Uninterrupted Infant Sleep, Development, and Maternal Mood

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OBJECTIVES: Contrary to the importance of total sleep duration, the association between sleeping through the night and development in early infancy remains unclear. Our aims were to investigate the proportion of infants who sleep through the night (6- or 8-hour sleep blocks) at ages 6 and 12 months in a longitudinal cohort and to explore associations between sleeping through the night, mental and psychomotor development, maternal mood, and breastfeeding.

METHODS: At 6 and 12 months of age, maternal reports were used to assess the longest period of uninterrupted infant sleep and feeding method (n = 388). Two different criteria were used to determine if infants slept through the night: 6 and 8 hours of uninterrupted sleep. Mental and psychomotor developmental indices (Bayley Scales of Infant Development II) and maternal mood (Center for Epidemiologic Studies Depression Scale) were measured at 6, 12, and 36 months of age.

RESULTS: Using a definition of either 6 or 8 hours of uninterrupted sleep, we found that 27.9% to 57.0% of 6- and 12-month-old infants did not sleep through the night. Linear regressions revealed no significant associations between sleeping through the night and concurrent or later mental development, psychomotor development, or maternal mood (P > .05). However, sleeping through the night was associated with a much lower rate of breastfeeding (P < .0001).

CONCLUSIONS: Considering that high proportions of infants did not sleep through the night and that no associations were found between uninterrupted sleep, mental or psychomotor development, and maternal mood, expectations for early sleep consolidation could be moderated.

WHAT'S KNOWN ON THIS SUBJECT: Sleep plays a fundamental role in child development. Lack of sleep (total sleep duration) is associated with both physical and mental health problems in childhood. However, the specific association between consecutive sleep duration and development in early infancy remains unclear.

WHAT THIS STUDY ADDS: A high percentage of 6- and 12-month-old infants do not sleep through the night (uninterrupted sleep duration). When controlling for well-known confounding variables, no significant association was found between sleeping through the night, mental and psychomotor development, and maternal mood.

Sleep plays a fundamental role in child development, and a growing body of evidence suggests that lack of sleep in children is associated with both physical and mental health problems. Considering the high percentages of children with sleep problems (ranging from 20% to 35%), interest has grown in sleeping through the night, resulting in behavioral interventions at increasingly younger ages. Researchers in several recent studies have proposed such interventions in infants as young as 3 months of age.

For most parents, the time when infants should consolidate their sleep is a major concern. Sleeping through the night is a different concept from total nocturnal sleep duration (which refers to the total sleep duration during the night), and it is also different from total sleep duration (which refers to the total sleep duration in a 24-hour period). Sleeping through the night is instead defined as the longest period of uninterrupted sleep without parental intervention (ie, sleep blocks of a specific duration, typically 6 or 8 hours). This is widely considered a developmental milestone that should be achieved at approximately age 5 or 6 months. However, researchers in several studies have reported that not all infants conform to this classic developmental timeline. Although studies show that increasing percentages of infants sleep through the night as they grow up, they also show major interindividual differences.

Sleeping through the night at age 6 to 12 months is generally considered the gold standard in Western industrialized nations, and behavioral sleep training (such as controlled crying) is popular among parents and professionals. However, the idea of night awakenings as being problematic in early development is not unanimous, leading to conflicting advice from professionals.

To get infants to sleep through the night, interventions such as delayed response and feeding during the night have been proposed. However, many parents report that these methods are incongruent with their personal beliefs and find sleep interventions too difficult, particularly attempts to ignore infant crying. The beneficial effects of sufficient total sleep duration on emotional regulation, attention, memory, and executive functions are well documented in the literature. Nevertheless, the specific contribution of sleeping through the night to infant development remains underinvestigated and unclear. Moreover, sleep interventions in early infancy are also meant to improve maternal well-being.

Because poor maternal sleep quality is associated with increased maternal depressive symptoms, whether infants sleep through the night may influence maternal mood. Finally, breastfeeding and cosleeping are frequently mentioned factors associated with sleep fragmentation in infants. Therefore, they are key factors to consider when investigating sleep-wake cycle consolidation.

Considering the importance of sleep in daily life and the conflicting messages parents receive about the importance of early sleep consolidation, it would be worthwhile to determine if sleeping through the night in early infancy is associated with early child development and maternal mood. Our aims in the current study were to (1) determine the percentage of infants who sleep through the night at ages 6 and 12 months (using 6- or 8-hour sleep blocks as criteria) in a longitudinal cohort; (2) determine feeding method as a function of sleeping through the night or not; and (3) explore associations between sleeping through the night, mental development, psychomotor development, and maternal mood.

**METHODS**

**Participants**

Participants were part of the longitudinal birth cohort study Maternal Adversity, Vulnerability, and Neurodevelopment (MAVAN). Sleep measures were available for 388 mother-infant dyads at 6 months of age (182 girls and 206 boys; Table 1) and for 369 mother-infant dyads at 12 months of age (176 girls and 193 boys; 308 participants completed sleep measures at both time points). Pregnant mothers were recruited between 13 and 20 weeks’ gestation from obstetric clinics in Montreal, Québec, and Hamilton, Ontario (Canada). Inclusion criteria were aged ≥18 years and fluency in English or French. Mothers who reported serious obstetric complications, chronic illness, congenital disease, or other serious medical conditions were excluded. Infants with serious complications during delivery, serious medical conditions, or who were born at <37 weeks’ gestation were also excluded. Mothers signed a consent form approved by the ethics committee of the Douglas Mental Health University Institute (Montreal) and St Joseph’s Healthcare (McMaster University, Hamilton).

**Measures and Procedures**

*Sleeping Through the Night*

When infants in the study were 6 and 12 months old, mothers responded to a questionnaire about their infant’s sleeping habits during the last 2 weeks (adapted from the Self-Administered Questionnaire for the Mother). To determine if infants slept through the night, mothers answered the following question: “During the night, how many consecutive hours does your child sleep without waking up?” In their
review, Henderson et al\textsuperscript{14} identified 6 or 8 hours of consecutive sleep as the 2 most often used criteria in the literature to define sleeping through the night. Accordingly, we used both criteria (6 or 8 hours of uninterrupted sleep) as definitions of sleeping through the night or not.

**Child Development**

Mental and psychomotor developmental indices were measured at the infant’s home at ages 6, 12, and 36 months (Bayley Scales of Infant Development II)\textsuperscript{38} by trained research assistants. This instrument includes both mental (cognitive and language) and motor (gross and fine motor skills) developmental scales and is used to assess development in early childhood.

**Maternal Mood**

Maternal mood was assessed during pregnancy (third trimester) and at 6, 12, and 36 months postnatally with the Center for Epidemiologic Studies Depression Scale.\textsuperscript{19} Items on the scale reflect symptom frequency during the previous week. This instrument has been validated in postpartum samples.\textsuperscript{40}

**Feeding Method**

Feeding method was assessed at 6 and 12 months of age with the retrospective breastfeeding questionnaire.\textsuperscript{41} At each time point, infants were classified as breastfed or not.

### Covariates

The Self-Administered Questionnaire for the Mother also contains questions on cosleeping status and total sleep duration in a 24-hour period. Given the well-known associations between education, income, sleep, and child development,\textsuperscript{42,43} socioeconomic status (SES) was assessed (as reported by the mother during pregnancy). Statistics Canada’s low-income cutoff (before tax) was used to assess income level (high versus low). Maternal education was dichotomized between low and high education (high education: at least some college education). SES was broken down into the following 2 categories: high SES (high income and high mother education) and middle to low SES (low on at least 1 category).

### Statistical Analyses

The percentage of infants who slept through the night in our cohort was calculated at ages 6 and 12 months by using a 6-hour criterion and an 8-hour criterion. \( \chi^2 \) tests were used to assess the relationships between sleeping through the night and infant sex, SES, and breastfeeding. The significance level for the descriptive statistics was set at \( P < .05 \). Linear regressions were used to assess the associations between sleeping through the night or not and mental development, psychomotor development, and maternal depression (concurrently and for the next available time point). For all regressions, infant sex, SES, breastfeeding status, cosleeping status, and total sleep duration in a 24-hour period were used as covariates. In addition, prenatal maternal mood was used as a covariate in regressions that predicted maternal mood to control for initial levels before birth. Statistical analyses were conducted by using IBM SPSS Statistics 24 (IBM Corporation, Armonk, NY). The Holm-Bonferroni method was used to adjust for multiple comparisons (regressions).

### RESULTS

#### Sleeping Through the Night or Not at 6 Months of Age Using the 6-Hour Criterion

In Fig 1A, we show the percentage of infants who slept through the night or not at 6 months of age using the 6-hour criterion (as reported by mothers). Whereas 62.4% of mothers reported that their infant got ≥6 hours of consecutive sleep (6-hour sleep blocks), 37.6% reported <6 hours. A higher percentage of girls than boys slept through the night (69.8% vs 55.8%; \( \chi^2 = 8.02, P = .005 \)). SES was similar between infants who slept through the night and those who did not (\( \chi^2 = 0.33, P = .57 \)). In the group that slept through the night, 55.0% of the infants were breastfed at age 6 months; however, this proportion was much higher in the group that did not sleep through the night (80.8%; \( \chi^2 = 26.67, P < .0001 \); Fig 2A).

Sleeping through the night or not at 6 months of age was not associated with concurrent mental development (\( \beta = -1.78, P = .10 \)), psychomotor development (\( \beta = -1.33, P = .39 \)), or maternal mood (\( \beta = -0.96, P = .34 \)). Similar results were observed for the same outcomes at 12 months of age (mental development: \( \beta = -1.89, P = .17 \); psychomotor development: \( \beta = -.75, P = .67 \); maternal mood: \( \beta = 1.17, P = .27 \)).

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### Table 1: Characteristics of the MAVAN Cohort

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total Sample at 6 Months of Age, ( n = 388 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>SES, low, high, %</td>
<td>21.8, 78.2</td>
</tr>
<tr>
<td>Sex, girl, boy, %</td>
<td>46.9, 53.1</td>
</tr>
<tr>
<td>Maternal age at birth, y, mean ± SD</td>
<td>30.53 ± 4.84</td>
</tr>
<tr>
<td>Maternal mood at 6 mo, using the CES-D, mean ± SD</td>
<td>11.36 ± 9.90</td>
</tr>
<tr>
<td>Infant mental development at 6 mo, using the Bayley Scales of Infant Development II, mean ± SD</td>
<td>97.32 ± 8.33</td>
</tr>
<tr>
<td>Infant motor development at 6 mo, using the Bayley Scales of Infant Development II, mean ± SD</td>
<td>98.36 ± 11.84</td>
</tr>
</tbody>
</table>

CES-D: Center for Epidemiologic Studies Depression Scale.
Sleeping Through the Night or Not at 6 Months of Age Using the 8-Hour Criterion

Using the 8-hour criterion, we found that 43.0% of mothers reported that their infant got at least 8 hours of uninterrupted sleep, whereas more than half of mothers (57.0%) reported <8 hours (Fig 1B). A slightly higher percentage of girls than boys slept through the night (47.8% vs 38.8%; $\chi^2 = 3.17, P = .08$), but this difference was not statistically significant. SES was similar for the 2 groups ($\chi^2 = 0.10, P = .76$). Again, the group that did not sleep through the night included a higher percentage of breastfed infants (76.5% vs 49.1%; $\chi^2 = 31.19, P < .0001$; Fig 2B).

Using the 8-hour criterion, we found that sleeping through the night or not at 6 months of age was not associated with concurrent mental development ($\beta = -1.53, P = .15$), psychomotor development ($\beta = -2.14, P = .15$), or maternal mood ($\beta = .12, P = .90$). Comparable results were observed for all variables at 12 months of age (mental development: $\beta = -1.78, P = .19$; psychomotor development: $\beta = -77, P = .66$; maternal mood: $\beta = 1.51, P = .14$).

Sleeping Through the Night or Not at 12 Months of Age Using the 8-Hour Criterion

At 12 months, a higher percentage of mothers reported that their infant slept at least 6 consecutive hours (72.1%), but 27.9% still reported <6 hours (Fig 1C). Again, the percentage of girls compared with boys who slept through the night was slightly higher but not statistically significant (76.7% vs 67.9%; $\chi^2 = 3.57, P = .059$), and no association with SES was observed ($\chi^2 = 1.01, P = .32$). Nonetheless, breastfeeding status and consecutive sleep duration remained strongly associated. In the group that slept through the night, only 23.8% of infants were breastfed; however, in the group that did not sleep through the night, half of the infants were still breastfed (56.4%; $\chi^2 = 34.96, P < .0001$; Fig 2C).

Using the 6-hour criterion, we found that sleeping or not through the night at 12 months of age was not associated with concurrent mental development ($\beta = -1.19, P = .45$), psychomotor development ($\beta = 1.43, P = .49$), or maternal mood ($\beta = -1.52, P = .19$). Similar results were observed when assessing the same outcomes at 36 months of age (mental development: $\beta = -1.51, P = .41$; psychomotor development: $\beta = -1.59, P = .48$; and maternal mood: $\beta = -0.08, P = .96$).

Sleeping Through the Night or Not at 12 Months of Age Using the 6-Hour Criterion

In Fig 1D, we show the percentage of infants who slept through the night at 12 months of age using the 8-hour criterion. 56.6% of mothers reported that their infant slept ≥8 consecutive hours, whereas 43.4% of mothers reported <8 hours. No significant associations were found between sleeping through the night and the infant’s sex ($\chi^2 = 2.38, P = .12$) or SES ($\chi^2 = 1.83, P = .18$).

However, breastfeeding status and sleeping through the night remained strongly associated; 22.1% of infants who slept through the night were breastfed at 12 months of age as opposed to 47.1% in the group that did not sleep through the night ($\chi^2 = 25.24, P < .0001$; Fig 2D).

Using the 8-hour criterion, we found that sleeping through the night or not at 12 months of age was not associated with concurrent mental development ($\beta = -92, P = .50$), psychomotor development...
and adolescence are well known, the associations between sleep-wake cycle patterns and development are much less straightforward during the first year of life. Although a few studies found associations between certain polysomnographic sleep measures and development in early infancy, most of these studies did not specifically measure consecutive sleep duration. To our knowledge, only 1 study conducted in 1985 revealed an association between the longest consecutive sleep duration and higher mental development scores at 24 months of age. However, this study was performed in a small sample of preterm infants. Considering that individual differences may also be linked to brain maturation, other authors have questioned the existence of a straightforward relationship between sleep and early development.

Moreover, we found no associations between sleeping through the night or not and postnatal maternal mood. This is noteworthy because maternal sleep deprivation is often invoked to support the introduction of early behavioral interventions. Perhaps maternal total sleep duration (during the night and/or daytime naps) or fatigue could be better predictors of maternal well-being. Future studies could document mothers’ sleep quality and durations in association with their infants’ sleep patterns, considering not only total sleep duration but also sleeping through the night. Earlier time points should also be assessed to clarify if associations are present before 6 months of age.

Importantly, our results reveal a strong relationship between breastfeeding and not sleeping through the night. This association was present at 6 and 12 months of age as measured by both the 6- and 8-hour criteria. Studies have documented the many benefits of breastfeeding for both children and mothers, including lower

### DISCUSSION

The results of this study indicate that by using a commonly accepted definition (6 hours of consecutive sleep), a high percentage of infants in our cohort did not sleep through the night at either age 6 months (37.6%) or 12 months (27.9%). Using an 8-hour criterion for consecutive sleep, we found that more than half of the 6-month-old infants did not sleep through the night (57.0%), whereas 43.4% of infants at 12 months of age did not sleep through the night. These results fall within the range reported in a recent review. Moreover, a higher percentage of girls than boys slept through the night at some time points. This sex-based difference is consistent with results from another recent, large, longitudinal study that found more awakenings in boys compared with girls in infancy.

In the present sample of typically developing infants, we were unable to find any significant associations between sleeping through the night or not at 6 and 12 months of age and variations in mental or psychomotor development. Whereas the beneficial effects of sufficient total sleep duration in childhood

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**FIGURE 2**

Percentages of breastfed infants as a function of sleeping or not through the night in the MAVAN cohort. A, Infants at 6 months of age who attained 6 hours of uninterrupted sleep. In the group that slept through the night (6-hour criterion), 49.1% of infants were breastfed at the age of 6 months as opposed to 76.5% that by using a commonly accepted definition (6 hours of consecutive sleep), a high percentage of infants who attained 8 hours of uninterrupted sleep. In the group that slept through the night (8-hour criterion), 22.1% of infants were breastfed at the age of 12 months as opposed to 47.1% in the group that did not sleep through the night (χ² = 34.96; P < .0001). D, Infants 12 months of age who attained 8 hours of uninterrupted sleep. In the group that slept through the night (8-hour criterion), 22.1% of infants were breastfed at the age of 12 months as opposed to 47.1% in the group that did not sleep through the night (χ² = 25.24; P < .0001).
Some authors have questioned the use of sleep behavioral techniques in young infants because sleep consolidation is a developmental process that is influenced by individual variations. Moreover, some mothers have reported feeling tense and depressed when they tried to get their infant to sleep through the night, explaining that for them rapid sleep consolidation was not a priority. In addition, authors have proposed that because parents are routinely asked about sleep consolidation at medical follow-up meetings, this may implicitly suggest that infants should sleep through the night. In a recent review, authors concluded that behavioral interventions at <6 months of age neither reduced crying nor prevented sleep problems, and they noted side effects such as anxiety and a premature cessation of breastfeeding. However, the conclusions of this review have been questioned by others, again reflecting the controversy over the desirability of early sleep consolidation.

In the absence of a consensus on the importance of the early onset of sleeping through the night, breastfeeding, and sleep-related parental practices, it was shown that experts often refer to their own values or experience when advising parents. However, these values are not necessarily congruent with every parent’s needs. It is important to teach behavioral sleep interventions when there is a need and on parental request. However, parental expectations and sleep arrangements vary considerably according to culture and values. Therefore, health professionals should also take into consideration alternative parental values, especially in nonclinical samples. The findings of this exploratory study should be replicated in larger normative cohorts. It is possible that results from a larger sample would reveal associations between sleeping through the night, mental development, psychomotor development, and maternal mood. Nevertheless, this study included 388 participants, and although several time points, criteria, and outcome measures were tested, no significant associations were found. In addition, the strength of our results is supported by the fact that no previous study to our knowledge has demonstrated a clear association between these measures and consecutive sleep duration.

It is possible that some awakenings were not signaled to the mothers by infants or that mothers did not hear their infant. Although it would be informative to replicate these results by using an objective measure of sleep (actigraphy or videosomnography), the present results reflect the general parental perception of wondering when their infant will (or should) sleep through the night. Variables such as the frequency of nocturnal breastfeeding, use of behavioral sleep interventions, introduction of solid food, and parental sleep exhaustion were not available in our study and should be measured in future studies.

CONCLUSIONS

New mothers appear to be greatly surprised about the degree of sleep disturbance and exhaustion that they experience. As a potential protective strategy, mothers could be more informed about the normal development of the sleep-wake cycle instead of only focusing on methods and interventions. The transition to parenthood is a vulnerable period of life, and it could be reassuring for parents to learn that in a typically developing cohort up to 37.6% of infants do not sleep 6 consecutive hours at age 6 months and up to 27.9% do not at age 12 months. Although there is a clear need to replicate these findings, we found no associations between infants sleeping through the night at 6 or 12 months of age and variations in their mental or motor development and maternal well-being. However, a significantly higher rate of breastfeeding was found in infants who did not sleep through the night. Keeping in mind the wide variability in the age when an infant starts to sleep through the night, expectations for early sleep consolidation could be moderated.

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ABBREVIATIONS

MAVAN: Maternal Adversity, Vulnerability, and Neurodevelopment
SES: socioeconomic status
participated in the data interpretation, and critically reviewed the manuscript for important intellectual content; and all authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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