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Research paper

Antepartum insomnia symptoms and its association with postpartum depression symptoms in women with and without psychiatric vulnerability: A prospective cohort study

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ABSTRACT

Background: Postpartum depression is common and may be linked to antepartum insomnia, a potentially modifiable risk factor. We examine the association between insomnia- and postpartum depression symptoms, considering whether psychiatric vulnerability moderates this link.

Method: Participants completed the Insomnia Severity Index during trimester two and three and the Hospital Anxiety and Depression questionnaire postpartum. Linear regression analyses were used to investigate the associations between antepartum insomnia- and postpartum depression symptoms. We used stratified regression models and a test for multiplicative interaction to understand if psychiatric vulnerability moderates this association.

Results: A total of 217 women participated (median age 37, IQR 5). Women with clinically significant insomnia symptoms in trimester two and three reported higher postpartum depression symptoms ($p = .008$ and $p = .002$ respectively). Linear regression analyses showed effect sizes that were almost equal for both trimesters (two: $\beta = 0.19$, 95 % CI -0.20., 0.40, $p = .069$ and three: $\beta = 0.23$, 95 % CI 0.09., 0.36, $p \leq .001$), but only statistically significant for trimester three. When antepartum depression was taken into account, neither the second nor third trimester was significantly associated with postpartum depressive symptoms. Psychiatric vulnerability did not moderate the relationship ($p = .163$).

Conclusion: Insomnia symptoms in the second and third trimesters are not associated with postpartum depression when antepartum depression is taken into account in both women with and without psychiatric vulnerability. Hence it is important to screen for both insomnia and depression during pregnancy to prevent postpartum depression in all pregnant women.

1. Introduction

Postpartum depression (PPD) is highly common, with prevalence rates ranging from 14 % to 17 % (Liu et al., 2022). It is characterized by major and minor depressive episodes occurring within the first four weeks after childbirth (American Psychiatric Association, 2022), although professionals in the field adhere to a broader clinical definition of peripartum depression as a minor or major depressive episode happening at any point during pregnancy or within the initial year postpartum (Wisner et al., 2010). PPD can lead to adverse outcomes for both mother and child, including poor mother-infant bonding and neurodevelopmental issues in the offspring (Closa-Monasterolo et al., 2017; Okun, 2016; Sliwerski et al., 2020). Specifically, women with a history or current symptoms of psychiatric disorders, here termed as

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"psychiatric vulnerability", are at an increased risk of developing a relapse of mental health problems, including depressive disorders during pregnancy and the postpartum period (Rodriguez-Cabezas and Clark, 2018). Therefore, it is crucial to mitigate PPD in women, particularly in those with psychiatric vulnerability.

Although several risk factors for PPD have been suggested including psychosocial support, stressful life events and psychiatric vulnerability (especially depression) (Liu et al., 2022; Norhayati et al., 2015; Fiala et al., 2017; Özcan et al., 2017), insomnia during pregnancy has been emerging as a potentially important modifiable risk factor for PPD (Meneo et al., 2024; Palagini et al., 2024; Quin et al., 2024). Insomnia symptoms involve subjective sleep quality issues *and* persistent difficulties with initiating and/or maintaining sleep, resulting in non-restorative sleep, which affects daytime functioning (American Psychiatric Association, 2022). It is known that good sleep quality is essential for mental health, impacting emotions and cognition (Freeman et al., 2020). Indeed, research has shown that sleep deprivation can lead to increased levels of stress hormones, which can contribute to the onset or worsening of postpartum depression (Dørheim et al., 2014). Additionally, insomnia can create a cycle where poor sleep quality worsens depressive symptoms, and those symptoms further disrupt sleep, making recovery more difficult. Addressing insomnia can therefore be a vital part of preventing and treating postpartum depression. (Okun and Lac, 2023), especially since new studies show possibilities to modify antepartum sleep (Quin et al., 2024).

In pregnant women, insomnia symptoms are common, specifically during the third trimester, possibly impacted by psychological and physiological changes (Manconi et al., 2024; Sedov et al., 2018). The overall prevalence rate for insomnia symptoms during pregnancy is 38.2 % and during the third trimester the prevalence varies from 39.7 % to 42.4 %, according to two meta-analyses (Salari et al., 2021; Sedov et al., 2021). Studies show that insomnia during pregnancy increase the odds of developing perinatal depression more than three times (Palagini et al., 2023), including PPD (Palagini et al., 2024). However, a recent systematic review and meta-analysis shows that particularly during the third trimester poor subjective sleep quality, rather than insomnia, is associated with PPD (Li et al., 2023). But, limited data were available for other trimesters, and the meta-analysis included only three studies on insomnia symptoms, that used different sleep assessment scales.

Women known with psychiatric vulnerability may have an increased risk for insomnia during pregnancy and more PPD symptoms. However, currently it is unknown if insomnia during pregnancy is more common in women with psychiatric vulnerability versus without. Also, there were no studies, to our knowledge, that have investigated if psychiatric vulnerability moderates the association between antepartum insomnia symptoms and PPD, which is expected as both insomnia and psychiatric vulnerability are associated with PPD (Hertenstein et al., 2023; Johansen et al., 2020). Hence, it is expected that having both antepartum insomnia and a psychiatric vulnerability, will increase the risk for more postpartum depressive symptoms than having antepartum insomnia without a psychiatric vulnerability.

To address these knowledge gaps, we aim to investigate whether insomnia symptoms in the second and third trimester are associated with PPD symptoms *and* whether psychiatric vulnerability moderates the association between antepartum insomnia- and PPD symptoms. We hypothesize that women with psychiatric vulnerability are more susceptible to developing more postpartum depressive symptoms when experiencing antepartum insomnia symptoms, compared to women without psychiatric vulnerability.

2. Method

2.1. Study design and participants

This study made use of data obtained by the UPSET study (Understanding Peripartum mental health and the role of Sleep and Early Trauma), a prospective cohort study concerning the influence of early childhood experiences, antepartum sleep disorders and distress on postpartum maternal and neonatal outcomes.

Pregnant women were recruited from perinatal psychiatry clinics as well as from the general obstetrics clinics at a large birthing hospital (OLVG) in Amsterdam, the Netherlands. Both clinics are located in the same hospital, with patients originating from the same region. Although there is considerable overlap in problems that patients encounter, at the perinatal psychiatry clinic psychiatric issues are more prominent, whereas at obstetrics, somatic issues are generally more common.

During the first consultation at the perinatal psychiatry clinic patients were invited to participate. The general obstetrics patients were approached in the obstetrics clinics waiting room. Inclusion criteria comprised: ability to read Dutch or English, at least 18 years old, pregnancy confirmed. We did not recruit women explicitly on reporting insomnia. Excluded were women who were florid psychotic, known with severe substance abuse and patients with severe pregnancy complications like pre-eclampsia at the start of the study. Additional inclusion criteria for this study were that we only included participants who filled out a sleep questionnaire in the third trimester and the depression questionnaire postpartum.

Patients were asked to fill out two demographic questionnaires and one sleep questionnaire at the first study measurement and subsequently in the third trimester. A questionnaire measuring depressive symptoms was sent at the first study measurement and between 6 and 8 weeks postpartum. Patients were able to enter the study at any time during their pregnancy. Hence, the timing of the initial measurements varied, while the measurement of week 34 and postpartum where based on the calculated due date with similar timings across participants. Based on the participants' gestational age at the time of enrolment, we categorized them according to their respective trimesters (see Fig. 1). The various questionnaires were distributed online to participants, who also completed them digitally.

2.2. Questionnaires

2.2.1. Insomnia Severity Index 3 (ISI 3)

Insomnia symptoms were measured with the Insomnia Severity Index 3 (ISI 3). The ISI 3 is considered a brief and valid self-report questionnaire for the measurement of insomnia symptoms with high discriminative validity (Thakral et al., 2021). It consists of three items derived from the ISI 7 that contain 'Satisfaction about sleep, sleep interference with daily functioning and worry about sleep', with a 5-point Likert scale based on the severity of the symptoms. Summed scores thus range from 0 to 15 and a combined score of $\geq$7 for the ISI 3 items was used as a cut-off for clinically relevant insomnia symptoms. This cut-off maximized sensitivity and specificity at 0.97 and 0.91, respectively (Thakral et al., 2021).

2.2.2. Hospital Anxiety and Depression Scale (HADS)

The main outcome variable was symptoms of postpartum depression measured with the HADS. It is a reliable and valid questionnaire to help identify depression (Bjelland et al., 2002; Zigmond and Snaith, 1983) and for this study we used the validated Dutch version (Spinhoven et al., 1997). The HADS Depression (HADS-D) scale consists of seven items, with a 3-point Likert scale measuring the severity of the symptoms. Summed scores range from 0 to 21. A cut-off score of 7 has been used to detect postpartum depression, as this maximises combined sensitivity and specificity for major depression, at 0.94–0.97 and 0.88–0.91 respectively, according to a systematic review and meta-analysis (Wu et al., 2021).

2.3. Other measurements

Psychiatric vulnerability (defined as diagnosis of a psychiatric disorder according to DSM-5 (American Psychiatric Association, 2022) in

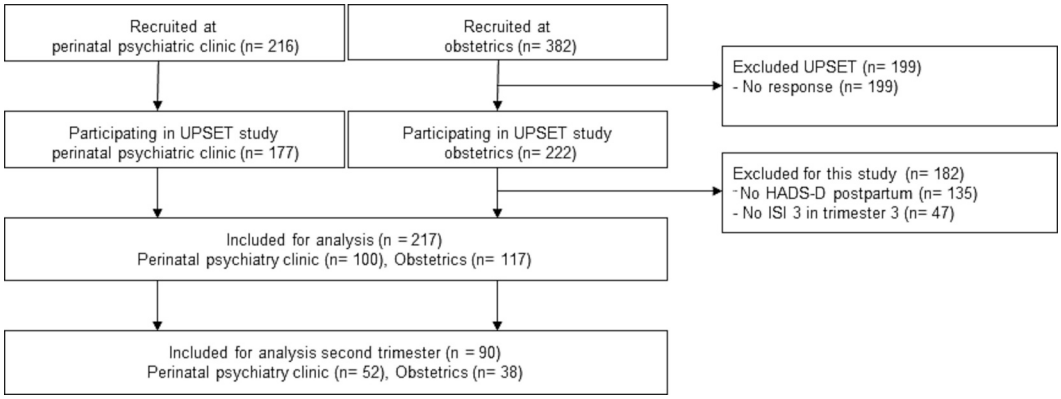

Fig. 1. Flow-chart.
Note. Research flow chart.

the past or present) was objectified in a categorical variable (yes or no), obtained from the medical record file. We selected the following confounders based on previous studies and on availability in our collected data: Educational level, parity and antepartum depressive symptoms (Liu et al., 2022; Norhayati et al., 2015; Fiala et al., 2017; Özcan et al., 2017; Tham et al., 2016). Educational level was categorized into low-to-moderate versus high educational level (defined as < and ≥ bachelor degree of university of applied sciences) and parity as primiparous (yes/no). Antepartum depressive symptoms were measured with HADS-D score during pregnancy.

3. Data analysis

All data analyses were conducted using SPSS Version 29 (IBM SPSS, Armonk, NY).

Descriptive statistics, including medians, interquartile range, and frequencies with percentages, were calculated for all variables to provide an overview of the data. All continuous variables were non-normally distributed, based on visual inspection and tests of normality. There were no missing data.

Hierarchical linear regression analyses were performed with symptoms of PPD (scores on HADS-D) as the dependent variable and symptoms of insomnia in trimester two and three separately (scores on ISI 3) as independent variable (model 1), both used as a continuous scale. To meet the assumptions on normality and homoscedasticity of residuals, a square root transformation was applied to the PPD variable. Standardized betas were reported for interpretation purposes. The second model was adjusted for education and parity. Since antepartum depressive and insomnia symptoms are suggested to be partly overlapping constructs and therefore likely correlate with each other (American Psychiatric Association, 2022; Victor et al., 2019), we performed additional adjustment for antepartum depressive symptoms separately in a third model. Next, we conducted stratified regression models in patients with and without psychiatric vulnerability, and a test for multiplicative interaction (regression model with interaction included) to understand if psychiatric vulnerability moderates the relation between insomnia symptoms on postpartum depression.

4. Results

4.1. Participants and characteristics

Table 1 presents an overview of the characteristics of the study population, insomnia and postpartum depressive symptoms. A total of 217 women participated in this study. Notably, the median age was 37 (IQR 5) and the majority was highly educated in both groups. Clinically significant insomnia symptoms were reported by 16 % for trimester two and for trimester three this was 14 % of women. Characteristics of

Table 1
Characteristics of study population.

	Median (IQR)	N (%)
Age	37 (5)	
Education		
Low to moderate		18 (8 %)
High		199 (92 %)
Parity		
Primiparous		104 (48 %)
HADS-D scores		
Antepartum	3 (4.75)	
Postpartum	3 (5)	
Postpartum score ≥ 7		43 (20 %)
Psychiatric vulnerability		101 (47 %)
Neurodevelopmental disorders		5 (2 %)
Schizophrenia spectrum and other psychotic disorders		2 (1 %)
Bipolar and related disorders		5 (2 %)
Depressive disorders		53 (24 %)
Anxiety disorders		46 (21 %)
Obsessive-compulsive and related disorders		5 (2 %)
Trauma and stressor-related disorders		9 (4 %)
Feeding and eating disorders		6 (3 %)
Personality disorders		10 (5 %)
Other mental disorders		5 (2 %)
Comorbidity		45 (21 %)
ISI 3 scores		
Trimester two	4 (5)	
Trimester two ≥ 7		14 (16 %)
Trimester two missing		127 (59 %)
Trimester three	3 (3)	
Trimester three ≥ 7		31 (14 %)

Data are shown as median (IQR) of number (percentage), ISI 3 = Insomnia Severity Index 3, HADS -D = Hospital Anxiety Depression Score, Educational levels: low to moderate = < bachelor degree university of applied sciences, high = ≥ bachelor degree university of applied sciences, antepartum HADS scores = the sum score from the baseline measurement, so not specific to a trimester, psychiatric vulnerability = diagnosis of a psychiatric disorder according to DSM-5 regardless of comorbidity (with percentages relative to the entire population, N 217), Comorbidity = participants with two or more DSM 5 diagnoses, (45 people), so 146–45 = 101 participants with psychiatric vulnerability.

participants from both the perinatal psychiatry clinic and obstetrics were similar (Supplementary Table 1).

4.2. Association between insomnia symptoms (in trimesters two and three) and postpartum depressive symptoms

With linear regressions for trimester 3, the crude model (model 1) showed that insomnia symptoms were significantly associated with PPD. After adjustment for education and parity the effect size was similar and the association remained statistically significant (model 2). Antepartum depressive symptoms and insomnia symptoms were positively correlated with Pearson's $r = 0.45$ $p \leq .001$. In Model 3 the association was no longer statistically significant after adjustment for antepartum depressive symptoms (Table 2). For trimester 2, effect sizes were largely similar to trimester 3, however, results were not statistically significant. See Supplementary data Table 2 for additional information about covariates.

4.3. Moderation by psychiatric vulnerability of the association between antepartum insomnia symptoms and postpartum depressive symptoms

In stratified regression models, the effect size was slightly higher in individuals with psychiatric vulnerability, but the association between antepartum insomnia symptoms in trimester three and postpartum depressive symptoms was not statistically significantly moderated by psychiatric vulnerability (p of interaction term = 0.163) (Table 3). For a visual view of raw data for stratified groups see Fig. 2. See Supplementary data Table 3 for a distribution of antepartum depressive symptoms for participants with and without psychiatric vulnerability.

5. Discussion

The present study aimed to investigate whether insomnia symptoms in the second and third trimester are associated with PPD symptoms and whether psychiatric vulnerability moderates the association between antepartum insomnia- and PPD symptoms.

Although women with more insomnia symptoms in both trimesters reported more PPD symptoms, the positive association between insomnia symptoms and PPD was only statistically significant for trimester three, but this significance was lost after adjustment for antepartum depressive symptoms. This is possibly due to the association between antepartum insomnia and antepartum depressive symptoms. Effect sizes were largely similar for trimester two. However, these results were not statistically significant, potentially due to smaller sample size in these analyses. Psychiatric vulnerability, i.e. having a psychiatric disorder in the past and/or present, does not moderate the relation between insomnia symptoms and PPD.

Table 2
Hierarchical linear regression model for insomnia- and postpartum depression symptoms.

	β	95 % confidence interval	*p*-Value	R^2
ISI 3 scores trimester 3				
Model 1	0.23	0.09, 0.36	<.001	5.1 %
Model 2	0.22	0.09, 0.36	.001	5.8 %
Model 3	0.01	−0.13, 0.15	.915	22.2 %
ISI 3 scores trimester 2				
Model 1	0.19	−0.20, 0.40	.069	3.7 %
Model 2	0.21	−0.05, 0.42	.056	5.1 %
Model 3	−0.05	−0.29, 0.19	.677	19.4 %

β = standardized Beta, the dependent variable = PPD symptoms (HADS-D scores square root transformed), Model 1: Linear regression model of PDD symptoms and antepartum insomnia symptoms (ISI 3 scores) as independent variable without adjustments for covariates, Model 2: Linear regression model of PDD symptoms and antepartum insomnia symptoms (ISI 3 scores) as independent variable, adjusted for education and parity, Model 3: Linear regression model of PDD symptoms and antepartum insomnia symptoms (ISI 3 scores) as independent variable, adjusted for education, parity and antepartum depressive symptoms.

Table 3
Moderation by psychiatric vulnerability in the relation between antepartum insomnia symptoms and postpartum depressive symptoms.

Stratification	ISI3 scores trimester 3 Participants without psychiatric vulnerability (n = 116)	ISI3 scores trimester 3 Participants with Psychiatric vulnerability (n = 101)	Interaction
β	0.11	0.31	0.21
95 % CI	−0.07, 0.31	0.12, 0.50	−0.90, 0.52
p-Value	0.225	0.001	0.163
R^2	1.0 %	10.0 %	

β = standardized Beta, dependent variable is HADS-D scores square root transformed, 95 % CI = 95 % confidence interval.

Our finding that the association between insomnia in the third trimester and PPD was no longer significant after adjusting for antepartum depression symptoms is in concordance with previous studies (Palagini et al., 2023). Palagini et al. (2023) performed a meta-analysis where they found that very often antepartum insomnia is associated with PPD, but peripartum depression also appears to be a contributing factor. It is known that there is considerable overlap between insomnia and depression (American Psychiatric Association, 2022; Victor et al., 2019) and a bidirectional association has been suggested (Fang et al., 2019; Riemann et al., 2020). Riemann et al. (2020) states in a review that insomnia may represent an initial step toward the onset of psychopathology, sharing some underlying (epi-) genetic, personality, and neurobiological changes. At the same time, it could also be possible that insomnia is a symptom of depression. In our findings we found a positive correlation between antepartum insomnia and antepartum depression. Antepartum depressive symptoms is an important confounding factor but might also be a mediating factor, resulting in potential over-adjustment in the third model, which could be an explanation why the association is no longer statistically significant after adjusting for antepartum depression. Furthermore, the treatment of insomnia with cognitive behavioural treatment (CBT—I) shows promising results for patients with comorbid depression (and other psychopathology) (Hertenstein et al., 2022; Mirchandaney et al., 2022). This means that taking insomnia symptoms into account during psychiatric evaluation is still important in daily practice, but also in future studies, even though effect sizes in this study are small.

In the second trimester, we found no significant association between insomnia and postpartum depression, possibly due to the small sample size. A meta-analysis by Sedov et al. (2021) reports a prevalence for insomnia in trimester two of 27.2 % which was significantly lower than observed in trimester three which was almost 40 %. It might be that patients who entered our study in trimester three already had insomnia symptoms in trimester two. In our sample most patients did not have measurements on both time points, hence we were not able to investigate this. Based on the literature, the third trimester is when most significant biological changes occur, which increases the likelihood of insomnia (Sedov et al., 2021), rather than trimester two.

In contradiction to our hypothesis, we did not find that the relation between insomnia during pregnancy and PPD was moderated by psychiatric vulnerability. It would be expected that women with insomnia symptoms and psychiatric vulnerability have more PPD symptoms, due to the emerging evidence suggesting a bidirectional relationship between insomnia and symptom severity of various psychopathologies (Lancel et al., 2021). Prior studies showed that insomnia is a known risk factor for psychiatric disorders (Hertenstein et al., 2023), that previous psychiatric illness is related to postpartum depression (Norhayati et al., 2015) and pregnant women with insomnia more often are also having depression or anxiety symptoms (Palagini et al., 2024). It is possible that our study was underpowered due to the small sample size. And although we had a small but reasonable group of women with PPD, the percentage

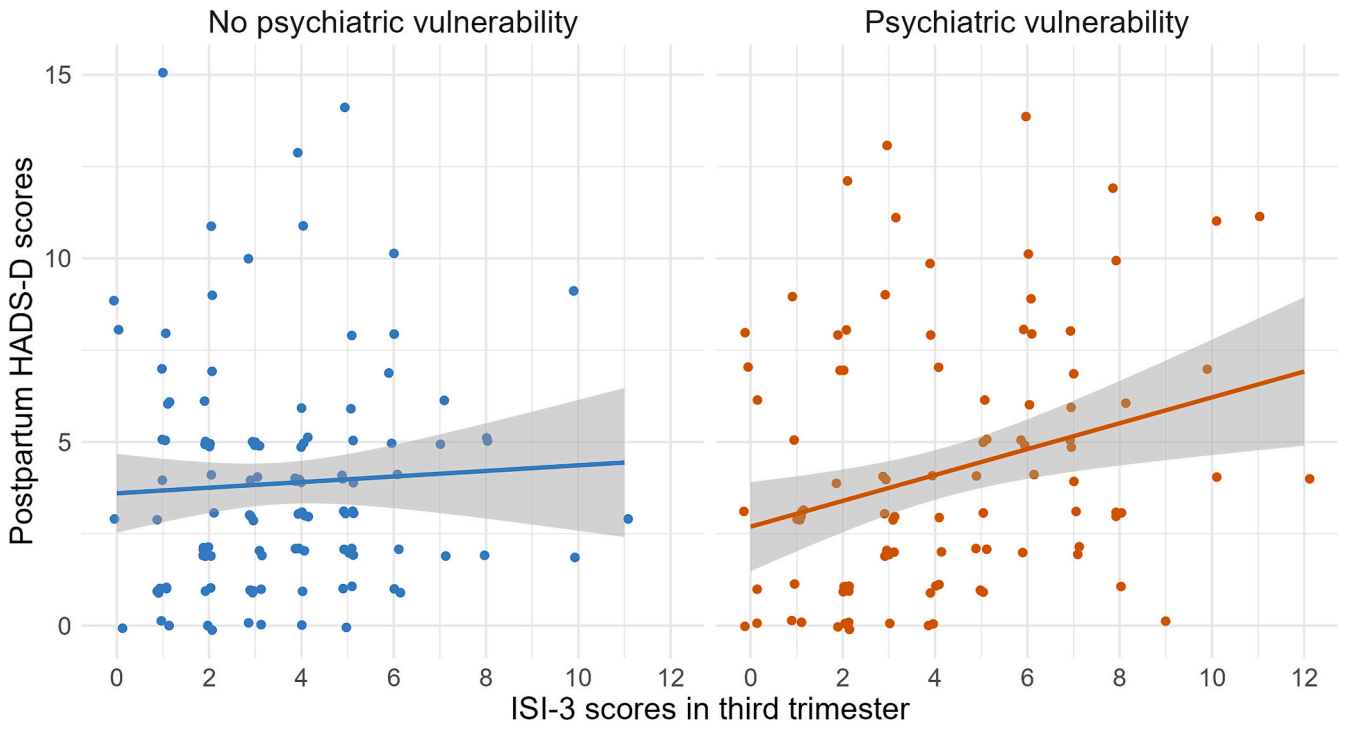

Fig. 2. Stratified moderation effects for psychiatric vulnerability in the association between antepartum insomnia- and postpartum depressive symptoms. HADS-D = Hospital Anxiety and Depression score – Depression, ISI 3 = Insomnia Severity Index 3, Psychiatric vulnerability = diagnosis of a psychiatric disorder now or in the past according to DSM-5, data in figure are raw data.

of women experiencing insomnia was much smaller than expected and reported in previous studies, which may have influenced our findings. Even though no interaction effect was found we did find a higher effect size for women with psychiatric vulnerability, which might still suggest that women with psychiatric vulnerability and insomnia are prone to develop more severe PPD symptoms. Future studies should investigate the role of psychiatric vulnerability in larger and more diverse samples.

A strength is that this is the first study looking into moderation for psychiatric vulnerability in pregnant women in a sample with a relative large percentage of pregnant patients with psychiatric vulnerability. Most previous studies focused on insomnia and/or depression instead of vulnerability for more varied psychopathology (Palagini et al., 2023), while in our sample we included women with a broad range of psychiatric disorders. Another strength is that we also focussed on trimester two, to gain more insight in insomnia symptoms earlier in pregnancy. If insomnia can be treated earlier, than the third trimester might be more tolerable and PPD might be reduced or prevented.

However, there are also some limitations. As stated earlier, the prevalence of insomnia symptoms (only 16 and 14 % in trimester two and three respectively) was not in concordance with other studies where prevalence rates vary from 39. 7 to 42.4 % in the third trimester (Salari et al., 2021; Sedov et al., 2021). A possible explanation for these low prevalence numbers might be the fact that 93 % of participants were highly educated. A recent study by Baranova et al. (2024) showed that high education is a protective factor for insomnia. Also, it might be that patients with more severe problems sought care outside the hospital and therefore, did not participate in this study. Or it is possible that patients with more severe symptoms did not want to participate because they were not able to due to their symptoms (health status bias). In addition due to the highly educated group we also assume a selection and cultural bias, where only this specific group wants (or was able) to participate. Our hospital has a large cultural diversity. However, patients with various migration backgrounds could not participate as the questionnaires were only provided in Dutch and English. The fact that we included a homogenous group limits the generalisability of our findings. Another possible explanation might be that we used the ISI-3 instead of the more common ISI-7 for detection of Insomnia Severity. An advantage is that there is less subject burden, but it may be less reliable than the full ISI. However Thakral et al. (2021) showed that the ISI 3 has high discriminant validity in identifying insomnia.

Furthermore, in the design of our study, patients were eligible to participate at any point during pregnancy, aligned with the logistics of the perinatal clinics However, the majority of participants were enrolled during the third trimester, with a smaller sample from the second trimester. The smaller sample size in the second trimester may be attributed to common issues with healthcare waitlists.

While we included some key confounding variables, we could not account for all potential confounders. Depression is multifactorial, and the literature suggests a broad range of risk factors and other important confounders like psychosocial stressors (such as life stress and lack of a partner) were not included. However, as antepartum depression is known to be one of the most important predictors of postpartum depression, it is unlikely that our results or conclusions for Model 3 would have changed (Hutchens and Kearney, 2020; Liu et al., 2022; Fiala et al., 2017; Özcan et al., 2017).

It would be interesting for future studies to explore a more diverse group of women with different sociodemographic backgrounds including education and a broader range of possible confounders, to see if we can replicate our findings that psychiatric vulnerability does not moderate the relation between insomnia and PPD. Also, experimental studies are needed to investigate whether interventions for insomnia can reduce or prevent PPD. It is known that digital CBT-I is effective for treatment of insomnia symptoms (Silang et al., 2024; Soh et al., 2020), is easy accessible, low in cost and would be feasible to implement in an obstetrics or perinatal psychiatry clinic.

In conclusion, insomnia symptoms in trimester three were associated with PPD after adjusting for parity and education, but this association lost significance after accounting for antepartum depression symptoms. Results for trimester two were largely similar, although not statistically significant. Psychiatric vulnerability did not moderate the relationship.

Even though the results are modest, it remains important to take antepartum insomnia (and depression) symptoms seriously as early as possible in pregnancy, but at least from the second trimester onwards, to prevent or reduce PPD.

CRediT authorship contribution statement

Lorân van der Hoeven: Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Formal analysis, Data curation, Conceptualization. **Amy Hofman:** Writing – review & editing, Visualization, Validation, Methodology, Formal analysis, Conceptualization. **Lara Rösler:** Writing – review & editing, Visualization. **Ysbrand D. van der Werf:** Writing – review & editing. **Birit F.P. Broekman:** Writing – review & editing, Validation, Supervision, Methodology, Conceptualization.

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work the author(s) used ChatGPT in order to improve readability. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the published article.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jad.2025.01.030.

Data availability

Due to the sensitive nature of the questions asked in this study, survey respondents were assured raw data would remain confidential and would not be shared. Also the Medical Ethical Commission requires that data is not shared.

References

American Psychiatric Association, 2022. Diagnostic and Statistical Manual of Mental Disorders, 5 ed.

Baranova, A., Cao, H., Zhang, F., 2024. Exploring the influences of education, intelligence and income on mental disorders. Gen Psychiatr 37, e101080. https://doi.org/10.1136/gpsych-2023-101080.

Bjelland, I., Dahl, A.A., Haug, T.T., Neckelmann, D., 2002. The validity of the Hospital Anxiety and Depression Scale. An updated literature review. J. Psychosom. Res. 52, 69–77. https://doi.org/10.1016/s0022-3999(01)00296-3.

Closa-Monasterolo, R., Gispert-Llaurado, M., Canals, J., Luque, V., Zaragoza-Jordana, M., Koletzko, B., Grote, V., Weber, M., Gruszfeld, D., Szott, K., Verduci, E., ReDionigi, A., Hoyos, J., Brasselle, G., Escribano Subias, J., 2017. The effect of postpartum depression and current mental health problems of the mother on child behaviour at eight years. Matern. Child Health J. 21, 1563–1572. https://doi.org/10.1007/s10995-017-2288-x.

Dørheim, S.K., Bjorvatn, B., Eberhard-Gran, M., 2014. Can insomnia in pregnancy predict postpartum depression? A longitudinal, population-based study. PLoS One 9, e94674. https://doi.org/10.1371/journal.pone.0094674.

Fang, H., Tu, S., Sheng, J., Shao, A., 2019. Depression in sleep disturbance: a review on a bidirectional relationship, mechanisms and treatment. J. Cell. Mol. Med. 23, 2324–2332. https://doi.org/10.1111/jcmm.14170.

Fiala, A., Švancara, J., Klánová, J., Kašpárek, T., 2017. Sociodemographic and delivery risk factors for developing postpartum depression in a sample of 3233 mothers from the Czech ELSPAC study. BMC Psychiatry 17, 104. https://doi.org/10.1186/s12888-017-1261-y.

Freeman, D., Sheaves, B., Waite, F., Harvey, A.G., Harrison, P.J., 2020. Sleep disturbance and psychiatric disorders. Lancet Psychiatry 7, 628–637. https://doi.org/10.1016/s2215-0366(20)30136-x.

Hertenstein, E., Trinca, E., Wunderlin, M., Schneider, C.L., Züst, M.A., Fehér, K.D., Su, T., Straten, A.V., Berger, T., Baglioni, C., Johann, A., Spiegelhalder, K., Riemann, D., Feige, B., Nissen, C., 2022. Cognitive behavioral therapy for insomnia in patients with mental disorders and comorbid insomnia: a systematic review and meta-analysis. Sleep Med. Rev. 62, 101597. https://doi.org/10.1016/j.smrv.2022.101597.

Hertenstein, E., Benz, F., Schneider, C.L., Baglioni, C., 2023. Insomnia-a risk factor for mental disorders. J. Sleep Res. 32, e13930. https://doi.org/10.1111/jsr.13930.

Hutchens, B.F., Kearney, J., 2020. Risk factors for postpartum depression: an umbrella review. J. Midwifery Womens Health 65, 96–108. https://doi.org/10.1111/jmwh.13067.

Johansen, S.L., Stenhaug, B.A., Robakis, T.K., Williams, K.E., Cullen, M.R., 2020. Past psychiatric conditions as risk factors for postpartum depression: a nationwide cohort study. J. Clin. Psychiatry 81doi:https://doi.org/10.4088/JCP.19m12929.

Lancel, M., Boersma, G.J., Kamphuis, J., 2021. Insomnia disorder and its reciprocal relation with psychopathology. Curr. Opin. Psychol. 41, 34–39. https://doi.org/10.1016/j.copsyc.2021.02.001.

Li, H., Li, H., Zhong, J., Wu, Q., Shen, L., Tao, Z., Zhang, H., Song, S., 2023. Association between sleep disorders during pregnancy and risk of postpartum depression: a systematic review and meta-analysis. Arch. Womens Ment. Health 26, 259–267. https://doi.org/10.1007/s00737-023-01295-3.

Liu, X., Wang, S., Wang, G., 2022. Prevalence and risk factors of postpartum depression in women: a systematic review and meta-analysis. J. Clin. Nurs. 31, 2665–2677. https://doi.org/10.1111/jocn.16121.

Manconi, M., van der Gaag, L.C., Mangili, F., Garbazza, C., Riccardi, S., Cajochen, C., Mondini, S., Furia, F., Zambrelli, E., Baiardi, S., Giordano, A., Rizzo, N., Fonti, C., Viora, E., D'Agostino, A., Cicolin, A., Cirignotta, F., Life, O.N.S.G., Group of, M, Aquilino, D., Barassi, A., Del Giudice, R., Fior, G., Gambini, O., Giordano, B., Martini, A., Serrati, C., Stefanelli, R., Scarone, S., Canevini, M., Fanti, V., Stein, H.C., Marconi, A.M., Group of, T, Raimondo, E., Viglietta, E., Group of, B, Santoro, R., Simonazzi, G., Bianconcini, A., Group of, L, Meani, F., Piazza, N., Filippakos, F., Gyr, T., 2024. Sleep and sleep disorders during pregnancy and postpartum: the Life-ON study. Sleep Med. 113, 41–48. https://doi.org/10.1016/j.sleep.2023.10.021.

Meneo, D., Baldi, E., Cerolini, S., Curati, S., Bastianini, S., Berteotti, C., Simonazzi, G., Manconi, M., Zoccoli, G., De Bartolo, P., Gelfo, F., Martire, V.L., Baglioni, C., 2024. Promoting sleep health during pregnancy for enhancing women's health: a longitudinal randomized controlled trial combining biological, physiological and psychological measures, Maternal Outcome after THERapy for Sleep (MOTHERS). BMC Psychol 12, 340. https://doi.org/10.1186/s40359-024-01827-1.

Mirchandaney, R., Barete, R., Asarnow, L.D., 2022. Moderators of cognitive behavioral treatment for insomnia on depression and anxiety outcomes. Curr. Psychiatry Rep. 24, 121–128. https://doi.org/10.1007/s11920-022-01326-3.

Norhayati, M.N., Hazlina, N.H., Asrenee, A.R., Emilin, W.M., 2015. Magnitude and risk factors for postpartum symptoms: a literature review. J. Affect. Disord. 175, 34–52. https://doi.org/10.1016/j.jad.2014.12.041.

Okun, M.L., 2016. Disturbed sleep and postpartum depression. Curr. Psychiatry Rep. 18, 66. https://doi.org/10.1007/s11920-016-0705-2.

Okun, M.L., Lac, A., 2023. Postpartum insomnia and poor sleep quality are longitudinally predictive of postpartum mood symptoms. Psychosom. Med. 85, 736–743. https://doi.org/10.1097/psy.0000000000001234.

Özcan, N.K., Boyacıoğlu, N.E., Dinç, H., 2017. Postpartum depression prevalence and risk factors in Turkey: a systematic review and meta-analysis. Arch. Psychiatr. Nurs. 31, 420–428. https://doi.org/10.1016/j.apnu.2017.04.006.

Palagini, L., Cipriani, E., Caruso, V., Sharma, V., Gemignani, A., Bramante, A., Miniati, M., Riemann, D., 2023. Insomnia during the perinatal period and its association with maternal and infant psychopathology: a systematic review and meta-analysis. Curr. Psychiatry Rep. 25, 617–641. https://doi.org/10.1007/s11920-023-01463-3.

Palagini, L., Miniati, M., Driul, L., Colizzi, M., Comacchio, C., Gemignani, A., Balestrieri, M., 2024. Prenatal insomnia disorder may predict concurrent and postpartum psychopathology: a longitudinal study. J. Sleep Res., e14202 https://doi.org/10.1111/jsr.14202.

Quin, N., Tikotzky, L., Astbury, L., Spina, M.A., Fisher, J., Stafford, L., Wiley, J.F., Bei, B., 2024. Preventing postpartum insomnia: findings from a three-arm randomized-controlled trial of cognitive behavioral therapy for insomnia, a responsive bassinet, and sleep hygiene. Sleep 47. https://doi.org/10.1093/sleep/zsae106.

Riemann, D., Krone, L.B., Wulff, K., Nissen, C., 2020. Sleep, insomnia, and depression. Neuropsychopharmacology 45, 74–89. https://doi.org/10.1038/s41386-019-0411-y.

Rodriguez-Cabezas, L., Clark, C., 2018. Psychiatric emergencies in pregnancy and postpartum. Clin. Obstet. Gynecol. 61, 615–627. https://doi.org/10.1097/GRF.0000000000000377.

Salari, N., Darvishi, N., Khaledi-Paveh, B., Vaisi-Raygani, A., Jalali, R., Daneshkhah, A., Bartina, Y., Mohammadi, M., 2021. A systematic review and meta-analysis of prevalence of insomnia in the third trimester of pregnancy. BMC Pregnancy Childbirth 21, 284. https://doi.org/10.1186/s12884-021-03755-z.

Sedov, I.D., Cameron, E.E., Madigan, S., Tomfohr-Madsen, L.M., 2018. Sleep quality during pregnancy: a meta-analysis. Sleep Med. Rev. 38, 168–176. https://doi.org/10.1016/j.smrv.2017.06.005.

Sedov, I.D., Anderson, N.J., Dhillon, A.K., Tomfohr-Madsen, L.M., 2021. Insomnia symptoms during pregnancy: a meta-analysis. J. Sleep Res. 30, e13207. https://doi.org/10.1111/jsr.13207.

Silang, K., MacKinnon, A., Madsen, J., Giesbrecht, G.F., Campbell, T., Keys, E., Freeman, M., Dewsnap, K., Jung, J.W., Tomfohr-Madsen, L.M., 2024. Sleeping for two: a randomized controlled trial of cognitive behavioural therapy for insomnia (CBTI) delivered in pregnancy and secondary impacts on symptoms of postpartum depression. J. Affect. Disord. 362, 670–678. https://doi.org/10.1016/j.jad.2024.07.117.

Sliwerski, A., Kossakowska, K., Jarecka, K., Switalska, J., Bielawska-Batorowicz, E., 2020. The effect of maternal depression on infant attachment: a systematic review. Int. J. Environ. Res. Public Health 17. https://doi.org/10.3390/ijerph17082675.

Soh, H.L., Ho, R.C., Ho, C.S., Tam, W.W., 2020. Efficacy of digital cognitive behavioural therapy for insomnia: a meta-analysis of randomised controlled trials. Sleep Med. 75, 315–325. https://doi.org/10.1016/j.sleep.2020.08.020.

Spinhoven, P., Ormel, J., Sloekers, P.P., Kempen, G.I., Speckens, A.E., Van Hemert, A.M., 1997. A validation study of the Hospital Anxiety and Depression Scale (HADS) in different groups of Dutch subjects. Psychol. Med. 27, 363–370. https://doi.org/10.1017/s0033291796004382.

Thakral, M., Von Korff, M., McCurry, S.M., Morin, C.M., Vitiello, M.V., 2021. ISI-3: evaluation of a brief screening tool for insomnia. Sleep Med. 82, 104–109. https://doi.org/10.1016/j.sleep.2020.08.027.

Tham, E.K., Tan, J., Chong, Y.S., Kwek, K., Saw, S.M., Teoh, O.H., Goh, D.Y., Meaney, M. J., Broekman, B.F., 2016. Associations between poor subjective prenatal sleep quality and postnatal depression and anxiety symptoms. J. Affect. Disord. 202, 91–94. https://doi.org/10.1016/j.jad.2016.05.028.

Victor, R., Garg, S., Gupta, R., 2019. Insomnia and depression: how much is the overlap? Indian J. Psychiatry 61, 623–629. https://doi.org/10.4103/psychiatry.IndianJPsychiatry_461_18.

Wisner, K.L., Moses-Kolko, E.L., Sit, D.K., 2010. Postpartum depression: a disorder in search of a definition. Arch. Womens Ment. Health 13, 37–40. https://doi.org/10.1007/s00737-009-0119-9.

Wu, Y., Levis, B., Sun, Y., He, C., Krishnan, A., Neupane, D., Bhandari, P.M., Negeri, Z., Benedetti, A., Thombs, B.D., 2021. Accuracy of the Hospital Anxiety and Depression Scale Depression subscale (HADS-D) to screen for major depression: systematic review and individual participant data meta-analysis. Bmj 373, n972. https://doi.org/10.1136/bmj.n972.

Zigmond, A.S., Snaith, R.P., 1983. The hospital anxiety and depression scale. Acta Psychiatr. Scand. 67, 361–370. https://doi.org/10.1111/j.1600-0447.1983.tb09716.x.