Published in final edited form as:
Infant Behav Dev. 2015 May ; 39: 131–135. doi:10.1016/j.infbeh.2015.02.010.

Associations between infant temperament, maternal stress, and infants' sleep across the first year of life

Barbara M. Sorondo* and **Bethany C. Reeb-Sutherland**
Department of Psychology, Florida International University, 11200 SW 8th Street, DM 256, Miami, FL 33199, United States

Abstract

Effects of temperament and maternal stress on infant sleep behaviors were explored longitudinally. Negative temperament was associated with sleep problems, and with longer sleep latency and night wakefulness, whereas maternal stress was associated with day sleep duration, suggesting infant and maternal characteristics affect sleep differentially.

Keywords

Sleep; Infancy; Temperament; Negative reactivity; Maternal stress; Sex differences

By the end of their first year, infants will have spent well over half their lives sleeping, suggesting sleep is not a trivial factor for their development. Indeed, sleep is associated with various aspects of infant development, particularly cognitive development (see Ednick et al., 2009 for a review), and can significantly impact parental behavior, mental health, and well-being (see Sadeh, Tikotzky, & Scher, 2010 for a review). However, the factors that contribute to sleep behaviors in infancy have not yet been clearly identified, and the relations between these factors remain poorly understood.

Infant sleep patterns develop rapidly over the first year of life, characterized by inconsistency during the first half of the year but stabilizing by the second half (Sadeh, Mindell, Luedtke, & Wiegand, 2009). Night sleep duration increases steadily across this period, from approximately 8.5 h in the first two months to between 10 and 12 h by 12 months, and day sleep duration simultaneously decreases, from nearly 6 h to approximately 2.5 h (Iglowstein, Jenni, Molinari, & Largo, 2003; Sadeh et al., 2009). Night wakings and wakefulness decrease as well during the first year, dropping rapidly from an average of 2 wakings per night and over 1 h of wakefulness in the first two months to approximately 1 waking per night and around or under half an hour of wakefulness in the remaining months of the first year (Galland, Taylor, Elder, & Herbison, 2012; Sadeh et al., 2009). In contrast, sleep latency, or the amount of time it takes an infant to fall asleep, tends to remain steady throughout infancy (Galland et al., 2012).

*Corresponding author. Tel.: +1 305 348 2415. bsorondo@fiu.edu, besuther@fiu.edu (B.M. Sorondo).

Although these general patterns of infant sleep have been well characterized, not all infants follow these patterns. Indeed, quite a bit of variability across infants has been observed, suggesting various factors must influence individual differences in sleep patterns. These factors include infant characteristics such as sex and temperament as well as environmental characteristics such as parental stress. Findings of sex differences in infant sleep patterns are mixed with some studies reporting sex differences (Anders, Halpern, & Hua, 1992; Bach, Telliez, Leke, & Libert, 2000; Kaley, Reid, & Flynn, 2012; Richardson, Walker, & Horne, 2010; So, Adamson, & Horne, 2007) but others reporting negligible or no differences (e.g., Tikotzky et al., 2010; Weinraub et al., 2012). Those studies reporting sex differences have found that males sleep less than females (Bach et al., 2000), particularly during the day (So et al., 2007), and have more frequent but shorter night wakings (Kaley et al., 2012; So et al., 2007), longer night wakefulness (Bach et al., 2000), and more sleep problems (Anders et al., 1992), such that overall females sleep more soundly than males (Richardson et al., 2010).

Studies examining temperament and various sleep outcomes during the first year have demonstrated temperament influences night, day, and total sleep duration (Kaley et al., 2012; Spruyt et al., 2008; Weissbluth, 1981), night wakings (Carey, 1974; Schaefer, 1990; Scher & Asher, 2004;Weinraub et al., 2012), and sleep problems (Kelmanson, 2004). Specifically, negative or difficult infant temperament has been associated with shorter sleep duration, particularly at night (Loutzenhiser & Sevigny, 2008; Weissbluth, 1981), and more night wakings (Weinraub et al., 2012) compared to positive or easy infant temperament, which has conversely been associated with greater night and total sleep duration (Kaley et al., 2012; Spruyt et al., 2008). In contrast, some studies report weak or no associations between temperament and sleep (e.g., Anders et al., 1992; DeLeon & Karraker, 2007; Scher, Tirosh, & Lavie, 1998), which may be the result of age-dependent changes in this relation (Spruyt et al., 2008; Weinraub et al., 2012), or temperament's differential relation with active compared to quiet sleep (Parslow et al., 2002). Therefore, though the majority of research suggests a relation between infant temperament and sleep, the exact nature of this relation remains ambiguous.

Previous studies have also found associations between maternal stress and infants' sleep. Increased maternal stress at 4 months has been associated with concurrent infant sleep problems (Sidor, Fischer, Eickhorst, & Cierpka, 2013) and a decrease in the percentage of night sleep (Becker, Chang, Kameshima, & Bloch, 1991), as well as with greater variability in infants' night sleep at 12 months, with infant temperament serving as a possible mediator in this latter relation (Becker et al., 1991). Furthermore, greater maternal stress has been associated with infants' sleep problems and, among mothers on maternity leave, with longer night wakefulness and shorter day sleep duration (Sinai & Tikotzky, 2012). Altogether, the above studies suggest both infant characteristics and maternal characteristics can significantly affect the development of infant sleep patterns.

The present study attempted to unify previous research on the association between infant temperament and maternal stress with infant sleep, by exploring numerous sleep outcomes among the same group of infants across the first year of their lives while taking potential sex differences into consideration. Based on previous research, we hypothesized that infant temperament and maternal stress would each play a partial role in the development of various sleep outcomes.

Participants were part of a larger longitudinal study examining the relation between early associative learning and social behavior development (for details, see Reeb-Sutherland, Levitt,& Fox, 2012). As part of the larger study, infants' temperament and sleep behaviors were assessed via maternal reports using the Infant Behavior Questionnaire (IBQ; Rothbart, 1981) and Brief Infant Sleep Questionnaire (BISQ; Sadeh, 2004), respectively. Maternal stress was also assessed via the Parenting Stress Index-Short Form (PSI-SF; Abidin, 1995). Temperament data has previously been examined in relation to infant behavior in the face-to-face still-face paradigm (Yoo & Reeb-Sutherland, 2013) while the sleep and maternal stress data have not yet been reported.

Initially, 123 infants (63 male, 60 female) were recruited for the larger study. Only data obtained from mothers who completed the IBQ and the PSI-SF when their infants were 5 months, and the BISQ when the infants were 5 (M = 5.15, SD = 0.22), 9 (M = 9.19, SD = 0.15), and 12 (M = 12.24, SD = 0.18) months, were included in the present study (N = 40; 21 male, 19 female). The population of infants used in the current study was representative of the greater Washington, DC area with 65% White, 7.5% Black, 5% Asian, 5% Hispanic, and 17.5% mixed/other ethnicity. The infants' mothers were well educated, with 42.5% completing a graduate degree, 37.5% completing a college degree, 10% completing a high school degree, and the remaining 10% reporting an "other" level of education or not reporting their level of education. All infants were born within 2 weeks of their due date and had a mean birth weight of 7.81 pounds (SD = 1.17). The infants included in the present study did not significantly differ from the other 83 infants from the larger study on demographic measures except ethnicity, $\chi^2(4, N = 123) = 11.47$, $p = 0.02$ (38.6% White, 30.1% Black, 3.6% Asian, 2.4% Hispanic, and 25.3% mixed/other ethnicity).

The 94-item IBQ asks parents to rate the frequency of several of their infants' behaviors, and categorizes responses into temperamental subscales including activity level, duration of orienting, distress to limitations, fear, soothability, and smiling/laughter. An index of negative reactivity was created by summing the distress to limitations and fear subscales (Rothbart, 1986; Yoo & Reeb-Sutherland, 2013).

The 36-item PSI-SF asks parents to rate various statements on their child's and their own behaviors and attitudes, categorizing responses into parental distress, parent–child dysfunctional interaction, and difficult child scales, and providing a total stress score. This total stress score was used as a maternal stress index. Bivariate Pearson correlation analyses revealed total stress was not significantly correlated with negative reactivity.

The 10-item BISQ asks parents to provide information on several of their infants' sleep behaviors. Six BISQ variables were used: (1) time spent in sleep between 7 in the evening and 7 in the morning (i.e., night sleep duration), (2) time spent in sleep between 7 in the morning and 7 in the evening (i.e., day sleep duration), (3) number of wakings per night (i.e., night wakings), (4) time spent in wakefulness between 10 in the evening and 6 in the morning (i.e., night wakefulness), (5) length of time required to put the infant to sleep in the evening (i.e., sleep latency), and (6) extent of the infant's sleep problems. The BISQ has previously been found (e.g., Sadeh, 2004) to be correlated with other measures typically used in sleep research, actigraphy and sleep diaries, suggesting that the BISQ may serve as a good proxy for both these types of measures. Moreover, the BISQ has been found to better approximate certain values obtained with actigraphy compared to sleep diaries. For example, night sleep duration values obtained with the BISQ and with actigraphy are similar while sleep diaries appear to overestimate night sleep duration compared to either the BISQ or actigraphy (Sadeh, 2004).

Repeated measures ANCOVAs were conducted for each of the six sleep variables with age (5, 9, and 12 months) as a within-subjects factor, sex (male, female) as a between-subjects factor, and negative reactivity and maternal stress as covariates. Corrections were made whenever statistical test assumptions were violated.

Table 1 provides means and standard deviations by age and sex for each of the sleep variables explored. Several sleep measures were found to be affected by infant temperament. For sleep latency, there was a significant age × negative reactivity interaction effect, $F(2, 70) = 3.843$, $p = 0.026$. There were also significant main effects of negative reactivity, $F(1, 35) = 10.859$, $p = 0.002$, and sex, $F(1, 35) = 11.697$, $p = 0.002$, as well as a trending main effect of age, $p < 0.10$. Follow-up Bivariate Pearson correlation analyses revealed negative reactivity was significantly correlated with sleep latency at 5, $r(40) = 0.487$, $p = 0.002$, but not 9 or 12, months, such that greater negative reactivity was associated with a longer time required to put the infant to sleep in the evening at 5 months (see Table 1). In addition, follow-up independent samples *t*-tests revealed it took longer to put females to sleep than males at 9, $t(22.105) = -3.555$, $p = 0.002$, but not at 5 or 12, months, though the difference at the latter age was trending, $p < 0.10$.

There was also a significant age × negative reactivity interaction effect for the extent of sleep problems, $F(2, 72) = 3.228$, $p = 0.045$. Follow-up Bivariate Pearson correlation analyses revealed negative reactivity was significantly correlated with the extent of sleep problems at 9, $r(40) = -0.335$, $p = 0.035$, but not at 5 or 12, months, such that greater negative reactivity was associated with more serious sleep problems at 9 months (see Table 1).

For night wakefulness, there was a significant main effect of negative reactivity, $F(1, 34) = 4.572$, $p = 0.040$, suggesting greater negative reactivity was related to longer night wakefulness. In addition, there was a trending main effect of sex, $p < 0.10$. For night wakings, there was a trending main effect of negative reactivity as well as a trending age × sex interaction effect, *p*s < 0.10.

With regards to maternal stress, only day sleep duration was affected. Specifically, there was a significant age × maternal stress interaction effect, $F(2, 70) = 3.205$, $p = 0.047$. Although not significant, follow-up Bivariate Pearson correlation analyses between maternal stress scores and day sleep duration at each age revealed a positive direction in slope between the variables at 5 months, but negative-going slopes at 9 and 12 months (see Table 1).

For night sleep duration, there was a significant age × sex interaction effect, $F(2, 72) = 5.386$, $p = 0.007$. Follow-up independent samples *t*-tests revealed males slept significantly longer at night than females at 9, $t(38) = 2.741$, $p = 0.009$, but not at 5 or 12, months. In addition, follow-up paired samples *t*-tests revealed that within males the duration of night sleep at 5 months was significantly lower than that at 9, $t(20) = -3.982$, $p = 0.001$, and 12, $t(20) = -3.866$, $p = 0.001$, months; the difference between 9 and 12 months was not significant. Females, in contrast, did not differ significantly in their night sleep duration at any age, though the difference between 9 and 12 months was trending, $p < 0.10$.

These results suggest temperament and maternal stress differentially affect infant sleep patterns across the first year of life. Specifically, negative infant temperament is associated with longer sleep latency, night wakefulness, and more sleep problems whereas maternal stress is associated with infant day sleep duration.

Some associations found between temperament and both sleep latency and sleep problems were qualified by age. Higher levels of negative temperament were associated with a longer amount of time required to put the infants to sleep in the evening at 5, but not at 9 or 12, months. In addition, negative temperament was related to more serious sleep problems at 9, but not at 5 or 12, months. In contrast, higher levels of negative temperament were associated with longer night wakefulness in the first year regardless of age. These results are consistent with previous research indicating negative temperament is associated with more sleep problems (e.g., Kelmanson, 2004) and with longer night wakefulness (e.g., Halpern, Anders, Garcia Coll, & Hua, 1994) in infancy. To our knowledge, this is the first study to find a relation between temperament and sleep latency during the first 6 months, results that are consistent with recent research demonstrating temperament in late infancy is associated with sleep latency in early childhood (Gartstein, Potapova, & Hsu, 2014). However, the present study failed to replicate previous studies finding a relation between infant temperament and sleep duration measures, likely due to differences in age (Kaley et al., 2012; Loutzenhiser & Sevigny, 2008) and the temperament dimensions (Spruyt et al., 2008) used in those studies compared to the current study.

The association between maternal stress and infant sleep in the present study was also qualified by age, suggesting an inclination toward a positive relation in early infancy but a negative relation in later infancy. Though an association between maternal stress and infant day sleep duration has been previously found (Sinai & Tikotzky, 2012), the prior finding indicated greater maternal stress was associated with shorter day sleep duration at 4–5 months, in contrast to our findings. This previous finding was present only among mothers on maternity leave (Sinai & Tikotzky, 2012), a potential moderator our study did not take into account. Furthermore, though the present study did not replicate previously found associations between maternal stress and infant sleep problems or night sleep behaviors, our sample was drawn from a low-risk population, in contrast to studies examining high-risk mothers (Becker et al., 1991; Sidor et al., 2013) or mothers on maternity leave compared to working mothers (Sinai & Tikotzky, 2012).

Longitudinally, the sleep patterns found in the present study fall in line closely with previous research on normative sleep patterns across the first year of infancy, and the values of the sleep behaviors explored at each age point are similar to those previously found (Galland et al., 2012; Iglowstein et al., 2003; Sadeh et al., 2009), thus validating the sleep measure we used. Sex differences were found, only at 9 months, for two of the sleep behaviors explored: at this age, sleep latency was longer for females than for males, and males had longer night sleep duration than females. Overall, the night sleep duration trajectory was smoother for females, who did not differ significantly in this sleep variable at any age, than for males, who showed a sharp increase in night sleep duration from 5 to 9 months that then remained steady between 9 and 12 months, which may be indicative of better sleep in early infancy for females than males, with the difference abating over time, as has been previously found (e.g., Richardson et al., 2010). In addition, there was a trending sex difference for night wakings, supporting previous research (Kaley et al., 2012). However, the results did not replicate previous findings suggesting males sleep less than females, particularly during the day, and have longer night wakefulness and more sleep problems (Bach et al., 2000; So et al., 2007), which is likely because such studies focused on infants younger than those in our study. In addition, no sex differences in sleep were found when infants closer to the age of the infants in the current study (6 months) were examined (e.g., Tikotzky et al., 2010).

Of note, the three measures we used were independent. Total stress on the PSI-SF was not significantly correlated with the negative reactivity measure obtained from the IBQ, and neither the IBQ nor the PSI-SF questions utilized inquired about the sleep behaviors examined. Though the IBQ includes several questions on infants' behavior before, during, and after sleep, only one question, inquiring about the extent of the infants' fussing and crying before sleep, was potentially and indirectly related to any of the BISQ variables used (in this case, sleep latency). The PSI-SF questions did not inquire about any sleep behaviors. Consequently, we have reason to believe that temperament and maternal stress are two independent mechanisms that accordingly influence infant sleep behaviors independently.

The results of the present study should be taken in light of several limitations. First, this study includes a relatively small sample size, making it difficult to assess sleep problems since very few of the infants had such problems. Moreover, the small sample size made it difficult to examine the interaction between temperament and maternal stress. In addition, the most rapid sleep development period in infancy, the first two months, was not examined, providing a limited picture of the full range of sleep behaviors across infancy.

Furthermore, all measures used relied on maternal ratings. Mothers and fathers perceive and are impacted by their infants' temperament and sleep behaviors differentially (e.g., Keener, Zeanah, & Anders, 1988; Loutzenhiser & Sevigny, 2008; Sinai & Tikotzky, 2012), so using only maternal report may not provide an accurate reflection of infants' behaviors and their effect on parents. Moreover, previous research (e.g., Halpern et al., 1994) has emphasized the need for objective measures of sleep and temperament in studies exploring the relation between these variables, in order to counteract the influence of parental factors. Indeed, though previous research (e.g., Sadeh, 2004; So et al., 2007) has found objective sleep measures such as actigraphy are correlated with subjective measures such as the BISQ and parent-completed sleep diaries, there are systematic differences between the measures. For instance, night wakings are underreported when obtained with the BISQ compared to actigraphy, and even fewer night wakings are reported when obtained with sleep diaries

(Sadeh, 2004; So et al., 2007). In addition, night sleep is over-reported in sleep diaries compared to actigraphy, though night sleep duration obtained with the BISQ is similar to that obtained with actigraphy (Sadeh, 2004; So et al., 2007). Future studies should take these limitations into account when examining infant sleep and its relation to factors such as temperament and parental stress in the first year.

In sum, the results of the present study suggest infant and maternal characteristics play differential roles in sleep patterns across infancy. Age, though not sex, qualifies the relations between these factors. These influences may in turn impact the various aspects of infant development associated with sleep, and have implications for promoting healthy sleep patterns, which consequently can promote both infant and parental well-being.

Acknowledgements

This project was supported by NIMH grant MH 080759 to Pat Levitt and Nathan Fox. The authors would like to thank the infants and their families for their participation in our study. A fuller report of the study will be provided upon request.

References

Abidin, RR. Parenting stress index [measurement instrument]. Lutz, FL: Psychological Assessment Resources; 1995.

Anders TF, Halpern LF, Hua J. Sleeping through the night: A developmental perspective. Pediatrics. 1992; 90(4):554–560. [PubMed: 1408509]

Bach V, Telliez F, Leke A, Libert J. Gender-related sleep differences in neonates in thermoneutral and cool environments. Journal of Sleep Research. 2000; 9(3):249–254. [PubMed: 11012863]

Becker PT, Chang A, Kameshima S, Bloch M. Correlates of diurnal sleep patterns in infants of adolescent and adult single mothers. Research in Nursing & Health. 1991; 14(2):97–108. [PubMed: 2047540]

Carey WB. Night waking and temperament in infancy. The Journal of Pediatrics. 1974; 84(5):756–758. [PubMed: 4820714]

DeLeon CW, Karraker KH. Intrinsic and extrinsic factors associated with night waking in 9-month-old infants. Infant Behavior and Development. 2007; 30(4):596–605. [PubMed: 17416420]

Ednick M, Cohen AP, McPhail GL, Beebe D, Simakajornboon N, Amin RS. A review of the effects of sleep during the first year of life on cognitive, psychomotor, and temperament development. Sleep. 2009; 32(11):1449–1458. [PubMed: 19928384]

Galland BC, Taylor BJ, Elder DE, Herbison P. Normal sleep patterns in infants and children: A systematic review of observational studies. Sleep Medicine Reviews. 2012; 16(3):213–222. [PubMed: 21784676]

Gartstein MA, Potapova NV, Hsu AJ. Infant temperament: Implications for later sleep and eating/feeding. Journal of Reproductive and Infant Psychology. 2014; 32(2):185–198.

Halpern LF, Anders TF, Garcia Coll C, Hua J. Infant temperament: Is there a relation to sleep-wake states and maternal nighttime behavior? Infant Behavior and Development. 1994; 17(3):255–263.

Iglowstein I, Jenni OG, Molinari L, Largo RH. Sleep duration from infancy to adolescence: Reference values and generational trends. Pediatrics. 2003; 111(2):302–307. [PubMed: 12563055]

Kaley F, Reid V, Flynn E. Investigating the biographic, social and temperamental correlates of young infants' sleeping, crying and feeding routines. Infant Behavior and Development. 2012; 35(3): 596–605. [PubMed: 22739022]

Keener MA, Zeanah CH, Anders TF. Infant temperament, sleep organization, and nighttime parental interventions. Pediatrics. 1988; 81(6):762–771. [PubMed: 3368275]

Kelmanson IA. Temperament and sleep characteristics in two-month-old infants. Sleep and Hypnosis. 2004; 6(2):78–84.

Loutzenhiser L, Sevigny PR. Infant sleep and the quality of family life for first-time parents of three-month-old infants. Fathering. 2008; 6(1):2–19.

Parslow PM, Horne RSC, Ferens D, Bandopadhayay P, Mitchell K, Watts A-M, et al. Temperament ratings do not predict arousability in normal infants and infants at increased risk of sudden infant death syndrome. Developmental and Behavioral Pediatrics. 2002; 23(5):365–370.

Reeb-Sutherland BC, Levitt P, Fox NA. The predictive nature of individual differences in early associative learning and emerging social behavior. PLoS ONE. 2012; 7(1):e30511. [PubMed: 22291971]

Richardson HL, Walker AM, Horne RSC. Sleeping like a baby—Does gender influence infant arousability? Sleep. 2010; 33(8):1055–1060. [PubMed: 20815186]

Rothbart MK. Measurement of temperament in infancy. Child Development. 1981; 52(2):569–578.

Rothbart MK. Longitudinal observation of infant temperament. Developmental Psychology. 1986; 22(3):356–365.

Sadeh A. A brief screening questionnaire for infant sleep problems: Validation and findings for an internet sample. Pediatrics. 2004; 113(6):e570–e577. [PubMed: 15173539]

Sadeh A, Mindell JA, Luedtke K, Wiegand B. Sleep and sleep ecology in the first 3 years: A web-based study. Journal of Sleep Research. 2009; 18(1):60–73. [PubMed: 19021850]

Schaefer CE. Night waking and temperament in early childhood. Psychological Reports. 1990; 67(1): 192–194. (Sychiatry and Mental Health, 7(1), 35). [PubMed: 2236396]

Scher A, Asher R. Is attachment security related to sleep–wake regulation?: Mothers' reports and objective sleep recordings. Infant Behavior and Development. 2004; 27(3):288–302.

Scher A, Tirosh E, Lavie P. The relationship between sleep and temperament revisited: Evidence for 12-month-olds: A research note. Journal of Child Psychology and Psychiatry. 1998; 39(5):785–788. [PubMed: 9690941]

Sidor A, Fischer C, Eickhorst A, Cierpka M. Influence of early regulatory problems in infants on their development at 12 months: A longitudinal study in a high-risk sample. Child and Adolescent Psychiatry and Mental Health. 2013

Sinai D, Tikotzky L. Infant sleep, parental sleep and parenting stress in families of mothers on maternity leave and in families of working mothers. Infant Behavior and Development. 2012; 35(2):179–186. [PubMed: 22306183]

So K, Adamson TM, Horne RSC. The use of actigraphy for assessment of the development of sleep/wake patterns in infants during the first 12 months of life. Journal of Sleep Research. 2007; 16(2): 181–187. [PubMed: 17542948]

Spruyt K, Aitken RJ, So K, Charlton M, Adamson TM, Horne RS. Relationship between sleep/wake patterns, temperament and overall development in term infants over the first year of life. Early Human Development. 2008; 84(5):289–296. [PubMed: 17707119]

Tikotzky L, De Marcas G, Har-Toov J, Dollberg S, Bar-Haim Y, Sadeh A. Sleep and physical growth in infants during the first 6months. Journal of Sleep Research. 2010; 19(1-Part-I):103–110. [PubMed: 19840242]

Weinraub M, Bender RH, Friedman SL, Susman EJ, Knoke B, Bradley R, et al. Patterns of developmental change in infants' nighttime sleep awakenings from 6 through 36 months of age. Developmental Psychology. 2012; 48(6):1511–1528. [PubMed: 22448981]

Weissbluth M. Sleep duration and infant temperament. The Journal of Pediatrics. 1981; 99(5):817–819. [PubMed: 7299565]

Yoo K, Reeb-Sutherland BC. Effects of negative temperament on 5-month-old infants' behavior during the still-face paradigm. Infant Behavior and Development. 2013; 36(3):344–348. [PubMed: 23567487]

Highlights

- Numerous sleep outcomes were examined longitudinally across the first year of life.
- Temperament was related to sleep problems, sleep latency, and night wakefulness.
- Maternal stress was related to day sleep duration.
- Sex differences were found for sleep latency and night sleep duration.
- Infant and maternal characteristics affect sleep differentially.

Table 1

Sleep values for each variable from the BISQ at 5, 9, and 12 months and their correlations with negative reactivity and maternal stress at 5 months.

Sleep variable	Age (months)	Mean (SD)	Correlations (*r*)	
			Negative reactivity	Maternal stress
Night sleep duration (in hours)	5	9.50 (1.39) [*F* = 9.66 (1.31); *M* = 9.36 (1.47)]	0.19	−0.08
	9	9.93 (1.26) [*F* = 9.39 (1.26); *M* = 10.40 (1.07)]	0.03	0.04
	12	10.25 (1.02) [*F* = 10.01 (0.89); *M* = 10.46 (1.10)]	−0.11	−0.05
Day sleep duration (in hours)	5	3.45 (1.49) [*F* = 3.25 (1.51); *M* = 3.62 (1.49)]	0.03	0.25
	9	3.35 (1.31) [*F* = 3.28 (1.66); *M* = 3.40 (0.96)]	0.05	−0.08
	12	2.99 (1.04) [*F* = 2.97 (1.18); *M* = 3.00 (0.94)]	0.07	−0.10
Night wakings	5	1.24 (1.13) [*F* = 0.89 (0.81); *M* = 1.55 (1.29)]	0.16	0.12
	9	0.96 (0.95) [*F* = 1.00 (1.00); *M* = 0.93 (0.94)]	**0.40***	0.23
	12	0.91 (1.19) [*F* = 0.89 (1.37); *M* = 0.93 (1.04)]	0.21	0.01
Night wakefulness (in minutes)	5	39.32 (73.80) [*F* = 55.76 (107.12); *M* = 26.00 (21.94)]	0.12	−0.04
	9	23.87 (26.56) [*F* = 28.94 (31.32); *M* = 19.76 (21.94)]	**0.35***	0.05
	12	19.61 (29.57) [*F* = 24.53 (36.68); *M* = 15.62 (22.45)]	0.12	−0.01
Sleep latency (in minutes)	5	23.38 (21.70) [*F* = 27.33 (26.60); *M* = 20.00 (16.35)]	**0.49***	0.11
	9	20.36 (14.73) [*F* = 28.61 (17.05); *M* = 13.29 (7.16)]	0.24	0.04
	12	22.74 (17.47) [*F* = 28.61 (22.15); *M* = 17.71 (10.28)]	0.13	0.05
Extent of infant's sleep problems	5	1.15 (0.36) [*F* = 1.21 (0.42); *M* = 1.10 (0.30)]	−0.03	0.07
	9	1.25 (0.42) [*F* = 1.37 (0.50); *M* = 1.14 (0.48)]	**0.34***	−0.07
	12	1.23 (0.48) [*F* = 1.21 (0.42); *M* = 1.24 (0.54)]	0.20	0.03

F = females; *M* = males.

* $p < 0.05$.