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Insomnia before and after childbirth: The risk of developing postpartum pain—A longitudinal population-based study☆

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ABSTRACT

Objective: To examine if insomnia before and after childbirth predicts the development of postpartum bodily pain.
Methods: This study is part of a longitudinal cohort study, the Akershus Birth Cohort Study, which targeted all women giving birth at Akershus University Hospital in Norway. The current sample is comprised of 1480 women who participated at all three time points, yielding a participation rate of 32% of the 4662 women who originally consented to participate. The Bergen Insomnia Scale (BIS) was used to measure insomnia and a latent profile analysis (LPA) was used to identify subsets of women who shared a similar pattern of responses on the BIS-scale across the three time points. Pain was measured using the bodily pain scale, derived from the Primary Care Evaluation of Mental Disorders (PRIME-MD) and symptoms of depression were measured by the Edinburgh Postnatal Depression Scale (EPDS).
Results: Using a latent profile analysis a three class model showed the best fit and identified one major group (55.6%) with a low BIS scores across all three time points, one group with intermediate BIS scores (32.9%), and a smaller group (11.5%) with higher BIS scores across all three times. The chronic high insomnia group had a 2.8-fold increased risk of reporting high levels of bodily pain. The chronic intermediate group was associated with a 2.2-fold increased risk of bodily pain at two years postpartum. Adjusting for demographics and lifestyle behaviors did not reduce any of the associations, while adjusting for depression significantly attenuated the associations. Additional adjustment for pain at eight weeks postpartum further reduced the magnitude of the associations, but both chronic intermediate insomnia and chronic high insomnia remained strongly associated with the onset of bodily pain in the fully adjusted models (RR = 1.75, 95% CI: 1.37–2.23) and RR = 1.63, 95% CI: 1.15–2.32, respectively).
Conclusions: The high prevalence of insomnia among women during and after childbirth, in combination with the strong prospective association with impaired physical health, emphasizes the importance of adequately identifying, preventing and treating insomnia for this population.

Introduction

Insomnia is a rising public health concern, and it is now estimated that around 15% of the adult population fulfills the diagnostic criteria for an insomnia disorder [1,2], as defined by difficulty initiating or maintaining sleep, for at least 3 months, in combination with impaired daytime functioning caused by the sleep disturbance [3]. Women report insomnia more frequently than men [4], and this sex-specific pattern tends to emerge in late adolescence [5]. Pregnancy and the postnatal period may be an especially vulnerable period for developing insomnia in women. In a previous publication we found a very high prevalence of an insomnia disorder (approximately 60%) both before and immediately after childbirth and although the prevalence decreased

☆ Condensation: Chronic insomnia during and after pregnancy is a risk factor for later onset of bodily pain.

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somewhat when the offspring reached toddlerhood, more than 4 out of 10 women still fulfilled the diagnostic criteria for DSM-IV insomnia two years postpartum [6].

The postpartum period is also marked by an increase in physical complaints, although the reasons for this have not been clearly explained [7–9]. While the physical and physiologic changes around pregnancy and birth may be plausible causes of poor sleep, another possibility is that chronic insomnia may lead to a new onset of bodily pain. The link between sleep and pain has been investigated extensively over the past few decades in the general population. Although the direction of causality is not entirely clear, and is most likely bi-directional, several lines of evidence point to sleep problems being the primary antecedent. This includes evidence that insomnia exacerbates existing pain and predicts new-onset pain [10–13]. Additionally, studies demonstrate that sleep quality predicts pain severity the following day. Several studies have also demonstrated an association between sleep complaints and physical symptoms in postpartum women. For example, two Korean studies found sleep disturbance among women to be closely related to postpartum fatigue [14,15].

One possible mechanism which might explain the link between sleep and bodily pain is co-occurring mental health problems [16]. Women in the postpartum period are at increased risk of developing depressive disorders, and both sleep problems and pain are closely interrelated with depression in the postnatal period [17]. Therefore, there is a need to clarify the relative contribution of depression when poor sleep impacts the development of bodily pain in the postpartum period. Maternal health care in the postpartum years remains a neglected area of women's health in general [18]. We lack knowledge both with regard to sleep problems and bodily pain in general, but especially in how these factors are related and whether changes in levels of depression may account for these associations. To the best our knowledge, no studies have examined the prospective association

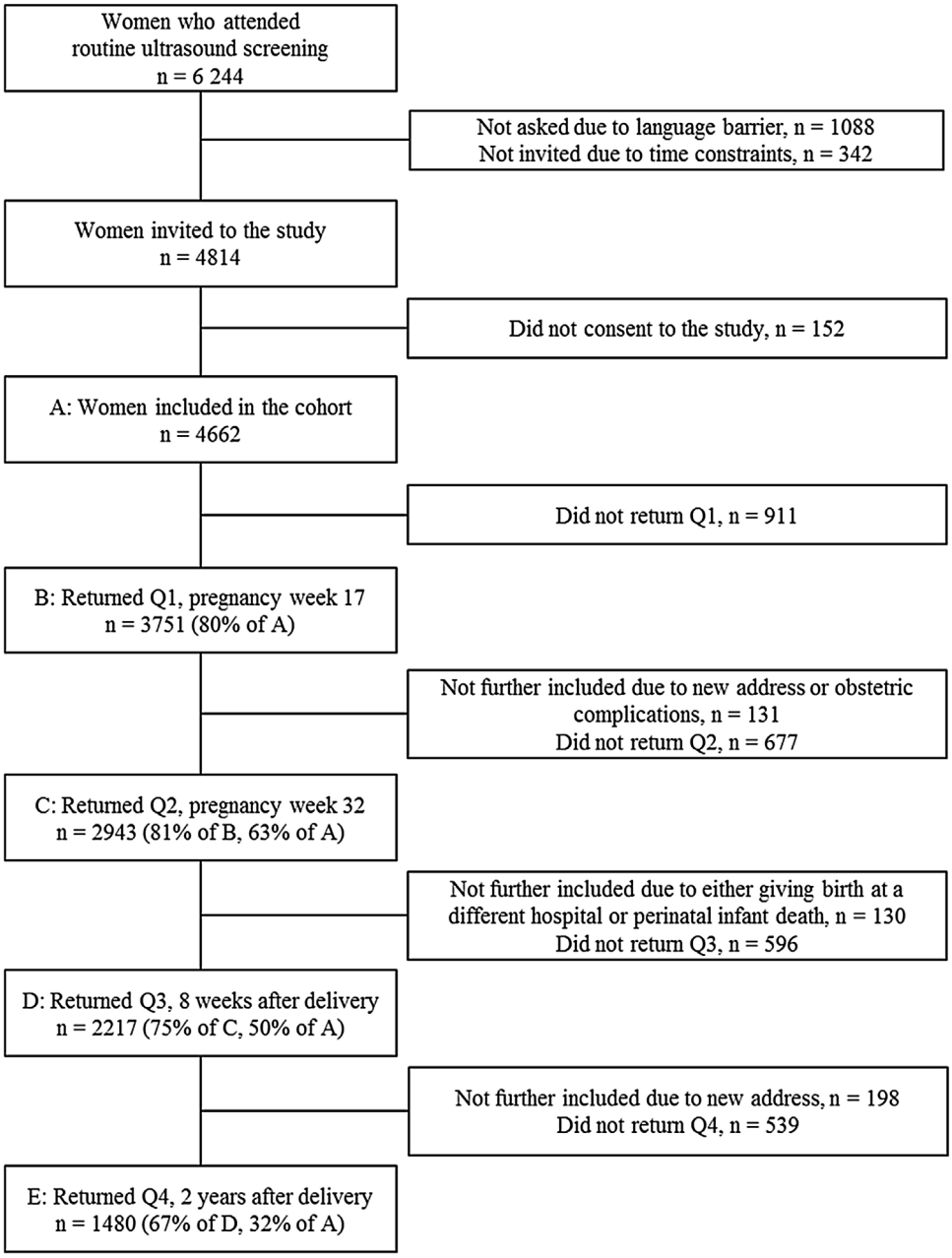

Fig. 1. Participant flow of the study.

between chronic sleep problems and the development of impaired physical health in postpartum women.

Based on the above considerations, the overall aim of the current study was to examine if different classes of insomnia trajectories during and after childbirth are linked to the development of subsequent bodily pain two years postpartum. We also aimed to explore if any association could be explained by postnatal depressive symptoms and other potential confounders.

Methods

Study population and design

The Akershus Birth Cohort is a longitudinal questionnaire study targeted at all women giving birth at Akershus University Hospital in Norway. The hospital serves a population of 350,000 from both urban and rural areas. All women scheduled to give birth at the hospital were approached in gestational week 17 when they underwent routine fetal ultrasound. Women were included if they gave consent to participate and were able to complete a questionnaire in Norwegian. The recruitment lasted from November 2008 until April 2010. Consenting women completed the first questionnaire at gestational week 17, and thereafter received a questionnaire by mail at week 32 of pregnancy, 8 weeks after delivery, and 2 years after delivery. In total, 2943 women returned the second questionnaire, 2217 women returned the third questionnaire and 2055 women returned the fourth questionnaire. The current study only included women who completed the baseline and three follow-up questionnaires. Therefore, the final study sample in the current study consisted of 1480 women, representing a participation rate of 32% of the 4662 women who originally consented to participate, and 72% of the women who returned the fourth questionnaire. See Fig. 1 for a flow chart of participants.

Instruments

Insomnia

The Bergen Insomnia Scale (BIS) [19] was used to assess insomnia at all three follow-up assessments. The BIS includes six items that correspond to the diagnostic criteria for insomnia in the DSM-IV-TR. Each item is scored using a scale from 0 to 7, where the respondents specify the frequency of the various insomnia symptoms in terms of days per week. The first four items assess sleep impairment (DSM-IV-TR criterion A for insomnia), and the last two items measure daytime sleepiness or tiredness (affecting school/work or private life) and dissatisfaction with sleep (DSM-IV-TR criterion B for insomnia). The BIS has a scoring range from 0 to 42, where higher scores correlate with more symptoms of insomnia. The BIS has previously demonstrated good psychometric properties [19].

Bodily pain

The bodily pain scale, derived from the Primary Care Evaluation of Mental Disorders (PRIME-MD) [20], was completed by women at the two last follow-up periods, and included the following five pain locations (rated no/yes): stomach pain, back pain, pain in arms/legs/joints, menstrual pain/problems, and pain/problems during sexual intercourse. In the current study, the PRIME-MD bodily pain subscale was used both continuously and dichotomously, the latter by employing a cutoff at the 90th percentile, as an indication of a high bodily pain load.

Background information

Demographic information collected at week 17 included maternal age, marital status (married or cohabitating versus single/widowed/divorced), number of previous children (parity), and level of education (elementary school, completed high school, or higher education). Body-mass index was assessed both at week 17 and week 32 and was calculated from weight (kg) divided by squared height (m^2).

Depression

The Edinburgh Postnatal Depression Scale (EPDS) [21,22] was used to measure depressive symptoms at all three follow-up periods. The EPDS is a 10-item questionnaire developed to screen for depression in the postpartum period; it addresses symptoms present in the last seven days. The scale also has good psychometric properties during pregnancy [23]. Each question has four alternative answers, ranging from 0 to 3. In the current study, the EPDS was used continuously with a scoring range from 0 to 30.

Statistics

Latent profile analysis (LPA) was used to identify subsets of women who shared a similar pattern of responses on the BIS-scale across the three time points. LPA is a person-centered approach, through which we aimed to estimate the number of latent classes that could be established based on the women's responses to the BIS. LPA is used to identify unobservable subgroups, called profiles, and is therefore an apt analytical approach when the aim is to identify subtypes of conditions or symptomology. For example, it can be used to find distinct profiles based on the responses on several different symptoms, in order to determine the number of potential subgroups. Furthermore, this information can be used to classify individuals according to their most likely latent profile, and use the profile membership in inferential statistics. The following criteria were used to determine the number of classes to retain: Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC and sample size adjusted BIC (adj BIC) [24]. Also, we used measures of entropy, as well as Vuong-Lo-Mendell-Rubin (VLMR) adjusted likelihood ratio test for testing the hypothesis that a model with one less class performs just as well.

The LPA was done in an iterative manner. We started with 1 class, and increased the number of classes until the fit criteria suggested a good enough model. LPA was preferred over latent class analysis, and we wanted to get the estimated means at each time point. Deciding on the retained model, both statistical criteria and meaningfulness of the classes were considered. Mplus version 7.1 was used for the LPA-analyses (Muthén & Muthén, 1998–2010).

All other analyses were performed using the SPSS statistical software package, version 23 (SPSS Inc., Chicago, IL, USA). Negative binomial regression analyses were used to examine associations between classes of insomnia and somatic symptoms. Rather than the more commonly used logistic regressions (producing odds-ratio (OR)), we used negative binomial regressions (producing relative risk (RR)) which provides more correct estimates when the prevalence of the outcome of interest (in this case somatic symptoms) is relatively high. ORs can overestimate an effect size when the outcomes are frequent [25]. Both crude/unadjusted and adjusted analyses were conducted. The adjustment variables included were maternal age, education, marital status, parity, BMI, symptoms of depression (T1-T3), and somatic symptoms at T2. As a sensitivity analysis, all regression models were repeated *excluding* individuals scoring above the 90th percentile on the somatic symptoms scale (PRIME-MD) at T2.

Ethics

All women asked to participate were given written information explaining the purpose of the study and informed that

participation was voluntary. Informed consent was obtained from all participants. The study was approved by the Regional Committee for Ethics in Medical Research in Norway, approval number S-08013a.

Results

Sample characteristics

The study sample included 1480 women, with a mean age of 31.6 (SD = 4.5). Nearly all women (97.9%) were married or living with a partner, and a majority of the sample (72.5%) had an educational level beyond high school. The mean BMI was 24.5 (SD = 4.5), and 79.6% reported that this was their first pregnancy.

An analysis of the background factors between responders and non-responders showed that women dropping out after the baseline assessment (week 17 of the pregnancy) were significantly younger, had less education, and were more likely to be divorced or separated, compared to the women who also participated at wave four (the current sample) (all *P*s < 0.001). No significant differences were observed for any of the sleep measures between those who dropped out and those who completed all of the follow-up assessments.

Classes of insomnia

A total of five different LPA-models were compared, ranging from one class to five classes (see Table 1 for fit indices across models). The AIC, BIC and adjusted BIC were markedly lower for the two-class solution compared to the one-class solution, with an entropy of 0.735. Also, the VLMR Adjusted-LRT indicated that the two-class solution was significantly better than the one-class solution ($p < 0.0001$). Increasing the number of classes to three, lowered the fit indices further, increasing the entropy slightly (0.766), and the VLMR Adjusted-LRT was again significant ($p = 0.0004$). There was only a slight decrease in the estimated fit indices when increasing to 4 classes, and the entropy dropped slightly (0.750) but the VLMR Adjusted-LRT was significant ($p = 0.0069$). Allowing for five classes did not improve the fit indices; the entropy dropped substantially (0.667); and the VLMR Adjusted-LRT was non-significant ($p = 0.3136$). For purposes of this study, the model with three classes was retained, and is presented in Fig. 2. The three class model identified one major group (55.6%) with a low BIS scores across all three time points, one group with intermediate BIS scores (32.9%), and a smaller group (11.5%) with higher BIS scores across all 3 time points. Inclusion of age, education, parity, and marital status as covariates yielded nearly identical results, and thus were not included in the final model.

Predictors of somatic symptoms at year 2 postpartum (T3)

A series of regression analyses were conducted to examine to what extent different classes of insomnia trajectories predicted subsequent onset of bodily pain at T3 (year 2 postpartum). As detailed in Table 2, compared to Class 1 (low score on insomnia from T1-T3), individuals in Class 3 (high insomnia load on all three points) had a 2.75-fold increased risk of reporting a high load of pain at T3. Being classified in Class 2 was associated with 2.16-fold increased risk of pain at T3. Adjusting for demographics and lifestyle behaviors did not reduce any of the associations, while adjusting for depression (T1-T3) substantially attenuated the associations. Including adjustment for bodily pain at T2 (eight weeks postpartum) further reduced the magnitude of the associations, but Class 2 and Class 3 of insomnia remained strongly associated with onset of bodily pain in the fully adjusted models (see Table 2 for details).

Sensitivity analyses

To further explore whether the insomnia predicted *onset* of bodily pain at T3, all regression analyses were repeated this time excluding individuals scoring above the 90th percentile on the bodily pain subscale (PRIME-MD) at T2. As shown in Fig. 3, all associations between both Class 2 and Class 3 and the onset of pain at T3 remained significant in the analyses. For example, even in the fully adjusted model, both Class 2 and Class 3 were associated with a 1.8 to 1.9-fold increased risk of later onset of a bodily pain (see Fig. 3 for details).

Comment

In this longitudinal population based study from pregnancy until two years postpartum we found that both intermediate and high levels of chronic insomnia from pregnancy to postpartum were associated with a later onset of subsequent bodily pain. Depression accounted for some of the associations, but even when adjusted for demographic variables, depressive symptoms as well as previous symptoms of pain, an independent effect of chronic insomnia remained. Insomnia was relatively stable from pregnancy until two years postpartum, with three latent classes describing the trajectories best; one stable low, one stable intermediate and one stable high. The latter comprised 11.5% of the sample, and intermediate high 32.9% of the sample.

While we are not aware of other longitudinal studies using trajectories of insomnia symptoms to predict later physical health, the close link observed between sleep and pain symptoms was in line with previous cross-sectional findings. While the causal pathways between insomnia and impaired physical health cannot be ultimately determined using an observational design, the temporal associations suggest that insomnia precedes the onset of pain, and, thus, is not a consequence of physical health complaints.

In terms of mechanisms of action, we examined several factors that might explain the link between impaired sleep and bodily pain. We found that neither background factors nor BMI were able to substantially attenuate any of the observed associations. However, as expected, depression was an important factor in linking sleep to pain, reducing the RR with 23% to 56% in the stable intermediate and stable high classes of insomnia, respectively.

Table 1
Goodness-of-fit indices across the latent profile analysis (LPA) models.

Number of classes	AIC	BIC	Adj. BIC	Entropy	VLMR Adj. LRT	Lowest estimated probability of class membership	Highest estimated probability of class membership
1	29047.710	29078.845	29059.786	N/A	N/A	N/A	N/A
2	28388.361	28440.252	28408.487	0.735	$p < 0.0001$	0.885	0.939
3	28280.120	28352.768	28308.296	0.766	$p = 0.0004$	0.843	0.922
4	28218.304	28311.709	28254.532	0.750	$p = 0.0069$	0.791	0.913
5	28170.640	28284.801	28214.917	0.667	$p = 0.3136$	0.745	0.847

AIC (Akaike Information Criterion); BIC (Bayesian Information Criterion), VLMR Adj. LRT (Vuong-Lo-Mendell-Rubin adjusted likelihood ratio test).

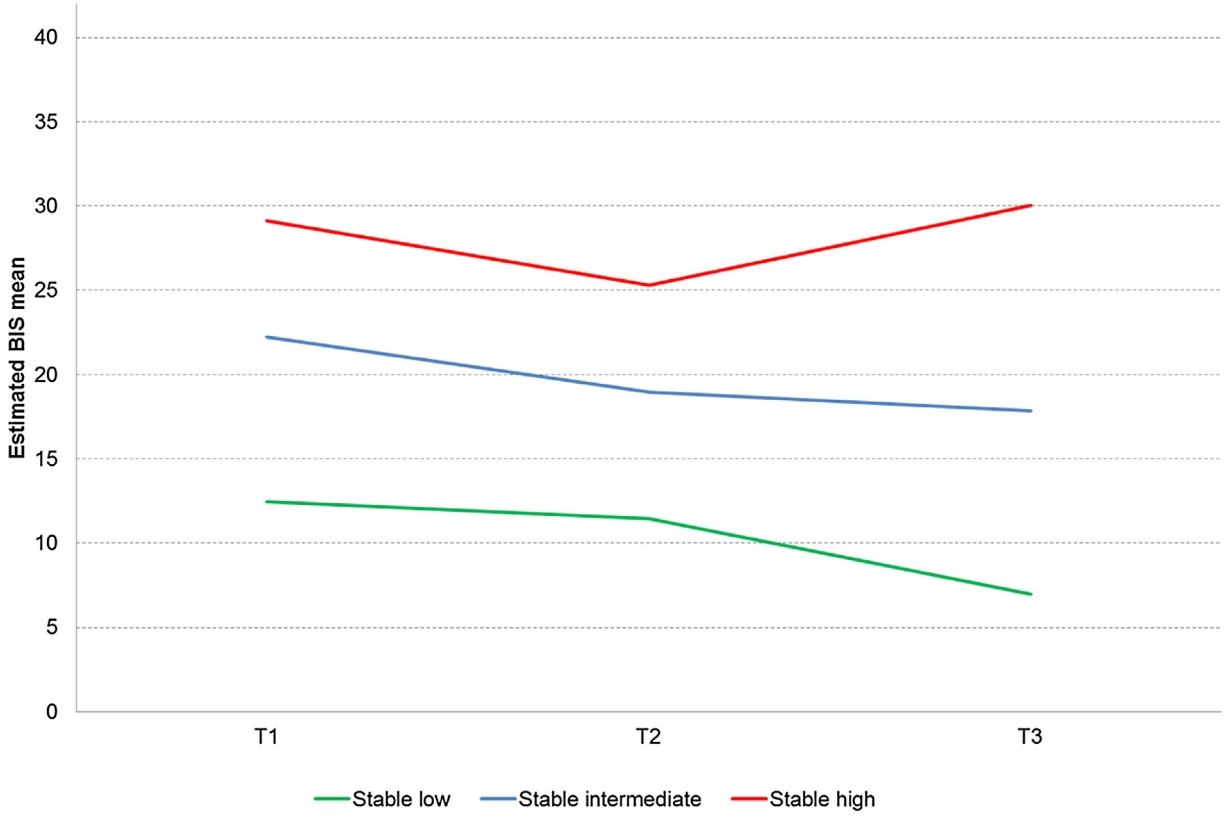

Fig. 2. Latent profiles across time across time points. Stable low (55.6%), stable intermediate (32.9%), and stable high (11.5%).

Table 2
Insomnia trajectories from T1 to T3 as risk factors for onset of bodily pain at year 2 postpartum (T3).

	Insomnia trajectories (classes) from T1 to T3					
	Stable low (Class 1)		Stable intermediate (Class 2)		Stable high (Class 3)	
Adjustment variables	RR	95% CI	RR	95% CI	RR	95% CI
Crude model	1.00	–	2.16	1.75–2.66	2.75	2.11–3.60
+ Age, education, parity, marital status, BMI (T1)	1.00	–	2.17	1.72–2.74	2.54	1.86–3.48
+ Symptoms of depression (T1, T2 and T3)	1.00	–	1.86	1.46–2.38	1.79	1.26–2.54
+ Bodily pain (T2)	1.00	–	1.75	1.37–2.23	1.63	1.15–2.32

RR: Risk ratio; CI: confidence intervals.

Even with the additional control for previous pain symptoms and by excluding participants with comorbid pain eight week postpartum, could not significantly reduce the close association between insomnia and the later onset of bodily pain.

There are some methodological limitations that should be mentioned. First, data on both sleep, pain and depressive symptoms were based on self-reported instruments and not through a clinical evaluation or use of objective measures. Although the authors did have access to the women's clinical records, these did not provide any information on these exact domains, which otherwise would have reduced the potential bias in observer ratings. While some important confounders were controlled for, other variables that could have influenced the association, such as other maternal psychopathology beyond depressive symptoms, were left unexplored. Moreover, while the research sample was large, the response rate across all three time points was not high, which may limit the generalizability of the sample. Unfortunately, the problem with non-participation in survey research seems to be on the rise [26]. It should also be noted that there were notable differences between the responders and non-responders, with responders being older, more educated, and more likely to be married/cohabitating. Of note, however, was that no differences in sleep were observed in women who completed all three waves compared to women who dropped out after T1 or T2.

There are several strengths in the present study. The current study is one of the largest studies of sleep during pregnancy, and, to the best of our knowledge, the only prospective study examining the effect of maternal sleep from pregnancy into toddlerhood, on the development of somatic complaints. Moreover, the questionnaires used in the current study are well-validated instruments, and the self-report sleep measure (BIS) has been shown to correspond well with objective sleep measures, including polysomnography (PSG) [19]. Although self-reported sleep parameters typically differ from those obtained from objective assessments [27], recent studies have shown that such self-report sleep assessments can be recommended for the characterization of sleep parameters in both clinical and population-based research [28]. Still, the BIS has not been validated for sleep problems in

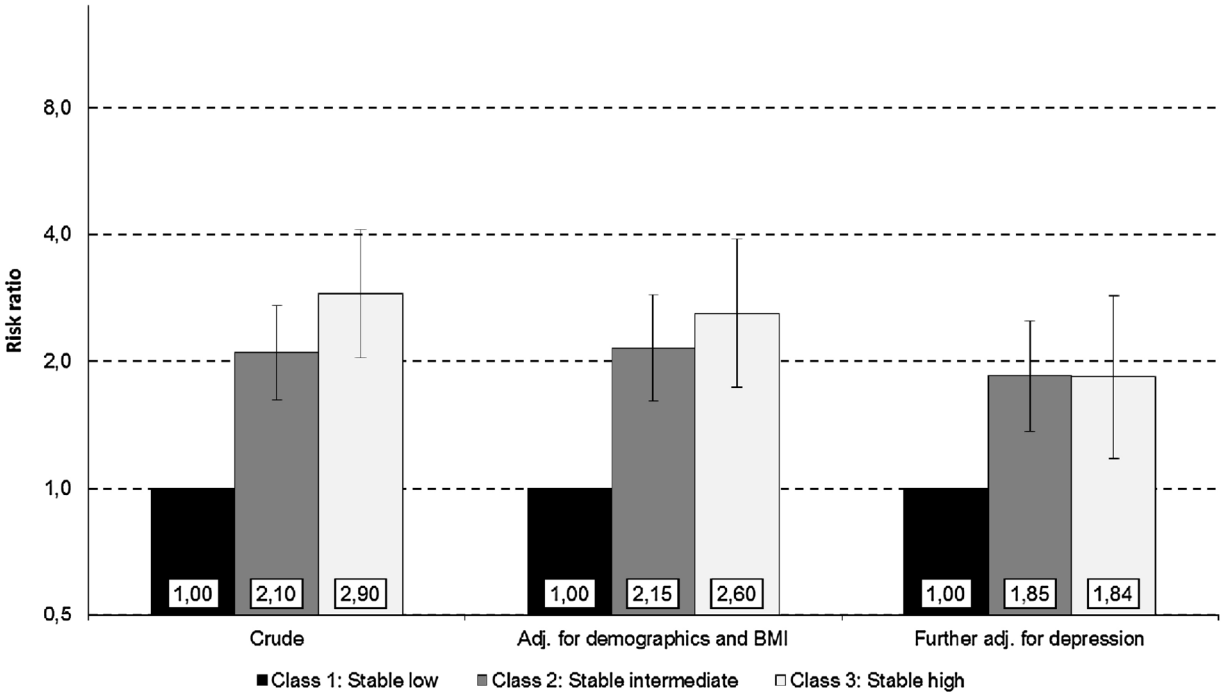

Fig. 3. Sensitivity analyses of insomnia classes from T1 to T3 as risk factors for onset of somatic symptoms. Bars represent risk-ratios (RR) and error bars represent 95% confidence intervals (Y-axis has a logarithmic scale). Class 1 (reference): stable low insomnia; Class 2: stable intermediate insomnia; Class 3: stable high insomnia.

pregnancy. Similarly, although the EPDS does not provide a clinical diagnosis of depression, it is well suited to assess symptoms of depression among Norwegian postpartum women [22], and the use of the continuous scale (as used in the current study) is also in line with the recommendations for use in population-based research [29].

Clinical implications

The main finding in the current study was that chronic insomnia was associated with increased risk developing postpartum pain symptoms. Given the high rates of sleep problems during pregnancy and the postnatal period, combined with the fact that both insomnia and bodily pain have been linked to increased disability [30], the need to improve sleep this patient group is evident. Both pharmacological [31] and non-pharmacological [32] interventions for insomnia and bodily pain have been thoroughly examined. With regards to behavioral interventions which now largely are considered the treatment of choice for persistent insomnia [33], cognitive-behavioral therapy addressing both pain and sleep, has been found to be effective [32]. Future research should examine to what extent low threshold interventions addressing *comorbid* sleep and pain may be effective, as internet-based self-help treatments have shown promising results in treating both conditions individually [34–36]. Moreover, given the significant contribution of depressive symptoms in explaining the observed sleep-pain association, we also recommend screening for depression during and after pregnancy, in addition to adequately identifying, preventing and treating insomnia for this population.

Conflict of interest

The authors report no conflicts of interest.

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Author contributions

Authors BS and MH drafted the manuscript, and Authors BS and JCS conducted the statistical analysis. Author MEG was responsible for conception and design of the study and was involved in acquisition of data. Authors KP and MEG gave critical revision of the manuscript for important intellectual content. All authors read and approved the final manuscript.

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