JOGNN

RESEARCH

Exploring the Association between Maternal Mood and Self-Reports of Sleep during the Perinatal Period

Soledad Coo, Jeannette Milgrom, Peter Kuppens, Pauline Cox, and John Trinder

Correspondence
Soledad Coo, PhD
Melbourne School of Psychological Sciences – The University of Melbourne
12th Floor Redmond Barry Building, Psychological Sciences
The University of Melbourne, Parkville Campus
Parkville, VIC 3010, Australia.
scoo@uc.cl;
s.coocalcagni@student.unimelb.edu.au

Keywords
maternal mood
subjective sleep quality
appraisal
perinatal

ABSTRACT

Objective: To explore the psychological mechanisms involved in the close association between maternal mood and self-reports of sleep quality during the perinatal period using appraisal theory of emotions.

Design: Repeated measures.

Setting: Antenatal clinics of a health center associated with the Northern Hospital in Melbourne, Australia.

Participants: 122 pregnant women in their third trimester of gestation.

Methods: Participants completed the Pittsburgh Sleep Quality Index (PSQI), the Edinburgh Postnatal Depression Scale, and an appraisal questionnaire during the third trimester of gestation, within 7 to 10 days after childbirth, and at 10 to 12 weeks postpartum. Correlational and regression analyses were used to explore the associations between sleep reports and appraisals.

Results: Self-reports of poor sleep quality, impaired daytime dysfunction due to poor sleep, and the global PSQI score were associated with a low perceived ability to cope practically and emotionally with motherhood-related issues as well as with negative expectations about the future.

Conclusions: Appraisal dimensions associated with self-reports of poor sleep quality are similar to those related to maternal distress identified by previous research. This finding contributes to a better understanding of the association between self-reports of sleep and maternal mood. Practical implications are discussed.

JOGNN, 43, 465-477; 2014. DOI: 10.1111/1552-6909.12464

Accepted March 2014

Soledad Coo, PhD, is a research officer in the Psychological Medicine Department, King Edward Memorial Hospital, Women and Newborn Health Service, Perth, Australia.

Jeannette Milgrom, PhD, is a professor in the Department of Psychology, The University of Melbourne, Melbourne, Australia, and CEO at the Parent-Infant Research Institute and Clinical and Health Psychology Department, Austin Health, Victoria, Australia.

(Continued)

The authors report no conflict of interest or relevant financial relationships.

Sleep problems are commonly experienced during pregnancy and the postnatal period due to physical discomfort and infant care–related behaviors. In view of the close association between sleep problems and depression in the nonpregnant population (Kahn-Greene, Killgore, Kamimori, Balkin, & Killgore, 2007), poor sleep has been studied as a possible contributor to antenatal and postnatal maternal mood.

In the perinatal period, low maternal mood, defined as the presence of symptoms of depression, may increase a woman's vulnerability to develop a mood disorder (Heron, O'Connor, Evans, Golding, & Glover, 2004) and may impair the development of maternal competence and responsiveness, which are crucial for the healthy development of infants (Baker, McGrath, Pickler, Jallo, & Cohen, 2013). Thus, the association between poor sleep and low maternal mood in the perinatal period is a relevant issue.

Subjective (i.e., self-report) and objective (i.e., polysomnography and actigraphy) measurements of sleep are often inconsistent with each other (Argyropoulos et al., 2003). This discrepancy has been explained in terms of the influence exerted by psychosocial circumstances (Jackowska, Dockray, Hendrickx, & Steptoe, 2011) and physical health and mood (Bliwise & Young, 2007; Krystal & Edinger, 2008) on self-reports of sleep. Thus, self-reported sleep quality may reflect psychological well-being rather than actual sleep patterns. Accordingly, self-reports of sleep and objective measurements of sleep interact differently with maternal mood, with a stronger association between maternal distress and subjective reports of sleep quality, as opposed to objective measurements of sleep, being observed during the third trimester of pregnancy (Bei, Milgrom, Ericksen, & Trinder, 2010) and the postpartum period in healthy women (Coo, Milgrom, & Trinder, 2014; Park, Meltzer-Brody, & Stickgold, 2013).

© 2014 AWHONN, the Association of Women's Health, Obstetric and Neonatal Nurses

Sleep quality is closely associated with maternal mood, but the psychological processes that may underlie this association have not been sufficiently addressed.

Research findings support a close association between self-reports of poor sleep and low maternal mood. During the third trimester of pregnancy, self-reports of poor sleep quality have been described as more common in women who report symptoms of depression than in nondepressed women (Jomeen & Martin, 2007), and complaints of poor sleep early in pregnancy have been found to be an antecedent of symptoms of depression in the third trimester of gestation (Skouteris, Germano, Wertheim, Paxton, & Milgrom, 2008). Similarly, reports of disrupted and poor sleep during the third trimester of pregnancy appear to be related to symptoms of depression in the postnatal period (Goyal, Gay, & Lee, 2007; Okun, Hanusa, Hall, & Wisner, 2009). It has also been suggested that sleep quality in late pregnancy predicts the timing and increases the vulnerability for the recurrence of postnatal depression in women who presented with this disorder in the past (Okun et al., 2010).

The association between self-reports of poor sleep and low mood observed in pregnant women and new mothers has also been found in a variety of nonpregnant populations, such as mature women with and without breast cancer (Enderlin et al., 2011), adolescents (Mahon, 1994), and children (Conroy, Usoro, Hoffmann, Brower, & Armitage, 2012). In addition, some researchers have attempted to identify the psychological and psychosocial aspects that may explain the association between self-reports of poor sleep and low mood. For instance, poor subjective sleep efficiency has been related to low levels of self-reported social support and happiness, depression symptoms, and overcommitment to work (Jackowska et al., 2011). Similarly, shorter subjective sleep duration has been associated with higher levels of worry (Kelly, 2002); in contrast self-reports of good sleep quality appear to be related to positive emotions (Baglioni, Spiegelhalder, Lombardo, & Riemann, 2010).

Although these findings support the association between self-reports of sleep and psychological well-being in both perinatal and nonpregnant populations, very few studies have addressed the psychological processes that may underlie the association between the subjective assessment of sleep quality and mood during pregnancy and the postnatal period.

Peter Kuppens, PhD, is an associate professor in the Department of Psychology, University of Leuven, Leuven, Belgium.

Pauline Cox, RN, RM, is a maternal and child health nurse, Maternal and Child Health Service, Whittlesea, Melbourne, Australia.

John Trinder, PhD, is a professor in the Department of Psychology, The University of Melbourne, Melbourne, Australia.

Theoretical Model of Appraisal Theories of Emotion

Appraisal theories of emotions provide a valid and widely accepted theoretical framework to study the psychological aspects involved in the relationship between perceived sleep quality and low maternal mood. This model aids understanding of the elicitation and differentiation of emotions by identifying the cognitive components that shape emotional experiences (Lazarus & Smith, 1988; Moors, 2009; Roseman, 1996; Scherer, Schorr, & Johnstone, 2001). Although some appraisal models differ in the emphasis that is placed on the emotion generation process, the central tenet remains the same: emotional responses to particular situations are the outcome of how people appraise or judge those circumstances. Thus, emotions are conceptualized as resulting from the assessment or appraisal of a specific event in terms of one's own goals, concerns, and well-being along a number of core appraisal dimensions such as motivational relevance, motivational congruence, coping potential, accountability, and future expectancy. A description of these appraisal dimensions can be found in Table 1. Although acknowledging that emotional experiences are dynamic and vary significantly between individuals, appraisal theory suggests that particular combinations of appraisals form patterns that underlie and result in specific emotions, such as anger or fear (Lazarus & Smith, 1988).

Appraisal Theories and Maternal Mood during the Perinatal Period

Appraisal theories have been only recently studied in pregnant women and new mothers. In one particular study, maternal distress, defined as the presence of symptoms of depression, anxiety, and/or stress, was related to specific appraisals including low emotion-focused and problem-focused coping potential (i.e., low perceived ability to cope emotionally and practically with motherhood-related issues), low congruence (i.e., inconsistency with individual goals), and low future expectancy (i.e., pessimistic expectations about the future) during the third trimester of pregnancy, 7 to 10 days postpartum, and 10 to 12 weeks after childbirth (Coo Calcagni, 2012, unpublished doctoral thesis). These findings are consistent with appraisal studies conducted in

Table 1: Appraisal Dimensions

Appraisal Dimension	Core Question	Definition
Motivational relevance	Is it important?	Refers to the significance of a situation in the pursuit of specific goals the individual is committed to.
Motivational congruence	Is it advantageous or disadvantageous?	Addresses the compatibility of a situation in the pursuit of specific goals the individual is committed to.
Accountability	Who or what is responsible for the circumstances?	Relates to the attribution of responsibility the individual makes in regard to a particular event. Distinctions are made between self-blame, the blaming of others and the blaming of impersonal circumstances.
Problem-focused coping potential (PFCP)	Can I cope with the situation?	Addresses the individual's perceived ability to modify the situation to make it coherent with his/her goals and plans through direct actions and thoughts.
Emotion-focused coping potential (EFCP)	Can I cope with my emotions?	Relates to the individual's perceived capacity to adjust emotionally to the circumstances, it entails actions like reappraising the events in a positive way or changing the personal goals.
Future expectancy	Will the circumstances remain as they currently are?	Describes the expectations the individual embraces regarding the future development of the event.

Note. From Smith & Lazarus (1993).

non-pregnant populations (Roseman, 2011; Smith & Lazarus, 1993).

Because self-reports of sleep reflect and are consistent with maternal mood during pregnancy and the postnatal period, it could be possible that the appraisals associated with maternal distress also underlie self-reports of poor sleep, thus providing an explanation for the close relationship between the two phenomena (see Figure 1). The aim of this study was to apply appraisal theory to identify the most significant appraisals associated with poor subjective sleep during the third trimester of pregnancy and the postnatal period in a group of healthy, low-risk women. Insight into which appraisals are particularly involved in the subjective perception of poor sleep during late pregnancy and the postnatal period may help to inform interventions for women who report sleep difficulties during or after pregnancy.

Because self-reports of sleep quality appear to be closely related to maternal mood, it is hypothesized that the specific appraisals identified in previous research (Coo Calcagni, 2012, unpublished doctoral thesis) as underlying maternal distress (i.e. low emotion-focused and problem-focused coping potential, low congruence and future expectancy) will be also associated with self-reports of sleep.

Materials and Method

Design

A repeated-measures design was used to assess participants' sleep, appraisals, and mood during the third trimester of pregnancy (Time-1), within the first 7–10 days after childbirth (Time-2), and at 10 to 12 weeks postpartum (Time-3). This study was approved by the Northern Hospital Ethics Committee, Melbourne, Australia.

Participants

A convenience sample of 122 women was recruited from the antenatal clinics of a local health center associated with the Northern Hospital (Melbourne, Australia) and from the general community. To be eligible to participate in the study women had to meet the following criteria (a) be

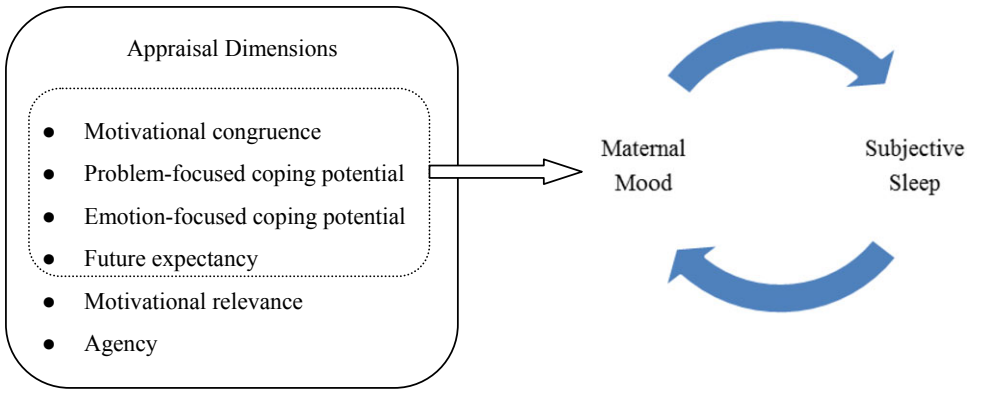

Figure 1. Appraisal dimensions and their association with maternal mood.

age 18 years or older, (b) present no major complications accompanying pregnancy at time of recruitment, (c) have no history of severe psychiatric conditions (e.g., psychotic disorders), (d) no use of any sleep medication, (e) not on nightshifts, and (f) be able to speak English. The participants had an average age of 29.7 (SD = 4.5) and all delivered full-term infants. Most of the women in the study were married (89%), highly educated (79.5%), and were first-time mothers (54.1%). Eighty-seven percent of the participants reported no significant mental health issues. See Table 2 for a complete demographic profile of the sample.

Procedures

Upon recruitment, during the third trimester of pregnancy (Time 1), participants were given a set of questionnaires that included a Demographic Questionnaire (DQ-1), the Edinburgh Postnatal Depression Scale (EPDS), the Pittsburgh Sleep Quality Index (PSQI), and an Appraisal Scale. Women recruited from the health center completed the questionnaires while they waited for their antenatal consultations. Participants recruited from the general community were sent the first set of questionnaires by mail; a prepaid envelope was enclosed to return the questionnaires to the researchers. For the second and third assessments, a similar set of questionnaires was sent to all participants by mail 2 weeks before their due dates (Time 2) and 10 weeks after childbirth (Time 3). Women were asked to complete the questionnaires at the end of the first week postpartum (Time 2) and within 10 to –12 weeks postpartum (Time 3), respectively.

Measures

Sleep. The Pittsburgh Sleep Quality Index (PSQI; Buysse, Reynolds, Monk, Berman, & Kupfer, 1989) was used to measure sleep at each assessment time. This well-validated self-report questionnaire measures various aspects of sleep, which produce a global score that reflects general sleep quality. The PSQI has been used extensively with perinatal women (Dørheim, Bondevik, Eberhard-Gran, & Bjorvatn, 2009; Skouteris et al., 2008). An additional item addressing the number and duration of daytime naps was included.

Following standardized scoring procedures, the following variables were derived: (a) total sleep time (TST), (b) sleep onset latency (SOL), (c) sleep efficiency (efficiency), (d) sleep disturbances/fragmentation (disturbance), (e) sleep quality (quality), and (f) daytime dysfunction due to poor sleep (dysfunction). The combination of these components reflects the overall subjective sleep quality ($PSQI_{total}$). The actual values of TST, SOL, and efficiency were used to conduct the statistical analyses, whereas scale scores ranging from 0 to 3, with higher values indicating higher sleep disruption, were used for the other sleep components (disturbance, quality, and dysfunction). Cronbach's alpha values of the PSQI global score for the three assessment times were .76, .61, and .69, respectively.

Mood. The Edinburgh Postnatal Depression Scale (EPDS; Cox, Holden, & Sagovsky, 1987) is a 10-item self-report questionnaire developed for screening and assessing for depression symptoms during and after pregnancy. The authors have reported high reliability (.87) and other researchers (e.g., Harris, Huckle, Thomas, Johns, & Fung, 1989) have reported high EPDS sensitivity (95%) and specificity (93%) when compared to longer established measures of depression. In this study, mood was measured by the EPDS global

Table 2: Sociodemographic Characteristics of the Sample (*N* = 122)

Factors		Number of participants	Percentage
Marital status	Single	3	2.5
	Married	109	89.4
	In stable relationship	10	8.2
Country of origin	Australia or New Zealand	71	58
	Europe	6	4.9
	Middle East	1	0.8
	Asia-India	25	20.5
	Africa	1	0.8
	North America	8	6.5
	South America	10	8.2
Education	Did not finish school	6	4.9
	High school	14	11.6
	Undergraduate degree	64	52.5
	Postgraduate degree	33	27.0
	Other	2	1.6
Number of older children	0	66	54.1
	1	38	31.1
	2	10	8.2
	3	5	4.1
	More than 3	3	2.5
Psychological disturbances before pregnancy	None	78	63.9
	Minor depression	25	20.5
	Anxiety	8	6.5
	Depression & anxiety	11	9
Psychological disturbances during pregnancy	None	107	87.7
	Minor depression	15	12.3
	Anxiety	14	11.5
Stressful life events	Yes	56	46.3
in the last year[a]	No	67	53.7

Note. [a]Stressful life events were measured with a checklist included in the demographic questionnaire.

score. Cronbach's alpha values for the three assessment times were .82, .84, and .88.

Appraisal. Appraisal scales are often tailored according to the aims of specific studies, with items being based on prototypical formulations as described by Smith and Lazarus (1993) and Schorr (2001). For this study 18 items (i.e., three items per appraisal component) with 5-point Likert-type scales were selected to assess specific appraisal components, namely, motivational relevance, motivational congruence, accountability, problem-focused coping potential (PFCP), emotion-focused coping potential (EFCP), and future expectancy (see Table 1). Scores for each appraisal component were calculated by adding the individual scores from the relevant items.

The items were rephrased to address pregnancy for the third trimester assessment and the recently born child for the two postnatal assessments.

Sample items include "Is being pregnant consistent with what you want?" "To what extent do you consider yourself responsible for what happens or has happened in your life during your pregnancy?" "How certain are you that you would be able to influence things to make (or keep) your pregnancy experience the way you want it to be?" "How consistent is your pregnancy experience with the way you wanted it to be?" Cronbach's alpha values for motivational relevance, motivational congruence, and agency were acceptable and ranged from .61 to .67 across the three assessments. Cronbach's alpha values for PFCP were .87, .92, and .86. EFCP and future expectancy had values than ranged consistently from .95 to .97 during the three assessment times.

Analyses

Data were analyzed with SPSS for Windows, version 20, the alpha value was set at .05 level. Changes in appraisal, experienced sleep, and mood across the three assessment times were assessed with a series of repeated-measures ANOVA. Greenhouse-Geisser corrections were made where the assumption of sphericity was not met. Pearson product–moment correlations were used to identify significant relations between appraisals and sleep parameters at each assessment time. Next, the appraisals that were significantly correlated with sleep parameters were used as predictors in multiple regression analyses. For this particular analysis, in the cases where only one significant correlation was identified, multiple regression converted to a simple regression. All regression analyses were cross-sectional.

Post hoc power analyses were conducted for the regression analyses using the software package GPower (Faul, Erdfelder, Lang, & Buchner, 2007). With a sample size of 122, an alpha value of .05, and one to four predictors used in the analyses, the statistical power for this study was adequate for detecting a medium ($f^2 = .15$) and large ($f^2 = .35$) effect size, with values that ranged from .93 to .99. However, the statistical power was less than adequate for the detection of a small ($f^2 = .02$) effect size, with values ranging from .19 to .34.

Results

Sleep, Appraisal and Mood Characteristics across Waves

Total sleep time (TST) decreased from nearly 7 hours (417 minutes) during late pregnancy to approximately 5.5 hours (342 minutes) within the first 7 to –10 days after childbirth. Although sleep duration increased by 35 minutes from Time 2 to Time 3 (i.e., 10–12 weeks postpartum), it was still reduced when compared to Time 1. Similarly, sleep onset latency (SOL) was shorter during the two postnatal assessments when compared to the third trimester of pregnancy. Disturbance remained stable from Time 1 to Time 2 but was slightly reduced at Time 3 when compared to Time 1. Finally, the PSQI global score ($PSQI_{total}$) decreased from Time 2 to Time 3, thus indicating an improvement in global sleep quality. No statistically significant changes were observed in sleep efficiency (efficiency), sleep quality (quality), and daytime dysfunction due to poor sleep (dysfunction) (see Table 3).

With regard to appraisals, motivational congruence increased from late pregnancy to the first 7 to 10 days after childbirth; similarly, emotion-focus coping potential (EFCP) and problem-focus coping potential (PFCP) at Time 2 and Time 3 were higher than at Time 1. No significant changes were observed in motivational relevance, agency, and future expectancy. EPDS scores remained stable across the three assessment times, and the scores consistently corresponded to the normal range (see Table 4).

Cross-Sectional Associations between Appraisal and Mood

Table 5 presents cross-sectional Pearson product–moment correlations between appraisals and sleep parameters at each assessment time. Reports of poor quality were consistently associated with low PFCP across the three assessments. In addition, quality was related to low motivational congruence (i.e., incongruence) and low future expectancy (i.e. negative future expectations) at Time 1 and Time 2, and to low EFCP at Time 2 and Time 3. Reports of high daytime dysfunction were systematically associated with low PFCP and EFCP during late pregnancy and the two postnatal assessments, as well as with low (i.e., negative) future expectancy at Time 2 and Time 3. Participants who reported longer sleep onset latency (SOL) showed low motivational congruence (i.e., incongruence) at Time 1 and Time 3 and reduced motivational relevance at Time 2. Finally, global PSQI scores, indicating poor overall sleep quality, were consistently correlated with low EFCP and negative future expectations across the three assessment times; as well as with low PFCP at Time 2 and Time 3.

Table 3: Mean Values and Repeated-Measures ANOVA for Mood, Sleep and Appraisal variables at Time 1, Time 2, and Time 3

	Time 1	Time 2	Pair-wise	Time 3	Pair-wise	Pair-wise		
	M (SD)	*M (SD)*	(T1–T2)	*M (SD)*	(T1–T3)	(T2–T3)	*F*	*df*
Mood								
EPDS	6.65 (4.36)	6.99 (4.11)	—	6.19 (4.58)	—	—	1.20	2,166
Sleep								
TST[a]	417 (118)	342 (91)	**[D26]	377.4 (79)	*[D27]	**	15.04**	2,156
SOL[a]	23.59 (17.64)	14.39 (14.93)	**	16.39 (18.04)	**	—	10.36**	2,156
Efficiency[a]	80.51 (16.57)	66.98 (17.21)	—	86.89 (10.92)	—	—	25.70	2,144
Disturbance	1.66 (0.59)	1.47 (0.57)	—	1.43 (0.59)	**	—	5.40**	2,164
Quality[a]	1.49 (0.83)	1.48 (0.78)	—	1.30 (0.77)	—	—	2.46	2,164
Dysfunction	1.02 (0.84)	0.92 (0.86)	—	1.07 (0.84)	—	—	1.11	2,164
$PSQI_{TOTAL}$[a]	7.42 (4.19)	8.56 (3. 48)	—	7.32 (3.64)	—	**	4.26*	2,154
Appraisal								
Relevance	4.42 (.59)	4.53 (.54)	—	4.49 (.56)	—	—	1.19	2,160
Congruence	4.04 (.75)	4.34 (.65)	**	4.17 (.66)	—	—	7.38**	2,160
Self-Agency	3.85 (1.34)	4.14 (1.01)	—	4.21 (1.07)	—	—	3.00	2,156
Other Agency	2.40 (1.23)	2.31 (1.20)	—	2.40 (1.15)	—	—	.25	2,154
Circumstances Agency	3.15 (1.14)	3.00 (1.24)	—	2.95 (1.20)	—	—	.79	2,140
PFCP[a]	3.77 (.76)	4.05 (0.81)	*	4.11 (.63)	**	—	7.91**	2,141
EFCP[a]	3.74 (.82)	3.97 (.81)	*	4.12 (.74)	**	—	9.30**	2,144
Future expectancy	3.79 (.76)	3.90 (.67)	—	3.93 (.71)	—	—	2.00	2,160

Note. EPDS = Edinburgh Postnatal Depression Scale; TST = Total sleep time; SOL = Sleep onset latency; PSQI total = PSQI total score; PFCP = Problem-focused coping potential; EFCP = Emotion-focused coping potential.
[a]Sphericity assumptions were not met.
*$p < .05$, **$p < .001$.

Regression analyses using as predictors the appraisals that were significantly correlated with individual sleep parameters at each assessment time, as described above, showed that most of the correlated appraisals were significantly, though weakly, related to sleep parameters. At Time 1 all the appraisals identified as significant by Pearson product–moment correlations were associated with changes in all sleep variables, excepting sleep efficiency during the third trimester of pregnancy, with R^2 values ranging from .09 to .17. Future expectancy-1 was observed to make a unique contribution to quality-1, SOL-1, and $PSQI_{total}$-1; whereas circumstances agency-1 contributed to disturbance-1.

During the first 7 to 10 days after childbirth, significantly correlated appraisals identified by correlational analyses at Time 2 were weakly associated with quality-2 (21%), SOL-2 (4%), TST-2 (.09%), disturbance-2 (16%), dysfunction-2 and $PSQI_{total}$-2 ($R^2 = .17$); with EFCP-2 making a significant contribution to quality-2. Finally, at 10–12 weeks after childbirth appraisals correlated with individual sleep parameters at Time 3 were related to quality-3 ($R^2 = .13$), efficiency-3 ($R^2 = .05$), dysfunction-3 ($R^2 = .31$), and $PSQI_{total}$-3 ($R^2 = .13$). Upon close examination, self-agency-3 and EFCP-3 were observed to contribute to quality-3 and dysfunction-3, respectively (see Table 5).

Discussion

Changes in the report of total sleep time are consistent with the literature in that nighttime sleep duration decreases after childbirth and is still reduced at 3 months postpartum when compared to pregnancy reports (Horiuchi & Nishihara, 1999;

Table 4: Pearson Correlation Coefficients between Appraisals and Sleep Variables at Time 1, Time 2, and Time 3

	Relevance	Congruence	Self Agency	Other Agency	Circumstances Agency	PFCP	EFCP	Future Expectancy
Sleep at Time-1								
Quality-1[D28]	−.09	−.19*	.04	−.01	.08	−.21*	−.16	−.28**
SOL-1	−.15	−.25**	.04	.17	.10	−.06	−.13	−.28**
TST-1	−.13	−.12	.01	.02	−.01	−.17	−.06	−.22*
Efficiency-1	−.05	−.07	.02	.00	−.05	−.08	−.03	−.16
Disturbance-1	−.15	−.21*	.09	.04	.21*	−.11	−.18*	−.16
Dysfunction-1	−.12	−.25**	.10	.25**	.20*	−.22*	−.31**	−.17
$PSQI_{total}$-1	−.14	−.23*	.02	.09	.10	−.18	−.19*	−.34**
Sleep at Time 2								
Quality-2	−.00	−.22*	.04	−.06	−.00	−.31**	−.44**	−.26*
SOL-2	−.23∗	−.19	−.05	−.10	−.03	−.01	−.05	−.11
TST-2	.02	−.15	−.08	−.13	.03	−.31**	−.25	−.20
Efficiency-2	−.09	.09	−.13	−.17	−.02	−.15	−.09	−.20
Disturbance.-2	.06	−.28	−.17	.02	.06	−.11	−.25*	−.08
Dysfunction-2	.00	−.15	.08	−.04	−.00	−.33**	−.37**	−.22*
$PSQI_{total}$-2	−.06	−.16	.08	−.18	−.01	−.35	−.39**	−.30**
Sleep at Time-3								
Quality-3	.15	−.02	.21*	.01	.16	−.25*	−.29**	−.19
SOL-3	−.11	−.21*	.10	.18	.14	−.06	−.12	−.16
TST-3	.02	−.11	.18	−.03	−.05	−.20	−.18	−.17
Efficiency-3	−.02	−.00	−.02	.09	.03	.20	.11	.22*
Disturbance-3	.01	−.18	−.03	−.10	.03	−.20	−.17	−.14
Dysfunction-3	.01	−.13	−.02	−.07	.06	−.44**	−.41**	−.29**
$PSQI_{total}$-3	−.02	−.14	−.08	−.03	.07	−.32**	−.28**	−.27*

Note. PFCP = Problem-focused coping potential; EFCP = Emotion-focused coping potential; SOL = Sleep onset latency; TST = Total sleep time; PSQItotal = PSQI total score.
$*p < .05$, $**p < .001$.

Lee, McEnany, & Zaffke, 2000; Lee & Lee, 2007). The reduction of sleep-onset latency from late pregnancy to the two postnatal assessments suggests that new mothers tend to fall asleep quicker after childbirth, a change that is possibly explained by sleep disruption and fatigue caused by infant care behaviors.

With regard to appraisals, women perceived motherhood as more significant and relevant to them in the first days after childbirth than during pregnancy, most likely due to the interaction with the newborn baby. Interestingly, new mother's perceived ability to cope practically and emotionally with motherhood-related issues was also higher in the postnatal period, thus suggesting that women may have gradually adjusted to their new circumstances and developed self-confidence in themselves as mothers. Finally, the stable and overall low levels of symptoms of depression reported by the women in the study confirm that they were an overall healthy and well-functioning group. Also, it is possible that some of the participant's psychosocial and demographic characteristics, such as being in a stable partner relationship and having a high level of education, may have acted as

Table 5: Summary of Regression Analyses using Sleep Variables at Time 1, Time 2, and Time 3 and their correlated Appraisals

				Significant contributors		
Sleep Variables	R^2	*F*	*df*	Variable	Appraisal Dimension	Beta
Sleep at Time 1						
Quality-1[D29]	.09	.06	3.65*	3,113	Future Expectancy-1	−2.08*
SOL-1	.10	.08	6.07**	2,114	Future Expectancy-1	−2.26*
TST-1	.05	.04	5.73*	1,115		
Efficiency-1	—	—	—	—		
Disturbance-1	.09	.07	3.73*	3,110	Circ. Agency-1	2.05*
Dysfunction-1	.17	.13	4.37**	5,107		
$PSQI_{total}$-1	.13	.10	5.45**	3,112	F. Expectancy-1	−2.80**
Sleep at Time 2						
Quality-2	.21	.17	5.53**	4,82	EFCP-2	−3.10**
SOL-2[a]	.04	.03	4.08*	1,89		
TST-2[a]	.09	.08	9.35**	1,89		
Efficiency-2	—	—	—	—		
Disturbance-2[a]	.06	.05	5.87*	1,88		
Dysfunction-2	.16	.12	5.18**	3,84		
$PSQI_{total}$-2	.17	.14	5.51**	3,83		
Sleep at Time 3						
Quality-3[a]	.13	.11	4.79*	3,92	Self.Ag[g]-3	2.10
SOL-3[a]	.01	.00	1.16	1,98		
TST-3	—	—	—	—		
Efficiency-3[a]	.05	.04	4.39*	1,90		
Disturbance-3	—	—	—	—		
Dysfunction-3	.31	.28	13.08**	3,88	EFCP-3	−2.87**
$PSQI_{total}$-3	.13	.10	4.43**	3,86		

Note. SOL = Sleep onset latency; TST = Total sleep time; PSQItotal = PSQI total score
F. Expectancy = Future Expectancy; Circ. Ag = Circumstances Agency; EFCP = Emotion-focused coping potential; Self. Ag = Self Agency; EFCP = Emotion-focused coping potential.
[a]indicates Linear Regression, – indicates no analysis was conducted
*$p < .05$, **$p < .001$,

protective factors for the development of symptoms of depression, as suggested by previous research (Lancaster et al., 2010; Robertson, Grace, Wallington, & Stewart, 2004).

Sleep quality appears to be related to women's perceived ability to cope practically and emotionally with motherhood and with their expectations about the future.

Relationship between Appraisals and Sleep

An interesting pattern of concurrent interaction between coping potential and future expectancy and some aspects of self-reported sleep was observed during the three assessment times. Perceived sleep quality, daytime dysfunction, and the global PSQI score were the areas of sleep that were most significantly associated with appraisals. This highlights the role of women's

perceived ability to cope practically and emotionally with motherhood and their expectations about the future in their subjective perception of poor sleep. Further, this finding is consistent with the appraisals identified as underlying maternal distress, thus suggesting that the way in which pregnant women and new mothers judge and evaluate their circumstances may explain to some extent the close association between self-reports of sleep and mood. With regard to the associations between self-reports of sleep and appraisals, it seems unlikely that appraisals had triggered particular judgments about sleep; however, it may be possible that negative emotions associated with low perceived coping potential and negative expectations about the future had influenced the perception of sleep quality.

Women who perceive they cannot cope effectively with motherhood- related issues and who think their situation will not improve in the future may feel overwhelmed by daily life issues, including sleep disruption and deprivation, and may perceive the quality of their sleep as poorer than it really is. Supporting this suggestion, a study comparing the psychological characteristics of nonpregnant adults who reported insomnia found that individuals with normal sleep duration (as assessed with polysomnography) were likely to report insomnia if they presented with depression and anxious-ruminative personality traits and insufficient coping resources (Fernandez-Mendoza et al., 2011).

Alternatively, women who report poor sleep quality may have a tendency to perceive a low ability to cope practically and emotionally with maternal specific issues (e.g., infant care, breastfeeding, etc.) and to hold negative expectations about the future due to fatigue and tiredness. Accordingly, restricted sleep time (i.e., < 7 hours of sleep) has been systematically associated with impaired cognitive performance during wakefulness, which includes low alertness and poor performance on working memory tasks (see Banks & Dinges, 2007, for a review). Similar effects have been described in adolescents, where tiredness and sleepiness due to reduced sleep duration have been related to changes in motivation, difficulty in initiating particular behaviors and in conducting complex tasks that demand planning (Dahl, 1999). Thus, it seems possible that poor self-reports of sleep quality in new mothers are related to the actual capacity to conduct daily activities and deal with the practical demands of infant care.

With regard to the role of the perceived ability to cope emotionally with pregnancy and motherhood-related issues, poor sleep has been associated with impaired emotional regulation, which is crucial to emotion-focused coping. Sleep deprivation has been found to be significantly associated with high perceived irritability and emotional disturbance (Walker, 2009). In a large Swedish study (Broman, Lundh, & Hetta, 1996), self-reports of insufficient sleep were more likely to be reported by adults who presented with dysphoric mood, somatic symptoms, and cognitive fatigue. Sleep disruption has also been found to amplify emotional reactivity in medical residents, which results in increased negative emotional responses to disruptive events and a reduction in the positive effect of rewarding activities (Zohar, Tzischinsky, Epstein, & Lavie, 2005).

Research addressing the neural mechanisms underlying the interaction between sleep and emotions using functional magnetic resonance imaging (fMRI) has found that in sleep deprivation conditions (i.e., 35 hours of total sleep deprivation) the amygdala shows increased reactivity and a reduced connectivity with the medial prefrontal cortex (mPFC). This pattern of activity has been proposed to impair the top-down inhibition exerted by the mPFC on the amygdala that results in effective emotional regulation (Yoo, Gujar, Hu, Jolesz, & Walker, 2007). In view of these findings, it is not surprising that the women in this study who reported poor sleep quality judged their ability to cope emotionally with motherhood-related demands as diminished.

In addition to problem focused- and emotion-focused coping potential, negative expectations about the future were also associated with self-reports of poor sleep quality. Although no studies have focused exclusively on the interaction between negative expectations and sleep, a negative view of the future is considered a key component of depression (Beck, 1979; Beck & Alford, 2009), thus, this finding is consistent with current evidence relating to the interaction between insufficient sleep and low mood.

Limitations

The findings of this study are restricted by the characteristics of the sample. Most participants were healthy women who reported overall positive mood during pregnancy and the postnatal period, they had a high education level, and were in married or stable relationships; Thus, the

results cannot be generalized to other groups. There are also some limitations associated with the nature of sleep data. Self-reports of sleep are related to the judgment of sufficient or insufficient sleep, which shows high inter-individual variability (Banks & Dinges, 2007). Although poor sleep has well-known deleterious effects on several areas, these negative consequences vary in intensity among individuals. Thus, it is possible that appraisals had a stronger interaction with self-reports of sleep in women for whom the consequences of poor sleep were highly negative, rather than in women who are less affected by sleep disruption and deprivation; however, this aspect was not controlled for in this study.

A third limitation refers to the use of the individual components of the PSQI for the statistical analyses. Buysse et al. (1989) advocated the use of the global PSQI score as an indicator of sleep quality, rather than using its individual subscales; however they also argue that the components of the PSQI address areas of sleep which are routinely screened for in clinical interviews of individuals with sleep difficulties and suggest that scores from single components may direct health professionals to areas of sleep that require further assessment. Thus, the PSQI components were used in an attempt to identify specific associations between particular aspects of sleep and appraisals. Finally, Cronbach's alpha values for the PSQI global score and for motivational relevance, motivational congruence, and agency were low across the three assessment times, which indicates a relatively low reliability of these measures.

Future researchers could address these limitations and could further explore the appraisals involved in the association between self-reports of poor sleep and low maternal mood in samples that include clinically depressed and/or anxious women, participants from more diverse socioeconomic and education backgrounds, as well as unsupported and sole parents. Because experienced mothers could have more realistic expectations and a higher sense of self-efficacy in the performance of the maternal role than first-time mothers, possible differences in terms of parity could be also studied.

Implications for Practice

The findings from this study contribute to a better understanding of the psychological processes that explain the association between self-reports of sleep and mood in pregnant women and new mothers. Further, they help to identify the appraisal components involved in the subjective perception of sleep and provide further support to the notion that sleep complaints in pregnant women and new mothers can be considered by care providers as a possible indicator of low mood. Specific interventions aiming to increase practical and emotional coping abilities could be beneficial for women who report poor sleep quality during pregnancy and the postnatal period. This could be particularly useful for women who also show vulnerable personality characteristics and/or complex social circumstances, which may negatively affect their coping resources.

Interventions to increase practical and emotional coping abilities could be beneficial for women who report poor sleep quality during the perinatal period.

In this regard, health professionals may have the opportunity to inform new mothers, their partners, and other relevant family members about the possible consequences of sleep deprivation in terms of impaired performance of practical tasks and emotional liability, to normalize these consequences and help women to develop effective ways to deal with them. Specifically, health professionals could assess and help women to identify sources of practical assistance and support within their relatives and/or friends, as well as in the community. Emotional coping abilities could be strengthened by the use of strategies aiming to reduce the feeling of being overwhelmed, which may include symptoms of stress and anxiety, such as relaxation techniques.

Conclusion

Maternal reports of poor sleep quality are associated with a poor perceived ability to cope practically and emotionally with motherhood-related issues and with negative expectations about the future. These appraisals are similar to those identified by previous research as underlying maternal distress. The results from this study help to clarify the mechanisms involved in the close association between self-reports of poor sleep and low maternal mood during pregnancy and the postnatal period and may have practical implications for the development of interventions for pregnant women and new mothers.

REFERENCES

Argyropoulos, S. V., Hicks, J. A., Nash, J. R., Bell, C. J., Rich, A. S., Nutt, D. J., & Wilson, S. J. (2003). Correlation of subjective and

objective sleep measurements at different stages of the treatment of depression. *Psychiatry Research*, *120*(2), 179–190.

Baglioni, C., Spiegelhalder, K., Lombardo, C., & Riemann, D. (2010). Sleep and emotions: A focus on insomnia. *Sleep Medicine Reviews*, *14*(4), 227–238.

Baker, B., McGrath, J. M., Pickler, R., Jallo, N., & Cohen, S. (2013). Competence and responsiveness in mothers of late preterm infants versus term infants. *Journal of Obstetric, Gynecologic, & Neonatal Nursing*, *42*, 301–310.

Banks, S., & Dinges, D. F. (2007). Behavioral and physiological consequences of sleep restriction. *Journal of Clinical Sleep Medicine*, *3*(5), 519–528.

Beck, A. T. (1979). *Cognitive therapy of depression*. New York, NY: Guilford Press.

Beck, A. T., & Alford, B. A. (2009). *Depression: Causes and treatment*. Philadelphia, PA: University of Pennsylvania Press.

Bei, B., Milgrom, J., Ericksen, J., & Trinder, J. (2010). Subjective perception of sleep, but not its objective quality, is associated with immediate postpartum mood disturbances in healthy women. *Sleep*, *33*(4), 531–538.

Bliwise, D. L., & Young, T. B. (2007). The parable of parabola: what the U-shaped curve can and cannot tell us about sleep. *Sleep*, *30*(12), 1614–1615.

Broman, J., Lundh, L., & Hetta, J. (1996). Insufficient sleep in the general population. *Neurophysiologie Clinique/Clinical Neurophysiology*, *26*(1), 30–39.

Buysse, D. J., Reynolds, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry Research*, *28*(2), 193–213.

Conroy, D. A., Usoro, A., Hoffmann, R. F., Brower, K. J., & Armitage, R. (2012). The influence of emerging low mood symptoms on sleep in children: A pilot study. *Nature and Science of Sleep*, *4*, 133.

Coo, S., Milgrom, T., & Trinder, J. (2014). Mood and objective and subjective measures of sleep during late pregnancy and the postpartum period. *Behavioral Sleep Medicine*, *12*(4), 317–330. doi:10.1080/15402002.2013.801348

Cox, J., Holden, J., & Sagovsky, R. (1987). Detection of postnatal depression. Development of the 10-item Edinburgh Postnatal Depression Scale. *British Journal of Psychiatry*, *150*, 782–786.

Dahl, R. E. (1999). The consequences of insufficient sleep for adolescents: Links between sleep and emotional regulation. *Phi Delta Kappan*, *80*, 354–359.

Dørheim, S., Bondevik, G., Eberhard-Gran, M., & Bjorvatn, B. (2009). Subjective and objective sleep among depressed and nondepressed postnatal women. *Acta Psychiatrica Scandinavica*, *119*(2), 128–136.

Enderlin, C. A., Coleman, E. A., Cole, C., Richards, K. C., Kennedy, R. L., Goodwin, J. A., … Mack, K. (2011). Subjective sleep quality, objective sleep characteristics, insomnia symptom severity, and daytime sleepiness in women aged 50 and older with nonmetastatic breast cancer. *Oncology Nursing Forum*, *38*(4), E314–E325.

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, *39*, 175–191.

Fernandez-Mendoza, J., Calhoun, S. L., Bixler, E. O., Karataraki, M., Liao, D., Vela-Bueno, A., … Vgontzas, A. N. (2011). Sleep misperception and chronic insomnia in the general population: role of objective sleep duration and psychological profiles. *Psychosomatic Medicine, 73*(1), 88–97.

Goyal, D., Gay, C. L., & Lee, K. A. (2007). Patterns of sleep disruption and depressive symptoms in new mothers. *Journal of Perinatal & Neonatal Nursing*, *21*(2), 123–129.

Harris, B., Huckle, P., Thomas, R., & Fung, H. (1989). The use of rating scales to identify post-natal depression. *British Journal of Psychiatry*, *154*(6), 813–817.

Heron, J., O'Connor, T. G., Evans, J., Golding, J., & Glover, V. (2004). The course of anxiety and depression through pregnancy and the postpartum in a community sample. *Journal of Affective Disorders*, *80*(1), 65–73.

Horiuchi, S., & Nishihara, K. (1999). Analyses of mothers' sleep logs in postpartum periods. *Psychiatry and Clinical Neurosciences*, *53*(2), 137–139.

Jackowska, M., Dockray, S., Hendrickx, H., & Steptoe, A. (2011). Psychosocial factors and sleep efficiency: Discrepancies between subjective and objective evaluations of sleep. *Psychosomatic Medicine*, *73*(9), 810–816.

Jomeen, J., & Martin, C. R. (2007). Assessment and relationship of sleep quality to depression in early pregnancy. *Journal of Reproductive and Infant Psychology*, *25*(1), 87–99.

Kahn-Greene, E. T., Killgore, D. B., Kamimori, G. H., Balkin, T. J., & Killgore, W. D. S. (2007). The effects of sleep deprivation on symptoms of psychopathology in healthy adults. *Sleep Medicine*, *8*(3), 215–221.

Kelly, W. E. (2002). Worry and sleep length revisited: Worry, sleep length, and sleep disturbance ascribed to worry. *Journal of Genetic Psychology*, *163*(3), 296–304.

Krystal, A. D., & Edinger, J. D. (2008). Measuring sleep quality. *Sleep Medicine*, *9*, S10–S17.

Lancaster, C. A., Gold, K. J., Flynn, H. A., Yoo, H., Marcus, S. M., & Davis, M. M. (2010). Risk factors for depressive symptoms during pregnancy: A systematic review. *American Journal of Obstetrics and Gynecology*, *202*(1), 5–14.

Lazarus, R. S., & Smith, C. A. (1988). Knowledge and appraisal in the cognition—emotion relationship. *Cognition & Emotion*, *2*(4), 281–300.

Lee, K. A., McEnany, G., & Zaffke, M. E. (2000). REM sleep and mood state in childbearing women: Sleepy or weepy? *Sleep*, *23*(7), 877–885.

Lee, S. Y., & Lee, K. A. (2007). Early postpartum sleep and fatigue for mothers after cesarean delivery compared with vaginal delivery: an exploratory study. *Journal of Perinatal & Neonatal Nursing*, *21*(2), 109–113.

Mahon, N. E. (1994). Loneliness and sleep during adolescence. *Perceptual and Motor Skills*, *78*(1), 227–231.

Moors, A. (2009). Theories of emotion causation: A review. *Cognition and Emotion*, *23*(4), 625–662.

Okun, M. L., Hanusa, B. H., Hall, M., & Wisner, K. L. (2009). Sleep complaints in late pregnancy and the recurrence of postpartum depression. *Behavioral Sleep Medicine*, *7*(2), 106–117.

Okun, M. L., Luther, J., Prather, A. A., Perel, J. M., Wisniewski, S., & Wisner, K. L. (2010). Changes in sleep quality, but not hormones predict time to postpartum depression recurrence. *Journal of Affective Disorders*, *130*(3), 378–384.

Park, E., Meltzer-Brody, S., & Stickgold, R. (2013). Poor sleep maintenance and subjective sleep quality are associated with postpartum maternal depression symptom severity. *Archives of Women's Mental Health*, *16*(6), 539–547. doi:10.1007/s00737-013-0356-9

Robertson, E., Grace, S., Wallington, T., & Stewart, D. E. (2004). Antenatal risk factors for postpartum depression: a synthesis of recent literature. *General Hospital Psychiatry*, *26*(4), 289–295.

Roseman, I. J. (1996). Appraisal determinants of emotions: Constructing a more accurate and comprehensive theory. *Cognition & Emotion*, *10*(3), 241–278.

Roseman, I. J. (2011). Emotional behaviors, emotivational goals, emotion strategies: Multiple levels of organization integrate variable and consistent responses. *Emotion Review*, *3*(4), 434–443.

Scherer, K., Schorr, A., & Johnstone, T. (2001). *Appraisal processes in emotion: Theory, methods, research* (pp. 331–348). New York, NY: Oxford University Press.

Schorr, A. (2001). Subjective measurements in appraisal research: Present state and future perspectives. In K. Scherer, A. Schorr, & T. Johnstone (Eds.), *Appraisal processes in emotion: Theory, methods, research* (pp. 331–348). New York, NY: Oxford University Press.

Skouteris, H., Germano, C., Wertheim, E. H., Paxton, S. J., & Milgrom, J. (2008). Sleep quality and depression during pregnancy: A prospective study. *Journal of Sleep Research*, *17*(2), 217–220.

Smith, C. A., & Lazarus, R. S. (1993). Appraisal components, core relational themes, and the emotions. *Cognition & Emotion*, *7*(3/4), 233–269.

Walker, M. P. (2009). The role of sleep in cognition and emotion. *Annals of the New York Academy of Sciences*, *1156*(1), 168–197.

Yoo, S. S., Gujar, N., Hu, P., Jolesz, F. A., & Walker, M. P. (2007). The human emotional brain without sleep–a prefrontal amygdala disconnect. *Current Biology*, *17*(20), R877–R878.

Zohar, D., Tzischinsky, O., Epstein, R., & Lavie, P. (2005). The effects of sleep loss on medical residents' emotional reactions to work events: a cognitive-energy model. *Sleep*, *28*(1), 47–54.