

## Maternal Sleep-Related Cognitions and Infant Sleep: A Longitudinal Study From Pregnancy Through the 1st Year

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Infant sleep is a major source of concern for many parents. The aims of this longitudinal study were to assess: (a) the development of sleep patterns among infants, (b) the development of maternal cognitions regarding infant sleep, and (c) the relations between these domains during the 1st year of life. Eighty-five mothers were recruited during pregnancy and completed a questionnaire aimed at assessing maternal sleep-related cognitions. After delivery (at 1, 6, and 12 months) sleep was assessed using actigraphy and sleep logs, and maternal cognitions were reassessed. The findings demonstrated significant predictive and concomitant links between maternal cognitions and infant sleep. Maternal soothing behaviors mediated the relations between these domains.

The present study focuses on the relations between infant sleep and maternal cognitions related to infant sleep. The study is theoretically based on a transactional model (Sadeh & Anders, 1993; Sameroff, 1989) that assumes that there are dynamic and bidirectional influences between children's behavior and symptoms (e.g., infant sleep problems) and their social environment (e.g., parental behaviors and cognitions).

### *Development of Sleep During the 1st Year*

During the 1st year of life, infant sleep develops rapidly. The most prominent features of this developmental process are the gradual reduction in sleep duration and the consolidation of sleep during the night (Anders & Keener, 1985; Mirmiran, Baldwin, & Ariagno, 2003). Although most infants attain this goal of consolidated sleep during the 1st year of life (Anders, Halpern, & Hua, 1992; Bernal, 1973), different studies have shown that the sleep of as much as 20%–30% in all infants continues to be fragmented as manifested by multiple and/or prolonged night wakings (Adair, Zuckerman, Bauchner, Philipp, & Levenson, 1992; Mindell, 1993; Mindell, Kuhn,

Lewin, Meltzer, & Sadeh, 2006). However, it is important to emphasize that night wakings are a natural phenomenon characteristic for most infants and children. In fact, the main factor discriminating between infants who “sleep through the night” and poor sleepers is the self-soothing capacity to resume sleep without alerting their parents by crying (Adair et al., 1992; Minde et al., 1993; Sadeh, Flint-Ofir, Tirosh, & Tikotzky, 2007; Sadeh, Lavie, Scher, Tirosh, & Epstein, 1991). It has been demonstrated that sleep difficulties in early childhood may be very persistent (Kataria, Swanson, & Trevathan, 1987; Zuckerman, Stevenson, & Bailey, 1987) and may place a significant burden on family functioning (Hiscock & Wake, 2002; Siskind, 1997).

Infant sleep is influenced by a variety of physiological and psychosocial factors (Mindell, 1993; Sadeh & Anders, 1993). From the psychosocial perspective it has been demonstrated that infant sleep is very vulnerable to stress and trauma (Sadeh, 1996b) and particularly to familial stressors such as mother–infant separation (Field, 1991). Maternal psychopathology (particularly depression), insecure attachment, and separation difficulties have been linked to infant sleep problems as well (Dennis & Ross, 2005; Van Tassel, 1985; Zuckerman et al., 1987). Studies have consistently demonstrated that there are very strong links between parent–infant bedtime and nighttime interactions and infant sleep

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patterns. It appears that infants of parents who are active soothers and more involved in settling their infant to sleep, present more night waking problems, compared with infants who developed self-soothing skills (Adair, Bauchner, Philipp, Levenson, & Zuckerman, 1991; Burnham, Goodlin-Jones, Gaylor, & Anders, 2002; Johnson, 1991; Van Tassel, 1985). These links could result from a direct effect of parental behavior on infant sleep but the opposite causal link (i.e., infants with difficult temperament and sleep disruptions demand more parental involvement during the night) cannot be ruled out (Sadeh & Anders, 1993).

The driving role of parents has been established by prevention studies that have demonstrated that changing parental knowledge on infant sleep prior to the child's birth can prevent infant sleep problems (Kerr, Jowett, & Smith, 1996; Wolfson, Lacks, & Futterman, 1992). Moreover, clinical studies on behavioral interventions for clinical management of sleep problems have consistently demonstrated that using parents as the main "agents" of change produces reliable and durable changes in infant sleep. Specifically, it has been shown that an infant's sleep can improve dramatically when parents succeed in reducing their bedtime and nighttime involvement (Mindell et al., 2006; Sadeh, 2005). However, it is important to emphasize that there is a theoretical debate regarding the consequences of these interventions for the infants' socioemotional development. For example, McKenna has published a series of articles in which he argues that expecting infants to self-soothe and to sleep separately from their parents runs counter to the infant's basic biological and emotional needs (McKenna, Ball, & Gettler, 2007; McKenna & Volpe, 2007).

#### *The Role of Parental Cognitions in Child Development and in Infant Sleep*

During the last two decades, there has been an emerging focus on the role of cognitions in family life and an increasing attention to the links between these cognitions and the actions and emotions of family members (Bugental & Johnston, 2000; Holden & Edwards, 1989; Miller, 1995). Parental cognitions regarding child behavior have been associated with child behavior. It is assumed that the influence parental cognitions have on child behavior is mediated through the way parents behave and react to the child (Bugental & Johnston, 2000; Gottman, Katz, & Hooven, 1996; Joiner & Wagner, 1996; Miller, 1995).

Extensive research has demonstrated the links between infant sleep problems and excessive parental involvement during bedtime and during the night. However, only a few studies have tried to explore factors that lead parents to be more actively involved. Clinical experience suggests that many parents find it difficult to reduce their involvement at night because they perceive it as insensitive, neglectful, or even abusive to the child. This is especially true when parents interpret their infant's crying at night as a sign of anxiety or distress (Sadeh, 2005; Siskind, 1997). These issues imply that parental cognitions related to infant sleep may influence the type and amount of parental involvement during the night (Sadeh, 2005). However, only a few studies directly examined the links between infant sleep and parental cognitions (Morrell, 1999; Morrell & Steele, 2003; Sadeh et al., 2007; Toselli, Farneti, and Salzarulo, 1995). Benoit, Zeanah, Parker, Nicholson, and Coolbear (1997) demonstrated that mothers of sleep-disturbed infants held unbalanced and more disengaged perceptions about their infants in comparison with mothers of infants without sleep problems. Morrell (1999) found that reported infant sleep problems were significantly correlated with maternal cognition related to difficulty with limit setting, increased doubts regarding parenting competence, and increased anger at the infant's demands. A follow-up study conducted 1 year later found that the most relevant factors for concurrent sleep problems were maternal cognition about setting limits and fussy difficult temperament (Morrell & Steele, 2003).

A recent study assessed the links between infant sleep and parental sleep-related cognitions in clinical and control samples (Sadeh et al., 2007). In this study, sleep of all infants was monitored for 1 week with both objective (actigraphs) and subjective (parental reports) measures. Both mothers and fathers completed two questionnaires testing their cognitions about infant sleep. The results demonstrated significant group differences with regard to parental cognitions. For example, when asked directly about their cognitions regarding their own child, parents of sleep-disturbed infants reported more concerns and difficulties with limit-setting than the control parents (Sadeh et al., 2007).

#### *Cultural and Social Influences on Infant Sleep and Related Parental Cognitions*

Parental practice, expectations, and cognitions regarding infant sleep and the definition of what constitutes a sleep problem vary vastly according

to culturally based values, ethnic background, and socioeconomic status. For example, solitary sleeping (vs. cosleeping) is the norm in the Western society but not in other cultures around the world (Jenni & O'Connor, 2005; Lozoff, 1995; McKenna & Volpe, 2007).

Israel, where the present study was conducted, consists of a variety of ethnic groups, originating from different cultural backgrounds. To the best of our knowledge, only one study assessed whether there are differences in sleep patterns of infants and young children between different sociocultural groups in Israel. However, in that study no significant differences between the groups were found in the number of night wakings, or in settling and comforting strategies. Moreover, the authors reported that the cultural norms and expectations concerning infant sleep patterns and sleeping arrangements and the prevalence of night wakings as reported by the Israeli mothers were very similar to those of other western societies (Scher et al., 1995).

#### *Study Goals and Hypotheses*

The present study was aimed to facilitate the understanding of the links between maternal cognitions and infant sleep in a sample of normal, nonreferred, solitary sleeping infants. A longitudinal design starting at pregnancy (to represent "pure" anticipatory cognitions unrelated to the real future characteristics of the infant) was used to assess maternal cognitions and infant sleep during the 1st year of life. As clinical experience and (preliminary) scientific findings demonstrate that a major issue arising in this context is the parents' difficulty in limiting their involvement in reaction to what they interpret as infant distress upon awakening, the present study focused on cognitions relevant to this issue. We examined whether maternal cognitions vis-à-vis infant distress and limiting parental involvement at night predict parental behaviors at night and the development of infant sleep.

The main aims of this study were to assess: (a) the development of infant sleep patterns using objective and subjective methods, (b) the development of maternal sleep-related cognitions, and (c) the relations between infant sleep patterns and maternal sleep-related cognitions during the 1st year of life.

We predicted concomitant and predictive correlations between maternal cognitions and infant sleep: maternal cognitions emphasizing the infants' distress at night and the need to directly soothe

them would be associated with more disturbed sleep, while maternal cognitions emphasizing the importance of infant self-soothing at night and of limiting parental responses to infant night wakings would be associated with more consolidated sleep. In addition, we hypothesized that parental soothing techniques would serve as a mediating variable between maternal cognition and infant sleep; when mothers put more emphasis on infant's distress the parents are more likely to use active soothing techniques, while increased use of these techniques would be related to more disturbed sleep. Finally, we predicted that the links between infant sleep and maternal cognitions would be bidirectional, and therefore infant sleep would predict maternal cognitions as well.

## **Method**

### *Participants*

Eighty-nine expectant couples were recruited for this study during the third trimester of pregnancy, and all were expecting their first child. Because of methodological considerations this report focuses only on data related to the mothers and the infants. Most mothers were recruited through prenatal courses or announcements on Internet forums for expectant parents. Four mothers dropped out after the 1-month stage because of lack of motivation. There was no attrition thereafter. Therefore, the final sample included 85 infants (51 male and 34 female) and their mothers. According to self-reports none of the mothers suffered from health complications following the birth (beyond normal recovery from caesarean section); furthermore, maternal psychopathology was screened by the Hebrew version of the Brief Symptom Inventory (Derogatis & Melisaratos, 1983). None of the mothers met the Israeli cutoff scores (Gilbar & Ben-Zur, 2002). Only mothers with full mastery of Hebrew participated. The sample was composed of middle to upper socioeconomic status (SES) Jewish families (five religious). All mothers were married (except for one unmarried mother who lived with her infant's biological father). Most mothers were young and well educated. Mean age of mothers was  $29.4 \pm 3.1$  (range = 21–37). Mean mother's education (years) was  $16.1 \pm 2.1$  (range = 12–22). Mean number of rooms at home was  $3.3 \pm 0.8$  (range = 2–6). These characteristics represent the middle to upper SES in Israel.

Preterm infants (born before the gestational age of 36 weeks) were excluded from the study. Mean

gestational age (weeks) was  $39.4 \pm 1.5$  and mean birth weight (kg) was  $3.3 \pm 0.4$  (range = 2.3–4.2). All infants were screened for medical problems including breathing-related sleep problems. According to maternal reports, three infants developed breathing problems and allergies during the year, which may exert negative influence on sleep. Because these infants did not demonstrate poorer sleep patterns compared with the averaged sleep patterns of the whole sample, they were included in the final sample.

At the age of 1 month, all the infants but one were taken care of by their mother at home and 71% of them were fully nursed. At 6 months 29% were completely home-reared with their mothers, and 71% were in day care (babysitter or nursery). Thirty-one percent of the infants were fully nursed. At 12 months, only 8% of the infants were completely home-reared with their mothers and 92% were in day care (babysitter or nursery). Two infants were still fully nursed.

#### *Procedure*

The study was approved by the Institutional Ethical Committee (the university's committee and the Helsinki Committee of the hospital where some of the couples were recruited). All mothers signed informed consent during the pregnancy phase. During the recruitment procedure, the expectant couples received a 10-min explanation about the importance of sleep during infancy and about the study's general aims and procedures. After signing the informed consent, the mothers were asked (during the third trimester of pregnancy) to complete a family background questionnaire and a hypothetical case description questionnaire (Infant Sleep Vignettes Interpretation Scale [ISVIS]) aimed at assessing parental sleep-related cognitions. After delivery, infant sleep and maternal cognitions were assessed three times: at the ages of 1, 6, and 12 months. All infants were assessed in good health. In case of appearance of an acute health problem (e.g., cold, flu) during the assessment week, the infants were reassessed after recovery.

Sleep was assessed by actigraphy and daily parental reports for 4 days at the ages of 6 and 12 months and by the Brief Infant Sleep Questionnaire (BISQ) at the ages of 1, 6, and 12 months. Maternal cognitions were reassessed by the ISVIS. In addition, questions about soothing were included in the daily parental reports to evaluate how parents soothe their children to sleep. All the questionnaires were completed at home during the

sleep assessment period. Parents received a graphic report on their infant's sleep patterns and a gift (value of about \$10) after completion of each stage.

#### *Instruments and Measures*

##### *Sleep Assessment*

*Actigraphy.* Actigraphy has been established during the last decade as a valid and reliable method for studying and assessing sleep-wake patterns in infants, children, and adults (Ancoli-Israel et al., 2003; Sadeh, 1994, 1996; Sadeh, Acebo, Seifer, Aytur, & Carskadon, 1995; Sadeh, Hauri, Kripke, & Lavie, 1995; Sadeh et al., 1991). Actigraphy is based on a miniature wristwatch-like device attached to the infant's ankle during the recording period. The device continuously records body motility data for extended periods (e.g., more than a week) with no interference with the child's natural sleep environment. In the present study we used the miniature actigraph (Ambulatory Monitoring Inc., Ardsley, NY), with amplifier setting 18 and a 1-min epoch interval according to the standard working mode for sleep-wake scoring.

Actigraphic sleep measures included: (a) sleep onset time—the 1st minute of the first consecutive 15 min of sleep after bedtime, (b) total sleep period from sleep onset time to morning awakening time, (c) morning awakening time, (d) sleep percent—percent of true sleep time (excluding wakefulness during the night) from total sleep period, and (e) number of night wakings (lasting 5 min or longer). The Actigraphic Sleep Analysis (ASA) program was used to score the data based on validated sleep-wake scoring algorithm for infants (Sadeh, Acebo, et al., 1995).

*Sleep diary.* The sleep diary has been developed for clinical and developmental research on infant sleep (Sadeh, 1994, 1996a). To assess infants' sleep from a parental perspective, parents were asked to complete a daily report on their infant's sleep patterns. Parents were instructed to report any night-waking they were aware of and its length. In addition, they were asked to describe their soothing behavior at each awakening. The derived measures included: (a) sleep onset time, (b) sleep location, (c) night wakings—reported number of wakings (of any length) during nocturnal sleep, and (d) sleep latency—reported length of time it took the child to fall asleep.

*BISQ.* The BISQ is a sleep questionnaire aimed at assessing the infant's averaged sleep patterns. The parents are instructed to refer to their infant's

regular sleep patterns. The questionnaire was validated in a previous study and its measures were found to be highly correlated with the sleep diary and actigraphic measures (Sadeh, 2004). The derived measures are: (a) sleep onset time, (b) nocturnal sleep duration, (c) daytime sleep duration, (d) number of night wakings, and (e) sleep latency—reported length of time it took the child to fall asleep.

#### *Assessment of Maternal Sleep-Related Cognitions*

*ISVIS*. This questionnaire was described in detail and validated in a previous study (Sadeh et al., 2007). Good internal reliability based on Cronbach's alpha of above .90 was found for its scales. The *ISVIS* includes 14 hypothetical case descriptions of infants who display behavioral sleep problems (find it difficult to fall asleep and resume sleep by themselves). After each description the parents are asked to rate (on a 6-point Likert-type scale from highly disagree to highly agree) their agreement with three different assertions reflecting possible interpretations of the sleep problem. In the present study we analyzed only two scales representing the following categories: (a) Distress—assertions that represent parental belief that infants experience distress or anxiety upon awakening and parents should therefore directly help or soothe them at night and (b) Limits—assertions that emphasize the importance of limiting parental involvement at night and focus on encouraging infants to learn self-soothing without or with minimal parental assistance. The third scale assessing interpretations related to infant temperament was not analyzed in this study.

#### *Assessment of Parental Soothing Patterns*

The assessment of parental soothing at bedtime and during the night was based on rating scales included in the sleep diary. The *bedtime* soothing scale was built to describe the way parents help their child to fall asleep. This scale includes five options ordering from *low involvement* (1) to *high involvement* (5). The options include: (a) in crib, by himself or herself, without a caregiver's help; (b) in crib with parent's passive presence (without talking, touching, etc.); (c) in crib with brief parental help for less than 2 min; (d) in crib with parental extended help; (e) while nursing, feeding, drinking or outside the crib with a caregiver's active help; or (f) falling asleep in parents' bed. Mothers were asked to mark all options related to the way they

help their child fall asleep. If they marked more than one option then their highest involvement option was entered into the analysis. The night-to-night stability (based on internight correlations) of these measures was .60 at 6 months and .68 at 12 months. The stability from 6 months to 12 months was .43. For each period, the score was averaged across the nights.

A similar scale was built for soothing during the *night*. Options included: (a) passive parental presence; (b) drink or brief parental help in crib for less than 2 min; (c) extended parental help in crib; (d) nursing, feeding, or soothing outside the crib; or (e) soothing in parents' bed. The night-to-night stability (based on internight correlations) of these measures was .81 at 6 months and .61 at 12 months. The stability from 6 months to 12 months was .25.

## Results

The findings are divided into two main sections: (a) developmental changes in infant sleep and maternal cognitions—analysis of variance (ANOVA) was used in order to examine these changes; and (b) relations between infant sleep and maternal sleep-related cognitions. Pearson correlations and structural equation modeling (SEM) were performed to test the predictive and concomitant links between the variables. There were less than 5% missing data for major measures of interest and they were replaced by the relevant group means in the multivariable analyses (Widaman, 2006).

#### *Development of Infant Sleep*

The findings regarding the development of infant sleep are based on three measures: actigraphy, parental sleep diaries, and the BISQ. The daily measures of actigraphy and parental diaries were averaged across the period of monitoring. To assess the development of infant sleep, ANOVA with period (age of the infant) as the repeated independent variable was conducted. No significant sex effects were found on any of the infant sleep measures, and the results for boys and girls are reported together. Data on the sleep parameters are presented in Table 1.

#### *Parental Reports on Infant Sleep*

According to the BISQ (averaged sleep patterns reported by the mothers), total sleep duration decreased significantly from 1 to 6 months, resulting from the sharp decrease in napping. Napping

Table 1  
Means, Standard Deviations, and F Values of the Sleep Parameters,  $n = 85$

	1 month		6 months		12 months		F
	M	SD	M	SD	M	SD	
Reported sleep measures—BISQ							
Fall asleep time	22.30 <sup>a</sup>	1.46	20.66 <sup>b</sup>	1.17	20.52 <sup>b</sup>	0.72	78.17***
Sleep duration (hr in 24-h)	14.13 <sup>a</sup>	2.35	12.86 <sup>b</sup>	1.39	12.39 <sup>b</sup>	1.05	20.35***
Napping (hr)	6.41 <sup>a</sup>	1.73	3.22 <sup>b</sup>	1.16	2.45 <sup>c</sup>	0.64	228.26***
Sleep latency (min)	40.31 <sup>a</sup>	33.18	21.54 <sup>b</sup>	16.5	18.12 <sup>b</sup>	13.25	19.25***
Nocturnal wakefulness (hr)	2.35 <sup>a</sup>	1.16	0.66 <sup>b</sup>	0.59	0.28 <sup>c</sup>	0.38	146.47***
Night wakings (no.)	2.61 <sup>a</sup>	0.99	2.09 <sup>b</sup>	1.81	1.62 <sup>c</sup>	1.14	14.21***
Reported sleep measures—diaries							
Lights-off time	NA		21.05	1.15	20.95	0.87	1.63
Sleep latency (min)	NA		19.2	12.29	16.95	9.98	1.76
Night wakings (no.)	NA		2.67	1.91	1.75	1.23	16.46***
Actigraphic sleep measures							
Sleep onset time	NA		21.11	1.15	21.08	0.77	0.45
Sleep period (hr)	NA		9.82	1.03	9.87	0.84	0.03
Night wakings (no.)	NA		1.69	1.05	1.26	0.87	12.48**
Sleep percent (%)	NA		94.28	3.95	95.88	2.99	13.91**

Note. Means with different superscript letters (a, b, c) are significantly different. BISQ = Brief Infant Sleep Questionnaire.  
\*\* $p < .01$ . \*\*\* $p < .001$ .

continued to decrease from 6 to 12 months. Time spent in wakefulness during the night decreased significantly across the 1st year and so did the number of night wakings. Parental daily reports (diaries) also indicated a significant decrease in the number of infant night wakings from 6 to 12 months.

Mothers reported (on the BISQ) that at the age of 6 months none of the infants were sharing a bed with their parents. At 12 months, 2 infants were cosleeping on a regular basis with their parents. In addition, at 6 and 12 months only 58% of the mothers reported that they did not consider the sleep of their infants to be problematic.

#### Actigraphy Measures

Significant effects were found on the actigraphic measures that reflect sleep quality; at the age of 12 months, infants had a lower number of night wakings than 6-month-old infants, and a higher sleep percent. No significant differences in sleep schedule measures (sleep duration, sleep onset time) were found from 6 to 12 months.

#### Developmental Changes in Maternal Cognitions

Good internal reliability based on Cronbach's alpha of .93 was found for the Distress and the Limits scales in the present study. To assess the

developmental changes in maternal cognitions on the ISVIS, repeated ANOVA was performed, with period as the within independent variable (pregnancy, 1, 6, and 12 months). The specific cognitions scales served as dependent variables. Because there were no significant differences between mothers of boys and mothers of girls, the results are reported for the combined sample, and sex was not included in subsequent analyses.

Significant period effects were found for the ISVIS Limits scale,  $F(3, 82) = 3.79$ ,  $p < .05$ . A post hoc (Duncan) analysis revealed that a statistically significant change occurred between the pregnancy and 12-month periods and between the 1- and 6-month periods of assessment. At pregnancy and 12 months, mothers emphasized more the importance of limiting parental nighttime involvement than at 1 and 6 months (see Table 2 for means and standard deviations).

#### Correlations Between Maternal Cognitions and Infant Sleep

The main aim of this study was to assess the links between maternal cognitions (pregnancy, 1, 6, and 12 months) and infant sleep quality (6 and 12 months). In order to assess these associations, Pearson correlations were first calculated between the ISVIS Distress and Limits scales of the mothers, and between the number of night wakings

Table 2  
Means, Standard Deviations, and F values of the ISVIS, n = 85

	Pregnancy		1 month		6 months		12 months		F
	M	SD	M	SD	M	SD	M	SD	
Distress	3.84	0.74	3.98	0.74	4.01	0.79	3.92	0.79	2.32
Limits	3.51 <sup>a</sup>	0.79	3.28 <sup>b</sup>	0.82	3.30 <sup>b</sup>	0.84	3.42 <sup>a</sup>	0.92	3.79*

Note. Means with different superscript letters (a, b) are significantly different. ISVIS = Infant Sleep Vignettes Interpretation Scale.  
\*p < .05.

(according to the actigraph, maternal diaries, and the BISQ). These correlations are presented in Table 3.

As expected, the findings demonstrated significant predictive and concomitant links between maternal cognitions and infant sleep. Predictive links were found mainly between maternal early cognitions and between infant sleep at 6 months. For example, maternal cognitions at pregnancy emphasizing the infant’s distress and need for help at night predicted more disturbed infant sleep at

the age of 6 months as reflected by a higher number of objective and reported night wakings. Similar associations were found for the concomitant links at 6 month of age. Predictive and concomitant correlations were found also between maternal cognitions at 6 and 12 months and between the subjective infant sleep measures at 12 months.

*Parental Soothing Behavior and Its Associations With Maternal Cognitions and Infant Sleep*

To examine the role of parental soothing patterns, Pearson correlations were calculated between maternal cognitions and parental soothing behavior, and between parental soothing behaviors and infant sleep.

*Maternal Cognitions and Parental Soothing*

Table 3 also presents the correlations between maternal cognitions and parental soothing behavior at bedtime and at night. Overall, the correlations reflect concomitant and predictive associations between maternal cognitions and parental soothing

Table 3  
Pearson Correlations Between the Main Variables of the Study, n = 85

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
ISVIS																	
1. Pregnancy Distress	—																
2. Pregnancy Limits	-.81***	—															
3. 1 month Distress	.61***	-.46***	—														
4. 1 month Limits	-.62***	.63***	-.76***	—													
5. 6 months Distress	.52***	-.39***	.62***	-.61***	—												
6. 6 months Limits	-.46***	.51***	-.55***	.72***	-.81***	—											
7. 12 months Distress	.23*	-.21	.49***	-.48***	.59***	-.60***	—										
8. 12 months Limits	-.23*	.26*	-.46***	.58***	-.55***	.69***	-.78***	—									
Soothing																	
9. 6 months BT	.37***	-.30**	.22	-.34**	.29**	-.41***	.06	-.15	—								
10. 6 months NT	.19	-.14	.06	-.17	.24*	-.23*	.02	-.14	.50***	—							
11. 12 months BT	.22	-.26*	.34**	-.26*	.40***	-.42***	.28*	-.25*	.43***	.30**	—						
12. 6 months NT	.21	-.16	.03	-.07	.13	-.10	.06	.01	.16	.27*	.16	—					
Sleep																	
13. 6 months ActW	.27*	-.17	.12	-.20	.34**	-.32**	.07	-.09	.34**	.45***	.05	.24*	—				
14. 6 months RepW	.31***	-.23*	.29**	-.32**	.24*	-.28**	.03	-.04	.38***	.14	.12	.01	.55***	—			
15. 6 months BisqW	.21*	-.10	.13	-.20	.10	-.15	-.10	.04	.22	.12	-.07	.10	.51***	.72***	—		
16. 12 months ActW	.01	.07	-.10	.07	.16	-.12	.12	-.04	.06	.16	.17	.14	.39***	.09	.10	—	
17. 12 months RepW	.22*	-.21*	.17	-.26*	.25*	-.28**	.28**	-.27*	.24*	.25*	.30**	.16	.27*	.29**	.20	.42***	—
18. 12 months BisqW	.19	-.13	.20	-.23*	.36***	-.41***	.25*	-.27*	.27*	.12	.37*	.14	.27*	.30**	.33**	.24*	.61***

Note. ISVIS = Infant Sleep Vignettes Interpretation Scale; ActW = actigraphic night-wakings; RepW = diary reported night wakings; BisqW = Brief Screening Sleep Questionnaire—night wakings; Soothing BT = parental involvement at bedtime based on parental diaries—high score represents higher parental involvement; Soothing NT = parental involvement during the night based on parental diaries—high score represents higher parental involvement.  
\* p < .05. \*\*p < .01. \*\*\*p < .001.

methods. In short, these correlations indicate that increased ratings on the Distress scale predict and are associated with more parental involvement in soothing. Increased ratings on the Limits scale predict and are associated with lower parental involvement and higher infant self-soothing. For example, when mothers during pregnancy put more emphasis on infant distress and need for help then parents were more involved later on in helping their infant to fall asleep.

#### *Parental Soothing and Infant Sleep*

Significant predictive and concomitant Pearson correlations were found between parental soothing at 6 and 12 months and infant sleep at 6 and 12 months (Table 3). In general, these correlations indicate that more parental involvement at bedtime and during the night predicts and is correlated with more infant night wakings. For instance, higher parental involvement at bedtime at 6 months was correlated with more actigraphic and diary reported night wakings at 6 months, and predicted more reported night wakings at 12 months.

In conclusion, when mothers put more emphasis on infant distress and need for help in their interpretations of infant sleep problems and night wakings, then parents were more likely to be actively involved during bedtime and at night. These soothing variables were significantly correlated with more disrupted infant sleep.

#### *SEM Analyses*

Two SEM analyses were conducted to summarize, and to extend, the main findings of the above-mentioned correlations analyses. Specifically, we were interested in ascertaining the direction of relations between maternal cognitions and infants' sleep, as well as in testing the hypothesis whereby maternal soothing behavior mediates these relations. SEM analyses were conducted using the Amos program (Version 7, Amos Development Corporation, Florida) using the maximum likelihood estimation method.

To that effect, we tested two SEM models. First, we specified a symmetrical cross-lagged latent variable model that comprised of maternal cognition and infant sleep at both 6 and 12 months. Each latent variable was assessed using two manifest indicators. Maternal cognition was assessed using the distress and limits variables whereas the infant sleep latent variable was assessed using the subjective and objective measures of night wakings. Three

types of effects were specified: (a) synchronous associations (i.e., correlations between 6-month levels of latent maternal cognitions and infant sleep as well as correlations between the "disturbances"—the residual variances—of 12-month latent maternal cognitions and infant sleep), (b) stability effects (effects of 6-month levels of latent maternal cognitions and infant sleep on their respective levels at 12 months), and most importantly, (c) cross-lagged effects, namely, effect of 6-month maternal cognitions on 12-month infant sleep, and vice versa (see Shahar & Davidson, 2003, for more details on cross-lagged models).

Prior to testing this structural model and consistent with the recommendations put forth by Anderson and Gerbing (1988), we examined the measurement model underlying the latent and manifest variables. In this measurement model, the latent variables are correlated but no unidirectional associations are specified between them. The fit of this model was excellent,  $\chi^2(df = 12) = 11.03, p = .52$ ;  $\chi^2/df = .91$ ; nonnormed fit index (NNFI) = 1.0, comparative fit index (CFI) = 1.00, root mean square error of approximation (RMSEA) = .00. Loadings of the manifest indicators onto their respective latent factors were strong (ranging from .47 to .94) and statistically significant ( $p < .01$ ).

Proceeding to the structural model, we obtained the identical fit indices that were reported for the measurement model. Results of this model are presented in Figure 1. At 6 months, maternal cognitions correlated with infant's sleep ( $\beta = .41, p < .01$ ) but at 12 months they did not ( $\beta = .07, ns$ ). Maternal cognitions were highly stable over time ( $\beta = .84, p < .001$ ) whereas infant sleep was not ( $\beta = .36, p = .10$ ). Most importantly, maternal cognitions at 6 months, predicted infant's sleep at 12 months after controlling for infant's sleep at 6 months ( $\beta = .46, p < .05$ ). In other words, elevated levels of maternal cognitions emphasizing the infant's distress rather than the importance of limits at 6 months, predict an increase in infant's wakings over the next 6 months. Moreover, infant's sleep at 6 months predicted maternal cognitions at the age of 12 months after controlling for maternal cognitions at 6 months ( $\beta = -.27, p < .05$ ). The direction of this effect was such that elevated wakings at 6 months predicted a decrease in maternal cognitions emphasizing distress more than limits over the next 6 months.

We then moved on to the examination of the mediating effect of bedtime soothing on the relations between maternal cognition and infant's sleep that was demonstrated in the abovementioned

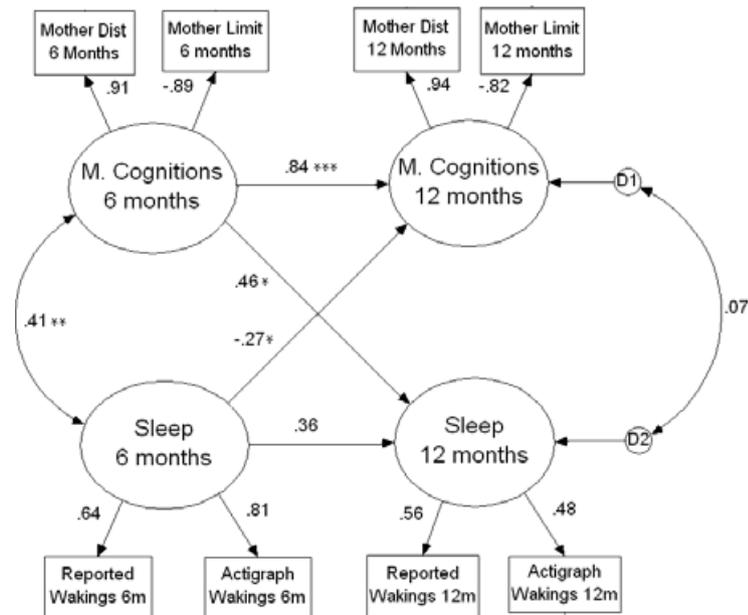


Figure 1. Structural equation modeling for cross-lagged model for the relations between infant sleep and maternal cognitions at 6 and 12 months of age.

Note. Mother Dist = Infant Sleep Vignettes Interpretation Scale, Distress scale of the mothers; Mother Limits = Infant Sleep Vignettes Interpretation Scale, Limits scale of the mothers.

\*  $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

cross-lagged model. To that objective, we specified an SEM, in which the outcome variable was 12-month latent infant sleep. This outcome was predicted by the following variables: 6-month latent infant sleep, 6-month latent variable of maternal cognitions, 6-month soothing, and 12-month soothing. Furthermore, 12-month soothing was predicted by 6 months of soothing, 6 months of latent infant sleep, and 6 months of latent maternal cognitions. The latter three variables were allowed to correlate. Our focus was on the indirect path leading from 6-month latent maternal cognitions to 12-month infant sleep via 12-month soothing, controlling for the effects of 6-month infant sleep and maternal cognitions on both 12-month soothing and 12-month infant sleep. To the extent that the component of this indirect effects are strong and statistically significant and that this indirect effect considerably accounts for the effect of maternal cognitions on infant sleep, which was demonstrated in the previous SEM model, the hypothesis regarding the mediating effect of soothing is supported (Baron & Kenny, 1986).

An adequate fit was demonstrated for this model,  $\chi^2(df = 12) = 18.65$ ,  $p = .10$ ;  $\chi^2/df = 1.55$ ; NNFI = .92, CFI = .96, RMSEA = .081. Results of this model are presented in Figure 2. The pattern is highly consistent with our hypothesis, namely, controlling for 6-month levels of infant sleep and

soothing, 6-month levels of maternal cognitions predicted 12-month soothing ( $\beta = -.31$ ,  $p < .05$ ); elevated maternal cognitions emphasizing distress rather than limits predicted a decrease in self-soothing (or an increase in parental involvement). In turn, this decrease predicted an increase in infant's waking ( $\beta = -.48$ ,  $p < .001$ ). Notably, when the indirect effect of 6-month maternal cognitions on 12-month infant sleep via soothing was taken into account, the residual direct effect of 6-month maternal cognitions on 12-month infant sleep dropped to  $\beta = .21$  and was nonsignificant. When compared with the effect of 6-month maternal cognitions on 12-month infant sleep, which was demonstrated in the cross-lagged model ( $\beta = .46$ ), this residual direct effect comprised only 46% of the magnitude of the original effect (i.e.,  $.21/.46 = .46$ ). Hence, the indirect effect can be said to account for 54% of the effect of 6-month cognitions on 12-month infant sleep, which is clearly a considerable amount.

## Discussion

This study assessed the development of infant sleep and maternal sleep-related cognitions and investigated the relations between these domains from pregnancy through the 1st year of life. Before discussing the findings of the study, several limita-

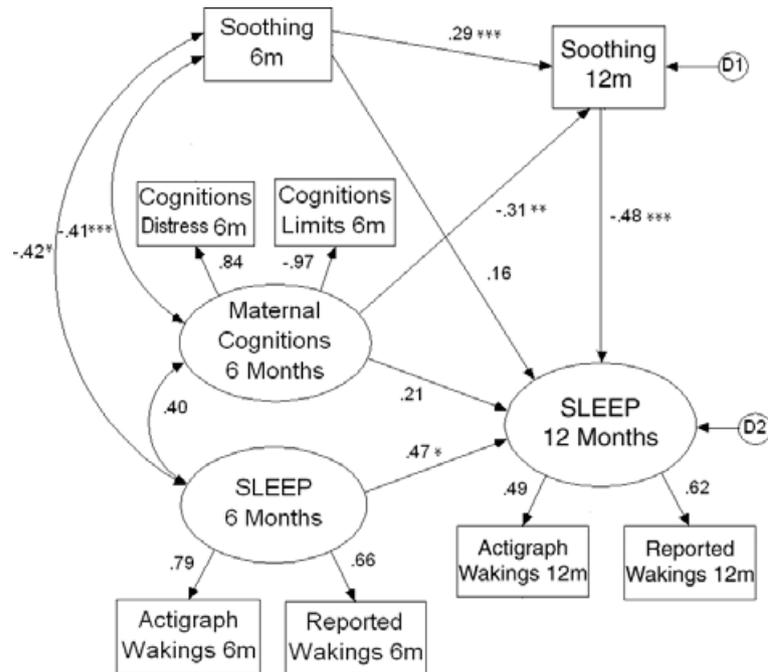


Figure 2. Structural equation modeling for the relations between maternal cognitions and infant sleep and at 6 and 12 months of age with soothing as a mediating factor.

\*  $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

tions should be addressed. First, the mothers in this study represented a highly educated middle to upper SES and their infants were all first-born. Moreover, this was a nonclinical sample of solitary sleeping infants. These characteristics limit the generalization of the findings. In addition, associations between reported sleep and maternal cognitions that are both based on subjective perceptions may be influenced by shared method variance.

#### *Development of Infant Sleep During the 1st Year*

Our findings are consistent with previous developmental studies of sleep-wake patterns in infancy (Anders & Keener, 1985; Burnham et al., 2002; Iglowstein, Jenni, Molinari, & Largo, 2003; Sadeh, 2004). Both objective and subjective assessment methods demonstrated that sleep becomes more consolidated during the 1st year of life. This was reflected by a decrease in the number of infant night wakings and in the time of nocturnal wakefulness, and in the increase in sleep percent. The decline in the number of reported night wakings can result either from the decrease in the number of natural night waking or from the growing ability of infants to resume sleep without signaling to their parents (Anders & Keener, 1985; Burnham et al.,

2002; Sadeh, 2004; Scher, Epstein, & Tirosh, 2004). Our findings demonstrated that on average reported parental diary awakenings are more numerous than actigraphic awakenings. This discrepancy could result from the fact that the actigraphic measure includes only those infant night wakings that lasted 5 min or longer while the reported night wakings include all awakenings detected by parents regardless of their length. In addition the actigraphic algorithm scores distinct awakenings if they are separated by at least 15 min of sleep, while parents may report distinct night wakings even if they are not separated by such a sleep interval.

In the present study the average number of actigraphic night wakings at the age of 6 and 12 months (1.7 and 1.3, respectively) is somewhat lower than in earlier studies focusing on the same age group (Burnham et al., 2002; Scher et al., 2004). It is noteworthy that most studies in this field are based on samples recruited after birth. As such, participation could be influenced or motivated by parents' awareness of their infants' night waking during the first months of infancy. This could result in a bias toward a higher number of awakenings in these samples in comparison with the general population. This could not be the case in our

study because the sample was recruited during pregnancy. Another possible explanation for the discrepancy in the number of actigraphic night wakings between the present study and earlier reports is that the number of actigraphic night wakings is dependent on the specific algorithm used to score the actigraphic records. For example, in our previous study (Sadeh et al., 2007), we used the algorithm developed for infants older than 1 year. This algorithm is more sensitive in identifying motility patterns as night wakings than the algorithm for younger infants that was used in the present study. This latter explanation seems more adequate because there is no difference in the average number of maternal reported night wakings between this study and earlier studies that relied on maternal reports focusing on similar ages (Matthey, 2001; Sadeh, 2004; Scher, 1991).

Parents in this study abstained from cosleeping with their infants on a regular basis, and 42% of them perceived their infant sleep as problematic. Although the sample was not composed of clinically sleep disturbed infants, these findings suggest that many mothers were concerned with their infants' sleep, and expected them to acquire independent sleeping habits.

#### *Maternal Sleep-Related Cognitions*

The use of the ISVIS (which is based on hypothetical vignettes of infants) enabled us to examine, for the first time, the development of maternal sleep-related cognitions starting already at pregnancy and throughout the 1st year of life. Although this hypothetical measure does not allow inferring about the direct cognitions of mothers regarding their own infant sleep, we believe that this limitation is also its strength because it makes it possible to assess the basic underlying beliefs mothers have about the issue of infant sleep problems. These underlying perceptions may not be directly related to the mothers' experiences with their infants.

The examination of the development of maternal cognitions over time revealed significant period effects only for the ISVIS Limits scale. After delivery, a small decrease was found in the endorsement of cognitions emphasizing the importance of limiting parental nighttime involvement but at the age of 12 months, mothers stressed these cognitions more than at the 1- and 6-month periods. It seems reasonable that during pregnancy parents give more weight to the importance of encouraging infant autonomy because they have not yet experienced the stressful emotional responses to coping

with their own infant crying and signaling at night. However, as infants approach the age of 1 year their mothers may develop greater expectation for self-soothing and this expectation is reflected in the higher endorsement of limits cognitions.

#### *Relations Between Maternal Cognitions and Infant Sleep*

The main aim of this study was to assess the links between maternal sleep-related cognitions and infant sleep. The longitudinal nature of the study, which started during pregnancy, afforded a unique opportunity to understand the contribution of maternal cognitions to the evolving sleep patterns of the infant and to evaluate the mediating role of maternal soothing behaviors. In addition, the design of the study enabled examination of the opposite prediction, thereby also shedding light on the question whether maternal cognitions and soothing patterns are predicted by the infants' evolving sleep patterns.

The main hypotheses of the study were supported by different data analysis methods. The SEM confirmed the simple correlational results. Even though the SEM did not include all of the study's hypotheses and variables, it was possible to examine the main hypothesis regarding the predictive links between maternal cognitions and infant sleep using specific models that showed excellent goodness of fit and supported the validity of these hypotheses.

The findings of the study demonstrated significant predictive and concomitant links between maternal sleep-related cognitions and infant sleep. Specifically, maternal cognitions related to concerns about the infants' distress at night were associated with more disturbed sleep, as reflected by a higher number of objective and subjective night wakings, while maternal cognitions emphasizing the importance of limiting parental involvement were associated with more consolidated sleep. These results are consistent with prior findings indicating that maternal cognitions are related to child behavior (Brody, Arias, & Fincham, 1996; Bugental, Brown, & Reiss, 1996; Donovan, Leavitt, & Walsh, 1997; Hastings & Grusec, 1998; Slep & O'Leary, 1998) and specifically to infant sleep problem (Morrell, 1999; Morrell & Steele, 2003; Sadeh et al., 2007).

A unique finding that derived from the different analyses demonstrated that there are predictive links between maternal prenatal cognitions and infant sleep at the age of 6 and 12 months, namely, cognitions that are shaped even before the infant is born predicted the quality of the infant's sleep

at later stages. These findings are consistent with previous studies showing that maternal prenatal representations may predict infant development (Adair et al., 1992; Huth-Bocks, Levendosky, Theran, & Bogat, 2004; Zeanah, Zeanah, & Stewart, 1990). However, this is the first study that demonstrates these links in the domain of infant sleep.

Predictive and concomitant links were found between maternal cognitions at later stages (6 and 12 months) and infant sleep at these stages. The correlational findings demonstrated more associations between the reported night wakings and maternal cognitions than between actigraphic night wakings and maternal cognitions. This could result from a bias related to shared method variance and to the fact that actigraphic night wakings and reported night wakings represent a somewhat different measure of awakenings.

The second hypothesis, regarding the mediating role of parental soothing behaviors, was confirmed as well: Predictive and concomitant links were found between maternal cognitions and parental soothing techniques and between these soothing patterns and infant sleep. From a theoretical standpoint, Stern (1995) stated that only those parental representations that are played out in the actual parent–infant interaction will directly influence the infant. In this study, mothers who put more emphasis on the infant's distress reported later greater parental involvement in soothing their infant to sleep. These patterns were related to poorer sleep at the age of 6 and 12 months. These findings support the hypothesis that parental soothing methods are not solely dependent on infant's characteristics. It appears that mothers bring their own perceptions into the interaction and those cognitions seem to shape their behavior toward the infant around bedtime.

The results of this study are in line with other studies demonstrating strong links between parental involvement at bedtime and infant sleep problems (Adair et al., 1991, 1992; Burnham et al., 2002; Morrell & Cortina-Borja, 2002). In the present study, concomitant links were found between parental soothing behavior and infant sleep at 6 and 12 months. In addition, moderate predictive associations were found so that increased parental involvement at bedtime and at night predicted a higher number of reported night wakings at 12 months.

The third hypothesis of the study was based on the premise of the transactional model, according to which the relations between maternal factors and infant sleep are bidirectional (Sadeh & Anders, 1993). In addition to the significant link between

maternal cognitions at 6 months and sleep at 12 months, a significant link between infant sleep at 6 months and maternal cognitions at 12 months was found. Interestingly, although maternal distress cognitions predicted consistently poorer sleep, it was found that poorer sleep at 6 months predicted lower maternal emphasis on distress cognitions or higher emphasis on the importance of limits at 12 months. One possible explanation for this finding is that over time, mothers of sleep-disturbed infants realize that in order to improve their infants sleep they should limit their nighttime involvement, or that their beliefs in distress interpretations are eroded. However, in practice they still find it hard to implement these changes. This result is consistent with findings from a previous study (Sadeh et al., 2007), which demonstrated that parents of sleep-disturbed infants were more likely than control parents to endorse the Limits scale as the appropriate approach on the ISVIS. However, when asked about their cognitions regarding their own child, these parents reported more difficulties with limit setting than control parents. The finding from these two studies support the assumption that parents of sleep-disturbed infants may experience an internal discrepancy between the knowledge of what is the "right" approach and their inability to follow this line of action with their own child.

It would be wrong to conclude from these findings that parents should abstain from approaching their infants at night in order to facilitate good sleep patterns. Undoubtedly during the first months of life, infants need their parents for comfort and regulation, while gradually these functions shift from the caregiver to the infant (Anders, 1994; Melendez, 2005). In the course of the infant's development, most parents sensitively balance between their infants' need for proximity and their need to develop separateness and autonomy. However, some parents find it difficult to keep this balance and adopt an unbalanced approach of either overinvolvement or avoidance. Earlier studies on child development have demonstrated that intrusive parenting during the first months of life is related to difficult infant temperament (Calkins, Hungerford, & Dedmon, 2004) and may interfere with the development of self regulatory skills (Calkins et al., 2004; Egeland, Pianta, & O'Brien, 1993), though one should note that this later study focused on a high-risk sample of mothers. We believe that our study, which focused on a normal sample, and the previous one, which focused on a sample of sleep disturbed infants (Sadeh et al., 2007), support the hypothesis that parents who become highly

sensitive to the possibility that the infant feels distressed at night and experience difficulties in encouraging self-soothing, are likely to use increased levels of active involvement at night. This pattern makes it difficult for the infant to develop self-soothing skills that are necessary for consolidated sleep.

It is also important to emphasize that the mothers included in this study responded with moderate or balanced scores on the ISVIS and there were almost no parents with extreme scores on these cognitive scales. Parents emphasizing the importance of limiting parental involvement at night did not devalue or disregard the interpretations underlying the need to sooth the infant. Moreover, in their actual soothing behavior, those parents who endorsed the limits interpretations were responsive to their infants and offered help although less intensively than parents who emphasized the distress interpretations and who relied more on active soothing.

#### *Conclusions and Clinical Implications*

The results of the present study confirmed that maternal cognitions emphasizing the infant's distress at night predict increased use of active soothing while increased use of these techniques is related to poorer infant sleep. On the other hand, maternal cognitions emphasizing the importance of limiting parental nighttime involvement predict less active soothing by parents, and this behavioral pattern is related to better infant sleep. These findings provide substantial support for the premise of the transactional model according to which parental cognitions influence parent–infant interactions around bedtime, which in turn influence infant sleep patterns (Sadeh & Anders, 1993).

The findings of this study may have important clinical implications. First, the predictive relations between prenatal maternal cognitions and later infant sleep underscore the importance of preventive interventions in this domain. Early parent education programs have shown promise in preventing infant sleep problems (Adair et al., 1992; Kerr et al., 1996; Kuhn & Elliott, 2003; Wolfson et al., 1992). We believe that these interventions should focus more on reviewing and modifying early parental cognitions and expectations. Similarly, the findings of this study highlight the importance of addressing parental cognitions in clinical sleep interventions of sleep-disturbed infants. The clinical focus on changing parental cognitions prepares the parents toward the behavioral intervention and addresses their

concerns about limiting their involvement at night. However, because the findings are based on a non-clinical sample, all clinical implications should be further examined in clinical settings. In addition, our findings should be further explored in other cultures and in samples with more varied SES to test their validity in settings that have different approaches, expectations, and values to child-rearing practices in general and to infant sleep in particular.

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