | -0.21 | | -0.01 | | 0.14 | | 0.07 |
| Child Care Hours 9, 21, 36 | -0.02 | -0.08 | 0.00 | -0.01 | -0.00 | -0.11 | 0.03** | 0.08 | 0.05 | -0.05 |
| | | -0.12 | | -0.01 | | -0.16 | | 0.11 | | -0.07 |
| Poverty | -0.02 | -0.04 | 0.00 | 0.01 | -0.02 | -0.08 | -0.02 | -0.11 | -0.06 | -0.13 |
| | | -0.05 | | 0.02 | | -0.11 | | -0.16 | | -0.19 |
| Parent with Partner 6, 21, 36 | -0.00 | -0.07 | 0.00 | 0.00 | -0.00 | -0.01 | 0.00 | 0.19 | -0.00 | 0.11 |
| | | -0.11 | | -0.01 | | -0.01 | | 0.28 | | 0.16 |
| **Intercepts, Variances & Covariances** | | | | | | | | | | |
| Sleepers | | | | | | | | | | |
| Intercept | -0.064 | | -0.05 | | -0.099 | | -0.052 | | -0.178 | |
| Variance | 0.111** | | 0.013 | | 0.066** | | 0.032 | | 0.207** | |
| Covariance Intercept with Slope | -0.031** | | --- | | -0.001 | | --- | | 0.149** | |
| Becoming Sleepers | | | | | | | | | | |
| Intercept | 0.334** | | -0.248** | | -0.099 | | -0.052** | | -0.215 | |
| Variance | 0.156** | | 0.013** | | 0.104** | | 0.026** | | 0.251** | |
| Covariance Intercept with Slope | -0.04** | | --- | | 0.002 | | --- | | 0.147** | |

[a] ES-S – Cohen's d measures of effect size -Sleepers
[b]ES-BS - Cohen's d measures of effect size - Becoming Sleepers

Figure Caption

*Figure 1.* The two class growth mixture model solution for the NIGHTS SA scores at 6, 15, 24, and 36 months.

**Figure 1. Developmental Trajectories for Two Class Solution**




NOTE: There are five horizontal lines that display the thresholds levels between response categories 0, 1, 2, 3 or 4, 5 or 6, and 7 nights/week with child awakenings. They are labled in the legend where for example "Th 0-1" stands for the threshold separating 0 and 1 night/week with awakenings. Some categories (3 or 4, and 5 or 6) were combined due to small cell counts.