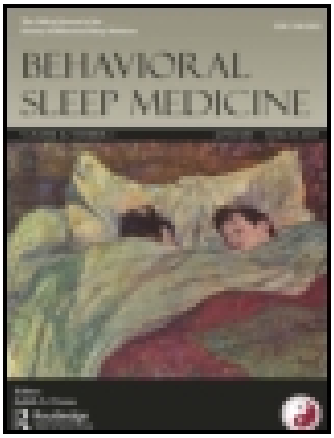

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Postpartum Maternal Sleep, Maternal Depressive Symptoms and Self-Perceived Mother-Infant Emotional Relationship

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Postpartum Maternal Sleep, Maternal Depressive Symptoms and Self-Perceived Mother–Infant Emotional Relationship

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This study examined the links between maternal sleep, maternal depressive symptoms, and mothers' perceptions of their emotional relationship with their infant in a self-recruited sample of mothers. Eighty mothers of infants 3–18 months old completed sleep diaries for 5 consecutive nights, and questionnaires assessing sleep (Insomnia Severity Index [ISI]), depressive symptom severity (Edinburgh Postnatal Depression Scale [EPDS]), and perceived mother–infant relationship (Postpartum Bonding Questionnaire [PBQ] and Maternal Postnatal Attachment Questionnaire [MPAQ]). Significant correlations, controlling for depression severity, were found between more disturbed maternal sleep and more negative maternal perceptions of the mother–infant relationship. Regression analyses revealed that EPDS showed the strongest association with PBQ, whereas ISI demonstrated the strongest association with MPAQ. The present study highlights the importance of deepening and expanding our understanding of the negative implications of maternal sleep problems.

INTRODUCTION

A healthy parent–infant relationship is crucial for infant development and is central for later cognitive, social, and emotional development of the child (Beardslee, Versage, & Gladstone, 1998; Field, 2010). Research on maternal depression and child development has clearly demonstrated that depressed mothers show poor parenting practices and compromised mother–infant relationship (Cornish et al., 2006; Edhborg, Matthiesen, Lundh, & Widstrom, 2005; Field, 2010; Lovejoy, Graczyk, O'Hare, & Neuman, 2000; Martins & Gaffan, 2000), which may be responsible for long-term negative outcomes for the child (Brockington et al., 2001; Goodman & Gotlib, 1999). As poor sleep is one of the defining symptoms of major depression (Manber & Chambers, 2009), it has been suggested that postpartum sleep disturbances may partially explain negative parenting attitudes and behaviors of depressed mothers (Lovejoy et al., 2000).

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However, the role of maternal sleep disturbances as a risk factor for problematic parenting has not been systematically examined, neither in the context of maternal depression nor as a risk factor in nonclinical samples of parents.

The present study aimed to examine the links between mothers' sleep in the postpartum period and their perceived relationship with their infants, while controlling for depression severity, in a self-recruited sample of women.

Implications of Poor Sleep

A broad range of converging evidence from multiple sources confirms the view that disturbed sleep negatively affects cognitive and emotional functioning and increases vulnerability to emotional and stressful events (Pilcher & Huffcutt, 1996; Vandekerckhove & Cluydts, 2010; Walker, 2009). Experimental sleep deprivation studies in adults have consistently shown a negative impact of sleep loss on individuals' cognitive functioning, including simple functions such as alertness, vigilance, attention, and memory, and complex executive functions, such as inhibitory control, working memory, error monitoring, and shifting between cognitive tasks (Chee et al., 2006; Chuah, Venkatraman, Dinges, & Chee, 2006; Heuer, Kleinsorge, Klein, & Kohlisch, 2004; Kendall, Kautz, Russo, & Killgore, 2006). Emotional functioning is also negatively influenced by sleep loss, and these effects include, among others, increased fatigue, irritability (Bonnet & Arand, 2003), reduced motivation, increased negative and decreased positive affective states (Franzen, Siegle, & Buysse, 2008; Norlander, Johansson, & Bood, 2005; Pilcher & Huffcutt, 1996), compromised emotional information processing (Pallesen et al., 2004; van der Helm, Gujar, & Walker, 2010), and difficulties with responses to frustration (Kahn-Greene, Lipizzi, Conrad, Kamimori, & Killgore, 2006).

Most of the experimental research on the effects of sleep loss is based on manipulating sleep quite dramatically but for no more than a few days. However, recent chronic partial sleep deprivation experiments demonstrate that these effects may accumulate to significant levels over time, supporting the premise that people do not adapt to chronic sleep deprivation (Durmer & Dinges, 2005; Goel, Rao, Durmer, & Dinges, 2009). Naturalistic studies focusing on clinical populations (e.g., insomnia patients) or on normative populations who experience unique sleep patterns (e.g., shift workers) have demonstrated significant associations between poor sleep and cognitive and emotional functioning (Baglioni, Spiegelhalder, Lombardo, & Riemann, 2010; Carey, Moul, Pilkonis, Germain, & Buysse, 2005; Fortier-Brochu, Beaulieu-Bonneau, Ivers, & Morin, 2012; Karlson, Gallagher, Olson, & Hamilton, 2013; Zohar, Tzischinsky, Epstein, & Lavie, 2005). Moreover, day-to-day changes in sleep quality and their relations to other aspects of functioning have been examined in community samples and show a substantial link between sleep quality and subsequent affect (Sonnentag, Binnewies, & Mojza, 2008; Totterdell, Reynolds, Parkinson, & Briner, 1994). Importantly, the links between sleep and affect seem to be bidirectional. Stress, negative emotions, disturbing thoughts, and emotional disorders can all affect sleep quality (Vandekerckhove & Cluydts, 2010; Walker, 2009).

Sleep of Parents in the Postpartum Period

Parents of infants are often chronically sleep deprived, and as such they are at risk for the negative implications of poor sleep. Surprisingly, only a few studies have focused specifically on

sleep disturbances in new parents and studies concerning the effects of these sleep disturbances are scarce (Insana, Williams, & Montgomery-Downs, 2013; Medina, Lederhos, & Lillis, 2009; Mindell, Sadeh, Kwon, & Goh, 2013). Findings indicate that compared with sleep during pregnancy, sleep during the postpartum period is significantly less efficient, more fragmented and shorter (Gay, Lee, & Lee, 2004; Hunter, Rychnovsky, & Yount, 2009; Lee, Zaffke, & McEnany, 2000; Matsumoto, Shinkoda, Kang, & Seo, 2003; Montgomery-Downs, Insana, Clegg-Kraynok, & Mancini, 2010; Swain, O'Hara, Starr, & Gorman, 1997). Moreover, maternal sleep disturbances lead to increased levels of sleepiness (increased *physiological* drive for sleep) and fatigue (subjective report of exhaustion and decreased capacity for activity), which may persist long into the postpartum period (Insana & Montgomery-Downs, 2010). Possible explanations for maternal sleep disturbances in the postpartum are hormonal changes (Moline, Broch, Zak, & Gross, 2003) and changes in melatonin levels (Parry et al., 2006). However, the most common cause of maternal sleep disturbances are awakenings due to the infant sleep–wake patterns and feeding needs (Meltzer & Montgomery-Downs, 2011; Mindell, et al., 2013).

Almost all studies about maternal sleep in the postpartum focused on the first three months because this is considered to be the most difficult period for the mother in terms of taking care of her baby during the night. However, it is important to note that as many as 20%–30% of all infants and toddlers between the ages of 6 months and 3 years have night-waking problems (Anders, Halpern, & Hua, 1992; Goodlin-Jones, Burnham, Gaylor, & Anders, 2001; Mindell, Kuhn, Lewin, Meltzer, & Sadeh, 2006; Sadeh, Tikotzky, & Scher, 2010). Since most of these night wakings require parental attention, the sleep of many parents continues to be highly disturbed well beyond the first months postpartum (Piteo et al., 2013; Sinai & Tikotzky, 2012).

Maternal Sleep Disturbances and Affective Functioning

Most research on the possible influences of maternal sleep disturbances on the mother's functioning has focused on the links between maternal sleep and depression. These studies found that poor maternal sleep is significantly related to increased severity of depressive symptoms (Chang, Pien, Duntley, & Macones, 2010; Coo, Milgrom, & Trinder, 2013; Dorheim, Bondevik, Eberhard-Gran, & Bjorvatn, 2009; Goyal, Gay, & Lee, 2009; Park, Meltzer-Brody, & Stickgold, 2013; Piteo et al., 2013; Posmontier, 2008; Swanson, Pickett, Flynn, & Armitage, 2011; Tsai & Thomas, 2011). Moreover, infant sleep problems have been associated with maternal emotional distress (Armitage et al., 2009; Dennis & Ross, 2005; Goldberg et al., 2013; Murray, 1992; Ross, Murray, & Steiner, 2005; Teti & Crosby, 2012), suggesting that infant night wakings impact maternal sleep, which in turn has an influence on maternal mood (Armstrong, O'Donnell, McCallum, & Dadds, 1998; Hall, Clauson, Carty, Janssen, & Saunders, 2006; Hiscock & Wake, 2001; Ross, et al., 2005). Also, maternal emotional distress seems to alleviate as a result of treating infant sleep problems and these sleep interventions may also have a positive effect on mothers' reported relationship with the child (Hiscock, Bayer, Hampton, Ukoumunne, & Wake, 2008; Hiscock & Wake, 2002). Poor sleep quality of parents has also been found to be significantly associated with family dysfunction (Piteo et al., 2013) and with problematic marital relationships (Meijer & van den Wittenboer, 2007). Overall, there is a paucity of research looking at maternal sleep in relation to other aspects of maternal functioning besides depression, and particularly in relation to mother–infant relationship. The mother–infant relationship includes two main aspects: the mother's feelings toward her infant

and perceptions of her emotional relationship to the infant (e.g., the bonding relationship), and the behavioral aspect as reflected by the actual interactions between the mother and her infant (Hornstein et al., 2006). The present study will focus only on maternal bonding.

Recently, poor maternal sleep was found to significantly predict maternal perception of sadness in her infant in a sample of women who were depressed during pregnancy (Tikotzky, Chambers, Gaylor, & Manber, 2010). Moreover, in a similar sample, it was found that disturbed maternal sleep at three months postpartum predicted poorer self-reported maternal–infant attachment three months later, after controlling for depression severity and infant temperament (Tikotzky, Chambers, Kent, Gaylor, & Manber, 2012). This effect was most pronounced for the mother's perceptions of her acceptance and tolerance of her infant. In addition, the longer the mothers were awake at night to care for their infants, the lower were their self-perceived attachment scores. The authors suggested that the negative affective states associated with sleep deprivation may interfere with the sleep-deprived mothers' ability to interact calmly and patiently with their infant. As these studies were based on a sample of women who suffered from depression during pregnancy, it remained unclear whether these finding could be generalized to nonclinical samples.

Aims and Hypothesis of the Present Study

The present study aimed to test whether maternal sleep is associated with maternal bonding. It was hypothesized that more disturbed maternal sleep patterns (e.g., higher insomnia scores, more night wakings, longer sleep latency) would be associated with more negative maternal feeling toward her infant and with more negative perceptions of the mother–infant relationship. Furthermore, it was hypothesized that these links would remain significant even after controlling for maternal depressive symptoms.

METHODS

Participants and Procedure

This study included 80 Israeli mothers with infants 3–18 months old (45 boys and 35 girls). The sample was composed of rural middle to upper socioeconomic status (SES) families. The study was approved by the ethics committee of the university psychology department. Mothers were recruited mainly through advertisements on Internet forums for parents between March 2013 and July 2013. They were told that the aim of the study is to investigate maternal sleep in the postpartum and to assess whether maternal sleep is related to their functioning and feelings. Mothers who contacted the research assistants were asked to sign a consent form and then received the study materials through a home visit or through the mail. Inclusion criteria included: (a) two-parent families with an infant between the ages of 3 months and 18 months; (b) singleton pregnancy; (c) Hebrew-speaking mothers. Exclusion criteria included: (a) preterm infants (born before week 37); (b) the existence of any reported chronic health problem in the infant. Two participants were excluded from the analyses: The first was a mother of a preterm infant (born week 26, weight 900 g) who by mistake was not excluded after the initial screening. The second was a mother with an extreme depression score (Edinburgh

Postnatal Depression Scale, EPDS = 22), that was more than 4 standard deviations above the sample mean. This mother had also a very high Insomnia Severity Index (ISI) score and negative mother–infant bonding scores. Because of these extreme (i.e., outlier) scores, which seemed to inflate the correlations (in the expected directions), it was decided to exclude her retrospectively.

Mothers were asked to complete within five days the following measures: a background questionnaire, a sleep questionnaire to assess insomnia severity, a sleep diary for five consecutive nights, a depression questionnaire, and two questionnaires aimed at assessing maternal perceptions of the mother–infant relationship.

MEASURES

Background Questionnaire

Mothers were asked to provide the following background information: age, education in years, number of rooms at home, employment status, parity, week of delivery of the infant, and difficulties during pregnancy or delivery. Questions regarding the infant included: sex, age, infant weight at delivery and present, nursing (full, partial, bottle-fed), day care (home with mother, babysitter, nursery), and whether the infant suffered from any chronic health problems.

Sleep

The Insomnia Severity Index (ISI; Bastien, Vallieres, & Morin, 2001). The ISI is a reliable and valid instrument to quantify perceived insomnia severity. It includes 7 items that provide an index of the global severity of insomnia. The ISI assesses the severity of sleep onset and sleep maintenance difficulties, satisfaction with current sleep pattern, interference with daily functioning, noticeability of impairment attributed to the sleep problem, and degree of distress caused by the sleep problem. Each item is rated on a 0–4 scale and the score range is between 0 and 28. Scores in the range of 0–7 represent "no clinically significant insomnia"; scores in the range of 8–14 represent "subthreshold insomnia"; scores in the range of 15–21 represent "clinical insomnia (moderate severity)"; and scores in the range 22–28 represent "clinical insomnia (severe)." In the present study, we used the original instructions, asking women to rate the current (i.e., last 2 weeks) severity of their sleep problems. No changes were made to adjust the ISI to the special circumstances of postnatal women (i.e., sleep disturbances related to the infant night wakings). These aspects were assessed by the sleep diaries.

Sleep diaries. Sleep diaries are commonly used in sleep research and have been validated relative to objective sleep measures such as polysomnography (Monk et al., 1994). Mothers in the present study were instructed to complete the sleep diary in the morning for five consecutive days. The derived measures included in the present study were: (a) sleep latency; (b) maternal total sleep time (time from sleep onset to wake-up time, excluding wakefulness during the night); (c) maternal subjective rating of sleep quality on a 1–10 Likert scale ("rate the quality

of your sleep last night: 1 = very poor; 10 = excellent"), (d) length of napping (i.e., daytime sleep) in minutes; (e) number of times the mother woke up during the night (to attend to her infant or for other reasons); and (f) length of time in minutes the mother was awake at night (to attended to her infant or for other reasons). Each of the sleep diary variables was averaged across the five days of assessment. To support the use of five-night means, intraclass correlations were calculated for each diary measure. The statistic used was reliability estimate for multiple repeated measurements (Winer, 1971). In general, most of the reliability estimates were found to be adequate (> .70) or better (Acebo et al., 1999): sleep latency = .72; total sleep time = .73; sleep quality = .88; daytime napping = .46; infant-related night wakings = .84; other night wakings = .62; infant-related nighttime wakefulness = .86; nighttime wakefulness for other reasons = .57.

Though we asked mothers to separately indicate awakenings (and their length) related to the infant and those unrelated to the infant, these variables were combined into one variable (reflecting the total number of awakenings and their length) in the correlation analyses. This decision was made after a preliminary examination, which revealed that the correlations between infant-related awakenings (and their length) and the bonding and EPDS measures were similar to the correlations between maternal awakenings unrelated to the infant and the bonding and EPDS measures.

Depression

The Edinburgh Postnatal Depression Scale (EPDS; Cox, Holden, & Sagovsky, 1987). This scale is a 10-item self-report measure assessing the common symptoms of depression, with high scores indicating low maternal mood. Each item is scored on a four-point scale (0–3). It is a widely used screening tool for postnatal depression. In the present study, we used it to assess maternal depressive symptom severity. The questionnaire has been validated before in Hebrew (Glasser & Barell, 1999).

Mother-Infant Relationship

The Postpartum Bonding Questionnaire (PBQ; Brockington et al., 2001). This is a 25-item scale reflecting a mother's feelings or attitudes toward her baby. The items are scored on a 6-point Likert scale ranging from *always* (score 0) to *never* (score 5) with low scores indicating good bonding. The PBQ has four subscales that reflect impaired bonding (scale 1), rejection and anger (scale 2), anxiety about care (scale 3), and risk of abuse (scale 4). Scale 4 was not used in the present study, and its items were not included in the total PBQ score because it has been demonstrated to show no variance in a validity study of the questionnaire in a community sample of women (Wittkowski, Wieck, & Mann, 2007). The cutoff scores to identify problematic bonding are 12 for scale 1, 17 for scale 2, and 10 for scale 3. For statistical analysis, both total and subscale scores were used. The PBQ has good levels of internal consistency. In a validation study, Cronbach's alpha for the total PBQ was 0.76, while Cronbach's alphas for subscales 1, 2, and 3 were 0.79, 0.63, and 0.63 (Wittkowski et al., 2007). Cronbach's alphas for the present sample were: scale 1 (12 items) = .86, scale 2 (7 items) = .79, scale 3 (4 items) = .56, Total scale = .84.

Maternal Postnatal Attachment Questionnaire (MPAQ; Condon & Corkindale, 1998). This questionnaire assesses self-rated maternal feelings toward her infant and perceptions of the mother–infant relationship. It includes 19 items scored on a five-point scale. Thus, the possible range of scores for the General scale is 19 to 95. The MPAQ assesses four dimensions: Pleasure in Proximity (a desire for proximity, enjoyment of interaction), Acceptance (lack of resentment about the impact of the infant upon parent's lifestyle), Tolerance (absence of feelings of anger and hostility toward the infant) and (parental) Competence. As suggested by Condon and Corkindale (1998), we combined the Acceptance and Tolerance subscales into a single subscale. Higher scores on each subscale indicate more intense positive perceptions and feelings toward the infant. The MPAQ has acceptable levels of internal consistency and test–retest reliability (Condon & Corkindale, 1998) and it is significantly associated with the Attachment Q-Set (an observer-rated scale of attachment; Feldstein, Hane, Morrison, & Huang, 2004). Cronbach alphas for the present sample were: Proximity subscale (8 items) = .68, Acceptance–Tolerance subscale (6 items) = .65, Competence subscale (5 items) = .60, and the General scale = .76 (all items).

Pearson correlations between the MPAQ subscales and the PBQ subscales ranged between .30 and .61. As these scales seem to capture somewhat different aspects of the mother–infant relationships, it was decided to use both scales in the analyses.

Statistical Analyses

In general, Pearson product–moment correlation coefficients were used to examine the associations between the study variables (i.e., background, sleep, depression and mother–infant relationship measures). For ordinal or categorical variables, Spearman rank order correlations were used (i.e., nursing, sex, daycare, maternal age, employment status, difficulties during pregnancy and labor). To examine the association between maternal sleep and perceived mother–infant relationship while controlling for maternal depressive symptoms, partial correlations (controlling for EPDS) were calculated between the sleep measures and the PBQ and MPAQ scales. Furthermore, hierarchical multiple regression analyses were used to assess how much of the variance in PBQ and MPAQ general scales would be uniquely explained by sleep measures after controlling for background variables and the EPDS. In these regression analyses, only those background variables and sleep measures associated with at least some of the main variables were included.

RESULTS

Sample Characteristics

The characteristics of the sample are described in Table 1. According to maternal reports none of the infants suffered from any chronic illness.

Descriptive Statistics and Preliminary Analyses

Descriptive statistics of main study variables and clinical cutoff. Means and standard deviations of the main variables are described in Table 2. According to the ISI, 10% of

TABLE 1
Sample Characteristics

Variable	*M*	*SD*	*%*
Mother's age (years)	30.8	4.8	
Mother's education (years)	15.3	2.1	
Number of rooms at home	3.7	1.0	
Gestational age (weeks)	39.0	1.4	
Birth weight (kg)	3.2	0.5	
Infant age (months)	8.8	4.3	
Infant age distribution			
3–6			35
7–12			41
13–18			24
Maternal employment status			
At home			27
Partial job			26
Full-time job			47
Number of children			
Primiparous			57
Multiparous			43
Feeding method			
Fully nursing			43
Partial nursing			39
Bottle feeding			18
Day care			
Home-reared			55
Babysitter/nursery			45

TABLE 2
Means, Standard Deviations, and Range for Sleep, Depression, and Bonding

	Mean	*SD*	*Range*
Insomnia Severity Index	8.73	5.10	0–22.00
Sleep latency (min)	11.65	8.39	0–36.00
Napping (min)	16.49	19.55	0–96.20
Total sleep duration (hr)	6.61	0.84	4.87–8.61
Number of night wakings, infant related	1.84	1.18	0–4.80
Number of night waking, other	0.47	0.57	0–2.40
Duration of wakefulness, infant related (min)	28.04	27.72	0–126.00
Duration of wakefulness, other (min)	4.36	6.54	0–30.10
Sleep quality	7.16	1.59	3.00–10.00
EPDS	4.88	3.99	0–14.00
PBQ impaired bonding	5.55	4.55	0–17.00
PBQ rejection & anger	2.46	2.86	0–10.00
PBQ anxiety about care	2.92	2.18	0–9.00
PBQ total	10.94	8.63	0–36.00
MPAQ proximity	36.41	3.24	20.66–40.00
MPAQ accept–tolerance	22.43	2.75	15.33–30.00
MPAQ competence	22.94	2.04	12.99–25.00
MPAQ total	81.72	6.69	49.31–95.00

the mothers had insomnia in the clinical range (7 mothers were in the moderate range and one in the severe range). Fifteen percent ($n = 12$) of the mothers had an EPDS score of 10 and above and 7% ($n = 5$) had an EPDS score of 13 and above, which is likely to reflect depression of varying severity (Cox et al., 1987). Regarding maternal bonding, 13% ($n = 10$) met the cutoff score of 12 on the first scale of the PBQ, which reflects problematic bonding. None of the mothers met the clinical cutoff scores for the other two PBQ scales.

Correlations between the background variables and main variables. To assess whether any of the background variables should be controlled for in the analyses, Pearson or Spearman correlations were calculated between all background variables (infant age, nursing, sex, day care, maternal age, education, employment status, primipara versus multipara, difficulties during pregnancy and labor) and the sleep, depression, and mother–infant relationship measures. The only demographic variables that were significantly associated with some of the variables of interest were employment status (scale ranging from 1 = unemployed to 5 = fully employed) and maternal retrospective reports of pregnancy-related difficulties. Mothers with a lower employment score (i.e., working less) reported higher levels of depression ($Rho = -.32$, $p < .005$), higher insomnia ($Rho = -.24$, $p < .05$), a larger number of night wakings ($Rho = -.41$, $p < .001$), longer time awake at night ($Rho = -.37$, $p < .01$) and lower sleep quality ($Rho = .25$, $p < .05$). However, this variable was not associated with the mother–infant relationship measures. Mothers who reported more pregnancy-related difficulties (a 3-point scale: no difficulties at all, a little, many difficulties) had a higher score on the PBQ anxiety about care subscale ($Rho = .32$, $p < .01$), and on the ISI ($Rho = .46$, $p < .001$), and reported longer sleep latency ($Rho = .26$, $p < .05$), shorter sleep duration ($Rho = -.28$, $p < .05$), lower sleep quality ($Rho = -.41$, $p < .001$), a larger number of awakenings ($Rho = .36$, $p < .001$) and longer time awake at night ($Rho = .40$, $p < .001$). Thus, the employment and the pregnancy-related difficulties variables were controlled for in the regression analyses.

Correlations between EPDS, sleep variables, and maternal bonding. To examine whether maternal depression severity should be controlled for, Pearson correlations were calculated between the EPDS score and the maternal sleep and bonding measures. EPDS scores were significantly associated with all sleep variables except napping. EPDS was correlated with: (a) ISI ($r = .43$, $p < .001$); (b) sleep latency ($r = .52$, $p < .001$); (c) sleep quality ($r = -.38$, $p < .001$); (d) number of night wakings ($r = .42$, $p < .001$); (e) duration of nighttime wakefulness ($r = .45$, $p < .001$); and (f) total sleep time ($r = -.30$, $p < .01$). EPDS scores were also significantly correlated with the MPAQ and PBQ scales and subscales, except with the MPAQ competence subscale. Specifically, EPDS was correlated with (a) the MPAQ general scale ($r = -.39$, $p < .001$); (b) MPAQ proximity ($r = -.28$, $p < .05$); (c) MPAQ acceptance-tolerance ($r = -.50$, $p < .001$); (d) the PBQ general scale ($r = .59$, $p < .001$); (e) PBQ bonding ($r = .47$, $p < .001$); (f) PBQ rejection and anger ($r = .55$, $p < .001$); and (g) PBQ anxiety ($r = .66$, $p < .001$). Because of these significant correlations, EPDS score was controlled for in subsequent analyses.

TABLE 3
Pearson Correlation (Full and Partial) Between Maternal Sleep and Bonding

	ISI	*Sleep Latency*	*Sleep Duration*	*Number of Night Wakings*	*Time Awake at Night*	*Sleep Quality*	*Napping*
PBQ							
Impaired bonding	.45***	.46***	−.21	.33**	.37***	−.20	.09
	.31**	.27*		.16	.21		
Rejection & anger	.52***	.54*	−.31**	.48***	.51***	−.32**	−.02
	.37***	.36**	−.17	.34**	.35**	−.14	
Anxiety about care	.55***	.54***	−.17	.33**	.51***	−.24*	.20
	.40***	.30*		.08	.32**	.03	
Total	.54***	.54***	−.25*	.41***	.50***	−.27*	.09
	.39***	.34**	−.09	.23	.31**	−.06	
MPAQ							
Proximity	−.50***	−.30**	.21	−.19	−.32*	.22	−.08
	−.43***	−.20			−.23*		
Accept-tolerance	−.42***	−.28*	.17	−.29*	−.37***	.22	−14
	−.27*	−.02		−.09	−.18		
Competence	−.42***	−.19	.07	−.21	−.25*	.16	−12
	−.40***				−.19		
Total	−.53***	−.31**	.16	−.27*	−.38***	.24*	−.14
	−.44***	−.13		−.13	−.25*	.10	

*$p < .05$, **$p < .01$, *** $p < .001$.
Top: full correlation. Bottom: partial correlation, controlling for depression.

Associations Between the Sleep Measures and the Mother–Infant Relationship Scales

Correlational analyses. The correlations between the sleep variables and the PBQ and MPAQ are presented in Table 3. Partial correlation controlling for EPDS scores are also presented. All the correlations between the ISI and the PBQ and MPAQ remained significant after controlling for EPDS. Thus, higher insomnia scores were associated with more negative perceptions of the mother–infant relationship as measured with both scales, while controlling for depressive symptoms (Figure 1 presents the scatter dots of the correlations between the ISI and the PBQ and MPAQ). In addition, longer sleep latency and longer time awake at night were significantly associated with higher PBQ scores and with lower MPAQ scores on most subscales, after controlling for EPDS. Also, the correlation between the number of maternal awakenings and the PBQ rejection and anger subscale remained significant after controlling for EPDS.

Multiple regression analyses. Hierarchical multiple regression analyses were used to assess whether and which of the maternal sleep variables were associated with maternal bonding after controlling for depressive symptoms and those background variables that were significantly correlated with the main variables (e.g., reported pregnancy difficulties and maternal employment status). Regression analyses were limited only to the prediction of the PBQ and MPAQ *general scales*. EPDS, pregnancy difficulties, and employment status were entered at

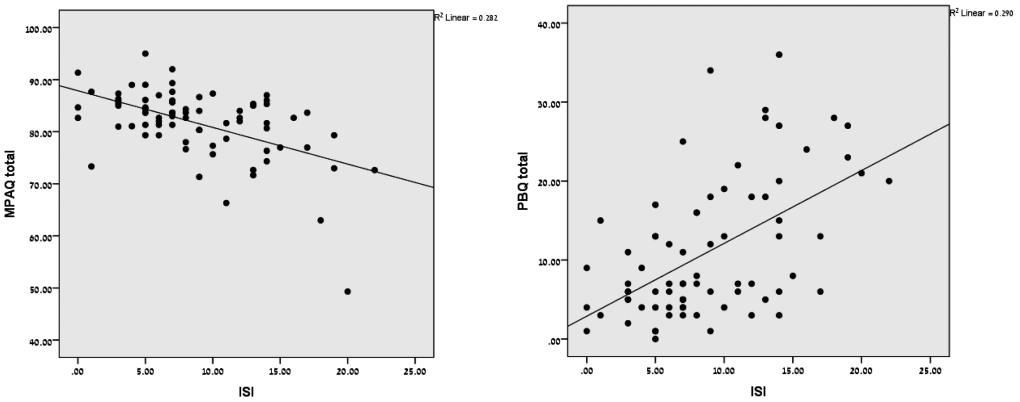

FIGURE 1 Scatter plots for maternal ISI and bonding. Left scatter: ISI and MPAQ general scale (low scores represent problematic bonding). Right scatter: ISI and PBQ general scale (high scores represent problematic perceived attachment).

step 1, and the sleep variables that were significantly associated with the PBQ and MPAQ general scales (e.g., ISI, sleep latency, and time awake at night) were entered at step 2.

Prediction of the PBQ general scale. The control variables entered at step 1 explained 37.8% of the variance of the PBQ general scale. After entry of the sleep variables at step 2 the total variance explained by the model as a whole was 50.7%, $F(6, 68) = 11.66$, $p < .001$. The sleep variables explained 12.9% of the variance in the PBQ general scale (F change (3,68) = 5.91, $p = .001$). In the final model, only EPDS, ISI, and sleep latency contributed significantly to the prediction of the PBQ general score, with the EPDS showing the strongest association (see Table 4 for standardized beta and percent of variance explained by the different variables).

Prediction of the MPAQ general scale. The control variables entered at step 1 explained 22.1% of the variance of the MPAQ general scale. After entry of the sleep variables at step 2, the total variance explained by the model as a whole was 36.1%, $F(6, 68) = 6.40$, $p < .001$. The sleep variables explained 14.0% of the variance in the MPAQ general scale (F change (3,68) = 4.96, $p < .005$). In the final model, the EPDS, employment status, and the ISI contributed significantly to the prediction of the MPAQ general score, with the ISI demonstrating the strongest association (see Table 4).

DISCUSSION

The findings of the present study revealed that poorer maternal sleep patterns were significantly associated with more problematic maternal bonding, even after controlling for maternal depression severity. The most robust sleep variable was the maternal insomnia severity index, which was associated with both mother–infant relationship scales (PBQ and MPAQ) and with all of their subscales. As to the sleep diary variables, maternal sleep latency and duration

TABLE 4
Hierarchical Multiple Regression Analyses

	PBQ General Scale		*MPAQ General Scale*	
Predictors Step 1	*Beta*	*Explained Variance*	*Beta*	*Explained Variance*
EPDS	.39***	9.8%	−.26*	4.5%
Job hours	.15	1.7%	−.22*	3.8%
Pregnancy difficulty	−.002	.00	−.06	.00
Predictors Step 2				
ISI	.29**	5.0%	−.44***	11.4%
Sleep latency	.24*	3.4%	.01	0.0%
Minutes awake at night	.11	1.1%	−.14	1.8%

*$p < .05$, **$p < .01$, ***$p < .005$.

of wakefulness at night showed significant links with the mother–infant relationship scales, while controlling for depression. The findings were also supported by the regression analyses, which demonstrated that the sleep variables explained about 13% of the variance of both mother–infant relationship scales, after controlling for depression severity and some of the background variables (i.e., those found to be preliminarily associated with the sleep and depression variables). In line with previous studies (Edhborg et al., 2005; van Bussel, Spitz, & Demyttenaere, 2010), there were significant relations between maternal depressive symptom severity and problematic bonding. However, the novel finding of the present study is that poor maternal sleep, and especially the subjective symptoms and consequences of insomnia, are uniquely associated with more negative feelings and perceptions of the mother toward her infant.

Examining the different subscales assessed by the mother–infant relationship questionnaires, the PBQ rejection and anger subscale seemed especially sensitive to poor maternal sleep as it was the only subscale significantly associated with four different sleep variables (i.e., ISI, sleep latency, number of night wakings, and duration of nighttime wakefulness). Though all the mothers in the present study scored in the nonclinical range of this subscale, the findings do suggest that mothers who present poorer sleep quality are more likely to feel distant from their infants, more likely to feel angry and annoyed with the infant, and less likely to enjoy being and playing with the infant. These findings are in line with a former study demonstrating significant concomitant and prospective links between postpartum disturbed maternal sleep and lower tolerance and acceptance of the infant as assessed by the MPAQ, in mothers who suffered from depression during pregnancy (Tikotzky et al., 2012).

Because maternal depression does not seem to be the sole underlying factor mediating the link between maternal sleep and mother–infant relationship, the question remains as to why and how is poor maternal sleep associated with more problematic maternal bonding? One speculation is that the link is mediated by deficits in executive functions (i.e., flexibility,

inhibition, and working memory) which constitute one of the main mechanisms underlying self-regulation (Hofmann, Schmeichel, & Baddeley, 2012). Executive functions and emotion regulation are negatively impacted by sleep deprivation (Dinges et al., 1997; Kahn-Greene et al., 2006; Zohar et al., 2005). Another line of research suggests that executive functions are important in helping mothers to focus on their infant's needs, to effectively manipulate the environment to adjust it for the infant, and to respond in a regulated and reasoned manner when faced with challenging circumstances (e.g., infant refuses to eat or sleep; Barrett & Fleming, 2011; Deater-Deckard, Sewell, Petrill, & Thompson, 2010). Combining these observations with the findings of the present study, it is suggested that poor maternal sleep leads to deficits in executive functions and emotion regulation (e.g., the mother has more difficulties to focus on the infant's needs and to inhibit her frustration when the infant is fussy), which may lead to a more negative emotional response to the infant (e.g., feelings of hostility, rejection, impatience, irritability). It should also be emphasized that because of the concomitant nature of the present findings, the opposite direction of explanation is also plausible. That is, mothers who have more negative perceptions of their relationship with their infants may experience more concerns and difficulties to regulate disturbing thoughts at night, which may lead to more difficulties in initiating and maintaining sleep. Of course, these explanations regarding the mediating role of executive functions and emotion regulation need to be tested, ideally using direct assessment of these functions and by means of observations of mother–infant interactions. Because the strongest relationships were found between the ISI and mother–infant bonding, it could also be that mothers who perceive their sleep as unsatisfying are more likely to develop negative feelings toward the infant, especially when they attribute their sleep problems to the impact of the infant's awakenings. Another possible explanation that should be considered is that infants react to the disturbances in their relationship with their mother by experiencing restlessness and wakefulness at night, which is likely to impact the mother's sleep. Theoretically, the findings might be best conceptualized in the context of a broad transactional model postulating dynamic and bidirectional influences between infants and their parents (Sadeh et al., 2010; Sameroff & MacKenzie, 2003).

The clinical prevalence of sleep disturbances, depression severity, and mother–infant bonding problems in the present sample is similar to the estimations of their prevalence in previous studies. For instance, the prevalence of insomnia in the general populations ranges from 9% for persistent sleep disturbances to 27% for occasional insomnia (Bastien et al., 2001). In the present study, 10% of the mothers had insomnia in the clinical range according to the ISI. It seems that the experience of maternal insomnia in this study could be attributed mainly to the effect of the infants' sleep–wake patterns on mothers' sleep, as the ISI score was strongly associated with the number of infant-related awakenings ($r = .43, p < .001$) and to the time mothers were awake at night tending to their infants ($r = .52, p < .001$). The average number of reported infant night wakings in this sample is also comparable to previous reports in other samples (Sinai & Tikotzky, 2012; Tikotzky & Sadeh, 2009). In addition, 7% of the mothers in the present sample had an EPDS score of 13 and above, which is likely to reflect depression (Cox et al., 1987). This rate is comparable to rates seen among similarly postpartum women assessed by the EPDS (Eberhard-Gran, Tambs, Opjordsmoen, Skrondal, & Eskild, 2004; Gorman et al., 2004; Heron, O'Connor, Evans, Golding, & Glover, 2004; Hewitt et al., 2009). For instance, in a study exploring the links between prenatal attachment and postnatal depression, the prevalence of an EPDS score of 12 and above was 7.6% at 3 weeks

postpartum and 6.8% at 18 months postpartum (Goecke et al., 2012). The mean scores on the mother–infant relationship questionnaires (PBQ and MPAQ) in the present study are also in line with previous studies that validated these questionnaires (Brockington et al., 2001; Condon & Corkindale, 1998; van Bussel et al., 2010). For example, van Bussel et al. (2010) reported that 13.64% of their sample met the clinical cutoff for the PBQ impaired bonding scale, whereas in the present study the rate was 12%. Overall, the fact that the prevalence of the different clinical symptoms in the present sample is similar to that reported in previous studies suggests that our sample of self-recruited women is representative, despite not being community based.

This study has some limitations that need to be considered. The cross-sectional and correlational design of the study precludes inferring about any causal relationships between the variables. In addition, the sample is restricted by its self-recruited nature, and the wide age ranges of the infants (3–18 months) presents a limitation because infant sleep develops rapidly during this age period (Tikotzky & Sadeh, 2009). The power of the study is limited by the relatively low incidence of women scoring in the clinical range of depression and insomnia. Therefore, the findings could not be generalized to clinical populations. Assessment of all variables is based on maternal subjective reports, thus increasing the risk of shared method variance. There is a need to replicate the findings while using objective measures of sleep (e.g., actigraphy; Dorheim et al., 2009; Tikotzky & Sadeh, 2001) and observational measures of the mother–infant relationship (Seifer, Sameroff, Barrett, & Krafchuk, 1994). However, even though the present findings are based on subjective measures, it should be emphasized that both the sleep diaries and the ISI have been validated relative to objective sleep measures such as polysomnography (Bastien et al., 2001; Monk et al., 1994). In addition, the mother–infant relationship scales used in the study have been previously associated with the EPDS (Edhborg et al., 2005; Klier, 2006; van Bussel et al., 2010) and with observational method of mother–infant interactions (Feldstein et al., 2004; Hornstein et al., 2006). For instance, the PBQ has been found to be associated with objective observations of mother–infant behavioral interactions in clinically depressed and psychotic mothers (Hornstein et al., 2006). Lastly, even if our findings indicate that poor maternal sleep is associated only with the self-perceived emotional quality of the mother–infant relationship and not with their objective or observable quality, maternal emotional perceptions and feelings toward the infants are of great significance because they may influence maternal behavior and predict later cognitive and socioemotional developmental of the child (Brockington et al., 2001; Teti & Towe-Goodman, 2008; Tikotzky & Sadeh, 2009; Wittkowski et al., 2007).

CONCLUSIONS AND CLINICAL IMPLICATIONS

Maternal bonding difficulties are an important area of research as they may have long-term negative effects on the infant (Taylor, Atkins, Kumar, Adams, & Glover, 2005). While it has been demonstrated that problematic bonding is related to maternal depression, little is known about how these difficulties relate to mothers' mental and physical health besides depression (Wittkowski, et al., 2007). The present study contributes to our understanding of the correlates of maternal bonding by demonstrating that the quality of sleep mothers experience during the postpartum is related to their perception and feelings of their relationship with their infant. As the role of maternal sleep has received only little attention in relation to the evolving relationship

of the mother with her infant, the present study highlights the importance of deepening our understanding of the negative implications of maternal sleep problems. Future research will have to examine possible underlying mechanisms of the links between maternal sleep disturbances and compromised mother–infant relationships, such as self-regulation functions (e.g., executive functions, emotion regulation). Moreover, future studies will have to assess the different objective and subjective facets of maternal sleep in order to identify whether it is maternal sleep duration, sleep fragmentation, timing of sleep, variability in sleep patterns, or the subjective experience of sleep that matters. This understanding may also be of clinical significance, as it may guide the development of clinical interventions that are targeted to improve maternal sleep, which will hopefully lead to an improvement in the domains that are expected to be negatively affected by maternal sleep disturbances, such as the mother–infant relationship.

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