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Brief Communication

Nocturnal cognitive hyperarousal, perinatal-focused rumination, and insomnia are associated with suicidal ideation in perinatal women with mild to moderate depression

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ABSTRACT

Objectives: This prospective study explored associations among insomnia, nocturnal cognitive hyperarousal, and nocturnal perinatal-focused rumination with suicidal ideation (SI) in perinatal women with depression.
Methods: From late pregnancy through early postpartum, 39 depressed women completed 17 weekly surveys assessing SI, insomnia, depression, stress, and cognitive arousal.
Results: Women with nocturnal cognitive hyperarousal at baseline, relative to those with low cognitive arousal, were at greater risk for new onset SI (33% vs 1%). Moreover, nocturnal perinatal-focused rumination was independently associated with SI. SI-risk was highest when women reported clinical insomnia combined with nocturnal cognitive hyperarousal (OR = 5.66, p = 0.037) or perinatal-focused rumination (OR = 11.63, p = 0.018). Daytime perseverative thinking was not uniquely associated with SI.
Conclusions: Nocturnal cognitive arousal predicts the development of new onset SI, and perinatal-focused rumination is also uniquely associated with SI-risk in late pregnancy and early parenting. Critically, SI-risk is highest when perinatal women endorsed insomnia and high cognitive arousal at the same time. Future research should determine whether alleviating nocturnal cognitive arousal, pregnancy- and fetal/infant-related concerns, and insomnia with psychotherapy reduces SI for women with perinatal depression.

1. Introduction

Perinatal suicidal ideation (SI) is associated with negative health consequences for mother and infant, and suicide is a leading cause of maternal death [1,2]. SI affects ~20% of US women with perinatal depression [3,4], which is considerably greater than 3–4% in the broader US perinatal population [5,6]. An emerging literature has identified sleep disturbances and insomnia as potential contributing factors to SI in perinatal depression [4,7,8]. Preliminary evidence suggests that risk for perinatal SI is greatest when insomnia is combined with cognitive dysregulation at night; namely, cognitive hyperarousal and perinatal-focused ruminative thinking when trying to sleep. In 267 pregnant women, 17% of those with insomnia and nocturnal cognitive hyperarousal endorsed SI, compared to just 6% of women with insomnia alone, 7% of women with only hyperarousal, and 5% of those with neither [9]. Despite these promising results, prospective data are needed to test directionality of associations using clinical assessments that accurately identify women with perinatal depression at risk for SI.

The present study is a secondary analysis wherein we prospectively investigated clinical insomnia, nocturnal cognitive hyperarousal, and nocturnal perinatal-focused rumination as predictors of SI in perinatal depression. The present study differed from prior investigations by assessing SI, sleep, and cognitive arousal symptoms weekly across late pregnancy and early postpartum, thereby allowing for characterization of prospective associations and the identification of women at-risk for SI based on

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clinical assessment tools. We hypothesized that SI-risk would be positively associated with clinical insomnia status, nocturnal cognitive hyperarousal, and nocturnal perinatal-focused rumination. Building on prior cross-sectional findings [9], we predicted that SI-risk would be highest when women endorsed clinical insomnia and nocturnal cognitive hyperarousal simultaneously, relative to when women endorsed only insomnia, only cognitive hyperarousal, or neither.

2. Methods

2.1. Participants and procedure

Pregnant patients receiving care in a multi-hospital health system were invited via email to participate in a study on sleep and health. Patients were baseline screened at gestational week 25–30. Exclusion criteria included high risk pregnancy, sedating medications, alcohol/substance use, bipolar disorder, untreated sleep disorder other than insomnia, and severe depression. A total of 535 women contacted our team with interest in the study, 272 were screened for eligibility, and 70 women were enrolled into the prospective observational study [10]. For this secondary analysis, we examined 39 women with mild-to-moderate depression (see Measures below). Participants were administered 17 weekly online surveys (15–20 min) beginning at gestational week 30, thereby assessing health across the third trimester and first 1.5–2 postnatal months. The study was approved by the hospital Internal Review Board. All participants consented.

2.2. Measures

Sociodemographics, health history, and clinical symptoms were assessed at baseline. Clinical measures administered at baseline retained their original assessment windows, but were re-oriented to measuring weekly symptoms during follow-up. The *Edinburgh Postnatal Depression Scale (EPDS)* [11] was administered at baseline and follow-up. EPDS≥10 indicates clinical depression. Women who scored ≥18 at baseline were excluded for severe depression, and referred to treatment. Participants with mean EPDS scores ≥10 across follow-up exhibited chronic depression, and were included in this secondary analysis. EPDS item #10 assessed SI (*the thought of harming myself occurred to me*). Any endorsement was considered a positive screen. The *Insomnia Severity Index (ISI)* was administered at baseline and follow-up [12]. ISI≥11 indicates clinical insomnia in clinical populations. The *Presleep Arousal Scale-Cognitive factor (PSASC)* [13] measured nocturnal cognitive arousal at baseline and follow-up. PSASC≥20 indicates hyperarousal [14]. *Nocturnal perinatal-focused rumination (PFR)* was assessed at baseline and follow-up by asking women how intensely they 'worried or had stressful thoughts about your pregnancy or new infant' when attempting to fall asleep [9]. ROC curve analyses in the parent study sample identified PFR≥2 as the optimal cut-point for SI.[i] The *Perseverative Thinking Questionnaire (PTQ)* [15] was administered across follow-up, and PTQ≥10 represented high perseverations (above the sample mean of 9.57 for parent study). The 10-item *Perceived Stress Scale* [16] was administered across follow-up. Median completion time for baseline and follow-up survey batteries was 17 ± 19 min.

[i] PFR≥2 and PFR≥3 yielded the highest Youden's J values in predicting SI. PFR≥2 corresponded to Youden's J of 1.14 with 0.71 sensitivity and 0.43 specificity. PFR≥3 corresponded to Youden's J of 1.18 with 0.47 sensitivity and 0.71 specificity. Although the PFR≥3 yields a slightly higher Youden's J, we prioritized sensitivity over specificity in detecting patients at risk for suicide.

2.3. Analyses

Analyses were run using STATA/SE 15.1. Logit mixed effects modeling tested between-subjects and within-subjects predictors of weekly reports of SI across late pregnancy and early postpartum. Predictors of primary clinical interest were dichotomized per empirically derived cut-points to facilitate comparison to the literature and inform clinical decision-making.

3. Results

3.1. Sample characteristics and SI rates

See Table 1 for sample characteristics. Follow-up adherence was high (15.36 ± 2.54 observations/participant). In total, 10 participants (25.6%) endorsed SI at least once across baseline and follow-up assessments. Three participants (7.7%) endorsed SI at baseline, whereas nine participants (23.1%) endorsed SI during follow-up (28 SI observations during follow-up). Among the three participants with baseline SI, two endorsed SI again during follow-up (66.7%). By comparison, 7/36 (19.4%) of women who denied baseline SI later endorsed new onset SI.

3.2. Perinatal factors predicting SI

Next, we predicted new onset SI as estimated by sociodemographics and baseline symptoms, while controlling for the effects of time and childbirth (Table 1, Model 1). Women with a prior prenatal loss (OR = 12.43) and those with baseline nocturnal cognitive hyperarousal (OR = 11.47) had higher odds of reporting future SI. For descriptive purposes: 7/21 (33.3%) of women with nocturnal cognitive hyperarousal endorsed new onset SI, whereas just 1/15 (0.7%) of women without baseline hyperarousal endorsed new SI.

We then examined associations of SI with weekly sleep and cognitive symptoms, while controlling for time and baseline covariates (Table 1, Model 2). Women were at increased odds of SI when endorsing nocturnal cognitive hyperarousal (OR = 7.57) or perinatal-focused rumination (OR = 5.66).

3.3. Is SI-risk highest when experiencing insomnia combined with cognitive hyperarousal?

Lastly, we tested whether SI-risk was highest when insomnia was combined with cognitive hyperarousal.

3.3.1. Nocturnal cognitive arousal

A dummy coded mixed effects logit regression compared observations where women endorsed (1) insomnia only, (2) cognitive hyperarousal only, and (3) both insomnia and cognitive hyperarousal to (4) observations of good sleep with low cognitive arousal levels (reference group), while controlling for time, stress, and baseline covariates. The combination of insomnia and cognitive hyperarousal was associated with elevated SI-risk (OR = 5.66, 95% CI = 1.11, 28.77, p = 0.037). SI-risk for women endorsing hyperarousal alone (p = 0.056) or insomnia alone (p = 0.892) was non-significant. For descriptive purposes: 14/156 (9.0%) of observations of insomnia with cognitive hyperarousal corresponded to SI, compared to just 1/130 (0.7%) for insomnia alone, 2/40 (5.0%) for hyperarousal alone, and 11/273 (4.0%) for good sleep with low cognitive arousal (Fig. 1).

3.3.2. Perinatal-focused rumination

A similar logit model showed that women were at increased SI-risk when endorsing high rumination alone (OR = 8.98, 95% CI = 1.34, 60.21, p = 0.024) or insomnia with high rumination

Table 1
Sample characteristics (left column), and results from mixed effects logit regression predicting suicidal ideation (right column).

Sociodemographic information		Model 1, Baseline factors predicting SI			
Sample size	39	**Baseline factors**	**OR**	**95%CI**	**p**
Age (M±SD)	28.21 ± 4.32	Age	0.80	–	0.097
Age range	20–39	Prior prenatal loss	12.43	1.17, 131.55	0.036
Gestational week (M±SD)	27.82 ± 1.10	ISI ≥ 11	0.35	–	0.120
Poverty (n;%)	10/38; 26.3%	PSASC ≥ 20	11.47	1.24, 97.02	0.025
Multiparous (n;%)	22/39; 56.4%	PFR ≥ 2	0.92	–	0.935
Prior prenatal loss	7/39; 17.9%	**Time-nested factors**			
Antidepressants	1/39; 2.6%	Time	1.11	–	0.352
Race		Prenatal vs Postpartum	0.46	–	0.467
White (non-Hispanic)	16; 41.0%				
Black (non-Hispanic)	13; 33.3%	**Model 2, Time-nested factors predicting SI**			
Asian	3; 7.7%	**Baseline factors**	**OR**	**95%CI**	**p**
Middle Eastern or Arabic	2; 5.1%	Prior prenatal loss	0.96	–	0.980
Hispanic or Latinx	2; 5.1%	PSASC ≥ 20	1.05	–	0.974
Multiracial	3; 7.7%	**Time-nested factors**			
		Time	1.14	1.01, 1.30	0.040
Baseline symptoms		ISI ≥11	0.50	–	0.465
ISI (M±SD)	12.36 ± 4.41	PSASC ≥ 20	7.57	1.07, 53.72	0.043
ISI ≥ 11 (n,%)	24; 61.5%	PFR ≥ 2	5.66	1.02, 31.48	0.048
EPDS (M±SD)	10.44 ± 4.41	PTQ ≥ 10	0.90	–	0.906
EPDS ≥ 10 (n,%)	23; 59.0%	PSS	0.78	–	0.085
PSASC (M±SD)	21.82 ± 7.36				
PSASC ≥ 20 (n,%)	22; 56.4%				
PFR ≥ 2 (n,%)	30; 76.9%				
Suicidal Ideation (n,%)	3; 7.7%				

Note: Model 1: (n = 35, obs = 560). Model 2: (n = 39, obs = 599). M±SD: Mean ± Standard deviation. Poverty = <$20,000 annual household income. ISI = insomnia severity index, scores ≥11 indicate clinically significant insomnia in clinical populations. EPDS = Edinburgh postnatal depression scale, scores ≥10 indicate probably minor or major depression. PSASC = Pre-Sleep Arousal Scale's Cognitive Factor, scores ≥20 indicate high nocturnal cognitive arousal. PFR = Nocturnal perinatal-focused rumination, scores ≥2 indicate presence of rumination. SI = Suicidal ideation. Interindividual factors indicate between-subject differences, whereas intraindividual factors indicate within-subject changes. Time = study week. Prenatal vs Postpartum scored as 1 = Pre and 2 = Post. PTQ = perseverative thinking questionnaire, scores ≥10 indicate high levels of perseverative thinking. PSS = perceived stress scale, scores 14 and higher indicate high levels of stress. OR = odds ratio. 95% CI = 95% confidence interval for the OR. p = significance value.

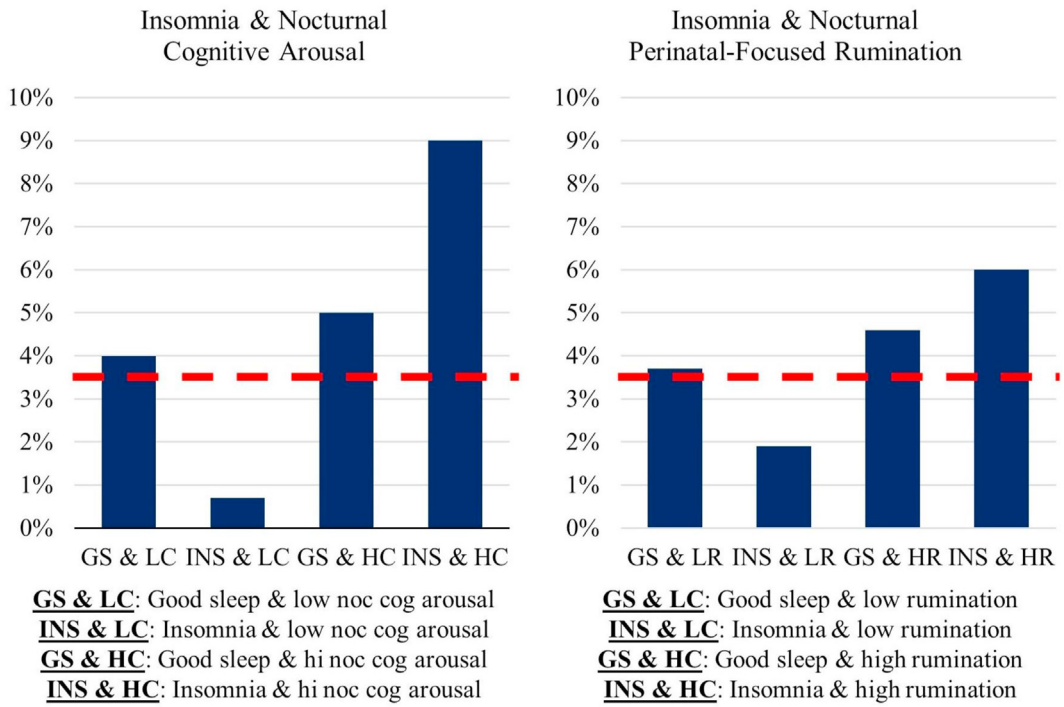

Fig. 1. Frequency rates of suicidal ideation by symptom presentation: Comparing (1) good sleep with low cognitive arousal to (2) insomnia with low cognitive arousal, (3) good sleep with high cognitive arousal, and (4) insomnia with cognitive arousal. US epidemiological data estimate the suicidal ideation rate as ~3.5% in perinatal women, represented here by a red line for descriptive purposes only. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

(OR = 11.63, 95%CI = 1.52, 89.14, p = 0.018). SI-risk was not elevated when women endorsed insomnia alone (p = 0.355). See frequency rates of SI by symptom presentation in Fig. 1.

4. Discussion

One-quarter of women with perinatal depression endorsed SI. Nocturnal cognitive hyperarousal shared strong concurrent and prospective associations with SI. However, SI-risk was highest when women endorsed insomnia and cognitive hyperarousal (in the forms of nocturnal cognitive arousal and perinatal-focused rumination) simultaneously. Although inferences from our study are limited by our relatively small sample size, this study builds on prior research on perinatal sleep and SI [4,7–9] by revealing a complex interplay between nighttime cognitive-emotional dysregulation and insomnia in their influence on SI. Nocturnal cognitive arousal, perinatal concerns, and sleep symptoms may serve as key therapeutic targets for reducing SI in women with perinatal depression.

Pregnant women with trait nocturnal cognitive hyperarousal reported higher rates of new onset SI than women without this vulnerability (33% vs 1%). Perinatal-focused rumination also played an important role in SI, highlighting the emotional toll of pregnancy- and infant-related concerns for mothers. Important to emphasize is that daytime perseverative thinking[ii] and perceived stress were not independently linked to SI, indicating that cognitive-emotional dysregulation at night plays a unique role in SI. Consistent with prior findings [9], our results suggest that the combination of insomnia and nighttime cognitive arousal presents serious risk for SI in pregnancy and postpartum. Struggling to sleep at night is often a lonely affair that can unleash a ruminative mind. Perseverating on concerns about pregnancy and fetal/infant health may fuel a depressed mind to wander to dark thoughts of self-harm. Rumination has been hypothesized as a mediator between insomnia and SI in the non-pregnant population [17]. Research is needed to test indirect effects from perinatal insomnia to SI as mediated by cognitive hyperarousal/rumination in a larger prospective study, and to determine whether these processes lead to suicide attempts.

Ethical approval

All procedures performed were in accordance with the ethical standards of the institutional review board and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent

All women provided informed consent prior to participation.

Disclosure statement

Dr. Cheng has received research support from Harmony Biosciences. Dr. Drake has received research support from Merck. and has served on speaker's bureau for Harmony Biosciences. No other financial or non-financial interests exist. The authors have no other disclosures to report.

[ii] When entered into a multivariate model, nocturnal cognitive arousal and nocturnal perinatal-focused rumination will account for much of the variance in cognitive arousal that occurs at night, whereas the PTQ will largely capture cognitive arousal that occurs during the day.

Credit author statement

DA Kalmbach: Conceptualization, methodology, data analysis, writing (original draft preparation). **BK Ahmedani:** Writing (reviewing and editing). **B Gelaye:** Writing (reviewing and editing). **P Cheng:** Writing (reviewing and editing). **CL Drake:** Supervision, conceptualization, resources, and writing (reviewing and editing).

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Conflict of interest

The authors declare no conflicts of interest.

The ICMJE Uniform Disclosure Form for Potential Conflicts of Interest associated with this article can be viewed by clicking on the following link: https://doi.org/10.1016/j.sleep.2021.03.004.

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