The Association between Sleep and Depression during Late Pregnancy and the Early Postpartum Period

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Abstract

Objective To assess and correlate sleep quality and depressed mood symptoms in the late pregnancy and early postpartum periods.

Study Design In a prospective pilot observational study, participants completed the Pittsburgh Sleep Quality Index (PSQI) and the Edinburgh Postnatal Depression Scale (EPDS) questionnaires at delivery, 1, and 2 months postpartum. Pearson's correlation coefficients and PROC MIXED function estimated overall correlation for repeated measures.

Results Twenty-six women were enrolled with a mean gestational age at delivery of 38.4 ($\pm$ 2.4) weeks. Sleep quality and mood data were available at the three time points for 24, 16, and 11 participants, respectively. Poor sleep scores were noted by 75.0, 87.5, and 72.7% of women at the three time points. An elevated EPDS score of 10 or higher was claimed by 20.8, 12.5, and 18.2% of women, respectively. Higher PSQI scores were positively associated with higher EPDS scores overall ($r = 0.71$, $p < 0.001$) and at each of the individual time points ($r = 0.79$, $p < 0.0001$; $r = 0.52$, $p = 0.04$; and $r = 0.70$, $p = 0.016$, respectively). None of the women reporting good sleep quality had elevated EPDS scores.

Conclusion Poor sleep is commonly reported around delivery, and at 1 and 2 months postpartum, and there is an association between poor sleep and depression symptoms.

Keywords
- pregnancy
- sleep
- depression
- postpartum
- postpartum depression

Sleep disturbances are common during the antenatal and postpartum periods.[1,2] Estimated prevalence of poor sleep quality throughout pregnancy varies widely, ranging from 46 to 92%, with studies consistently demonstrating a higher prevalence with advancing gestational age.[1–3] African American race, low socioeconomic status, and older maternal age have all been linked to a higher prevalence of poor sleep quality during pregnancy.[1,3–5] In the early postpartum period, dissatisfaction with the childbirth experience, nighttime infant care, and asynchronous mother–infant sleep were identified as key contributors to lower sleep quality.[6] In one study, nearly 60% of women experienced poor sleep

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quality during the early postpartum period.[7] Poor sleep quality during the antenatal and early postpartum periods was shown to be associated with a higher burden of depressive symptomatology and higher odds of postpartum depression and suicidal ideation.[8–11] In addition, poor sleep quality was associated with the recurrence and persistence of postpartum depression in both women and partners.[10–12]

Most prior studies demonstrating a relationship between poor sleep quality and depressive symptomatology in the antenatal and postpartum periods were conducted retrospectively, introducing the potential for recall bias. To address these potential biases in prior studies, we performed a prospective observational study of a subgroup of women enrolled in the Hoosier Moms Cohort (HMC), a prospective pregnancy cohort. In this study, prospective data on sleep quality and depressive symptomatology were collected serially during late pregnancy and the early postpartum period. The objective of the study was to assess and correlate sleep quality and depressed mood symptoms among participants across the early postpartum time frame. We hypothesized that mothers who indicate poor sleep quality would be more likely to report a higher burden of depressed mood symptoms.

Methods

This was a prospective observational study using a subgroup of women enrolled in the HMC, a prospective pregnancy cohort primarily focused on predictors of gestational diabetes.[13] Inclusion criteria for the parent cohort were (1) age of 18 years or older at the time of consent; (2) singleton gestation; and (3) gestational age less than or equal to $19+6$ confirmed via American College of Obstetricians and Gynecologists dating criteria.[13] Exclusion criteria for the parent cohort were (1) prepregnancy diabetes or prediabetes by history or screening hemoglobin A1c; (2) planned pregnancy termination; (3) inability to provide consent in English or Spanish; (4) inability to complete longitudinal study activities; and (5) major fetal anomalies.[13] HMC participants engaged in two in-person study visits for surveys and biologic specimens. Maternal and cord blood specimens were obtained at delivery as well. Additional study-specific exclusion criteria for the subgroup in the current study were (1) prior diagnosis of any sleep disorder within the year prior to participation by history (including diagnosed during the HMC pregnancy); (2) current use of medications or interventions prescribed by a health care provider to treat an existing sleep disorder; (3) mothers who planned to work night shift immediately postpartum for more than 6 days per 4-week period or worked night shift during the last month of pregnancy for more than 6 days; and (4) mothers who did not plan to be responsible for any night time child care. Informed consent was obtained from all participating women. The study was approved by the Institutional Review Board of Indiana University and conducted in compliance with applicable Health Insurance Probability and Accountability Act (HIPAA) Privacy Rule.

The sleep quality of participants was assessed through the Pittsburgh Sleep Quality Index (PSQI), a tool composed of a 19-item self-report questionnaire and validated for such an assessment in the antenatal and postpartum periods.[14,15] PSQI total score ranges from 0 to 21 with a higher score implying a worse sleep quality and a score of 5 or higher indicating poor sleep quality with a sensitivity and a specificity of 89.6 and 86.5%, respectively.[14] Participants were screened for depression with the Edinburgh Postnatal Depression Scale (EPDS), a 10-item self-report questionnaire asking about depression symptoms which is validated for use in the antenatal and postpartum periods.[16,17] EPDS total score ranges from 0 to 30 with a higher score indicating a higher burden of depressive symptoms and a score of 10 or higher indicating a possible minor or major depression with a sensitivity and a specificity of 85 and 84%, respectively.[17]

Data collection started at the day of delivery and continued through 8 weeks postpartum. All subjects were asked to complete the PSQI and the EPDS questionnaires at three time points: delivery (T0, which covered the 7 days before delivery), 1 month postpartum (T1), and 2 months postpartum (T2). The questionnaires at delivery were a reflection of the week prior to delivery (i.e., late pregnancy). We initially aimed for a sample size of up to 200 women; however, recruitment was terminated early due to the coronavirus disease 2019 (COVID-19) pandemic and end of pilot funding for the project.

Pearson's correlation coefficient analysis was performed to evaluate correlations between PSQI and EPDS scores at T0, T1, and T2, and PROC MIXED SAS was used to estimate the overall correlation in the presence of repeated measures. Fisher's exact tests were used to explore the correlation between dichotomous cutoffs of poor subjective sleep (PSQI $\geq$ 5) and depressive symptoms indicating risk for postpartum depression (EPDS $\geq$ 10) at the three time points.

Results

A total of 26 participants (mean age 29.1 ± 6.3 years) were enrolled in the study. Participants had a mean (standard deviation, SD) body mass index of 29.0 (5.9) kg/m^2 and were on average 38.4 (2.4) weeks of gestation at the time of delivery. Baseline characteristics of participants are reported in ►**Table 1**.

Completed PSQI and EPDS questionnaires were available for 24 participants at late pregnancy (T0), 16 at 1 month postpartum (T1), and 11 at 2 months postpartum (T2). There were no significant differences in the sociodemographic and reproductive characteristics among the women contributing sleep quality and mood data at the three time points (data not shown). The mean PSQI scores (SD) at T0, T1, and T2 were 8.5 (4.1), 7.7 (3.4), and 7.9 (4.1), respectively. Poor subjective sleep quality was reported by 75.0% of women at T0, 87.5% at T1, and 72.7% at T2. The mean EPDS scores (SD) at T0, T1, and T2 were 5.0 (6.1), 4.5 (4.2), and 4.9 (4.6), respectively. Elevated EPDS scores 10 or higher were reported by 20.8% of women at T0, 12.5% at T1, and 18.2% at T2.

Utilizing PSQI and EPDS clinical thresholds, ►**Table 2** displays the direct comparison of sleep scores and depression symptoms at the three time points of interest. None of the

Table 1 Sociodemographic and reproductive characteristics of the cohort

Baseline characteristics	Overall ($N = 26$)
Age, y, mean (SD)	29.1 (6.3)
Race, *n* (%)	
White	16 (61.54)
Black, African American, or African descent	3 (11.54)
Asian Indian	1 (3.85)
American Indian or Alaska Native	1 (3.85)
Other	3 (11.54)
White and black, African American, or African descent	2 (7.69)
Ethnicity, *n* (%)	
Hispanic	6 (23.08)
Non-Hispanic	20 (76.92)
BMI, kg/m^2, *n* (%)	
< 25	7 (26.92)
25–29	8 (30.77)
≥ 30	10 (38.46)
Missing	1 (3.85)
Gestational age at delivery, wk, *n* (%)	
< 34	3 (11.54)
34–36	1 (3.85)
≥ 37	22 (84.62)

Abbreviations: BMI, body mass index; SD, standard deviation.

women reporting good sleep quality (PSQI < 5) reported higher EPDS scores indicative of depression (EPDS ≥ 10), a finding consistent across T0, T1, and T2. Of women reporting poor subjective sleep quality, 27.78% were likely to report an elevated EPDS at T0, 14.29% at T1, and 25% at T2.

Higher PSQI scores positively correlated with higher EPDS scores overall ($r = 0.71$, $p < 0.001$) (►**Fig. 1**, ►**Table 3**) and at each of the individual time points: T0 ($r = 0.79$, $p < 0.0001$), T1 ($r = 0.52$, $p = 0.04$), and T2 ($r = 0.70$, $p = 0.016$). An association between poor sleep quality and depression could not be demonstrated using the clinical cutoffs.

Discussion

In congruence with other studies, our prospective pilot study suggests a high prevalence of poor sleep quality among women at late pregnancy and the early postpartum period. The highest prevalence of poor sleep quality was noted at 1 month postpartum, whereas the lowest was at 2 months postpartum. The prospective and frequent observations of the cohort have enabled the detection of sleep quality variability within the early postpartum period. This likely is due to the variability in infant sleep cycles in the early neonatal period. While one systematic review reported a higher prevalence of poor sleep quality in the postnatal period, a longitudinal study found that sleep quality improved as the time progressed after delivery during the postnatal period.[18,19] Our study found that self-reported poor sleep is common in late pregnancy, may increase in early postpartum time frame, and then may decrease as the infant gets older, although our small sample size limits definitive conclusions. This is understandable as older infants may begin to sleep longer periods through the night.

In addition, our study has demonstrated a significant positive correlation between higher PSQI scores indicating lower sleep quality and higher EPDS scores indicating higher depressive symptomatology. This correlation was the strongest at late pregnancy and lowest at 1 month postpartum, explaining the percentage of likely depressed women among those with poor self-reported sleep quality being the lowest at 1 month postpartum and the highest at late pregnancy. Our finding that none of the women with good self-reported sleep quality reported high EPDS scores needs to be replicated in a larger cohort.

This study was limited by the small sample size of this pilot cohort. While accounted for by the COVID-19 pandemic restrictions on clinical research, this limits our ability to explore associations and patterns of sleep and depression further. This may be the reason for the lack of an association between clinical cutoffs of poor sleep quality and depression in our study. Another limitation of the study lies in its use of self-reported measures of sleep quality and depression which may have introduced some potential bias; however, these measures are validated and used in similar cohorts.[20] The implementation of objective measurements of sleep quality and depression in future studies can obtain a more

Table 2 Sleep quality and depressive symptomatology of participants based on the clinical cutoffs for PSQI and EPDS scores

	Sleep quality	Nondepressed	Likely depressed	*p*-Value
Late pregnancy (T0) ($n = 24$)	Good sleep quality, *n* (%)	6 (100.00)	0 (0.00)	0.280
	Poor sleep quality, *n* (%)	13 (72.22)	5 (27.78)	
1-mo postpartum (T1) ($n = 16$)	Good sleep quality, *n* (%)	2 (100.00)	0 (0.00)	1.00
	Poor sleep quality, *n* (%)	12 (85.71)	2 (14.29)	
2-mo postpartum (T2) ($n = 11$)	Good sleep quality, *n* (%)	3 (100.00)	0 (0.00)	1.00
	Poor sleep quality, *n* (%)	6 (75.00)	2 (25.00)	

Abbreviations: EPDS, Edinburgh Postnatal Depression Scale; PSQI, Pittsburgh Sleep Quality Index.
Note: Clinical cutoffs: poor sleep quality: PSQI ≥ 5, likely depressed: EPDS ≥ 10.

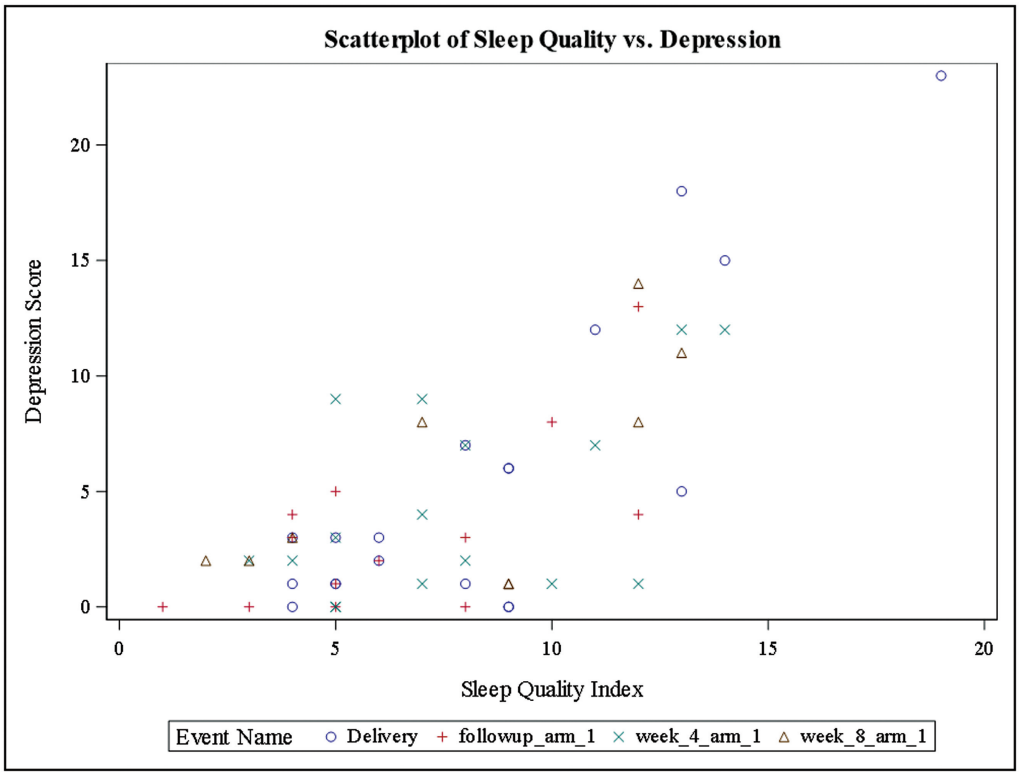

Fig. 1 Correlation scatterplot of individual sleep quality and depression scores. Higher Pittsburgh Sleep Quality Index scores positively correlated with higher Edinburgh Postnatal Depression Scale scores overall ($r = 0.71$, $p < 0.001$).

Table 3 The overall estimated correlation using repeated measurements of sleep quality and depression at late pregnancy, 1 month, and 2 months postpartum using the mixed procedure

Row	Col1	Col2	Col3	Col4	Col5	Col6	Col7	Col8
1	1.0000	0.7080	0.4394	0.5516	0.4394	0.5516	0.4394	0.5516
2	**0.7080**	1.0000	0.5516	0.7486	0.5516	0.7486	0.5516	0.7486
3	0.4394	0.5516	1.0000	0.7080	0.4394	0.5516	0.4394	0.5516
4	0.5516	0.7486	**0.7080**	1.0000	0.5516	0.7486	0.5516	0.7486
5	0.4394	0.5516	0.4394	0.5516	1.0000	0.7080	0.4394	0.5516
6	0.5516	0.7486	0.5516	0.7486	**0.7080**	1.0000	0.5516	0.7486
7	0.4394	0.5516	0.4394	0.5516	0.4394	0.5516	1.0000	0.7080
8	0.5516	0.7486	0.5516	0.7486	0.5516	0.7486	**0.7080**	1.0000

Notes: Col1/row1 = Edinburgh Postnatal Depression Scale (EPDS) score at delivery, Col2/row2 = Global Pittsburgh Sleep Quality Index (PSQI) at delivery, Col3/row3 = EPDS score at 1 month postpartum, Col4/row4 = Global PSQI at 1 month postpartum, Col5/row5 = EPDS score at 2 months postpartum, Col6/row6 = Global PSQI at 2 months postpartum. This table depicts that any measures of correlation between Col1 and row2, or between Col3 and row4 or between Col5 and row6 is the measure of overall correlation. Bold values significant at $p < 0.001$.

accurate assessment of these parameters. We were not able to determine if poor sleep caused depression or depression symptoms caused poor sleep. Sleep disorders are common in pregnancy and may be multifactorial. We were also not able to granularly record infant sleep patterns in this pilot study. Understanding maternal sleep in relation to newborn sleep in the early postpartum time frame will be important in future studies. In this small pilot study, we were unable to fully explore the impact of other psychosocial and social determinants of health on sleep and depression symptoms. As the pandemic subsides, if we begin the study again to reach the initially planned sample size, we will adjust the protocol to overcome these limitations.

Overall, we found a correlation of PSQI and EPDS scores in the late pregnancy and early postpartum periods in a pilot cohort study. The prevalence of these issues is high, indicating that these should be explored as potential important contributors to delivery and early postpartum outcomes and care rendered by obstetric providers. We also found that clinically defined subjective good sleep may be protective

against depression, although small sample size limits any clear conclusions. Asking women routinely about their sleep and mood symptoms is important for care.

Conclusion

We found a high prevalence of self-reported poor sleep during late pregnancy and the early postpartum time periods, with the highest prevalence being at 1-month postpartum. The positive correlation between PSQI and EPDS scores suggests that lower perceived sleep quality and higher self-reported depressive symptomatology may be present simultaneously in patients. Screening and interventions for both issues may be needed to optimize maternal and child health in the late prenatal and early postpartum periods.

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Conflict of Interest
None declared.

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