Infant Sleep and Feeding Pattern: Effects on Maternal Sleep

Karen A. Thomas, RN, PhD, and Shuyuann Wang Foreman, RN, MS

Factors contributing to maternal sleep when infants are 4 to 10 weeks of age were examined. Twenty-four-hour sleep-wake diaries collected from 37 mother-infant dyads in the home environment were summarized to describe total, longest, and mean sleep period; synchrony of maternal and infant sleep; and feeding frequency and duration. Regression and post hoc analysis of variance were used to examine factors contributing to maternal and infant sleep. Maternal sleep is driven by infant sleep and feeding pattern. The minimum and maximum numbers of infant sleep episodes per day were 6 and 15, respectively, and mean infant total sleep was 13.47 hours (SD 1.73). Mean maternal total sleep was 7.18 hours (SD 1.51), with half of the mothers reporting less than 7 hours of sleep per 24 hours. Mean number of infant feedings was 11.14 (SD 3.27), with 11 infants (29.7%) receiving 13 or more feedings per 24 hours; minimum and maximum times per feeding were 15 and 41.7 minutes, respectively. Male infants had more sleep episodes, shorter sleep periods, and less sleep than females, and these gender differences resulted in shorter and more fragmented sleep for mothers. Findings suggest there is continued need for interventions to improve maternal sleep following childbearing. J Midwifery Womens Health 2005;50:399–404 © 2005 by the American College of Nurse-Midwives.

keywords: sleep, maternal behavior, maternal child nursing

INTRODUCTION

Infant sleep is characterized by multiple sleep and wake periods throughout the 24-hour day. In addition, metabolic demands and stomach volume necessitate frequent feedings. Consequently, nighttime sleep disruption among new mothers is a normative and accepted condition. Although reduced maternal sleep is widely recognized, this condition is persistent and pervasive, despite evidence of the deleterious effects of sleep loss. Understanding infant sleep pattern and the factors that contribute to maternal sleep provides the basis for interventions to improve functioning after childbirth. The purpose of this research was to explore factors contributing to sleep in mothers of 4- to 10-week-old infants. The specific aims of the project were to 1) describe maternal and infant sleep pattern, 2) examine the influence of feeding on the sleep-wake pattern of both mothers and infants, and 3) explore the effects of infant and maternal factors on maternal sleep.

Development of infant sleep-wake pattern is characterized by increasing organization of sleep states, decreased total sleep time, increased active and quiet waking, and increasing sleep in nighttime hours.[1] The infant's immature sleep-wake pattern is a primary concern among new mothers.[2] One in five parents of 5-month-old infants reported being distressed by their infant's sleep.[3] In another survey, 46% of mothers reported their 6- to 12-month-old infant's sleep as problematic.[2]

Mothers of infants typically experience sleep deprivation and sleep fragmentation.[4] Research has shown that the mean daily total sleep for mothers 4 weeks postpartum is 7.53 hours, with 6.15 hours (range 3.92–7.92) occurring during regular sleep time, compared with reported prepregnant average of 8.43 total hours of sleep.[5] Mothers experience a mean of 1.57 (range 0.67–2.5) nighttime sleep disruptions.[5] Mothers of 12- to 16-week-old infants have reported 6.75 hours of sleep per night.[6] In a study of 8 women, the postpartum period was characterized by a doubling in daytime sleepiness, decreased sleep efficiency, three times the amount of nighttime waking, and changes in electroencephalogram sleep architecture compared with the antepartum period.[7]

The consequences of maternal sleep loss and fragmented sleep have been documented in mothers' reports of postpartum fatigue.[8] Changes in sleep and rest have been identified as a source of postpartum stress.[9] The effects of sleep disruption are extensive. Sleep deprivation and fatigue are related to health problems, altered immune response, reduced job performance, mood alteration, decreased motivation, increased vehicular accidents, and short-term memory impairment.[10–12]

Sleep disruption is highly related to fatigue and depression after childbirth.[2,13] Infant feeding and sleeping difficulties contribute to postpartum depression.[14] Furthermore, depressed mothers exhibit early cessation of breastfeeding.[14] In one study of an intervention aimed at infants (less than 1 year) with sleep problems, improved infant sleep was associated with improvement of maternal mood and reduction of maternal depression.[15] These findings suggest that postpartum depression may, in part, reflect fatigue and mood change related to chronic sleep disruption.[15]

Sleep loss is an important consideration for employed mothers. In a study of female physician residents returning to work after maternity leave, sleep deprivation and fatigue were cited as frequent problems.[16] Work by Killien[17] has shown that depression and fatigue were associated with

Address correspondence to Karen A. Thomas, RN, PhD, Department of Family and Child Nursing, Box 357262, University of Washington, Seattle, WA 98195-7262. E-mail: kthomas@u.washington.edu

1526-9523/05/$30.00 • doi:10.1016/j.jmwh.2005.04.010

parenting stress and anxiety in mothers returning to work postpartum.

Failure of infant night sleep consolidation and waking at night are problems for infants and parents.[18] Parents mold their infant's sleep by structuring the environment and promoting self-regulation.[19,20] It is well established that child sleep problems begin early in life, tend to increase with age, and are highly dependent on parent behaviors that shape and reinforce early sleep patterns.[21] Sleep problems typically continue if not ameliorated, and sleep disturbance can affect child learning and behavior in addition to altering family function.[22] Infants with sleep problems often cry excessively. Persistent sleep-wake organization problems and crying are related to mothers' high physiological and psychosocial risk, depression, exhaustion, and marital distress.[23]

Maternal and infant sleep pattern are essential to health. In this study, factors contributing to maternal sleep were examined in mothers of 4- to 10-week-old infants. Research questions included the following: What are the sleep patterns exhibited by mothers and their infants? What is the effect of infant feeding pattern on both mother and infant sleep pattern? What factors influence maternal sleep?

STUDY DESIGN AND METHODS

Thirty-seven mother and infant pairs were studied by using an intensive within-subject design. Criteria for maternal participation included the following: age 18 to 40 years, primiparous, vaginal birth, and absence of antepartum or postpartum health problems. Infants were 38 to 42 weeks' gestation, 4 to 10 weeks' postnatal age, singleton birth, with no postnatal complications. The convenience sample was recruited through advertisements and flyers.

Maternal and infant sleep-wake patterns were recorded by the mother using the Sleep-Activity Record,[24] which is a diary form, completed by the mother, documenting both maternal and infant sleep. The Sleep-Activity Record divides the 24-hour day into 15-minute blocks of time. Mothers entered alphabetical codes to indicate maternal and infant activity (S = Sleep, A = Wake, C = Cry) for each 15-minute block of time. In addition, infant feeding episodes were recorded, and mothers noted periods of infant crying. When more than one state occurred within the 15-minute epoch, mothers were instructed to record the predominant state. The information recorded in sleep diaries are, in general, sensitive indicators of sleep time. Information in sleep-wake records compiled by parents correlate (r = 0.90) with sleep-wake states coded from videotapes.[25]

Because fatigue and depressive symptoms are intertwined, mothers were screened for postpartum depression using the Edinburgh Postnatal Depression Scale,[26,27] which is a 10-item instrument assessing maternal depression, with Likert scale responses (0–3) to questions such as "I have felt sad and miserable." Responses for the 10 items were totaled. Women scoring 13 or greater, the cutoff point for depression,[26] were not enrolled in the project. Infants were weighed by using an electronic portable scale accurate to 0.1 g (Smart Scale; Olympic Medical, Seattle, WA).

Subjects were recruited through flyers posted in midwifery and obstetric clinics as well as public locations and through advertisements in local maternal-infant newsletters. Study procedures were approved by the institutional human subjects review committee, and mothers provided written informed consent for participation. Home visits were scheduled after initial phone contact and screening. Home visits were not scheduled within 3 days of infants receiving immunizations. Mothers were instructed in use of the Sleep-Activity Record to record both their own and their infants' sleep-wake pattern, and data were recorded for a 24-hour period. A second home visit was made on the following day to collect the diaries.

Both infant and mother sleep and wake were coded as dichotomous data (0, 1) with 96 data points depicting sleep-wake pattern throughout the 24-hour period. Sleep onset and offset were determined (i.e., the time when subjects went to sleep and the time of awakening). Data were aggregated by subject, resulting in the following maternal and infant summary measures for the 24-hour period: number of sleep periods, number of feeding episodes, total sleep time (hours), duration of longest sleep period and mean sleep period (hours), and timing of longest sleep period. Stepwise linear regression was used to determine factors contributing to mothers' sleep, and infants' sleep and feeding patterns. Factors entered as independent variables included infant postnatal age, weight and weight gain, gender, type of feeding, feeding pattern, sleep pattern, infant cry, maternal age, and the Edinburgh Postnatal Depression Scale score. These factors were chosen on the basis of evidence from the literature as well as clinical experience. Post hoc analysis included analysis of variance.

RESULTS

Sample Description

Data were obtained from 37 mother-infant pairs (Table 1). Thirty of 37 (81.1%) infants were exclusively breastfed. Twenty-eight (75.7%) of the mothers were married, and 29 of 37 (78.4%) mothers were living with the father of the baby. Seven of the households involved in the study included one or more grandparents. Mean Edinburgh Postnatal Depression Scale total score was 4.76 (SD 2.87), reflecting a sample that was not experiencing postpartum depression. Two of the 37 mothers were working; one infant accompanied the mother to her job as a nanny, whereas the other mother worked at home.

Karen Thomas, PhD, RN, is Professor in the Department of Family and Child Nursing at the University of Washington in Seattle, Washington.

Shuyuann Wang Foreman, RN, MS, Ph(C), is a graduate student in the PhD in Nursing Science program at the University of Washington in Seattle, Washington.

Table 1. Sample Description (N = 37 Mother-Infant Pairs)

Characteristic	Value
Maternal age (y) (SD)	28.46 (5.56)
Gestation (wk) (SD)	39.85 (1.01)
Infant postnatal age (wk) (SD)	7.52 (2.11)
Infant weight (g) (SD)	5368 (858)
Infant gender (n) (%)	
Male	21 (56.8)
Female	16 (43.2)
Race and ethnicity (n) (%)	
Hispanic	5 (6.8)
Asian	6 (8.1)
African American	7 (9.5)
White	56 (75.6)
Feeding and sleeping methods (n) (%)	
Cosleep with mother	30 (81.1)
Exclusively breastfed	30 (81.1)

The majority of infants slept in their mothers' bedrooms (n = 30 [81.1%]). More than half of the infants (n = 19 [51.4%]) slept in the mothers' bed, whereas other infants who shared the mothers' bedroom slept predominantly in cribs, cradles, and bassinets. Breastfeeding was not the sole determinant of room sharing. Of the 30 exclusive breastfeeding infants, 24 (80%) shared the mothers' bedroom, and 6 of 7 mixed or bottle feeding infants shared the mothers' bedroom.

Maternal and Infant Sleep Wake Patterns

Descriptive information for sleep-wake pattern is provided in Table 2. Infants experienced an average of 9.35 sleep periods per 24 hours; however, the minimum and maximum (6 and 15, respectively) show evidence of considerable differences among infants. Infant longest sleep period and mean duration of sleep period were influenced by number of awakenings and feedings. Although one infant's longest sleep period was 8.75 hours, the mean longest sleep period was 4.17 hours (SD 1.57). Infant total sleep varied from 9.75 to 16.5 hours per 24 hours, mean 13.47 hours (SD 1.73).

Table 2. Description of Maternal and Infant Sleep-Wake and Feeding Pattern for 24-Hour Period (N = 37)

Variable	Mean (SD)	Min, Max
Mother		
Sleep periods	3.76 (1.36)	1, 6
Longest sleep period (h)	3.57 (1.37)	1.75, 8
Mean sleep period (h)	2.20 (0.98)	0.96, 4.75
Total sleep (h)	7.18 (1.51)	4.50, 10.50
Infant		
Sleep periods	9.35 (2.06)	6, 15
Longest sleep period (h)	4.17 (1.57)	2, 8.75
Mean sleep period (h)	1.47 (.38)	0.8, 2.32
Total sleep (h)	13.47 (1.73)	9.75, 16.5
Cry (h)	0.85 (0.77)	0.00, 3.50
Feeding episodes	11.14 (3.27)	6, 20
Time per feeding (min)	23.7 (7.05)	15, 41.7

Although mothers' mean total sleep was 7.18 hours (SD 1.51), this sleep was highly fragmented. Half of the mothers reported less than 7 hours of sleep per 24 hours. Mothers had far fewer sleep episodes than their infants, mean 3.76 hours (SD 1.36). Mothers' average longest sleep period was 3.57 hours (SD 1.37), and the minimum longest sleep episode was 1.75 hours. Twenty-nine (78.4%) of the infants experienced their longest sleep episode during nighttime hours (defined as 10 PM to 6 AM). However, beginning consolidation of infant sleep into nighttime hours did not translate to synchrony between mother and infant schedules. In only 17 subjects (45.9%) did mother and infant longest sleep periods occur jointly during nighttime hours (10 PM to 6 AM). Although developmental changes in infant sleep occur during the first weeks of life, there were no correlations between infant postnatal age and maternal total or nighttime sleep hours, infant total or nighttime sleep hours, and infant longest or average sleep period.

Infant Feeding Schedule

The mean number of infant feedings was 11.14 (SD 3.27) per 24 hours, although for some infants, a substantial portion of the day was occupied by feeding. Eleven infants (29.7%) received 13 or more feedings per 24 hours (maximum number of feedings = 20). The approximate mean time spent feeding per 24 hours was 4.4 hours (SD 1.6), minimum 1.5 hours, maximum 7.25 hours. To assist understanding of the influence of feeding pattern, time per feeding (feeding efficiency) was defined as the total feeding time per 24 hours divided by the number of feeding episodes. Minimum and maximum times per feeding were 15.0 and 41.7 minutes, respectively, mean 23.7 minutes (SD 7.05). Infants demonstrated variability in the amount of time required for each feeding, and amount of time and number of feedings shaped maternal sleep. Infant mean daily weight gain, expressed as percent increase from birth weight divided by postnatal age, was 0.95% (SD 0.29), minimum 0.14%, maximum 1.55%. There was a low nonstatistically significant correlation between number of feeding episodes per 24 hours and weight gain ($r = 0.28$). Thus, the infants receiving more feedings did not have the greatest weight gain. There were no differences in weight gain or feeding efficiency based on type of feeding. Mothers performed the majority of feedings and rarely did mothers sleep while the infant was fed by another person. There were 10 instances (representing 9 subjects) in the entire sample (412 total feedings) in which someone else fed the infant while the mother slept.

Factors Determining Maternal Sleep

Separate stepwise multiple regression analyses were run predicting infant feeding, infant sleep, and mother sleep. Results of regression analysis illustrate the statistically

Table 3. Predictors of Maternal and Infant Sleep Using Stepwise Regression (N = 37)

Dependent Variable	Independent Variable(s) Entered	R^2*	P
Mother total sleep (h)	Time per feeding Maternal age	0.261	.006
Mother longest sleep period (h)	Infant longest sleep period	0.446	.000
Mother mean sleep period (h)	Infant number of sleep episodes	0.249	.002
Mother number of sleep periods	Infant longest sleep episode	0.235	.002
Infant feeding episodes	Gender	0.167	.012
Infant total sleep (h)	Time per feeding Gender Weight gain % Feeding episodes Maternal age	0.638	.000
Infant longest sleep (h)	Feeding episodes	0.185	.008
Infant mean sleep (h)	Feeding episodes Weight gain % Gender	0.469	.000
Infant number of sleep periods	Feeding episodes	0.211	.004

R^2 and P = values for model. Source: Cohen.[34]

*R^2 of > .09 represents a medium effect, whereas an R^2 > .25 (i.e., explanation of >25% of the variance) is a large effect.

Table 4. Analysis of Variance of Gender Differences in Sleep Pattern (N = 37)

	Females (n = 16) Mean (SD)	Males (n = 21) Mean (SD)	P
Infant			
Feeding episodes	9.63 (1.93)	12.29 (3.64)	.012
Sleep periods	8.38 (1.09)	10.10 (2.32)	.010
Longest sleep period (h)	4.66 (1.68)	3.81 (1.42)	.106
Mean sleep period (h)	1.65 (0.29)	1.33 (0.39)	.010
Total sleep (h)	14.00 (1.66)	13.07 (1.71)	.106
Cry (h)	.92 (1.01)	.80 (.56)	.635
Weight gain (%)*	.852 (.24)	1.03 (.30)	.060
Mother			
Sleep periods	3.19 (1.11)	4.19 (1.40)	.024
Longest sleep period (h)	3.86 (1.16)	3.36 (1.50)	.275
Mean sleep period (h)	2.49 (1.02)	1.97 (.90)	.115
Total sleep (h)	7.05 (1.69)	7.29 (1.38)	.623

*Average percent weight increase per day.

significant factors contributing to infant feeding, sleep-wake pattern, and maternal sleep (Table 3). Maternal sleep is driven by infant feeding and sleep-wake pattern. The number of infant feedings increased the number of infant sleep periods and decreased infant total sleep, infant longest sleep period, and mean sleep period. Increased time per feeding (feeding efficiency) decreased both infant and maternal total sleep. The length of the infants' longest sleep period was directly related to duration of maternal longest sleep period and indirectly related to number of maternal sleep episodes. Infants with higher rate of weight gain had more total sleep and longer mean sleep duration. Maternal age was a significant predictor of mother and infant total sleep. Older mothers slept less and so did their infants. Infant gender was predictive of number of infant feeding episodes, total infant total sleep time, and mean sleep period. Male infants received more feedings per day, had less total sleep, and shorter mean sleep than female infants.

The effect of gender was further analyzed by using analysis of variance. Gender resulted in differences in both feeding and sleep-wake pattern (Table 4). Male infants had statistically significant more sleep episodes and shorter mean episode duration. Although not statistically different, duration of longest sleep period was shorter for males than female infants (4.66 versus 3.81 hours), and total sleep was less in male than female infants (13.07 versus 14.0 hours). Male infants received significantly more feedings than females (12.29 versus 9.63) per day. Total sleep time did not differ significantly between mothers of male and female infants. Although not statistically significant, compared with mothers of female infants, mothers of male infants tended to have shorter sleep periods (1.97 versus 2.49 hours) and shorter duration of the longest sleep period (3.36 versus 3.86 hours). None of the following variables showed differences based on gender: postnatal age, weight, maternal age, crying, or feeding efficiency. There was a small (nonstatistically significant) difference in weight gain, with male infants gaining slightly more weight per day than female infants (1.03% versus 0.85%).

Clinical Implications

Findings confirm sleep disruption experienced by mothers of young infants. Although mothers' total sleep time is similar to prior reports in the literature, infant total sleep (mean 13.47) was less than the average 16 to 17 hours per day reported in a classic study of infant sleep development.[28] Further descriptive research is needed to examine possible historic changes in infant sleep characteristics. Caution is required when interpreting results from this small sample; however, findings suggest that the increasing rate of sleeplessness in modern society may be reflected in infants as well as adults.[11] The high proportion of infants cosleeping with their mothers in this sample corresponds with other reports of this growing trend.[29] Future research should address the effect of cosleeping on both maternal and infant sleep pattern.

The finding that maternal sleep is dependent on infant sleep-wake and feeding patterns is not unexpected. Based on an understanding of sleep physiology and the sleep disruption experienced by new mothers, nursing goals include maximizing mothers' total sleep hours; pairing maternal longest sleep with the infant's longest sleep, resulting in consolidated sleep periods; and napping to compensate for sleep loss. The data confirm the fragmented

nature of maternal sleep. Mothers experienced far fewer sleep episodes than their infants, signifying that common advice to "sleep when your baby sleeps" is not being followed. The data suggest that the infants were beginning to demonstrate nighttime sleep consolidation; however, mothers did not take advantage of their infants' longest sleep period occurring during nighttime hours. It appeared that mothers frequently delayed going to bed after the start of their infant's nighttime sleep. Furthermore, mothers did not consistently nap during their infant's daytime sleep. Evidence from the sleep literature suggests that sleep-deprived individuals accept fatigue as normative. Despite sleep disturbance, napping occurs in only half of mothers of 12- to 16-week-old infants.[6] Mothers' perception of sleep disturbance was more predictive of daytime napping than actual total nighttime sleep.[6] In other words, mothers who thought their sleep was disturbed engaged in napping. Clinicians may be instrumental in assisting mothers to recognize and appreciate the effects of sleep disruption and in supporting maternal naps. On the basis of study findings, mothers may require additional encouragement to take advantage of the missed sleep opportunities, including attempting to sleep during the infant's longest nighttime sleep bout and napping during the infant's daytime sleep episodes.

Frequency of feeding and feeding efficiency impact maternal sleep. Approximately 30% of the infants received 13 or more feedings over the 24-hour period. Increased time per feeding was related to increased infant wake time and decreased infant sleep. Although infants may normally have periods of frequent feeding, a persistent pattern of frequent feedings may reflect problems with infant sucking, restricted milk supply in breastfeeding mothers, or misinterpretation of infant hunger and satiety cues. Use of a diary to assess feeding frequency and duration of feeding episodes may provide valuable clues to improve infant feeding and sleep and, consequently, improve mothers' sleep. Live observation of infant feeding may pinpoint positioning or infant sucking-swallow characteristics contributing to increased time per feeding.

Gender differences in sleep and related behaviors have been previously documented. Compared with females, male infants exhibit more motor movement,[30] less self-regulation,[31] and higher energy requirements.[32] Male infant sleep is characterized by less quiet sleep, more time out of crib during the night, and shorter sleep periods.[33] However, there are few reports showing that gender differences influence maternal sleep. The mothers of male infants had shorter sleep periods, and sleep was more fragmented because of their infants' higher feeding frequency, shorter sleep periods, and reduced total sleep. Education and anticipatory guidance regarding these gender differences may assist mothers' adaptation after childbirth.

Findings should be viewed in light of study limitations. The small convenience sample may not be generalizable to the larger population of postpartum women and their infants. Future research should incorporate a more ethnically and culturally diverse sample and include economic indicators. The study focused on mothers and infants at one point in time. Longitudinal research is needed to track maternal and infant sleep over time and to identify early infant sleep problems. Maternal diary reports of sleep could be augmented with actigraphy monitoring to improve measurement precision. In addition to the sleep record, additional data regarding maternal sleepiness and fatigue would strengthen the study. To aid clinicians in advising new mothers, future studies regarding maternal use of napping and means to maximize sleep are needed. Sample size did not allow analysis of the effect of sleep location and infant bed type. The effect of these variables, particularly infant cosleeping, requires further analysis. In addition, further knowledge of maternal support from spouses, partners, or other family members and effect of support on maternal sleep should be developed.

In summary, infant and maternal sleep are potentially problematic for many mother-infant dyads. Maternal nighttime sleep is reduced in quantity and fragmented. High infant feeding frequency and increased time per feeding further contribute to impaired maternal sleep. Gender-based differences in sleep organization translate into shorter maternal sleep periods and more fragmented sleep. Total amount of maternal sleep and increasing sleep occurring in nighttime hours could be improved by more frequent napping and coordinating nighttime sleep with infant's emerging nighttime consolidation of sleep. Sleep-wake diaries provide important information used to evaluate maternal and infant sleep and to plan appropriate nursing interventions to improve sleep. Sleep hygiene is an important consideration in providing care to mothers and their infants.

This study was funded by grant K01-NR00167 awarded by the National Institute for Nursing Research.

REFERENCES

1. Louis J, Cannard C, Bastuji H, Challamel MJ. Sleep ontogenesis revisited: A longitudinal 24-hour home polygraphic study on 15 normal infants during the first two years of life. Sleep 1997;20:323–33.

2. Hiscock H, Wake M. Infant sleep problems and postnatal depression: A community-based study. Pediatrics 2001;107:1317–22.

3. Wolke D, Sohne B, Riegel K, Ohrt B, Osterlund K. An epidemiologic longitudinal study of sleeping problems and feeding experience of preterm and term children in southern Finland: Comparison with a southern German population sample. J Pediatr 1998;133:224–31.

4. Lee KA, McEnany G, Zaffke ME. REM sleep and mood state in childbearing women: Sleepy or weepy? Sleep 2000;23:877–85.

5. Quillin SIM. Infant and mother sleep patterns during 4th postpartum week. Issues Compr Pediatr Nurs 1997;20:115–23.

6. Cottrell L, Karraker KH. Correlates of nap taking in mothers of young infants. J Sleep Res 2002;11:209–12.

7. Nishihara K, Horiuchi S. Changes in sleep patterns of young

women from late pregnancy to postpartum: Relationships to their infants' movements. Percept Mot Skills 1998;87:1043–56.

8. Wambach KA. Maternal fatigue in breastfeeding primiparae during the first nine weeks postpartum. J Hum Lact 1998;14:219–29.

9. Horowitz JA, Damato EG. Mother's perceptions of postpartum stress and satisfaction. J Obstet Gynecol Neonatal Nurs 1999;28:595–605.

10. Giam GC. Effects of sleep deprivation with reference to military operations. Ann Acad Med Singapore 1997;26:88–93.

11. Bonnet MH, Arand DL. We are chronically sleep deprived. Sleep 1995;18:908–11.

12. Van Dongen HPA, Maislin G, Mullington JM, Dinges DF. The cumulative cost of additional wakefulness: dose-response effects on neurobehavioral functions and sleep physiology from chronic sleep restriction and total sleep deprivation. Sleep 2003;26:117–26.

13. Lam P, Hiscock H, Wake M. Outcomes of infant sleep problems: A longitudinal study of sleep, behavior, and maternal well-being. Pediatrics 2003;111:e7–e203.

14. Righetti-Veltema M, Conne-Perreard E, Bousquet A, Manzano J. Postpartum depression and mother-infant relationship at 3 months old. J Affect Disord 2002;70:291–306.

15. Armstrong KL, Van Haeringen AR, Dadds MR, Cash R. Sleep deprivation or postnatal depression in later infancy: Separating the chicken from the egg. J Paediatr Child Health 1998;34:260–2.

16. Gjerdingen DK, Chaloner KM, Vanderscoff JA. Family practice residents' maternity leave experiences and benefits. Fam Med 1995;27:512–8.

17. Killien MG. Postpartum return to work: Mothering stress, anxiety, and gratification. Can J Nurs Res 1998;30:53–66.

18. Anders TF. Infant sleep, nighttime relationships, and attachment. Psychiatry 1994;57:11–21.

19. Thunstrom M. Severe sleep problems among infants in a normal population in Sweden: Prevalence, severity and correlates. Acta Pædiatr 1999;88:1356–63.

20. Nishihara K, Horiuchi S, Eto H, Uchida S. The development of infants' circadian rest-activity rhythm and mothers' rhythm. Physiol Behav 2002;77:91–8.

21. Sadeh A. Assessment of intervention for infant night waking: Parental reports and activity-based home monitoring. J Consult Clin Psychol 1994;62:63–8.

22. Stores G. Children's sleep disorders: Modern approaches, developmental effects, and children at special risk. Dev Med Child Neurol 1999;41:568–73.

23. Papousek M, von Hofacker N. Persistent crying in early infancy: A non-trivial condition of risk for the developing mother-infant relationship. Child Care Health Dev 1998;24:395–424.

24. Beginning rhythms: The emerging process of sleep wake behavior and self-regulation. Seattle (WA): NCAST, University of Washington, 1999.

25. Anders TF. A longitudinal study of sleep-wake pattern development during the first year of life. San Diego (CA): Academy of Child Psychiatry, 1978.

26. Harris B, Huckle P, Thomas R, Johns S, Fung H. The use of rating scales to identify post-natal depression. Br J Psychiatry 1989;154:813–7.

27. Cox JL, Holden JM, Sagovsky R. Detection of postnatal depression. Development of the 10-item Edinburgh Postnatal Depression Scale [see comments]. Br J Psychiatry 1987;150:782–6.

28. Parmelee AH, Stern E. Development of states in infants. In Clemente CD, Purpura DP, Mayer FE eds. Sleep and the maturing nervous system. New York: Academic Press, 1972:199–219.

29. Willinger M, Ko CW, Hoffman HJ, Kessler RC, Corwin MJ. Trends in infant bed sharing in the United States, 1993–2000: the National Infant Sleep Position study. Arch Pediatr Adolesc Med 2003;157:43–9.

30. Almli CR, Ball RH, Wheeler ME. Human fetal and neonatal movement patterns: Gender differences and fetal-to-neonatal continuity. Dev Psychobiol 2001;38:252–73.

31. Lundqvist-Persson C. Correlation between level of self-regulation in the newborn infant and developmental status at two years of age. Acta Paediatr 2001;90:345–50.

32. Butte NF, Wong WW, Hopkinson JM, Heinz CJ, Mehta NR, Smith EO. Energy requirements derived from total energy expenditure and energy deposition during the first 2 y of life. Am J Clin Nutr 2000;72:1558–69.

33. Goodlin-Jones BL, Burnham MM, Gaylor EE, Anders TF. Night waking, sleep-wake organization, and self-soothing in the first year of life. J Dev Behav Pediatr 2001;22:226–33.

34. Cohen J. Statistical analysis for the behavior sciences, second edition. Hillsdale (NJ): Lawrence Erlbaum, 1988.