SCIENTIFIC INVESTIGATIONS

Perception of infant sleep problems: the role of negative affectivity and maternal depression

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Study Objectives: To investigate whether the interaction between infant negative affectivity and maternal depressive symptoms is associated with the degree to which mothers perceive infant sleep to be problematic at 6 months postpartum, independent of infant sleep and sociodemographic factors.

Methods: Infant negative affectivity and maternal depressive symptoms were assessed in a sample of 59 mother–infant dyads at 6 months postpartum using standardized measures. Mothers reported the degree to which they perceived their infant's sleep to be problematic via an item composite of the Sleep Practices Questionnaire. Nocturnal infant sleep variables (duration, number of awakenings) were retrieved from a 2-week infant sleep diary (maternal report).

Results: There was a significant interaction between infant negative affectivity and maternal depressive symptoms in predicting mothers' perceived extent of infant sleep problems. Simple slope analysis showed that high levels of depression were related to higher maternal perception of infant sleep problem scores only among mothers of infants with high levels of negative affectivity. Moreover, infant negative affectivity and maternal depressive symptoms positively predicted perception scores after adjustment for infant sleep, maternal age, and parity (*P* < .05).

Conclusions: The current study provides evidence that high levels of maternal depression combined with high levels of infant negative affectivity may contribute to mothers' perceptions of infant sleep problems, independent of infant sleep duration and awakenings. These findings highlight the importance for pediatricians and other health professionals to consider infant temperament in conjunction with mothers' depressive symptoms when addressing mothers' concerns about infant sleep problems.

Keywords: depression, infancy, negative affectivity, sleep problem, temperament

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BRIEF SUMMARY

Current Knowledge/Study Rationale: Infant negative temperament and maternal depressive symptoms have been independently associated with mothers' perceptions of infant sleep problems. This study builds on previous research by examining whether the interactive relation between infant negative affectivity and maternal depression is associated with mothers' perceptions of infant sleep problems irrespective of infant sleep.

Study Impact: This study shows that high levels of maternal depression are associated with a greater degree of perceived infant sleep problems among mothers of infants with high, but not low, levels of negative affectivity independent of infant sleep. Health professionals should consider infant temperament in conjunction with mothers' depressive symptoms when addressing mothers' concerns about infant sleep problems.

INTRODUCTION

Sleep problems in infancy are a major source of concern for parents and are among the most frequent reasons for pediatric consultation in the first year of life.[1,2] Parental estimates of infant sleep problems range between 20% and 45%.[3–7] However, estimates obtained from parental report do not always correspond with those obtained from research criteria.[8,9] For example, in 1 study, 35% of mothers reported an infant sleep problem, yet only 17% of infants met research criteria.[9] It is therefore unclear how mothers determine whether or not their infant has a sleep problem. As pediatricians are among the primary receivers of sleep problem complaints, a comprehensive understanding of mothers' perceptions is needed.

A growing body of research suggests that maternal perceptions of infant sleep problems are associated with infant sleep parameters. Mothers' perceptions of infant sleep problems have been associated with more frequent mother-reported infant nighttime awakenings,[4–6] greater total nocturnal wake time,[8] longer sleep latency,[4–6] shorter longest consecutive sleep duration,[6] and shorter daytime sleep.[6] However, infant sleep parameters only accounted for a small proportion of the variance in maternal perceptions of infant sleep problems in these studies.[4,5] This strongly suggests that factors beyond infant sleep are influencing mothers' perceptions.

One such factor that has been identified in the literature is mothers' depressive symptoms.[4,8,10] One study found an association between elevated levels of maternal depression and maternal report of an infant sleep problem.[10] A second study

found that elevated levels of maternal depression were associated with more severe perceptions of infant sleep problems.[4] These findings suggest that depressive symptomology may be linked to greater negative attributions about infant sleep.

Another factor previously associated with maternal report of infant sleep problems is negative infant temperament, often referred to as negative affectivity.[5,11] Negative affectivity refers to individual differences in the tendency to experience and recover from negative emotions such as fear, discomfort, and frustration.[12] In 1 cross-sectional study using a single-item temperament measure, mothers of infants with a more difficult temperament were 1.45 times more likely to perceive their infant as having a sleep problem, independent of infant sleep behaviors.[5] Another cross-sectional study using a multi-item temperament questionnaire reported a significant association between negative infant temperament and perceived extent of sleep problems; however, this study did not include measures of infant sleep.[11]

While both maternal depressive symptoms and negative infant temperament seem to be independently associated with maternal perceptions of infant sleep problems, it remains unclear whether the interaction between these 2 factors might exacerbate mothers' perceptions of infant sleep problems. The current study sought to build upon previous research by assessing whether maternal depressive symptoms and infant negative affectivity are not only uniquely associated, but also interactively associated, with maternal perceptions of infant sleep problems at 6 months postpartum, while accounting for infant sleep. We hypothesized that greater depressive symptoms and greater infant negative affectivity would be associated with more severe perceptions of infant sleep problems, independent of infant sleep factors. We further hypothesized that infant negative affectivity would moderate the relation between mothers' depressive symptoms and their sleep problem perceptions, such that mothers with the highest levels of depressive symptoms would perceive the greatest extent of sleep problems in infants with the highest levels of negative affectivity.

METHODS

Participants and procedure

As part of a larger study investigating sleep, parental practices, and mood in new parents, 59 mothers were recruited through social media advertisements targeting families in the Greater Montreal area (Quebec, Canada). Only data from the first time point, when the mothers' infants were 6 months old, were used in the present study. Mothers who were at least 18 years of age and fluent in English or French were eligible. Mothers were excluded if they had serious obstetric complications, chronic illnesses, congenital diseases, or any other serious medical condition. Mothers of infants with serious medical conditions or born at ≤ 37 weeks' gestation were also excluded. Questionnaires were administered by 2 trained research assistants at the participants' homes. This study was approved by the Research Ethics Board of the Hôpital en Santé Mentale Rivières-des-Prairies (CIUSSS-NIM) and McGill University.

Measures

Infant temperament

Negative affectivity was assessed using a composite score derived from the Infant Behavior Questionnaire–Revised (IBQ-R).[13] The IBQ-R is a 191-item measure designed to assess infant temperament between 3 and 12 months of age. Mothers were asked to report the frequency of specific infant behaviors over the past week on a 7-point Likert scale, with response options ranging from 1 (never) to 7 (always). The IBQ-R comprises 14 subscales and yields 3 overarching temperament factors (surgency/positive affectivity, negative affectivity, and regulation/orienting). The negative affectivity factor contains the subscales sadness, distress to limitations, fear, and the reversed subscale of falling reactivity.[13] A factor composite for negative affectivity was formed by averaging the responses for the relevant scales; 18 items pertaining to infant sleep were eliminated to avoid confounding with the outcome measure. Higher scores on this factor indicate greater negative affectivity. The IBQ-R has demonstrated good internal consistency, as well as convergent validity with other measures of temperament.[13,14] In the present sample, Cronbach's α for the negative affectivity factor was .90.

Maternal depression

Maternal depressive symptoms were assessed using the Center for Epidemiologic Studies–Depression Scale (CES-D),[15] a 20-item measure used to assess the frequency of depressive symptoms over the past week. Items are rated on a 4-point scale, ranging from 0 (rarely or none of the time: <1 day) to 3 (most or all of the time: 5–7 days). Total scores range from 0 to 60, with higher scores indicating greater frequency of depressive symptomatology. The CES-D has demonstrated good internal consistency in a sample of pregnant and postpartum women.[16] Internal consistency in the present sample was also good, Cronbach's α = .89.

Maternal perception of infant sleep

Mothers' perceptions of their infant's sleep-related behaviors were assessed using the Sleep Practices Questionnaire, which includes items that measure the degree to which mothers perceived their infant's sleep as problematic. Items are rated on a 5-point Likert scale, ranging from 1 (not at all a problem) to 5 (definitely a problem).[17,18] A composite variable was created by averaging the responses to the following 3 items:

1. "How much of a problem for you are your baby's night wakings?"
2. "Overall, how much of a problem is it for you to put your baby to sleep at bedtime?"
3. "How much of a problem for your baby is it to learn to sleep through the night?"

Infant sleep

On 13 consecutive mornings, mothers were asked to complete an adapted infant sleep diary[19] to obtain an evaluation of their infant's sleep. Using arrows, mothers were asked to indicate when they put their child to bed at nighttime (bedtime) and when they took their infant out of bed in the morning (rise time). Mothers were also instructed to shade in 15-minute intervals to

indicate when they thought their infant was sleeping during the night, and to not shade in intervals when they believed their infant was awake during the night. Two sleep parameters were derived from the sleep diary data: total nocturnal sleep duration (minutes) and number of nocturnal awakenings. Aggregate scores across the 13 days were computed for both sleep parameters. Mothers who had complete vs incomplete sleep diary data did not differ on study variables ($P > .05$).

Covariates

Sociodemographic variables and factors that have previously been associated with maternal perceptions of infant sleep problems were considered as covariates.[4,20] Specifically, infant sex, infant age (months), maternal age (years), parity, marital status, maternal education, feeding status, and cosleeping status (sharing a room or sleep surface vs solitary sleeping) were included.

Statistical analysis

Prior to analyses, data were examined for the presence of univariate and multivariate outliers. One univariate outlier (z-score $> |3.29|$) for maternal depressive symptoms was detected and winsorized by replacing the outlying score with a value 1 unit larger than the nearest non-outlying score.[21] No multivariate outliers were identified using Mahalanobis distance with $P < .001$.[21] As the distribution of depression scores was positively skewed, a square-root transformation was applied to normalize the distribution. The transformation led to similar results in subsequent analyses; therefore, raw scores are reported hereafter.

The overall level of missingness was 3%. Little's Missing Completely at Random test revealed no pattern of missingness [$\chi^2(34) = 30.89, P = .62$]. Multiple imputation was performed on the missing data of study variables using the chained equation method with 20 imputed datasets.[22,23] All subsequent results are based on multiply imputed data. A sensitivity analysis was conducted using complete-case data to assess the robustness of study findings.

Pearson correlations were used to examine bivariate associations among study variables. Next, hierarchical linear regression analyses were conducted to examine whether infant negative affectivity and maternal depressive symptoms were associated with the degree to which mothers perceived infant sleep as problematic, independent of infant sleep and covariates. A 2-way interaction term tested whether infant negative affectivity moderated the relation between mothers' depressive symptoms and their perceived extent of infant sleep problems. All continuous variables were mean centered prior to analysis.[24] To avoid reductions in statistical power, covariates were included in the regression models only if they were significantly correlated with the criterion. Collinearity was assessed using the variance inflation factor. Multiple imputation was performed in R version 3.3.2 (The R Foundation for Statistical Computing, Vienna, Austria). All other statistical analyses were performed in IBM SPSS version 25.0 (SPSS, Inc, Chicago, IL). Tests were 2-tailed, and $P < .05$ was considered statistically significant.

RESULTS

Descriptive results

Table 1 presents descriptive data for sample characteristics, sleep measures, negative affectivity, and depressive symptoms. Mean depressive symptom scores (9.54 ± 7.43) were well below the criterion for probable clinical depression (CES-D score ≥ 16) with only 9 mothers (15%) meeting this criterion in our sample.[15] Nearly one-third (27%) of mothers had a mean sleep perception composite score of ≥ 3, indicating they perceived their infant's sleep to be somewhat to definitely a problem.

Bivariate associations

Table 2 reports Pearson r correlations among study variables. Maternal age, parity, number of nocturnal awakenings, total nocturnal sleep duration, infant negative affectivity, and maternal depressive symptoms were significantly correlated with maternal perceptions of infant sleep problems, whereas infant sex, infant age, marital status, maternal education, feeding status, and cosleeping status were not. Younger mothers and those having ≥ 2 children reported more problematic infant sleep ($P < .05$). More infant nighttime awakenings, shorter total nocturnal infant sleep, higher levels of infant negative affectivity, and higher levels of maternal depression were associated with more problematic perceptions of infant sleep ($P < .05$).

Regression analyses

Table 3 summarizes the results from the hierarchical regression analyses. Maternal age and parity were significantly correlated with the perception scores and were entered as demographic covariates in step 1 of the regression models. Total nocturnal sleep duration and number of nocturnal awakenings were entered as infant sleep covariates in step 2. Infant negative affectivity and maternal depressive symptoms were entered simultaneously as key predictor variables in step 3, and the interaction between infant negative affectivity and maternal depressive symptoms was entered in step 4.

The full model including all predictors was statistically significant and accounted for 63% of the variance in mothers' perception scores. In step 1, demographics significantly explained 25% of the variance in perception scores. Younger age ($P = .001$) and being an experienced mother ($P = .001$) was associated with a greater extent of perceived infant sleep problems. Introducing infant sleep in step 2 significantly explained an additional 10% of the variance; shorter nocturnal sleep duration was associated with a greater extent of maternally perceived infant sleep problems ($P = .036$). After adjusting for covariates in step 3, depressive symptoms and temperament together significantly explained an additional 25% of the variance in perception scores. Higher levels of maternal depressive symptoms ($P < .001$) and infant negative affectivity ($P = .02$) were associated with a greater extent of perceived infant sleep problems. Finally, the addition of the interaction term in step 4 significantly explained an additional 4% of the variance.

The significant interaction effect was probed with simple slope analysis at low and high levels of the moderator (± 1 SD) while adjusting for covariates.[24] Simple slope analysis revealed that mothers who were high in depression perceived a greater degree of infant sleep problems if their infant was high in negative affectivity ($P < .001$; **Figure 1**). This pattern of findings was not observed in mothers of infants with low levels of negative affectivity ($P = .97$).

Table 1—Sample demographics and descriptive data.

Characteristics	Values
Infant sex: female, n (%)	27 (46)
Infant age (months), mean (SD)	6.04 (0.40)
Maternal age (years), mean (SD)	32.97 (3.76)
Married or cohabitating, n (%)	57 (97)
Parity, n (%)	
Primiparous	24 (41)
Multiparous	35 (59)
Last obtained diploma, n (%)	
College/professional	12 (20)
University (Bachelor's)	24 (41)
University (Master's)	20 (34)
University (Doctorate)	3 (5)
Exclusive breastfeeding, n (%)	43 (73)
Co-sleeping, n (%)	26 (44)
Infant sleep, mean (SD)	
Total nocturnal duration (min)	589.79 (59.33)
Number of awakenings	2.13 (1.18)
Negative affectivity (IBQ-R), mean (SD)	2.77 (0.78)
Maternal depression (CESD), mean (SD)	9.54 (7.43)
Perceived sleep problem score (SPQ), mean (SD)	2.33 (0.95)

Based on multiply imputed data. n = 59. CESD = Center for Epidemiologic Studies–Depression Scale, IBQ-R = Infant Behavior Questionnaire–Revised, SD = standard deviation, SPQ = Sleep Practices Questionnaire.

Specificity analyses

Given that there is evidence for a bidirectional link between maternal depression and infant sleep,[4,8,10] hierarchical regression models were conducted in which the predictor and outcome variables were switched to investigate whether infant negative affectivity moderated the relation between mothers' perception of infant sleep problems and their depressive symptoms. Results yielded a nonsignificant interaction both prior to ($\beta = .05$, $P = .74$, $sr^2 = .002$) and after ($\beta = -.003$, $P = .98$, $sr^2 = .000$) adjustment for infant sleep, maternal age, and parity.

Sensitivity analyses

Two sensitivity analyses were conducted. First, results from the complete-case dataset were compared with those obtained from multiple imputation methods; minimal differences in estimates were observed. Second, results using nontransformed depression scores were compared with those using transformed depression scores. Sensitivity analyses based on transformed data yielded similar results (data not shown).

DISCUSSION

Consistent with our hypotheses, we found that higher levels of maternal depressive symptoms and infant negative affectivity were associated with a greater degree of perceived infant sleep problems. Moreover, the present results add to current knowledge by showing that infant negative affectivity moderated the relation between mothers' depressive symptoms and their perceptions of infant sleep problems. Mothers high in depression perceived a greater degree of infant sleep problems if their infant was high, but not low, in negative affectivity. Importantly, these associations were found irrespective of infant sleep, maternal age, and parity. In our sample, 27% of mothers perceived their infant's sleep to be somewhat to definitely a problem, which is consistent with the range reported in the literature.[4,5]

The presence of actual sleep disturbances is the most evident factor to explain perceptions of infant sleep problems. Indeed, previous work indicates that mothers are more likely to perceive

Table 2—Zero-order Pearson correlations between predictors and degree of infant sleep perceived as problematic.

	1	2	3	4	5	6	7	8	9
1. Perceived sleep problem	—								
2. Maternal age	−.29*	—							
3. Parity	.28*	.35**	—						
4. Feeding status	.05	.07	.27*	—					
5. Co-sleeping status	.16	.24	.32*	.08	—				
6. Nocturnal sleep duration	−.43**	.04	−.28*	−.17	−.40**	—			
7. Number of awakenings	.34**	−.003	.37**	.42**	.40**	−.62***	—		
8. Negative affectivity	.54***	−.37**	.12	.01	.15	−.19	.05	—	
9. Maternal depression	.48***	−.11	.09	−.12	−.10	.04	−.16	.35**	—

Based on multiply imputed data. n = 59. Infant sex: boy (0)/girl (1); parity: primiparous (0)/multiparous (1); feeding status: nonexclusive breastfeeding (0)/exclusive breastfeeding (1); co-sleeping status: solitary sleeping (0)/co-sleeping (1). *$P < .05$. **$P < .01$. ***$P < .001$.

Table 3—Summary of hierarchical regression analysis for predicting perception of infant sleep as problematic score.

Step	Predictor Variables	F	ΔF	R^2	ΔR^2	B (SE)	95% CI	β	sr^2
1	Sociodemographic	9.37	9.37	.25	.25				
	Maternal age					−0.11 (0.03)	[−0.18, −0.05]	−.45	.17**
	Parity					0.83 (0.24)	[0.36, 1.31]	.43	.16**
2	Infant sleep	7.14	3.93	.35	.10				
	Maternal age					−0.10 (0.03)	[−0.16, −0.04]	−.39	.13**
	Parity					0.61 (0.25)	[0.11, 1.10]	.32	.07*
	Nocturnal sleep duration					−0.005 (0.002)	[−0.009, −0.000]	−.31	.06*
	Number of awakenings					−0.03 (0.12)	[−0.21, 0.27]	.04	.001
3	Temperament and depression	12.72	15.96	.60	.25				
	Maternal age					−0.05 (0.03)	[0.10, 0.005]	−.19	.03†
	Parity					0.27 (0.21)	[−0.15, 0.69]	.14	.01
	Nocturnal sleep duration					−0.004 (0.002)	[−0.007, 0.000]	−.23	.03†
	Number of awakenings					0.16 (0.10)	[−0.03, −0.36]	.20	.02
	Negative affectivity					0.31 (0.13)	[0.05, 0.57]	.26	.05*
	Depression					0.05 (0.01)	[0.03, 0.08]	.40	.13***
4	Interaction term	12.63	5.48	.63	.04				
	Maternal age					−0.04 (0.03)	[−0.10, 0.01]	−.17	.02
	Parity					0.29 (0.20)	[−0.11, 0.69]	.15	.02
	Nocturnal sleep duration					−0.004 (0.002)	[−0.007, −0.000]	−.24	.03*
	Number of awakenings					0.14 (0.09)	[−0.05, 0.33]	.17	.02
	Negative affectivity					0.38 (0.13)	[0.12, 0.63]	.31	.06**
	Depression					0.03 (0.01)	[0.005, 0.006]	.26	.04*
	Affectivity × depression					0.04 (0.02)	[0.006, 0.08]	.24	.04*

Based on multiply imputed data. n = 59. †$P < .10$, *$P < .05$, **$P < .01$, ***$P < .001$. CI = confidence interval. $sr2$ = squared semi-partial correlation coefficients

an infant sleep problem when their infant wakes up more frequently during the night.[4–6] In our sample, the frequency of nighttime awakenings was correlated with mothers' perceived extent of sleep problems; however, it was not a significant predictor in adjusted analyses. Shorter daytime sleep duration, but not nocturnal sleep duration, was also previously associated with an increased likelihood of mothers perceiving an infant sleep problem.[6] Conversely, our study found that shorter infant nocturnal sleep duration was associated with a greater degree of maternally perceived problematic infant sleep. This inconsistency may be, in part, explained by a difference in sleep variables, the type of sleep and temperament measures used, variables controlled for, and the age at sleep perception assessment, which varied between 0 and 36 months postpartum.

Our results also showed that infant negative affectivity and maternal depressive symptoms were uniquely associated with more severe perceptions of infant sleep problems. These results are consistent with prior research that found that negative infant temperament[5,11] and maternal depression[4,8,10] were associated with mothers' perceptions of an infant sleep problem. Furthermore, we found that infant negative affectivity moderated the relation between mothers' depressive symptoms and their perceived extent of infant sleep problems. More specifically, mothers with higher levels of depression who had infants with

high levels of negative affectivity reported the most problematic infant sleep. This relationship was not present among mothers of infants with low levels of negative affectivity. Importantly, these findings were independent of infant nocturnal sleep duration and awakenings. This indicates that high levels of depressive symptomatology coupled with high levels of infant negative affectivity contribute to mothers' perceptions, irrespective of the duration or fragmentation of their infant's sleep.

Infants who are high in negative affectivity experience negative emotions with greater intensity and frequency and have more difficulty self-soothing than other infants.[12] As these infants typically need their parents to comfort them more frequently and intensively at bedtime and during the night, mothers may be more likely to perceive their infant's sleep as problematic, creating a bidirectional loop. It is also plausible that mothers of infants with greater negative affectivity are more likely to perceive their infants as more difficult in general, across various spheres of development, including sleep.[25,26] Depressed mothers might also have more biased perceptions of their infant's sleep. This explanation would be consistent with cognitive models of depression that posit that depressed individuals are more likely to have negative cognitive biases.[27] Moreover, according to the diathesis stress hypothesis, some individuals are more vulnerable to the adverse effects of negative experiences and exposures than others.[28] It is possible that mothers

Figure 1—Extent of maternally perceived infant sleep problems as a function of the interaction between maternal depressive symptoms and infant negative affectivity.
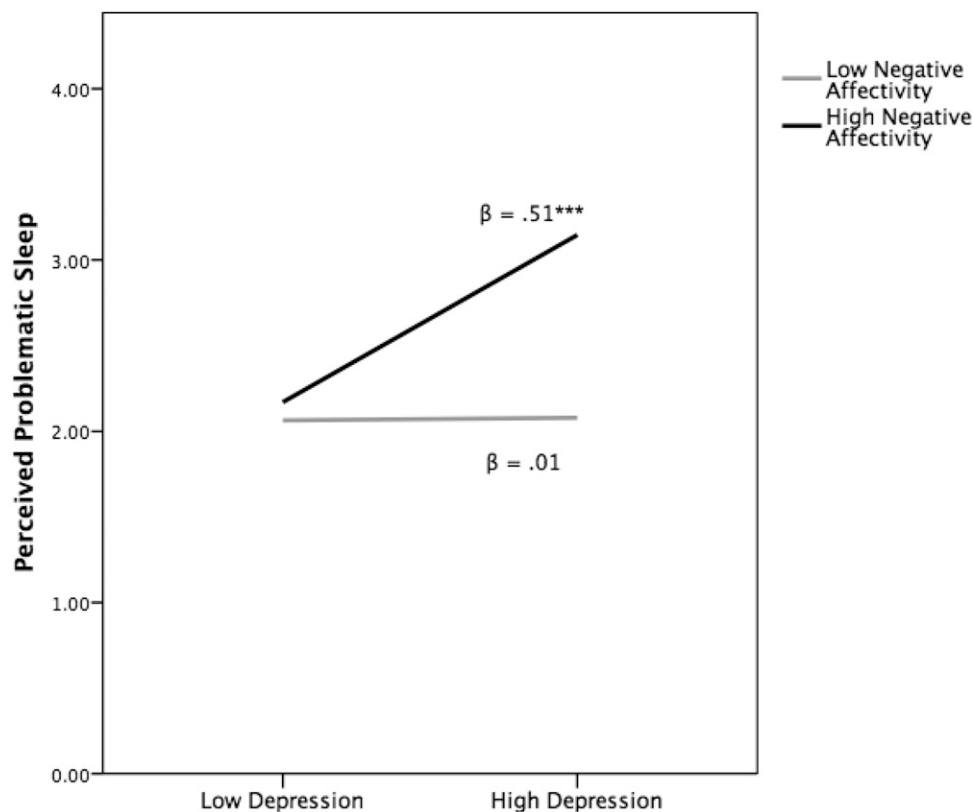
***P < .001.

high in depression are more vulnerable to the negative affectivity of their infants, thus increasing the extent to which they perceive their infant's sleep as problematic.

The present findings have important clinical and research implications. They underscore the importance of better understanding maternal sleep problem perceptions. Clinicians and researchers should not merely ask mothers if their infant has a sleep problem (yes/no) but rather inquire about the reasoning behind their perception and explore factors other than sleep, such as those found in our study, that may be uniquely or interactively influencing their perception. When clinicians and researchers rely exclusively on maternal report of the presence of a sleep problem, what is labeled as a sleep problem by the mother could sometimes reflect a more complex and problematic familial situation that should be further investigated. Finally, present results also showed that more problematic perceptions of infant sleep were associated with having ≥ 2 children. Having > 1 child likely complicates sleep management since parents need to balance the demands of multiple children. Clinicians should therefore also consider this factor when addressing mothers' concerns about infant sleep problems.

Some limitations should be noted. First and foremost, the study design was cross-sectional, which precludes establishing cause-and-effect relationships among studied variables. However, we attempted to address this limitation by conducting a specificity analysis; we found that negative affectivity did not interact with mothers' perceived extent of infant sleep problems to predict depression scores. Second, although we adjusted for maternal age and parity, most of the mothers in this study were highly educated and married or cohabitating with a partner, which limits the generalizability of the findings. Third, all measures were reported by mothers. It is therefore unclear whether mothers' depressive symptoms influenced their ratings of infant sleep or temperament. It will be important for future studies to examine whether more objective measures of sleep (eg, actigraphy) and temperament (eg, behavioral assessment) yield similar results. Finally, the sample size was relatively small, and in turn, the statistical power was low. Despite this limitation, significant results in line with our hypotheses were found. Optimally, findings should be replicated in a larger sample.

CONCLUSIONS

This study advances the literature by examining the moderating role of infant negative affectivity in the relation between mothers' depressive symptoms and their degree of perceived infant sleep problems. While more research on the temporal sequencing of relationships is warranted, we found that higher infant negative affectivity exacerbated the association between depressive symptoms and perceptions of infant sleep problems

among mothers, such that mothers who are high in depressive symptomatology perceived a greater extent of infant sleep problems if their infant was also high, but not low, in negative affectivity. Given this finding, pediatricians and other health professionals should consider an infant's temperament coupled with the mother's depressive symptoms when consulting mothers' concerns about infant sleep. As these factors play a role beyond infant sleep, mothers who report an infant sleep problem may benefit from sleep interventions that also target well-being and coping with negative infant temperament.

ABBREVIATIONS

CES-D, Center for Epidemiologic Studies–Depression Scale
IBQ-R, Infant Behavior Questionnaire–Revised
SPQ, Sleep Practices Questionnaire

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DISCLOSURE STATEMENT