European Journal of Obstetrics and Gynecology 283 (2023) 25–31

Contents lists available at ScienceDirect

European Journal of Obstetrics & Gynecology and Reproductive Biology

journal homepage: www.journals.elsevier.com/european-journal-of-obstetrics-and-gynecology-and-reproductive-biology

Full length article

Depressive symptoms and sleep disturbances in late pregnancy: Associations with experience of induction of labor with a catheter

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ARTICLE INFO

Keywords:
Experience
Induction of labor
Depression
Sleep disturbance
Insomnia
Sleep quality

ABSTRACT

Objective: Depressive symptoms and sleep disturbances have been found to be associated with negative labor experiences, particularly an increased level of pain. However, the associations between maternal depressive symptoms and sleep disturbances and the experience of induction of labor (IOL) remain unknown. In this study, we evaluated these associations with balloon catheter IOL.

Study design: A prospective study was conducted on 106 women with planned IOL. Depressive symptoms were evaluated with The Edinburg Postnatal Depression Scale (EPDS) and sleep disturbances with the Basic Nordic Sleep Questionnaire (BNSQ) at the beginning of IOL. The IOL experience was investigated both during the IOL and postpartum with the same nine visual analogue scale (VAS) questions.

Results: Regarding sleep disturbances, during the IOL, women with worse general sleep quality were less satisfied ($P = 0.019$), less relaxed ($P = 0.008$), experienced more pain in general ($P = 0.002$) and reported higher contraction frequency ($P = 0.003$). Furthermore, women who experienced difficulties falling asleep were less relaxed ($P = 0.009$), reported more general pain ($P < 0.001$) and contraction pain ($P = 0.005$), while those with more daytime sleepiness reported less contraction pain ($P = 0.033$). In postpartum, women with worse general sleep quality reported more general pain ($P = 0.003$), while women with longer sleep duration and those with higher sleep loss reported more anxiety ($P = 0.009$ and $P = 0.024$, respectively). Additionally, women who woke up too early in the morning were less satisfied ($P = 0.042$), less relaxed ($P = 0.004$) and reported more general pain ($P = 0.018$). However, those who experienced more frequent nocturnal awakenings reported being more relaxed ($P = 0.014$) and having less general pain ($P = 0.033$). Higher depressive symptoms were associated with a higher frequency of contractions during IOL ($P = 0.030$), but with less general pain in postpartum ($P = 0.027$).

Conclusions: Women with sleep disturbances during pregnancy were more likely to report more negative experiences during the IOL. Specifically, they reported more pain, feeling less relaxed and they were less satisfied with IOL. Conversely, the association between depressive symptoms and the experience of IOL seemed weaker. Thus, the quality of sleep of pregnant women is important for a better experience of IOL.

Abbreviations: BNSQ, Basic Nordic Sleep Questionnaire; EPDS, Edinburg Postnatal Depression Scale; IOL, induction of labor; SDB, sleep disordered breathing; VAS, visual analogue scale.

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https://doi.org/10.1016/j.ejogrb.2023.01.028
Received 22 September 2022; Accepted 24 January 2023
Available online 25 January 2023

Introduction

Depressive symptoms [1] and sleep disturbances [2,3] are common during pregnancy. The prevalence of depression during the perinatal period is about 15 % [4]. Sleep quality deteriorates as pregnancy preceeds [1,2]. Furthermore, similar to the general population, pregnant women with depressive symptoms suffer from sleep disturbances and vice versa [1,2].

Nowadays a quarter of labors are induced [5]. A good experience of induction of labor (IOL) is important, as negative labor experiences can lead to postpartum depression [6], fear of childbirth [7] or even a desire for a cesarean section in the next labor [8]. Previous studies have shown that women who undergo IOL are less satisfied with their care during labor [9] and report higher depressive symptoms in postpartum compared to women with spontaneous labor [10,11]. Furthermore, antenatal depression is associated with adverse labor experiences, such as a higher experience of pain [12,13]. Likewise, previous studies have proposed an association between maternal sleep disturbances and negative labor experiences, such as more pain and discomfort during labor [14]. Nevertheless, studies concerning the association of depressive symptoms or sleep disturbances with the experience of IOL have not been published. Accordingly, we conducted a prospective study evaluating the associations between maternal depressive symptoms and sleep disturbances and the experience of IOL. We hypothesized that depressive symptoms and sleep disturbances negatively affect the experience of IOL.

Material and methods

Subjects

This study was a part of an IOL study which evaluated the experience of balloon catheter IOL in outpatient and inpatient settings. The pregnant women were recruited between 2016 and 2019 in The Department of Obstetrics and Gynecology, Turku University Hospital, Finland. Women with singleton, cephalic presented fetuses in gestation week (gwk) 37–41 + 5 entering the department for planned IOL were invited to participate in the study. Volunteers with uncomplicated pregnancies, unripe cervixes (Bishop score < 6), intact membranes, normal cardiotocography, a short distance to the hospital (less than a half-hour drive) and Finnish knowledge were enrolled. In our first study of this data, the outpatient and inpatient groups were similar in terms of their basic characteristics [15] and thus in the present study the data were combined. Altogether 117 women were enrolled, with 11 dropouts because of missing questionnaires. Therefore, the final data consisted of 106 women (Fig. 1.).

Basic maternal characteristics, as well as the delivery and the newborn data were taken from the medical records (Table 1). For IOL, the cervical ripening double-balloon catheter was filled with 80 ml of saline in both balloons. In five cases, only a single balloon catheter with 60–80 ml of filling was used.

Questionnaires

After insertion of the balloon catheter, all women completed in The Edinburgh Postnatal Depression Scale (EPDS) [16] to evaluate depressive symptoms and The Basic Nordic Sleep Questionnaire (BNSQ) [17] to evaluate sleep disturbances. In addition, The concurrent induction experience questionnaire was completed during the IOL and The postpartum induction experience questionnaire after labor. In case of unfilled questionnaires, the women were re-contacted by mail or by phone. Four EPDS and BNSQ questionnaires and 24 postpartum questionnaires were completed after leaving the hospital.

In the EPDS, depressive symptoms were evaluated with 10 questions covering for a past week before IOL and scored on a 4-point Likert scale with 0–3 points per item. A score ≥10 was considered as a sign of clinical depression [18]. In the BNSQ, sleep quality was evaluated with 13 questions covering the past month before IOL (Appendix). The Insomnia score was computed by adding the scores for ‘difficulty to fall asleep’, ‘nocturnal awakenings (per week)’ and ‘too early morning awakening (without being able to fall asleep again)’. The Sleep Disordered Breathing (SDB) score was calculated by adding the scores for ‘snoring’ and ‘witnessed apneas’ and the Sleepiness score by adding the scores for ‘sleepiness in the morning’, ‘daytime sleepiness’ and ‘daytime napping’. ‘Sleep loss’ was computed by subtracting ‘sleep need’ from ‘sleep duration’ and expressed as minutes. In addition, women’s physical

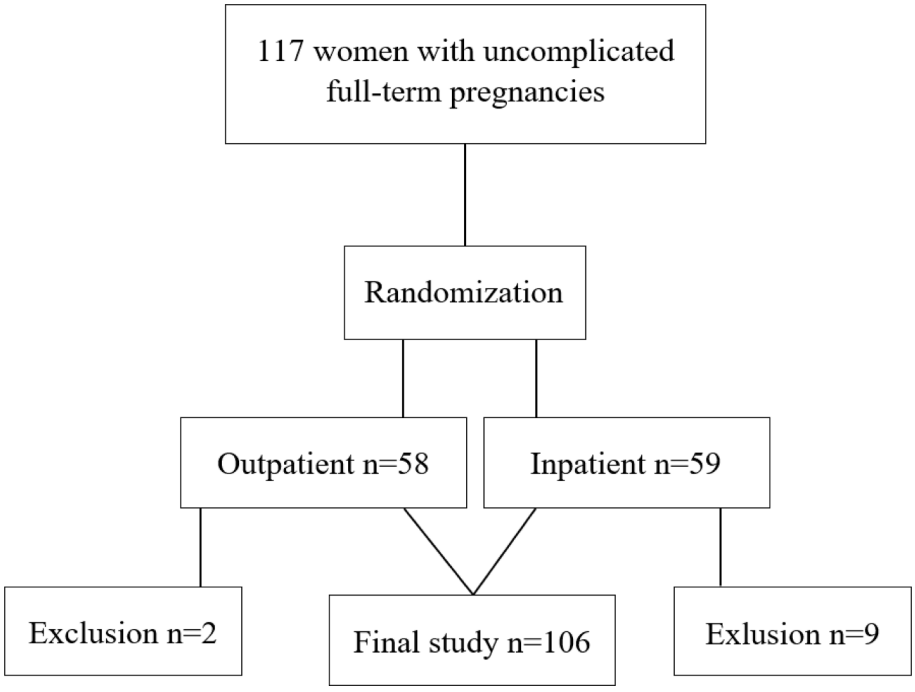

Fig. 1. The flow chart of the study.

Table 1
Characteristics of the women and delivery (n = 106).

	Mean ± SD	Range
Maternal age (years)	30.2 ± 4.4	19–44
BMI (kg/m^2)	25.7 ± 4.4	18–41
Gestational age (weeks)	41 + 1 ± 1	38 + 0–41 + 5
Baseline Bishop Score	4 ± 1	1–5
Cervix length (mm)	31 ± 11	12–56
Physical health (Visual analogue score)	85 ± 13	32–100
	n (%)	
Primiparous	64 (60)	
Reasons for inductions		
Large for gestational age	14 (13)	
Fear of childbirth	3 (2.8)	
Threatening prolonged pregnancy lk(gw 41 + 3–41 + 5)	82 (77)	
Removed balloon catheter after 24 h	26 (25)	
Balloon catheter used twice	2 (1.9)	
Use of misoprostol	25 (24)	
Rupture of membranes (amniotomy)	80 (76)	
Oxytocin augmentation	59 (56)	
Painrelief during labor		
Epidural analgesia	70 (66)	
Spinal analgesia	5 (4.7)	
Paracervical or pudendal block	24 (23)	
Mode of delivery		
Vaginal delivery	70 (66)	
Vacuum extraction	16 (15)	
Cesarean section	20 (19)	
Suspected infection during or after labor	10 (11)	
	Mean ± SD	
Length of the labor (min)	615 ± 447	
Birthweight (grams)	3902 ± 398	
	n (%)	
Newborn's uApH ≤ 7.1	5 (4.6)	
Newborn's uVpH ≤ 7.1	2 (1.8)	
Apgar ≤ 7 at 15 min	1 (0.9)	

health was assessed with one visual analogic scale (VAS) -question, with a higher number indicating better physical health.

The questionnaires used to evaluate the experience of the IOL are shown in Appendix. The concurrent induction experience questionnaire was completed in at the time points of 1 h, 5 h, 9 h and 13 h after insertion of the catheter but before the catheter came out. The postpartum induction experience questionnaire was completed in after labor on the maternity ward. Both questionnaires included the same nine VAS questions. A lower value in VAS indicated a better experience and fewer negations.

Statistical analysis

The data are presented as means and standard deviations (SD) or medians with 95 % confidential intervals (CI) when appropriate. EPDS and BNSQ variables (both distinct questions and Insomnia, SDB and Sleepiness scores) were calculated as continuous variables. For all VAS questions, an instruction was given to mark with a tick on the VAS-line, however, 20 women used numbers instead, and in these cases, these numbers were used in the analyses. Normal distribution of the variables was evaluated visually from studentized residuals. In the analyses requiring normal distribution, all VAS questions were square root transformed. For the presentation of the results, the estimates were back transformed.

Hierarchical linear mixed models (HLMM) with repeated measures were used to analyze different VAS questionnaires (both in The concurrent induction experience and in The postpartum induction experience). Initially, a univariate analysis was performed. Then correlations between the variables were evaluated to avoid collinearity in the multivariate models. Because of a strong correlation between a question about general sleep quality and the Insomnia score, general sleep quality was chosen for further analysis. Two multivariate models were constructed for all experience variables. The first model evaluated the effects of depressive symptoms and sleep quality including EPDS, general sleep quality, SDB score, sleep duration, sleep loss, Sleepiness score, BMI, age, parity and physical health. The second multivariate model was conducted to more specifically examine the sleep disturbances symptom effects and included difficulties falling asleep, nocturnal awakenings per night, too early morning awakening, daytime sleepiness, BMI, age, parity and physical health. The models in The Concurrent induction experience questionnaire also included a within-factor (time). Non-significant factors were gradually omitted from these models. All tests were performed as two-sided with a significance level set at 0.05. The analyses were carried out using SAS System (version 9.4) for Windows (SAS Institute Inc., Cary, NC, US).

Ethical approval

The study received the approval from the Ethics Committee of the Hospital District of Southwest Finland (3/1801/2016 and 40/1801/2017) and was registered at clinicaltrials.gov (NCT 02793609). Written informed consent was obtained from all women.

Results

Depressive symptoms and sleep disturbances

The most frequent self-reported sleep disturbances included nocturia (23 %), physical feelings such as contractions, hip pain and fetal movements (altogether 19 %) and restless legs (4 %). The frequencies and mean values of the EPDS score and sleep disturbances are presented in Table 2.

Experience of IOL

The data from The concurrent and The postpartum induction experience questionnaires are shown in Table 3. In general, median VAS scores were low, indicating a good experience of IOL.

Associations between depressive symptoms, sleep disturbances and experiences of IOL

According to The concurrent induction experience questionnaire, women with higher depressive symptoms reported higher frequency of contractions ($P = 0.030$). In addition, women with worse general sleep quality were less satisfied ($P = 0.019$) and less relaxed ($P = 0.008$), reported more pain in general ($P = 0.001$) and a higher contraction frequency ($P = 0.003$). However, women with higher Sleepiness scores reported a lower contraction frequency ($P = 0.029$). By contrast, the SDB score, sleep duration and sleep loss were not associated with the VAS questions. Regarding insomnia symptoms in details, women who experienced difficulties falling asleep were less relaxed ($P = 0.009$), reported more general ($P < 0.001$) and contraction pain ($P = 0.005$,) while those with more daytime sleepiness reported less contraction pain ($P = 0.033$). The results of the multivariate models are shown in Table 4.

In The postpartum induction experience questionnaire, women with higher depressive symptoms reported experiencing less pain in general ($P = 0.027$), while those with worse general sleep quality reported experiencing more ($P = 0.003$). Further, those with higher SDB scores experienced less pain in general ($P = 0.041$). Women with a longer sleep duration ($P = 0.009$) and with higher sleep loss experienced more anxiety ($P = 0.024$) and the latter were less satisfied ($P = 0.053$, tendency). Regarding insomnia symptoms, women with more frequent nocturnal awakening reported being more relaxed ($P = 0.014$) and experiencing less pain in general ($P = 0.033$). However, women who frequently woke up too early were less satisfied ($P = 0.042$), less relaxed ($P = 0.004$) and reported more pain in general ($P = 0.018$) (Table 4).

Table 2
Sleep disturbances and depressive symptoms (n = 106).

	n (%)	Mean ± SD
EPDS points		3.6 ± 3.4
EPDS points ≥ 10	7 (6.6)	
EPDS points ≥ 13	0	
General Sleep Quality (quite poor or poor)	25 (24)	
Insomnia score *		9 ± 2
Difficulty to fall asleep ≥ 3–5 nights/week	19 (18)	
Nocturnal awakenings ≥ 3–5 nights/week	96 (91)	
Too early morning awakenings (without being able falling l asleep again) ≥ 3–5 nights/week	21 (20)	
Nocturnal awakenings per night ≥ 3	43 (41)	
Sleep Disordered Breathing score**		3 ± 2
Snoring ≥ 3–5 nights/week	18 (17)	
Witnessed apneas ≥ 3–5 nights/week	4 (3.8)	
Sleepiness score***		8 ± 3
Morning sleepiness ≥ 3–5 days/week	14 (13)	
Daytime sleepiness ≥ 3–5 days/week	26 (25)	
Napping ≥ 3–5 days/week	34 (32)	
Sleep duration (min)		457 ± 72
<7h	15 (14)	
≥9h	15 (14)	
Sleep loss**** (min)		40 ± 83
= 0 or negative (need < duration)	12 (11)	
= sleep loss ≥ 60 min	49 (46)	
= sleep loss ≥ 120 min	16 (15)	

IOL= Induction of labor.
EPDS= Edinburg Postnatal Depression Scale (assessed during the past week before the IOL).
BNSQ = Basic Nordic Sleep Questionnaire (assessed during the past month before the IOL).
*Insomnia = A sum score of the questions 'Difficulty falling asleep,' 'Nocturnal awakenings' and 'Too early morning awakening'.
**Sleep Disordered Breathing score = A sum score of the questions 'Snoring' and 'Witnessed apneas'.
*** Sleepiness = A sum score of the questions 'Sleepiness in the morning,' 'Daytime sleepiness' and 'Napping.'
**** Sleep loss (min) = sleep need (min) – sleep duration (min).

Discussion

To the best of our knowledge, this is the first study to address the associations between depressive symptoms and sleep disturbances and the experience of IOL. We found that women with worse general sleep quality reported more negative experiences during IOL. Specifically, they felt more pain and they were less relaxed and satisfied. In addition, they reported a higher contraction frequency. Of the insomnia symptoms, difficulty falling asleep appeared to be the most important, as symptomatic women experienced more pain and were less relaxed. Surprisingly, women with higher Sleepiness score reported a lower frequency of contractions, and those with more daytime sleepiness reported less contraction pain. In terms of experiences with IOL assessed postpartum, women with worse general sleep quality reported more pain during IOL. Awakening too early in the morning was the most important insomnia symptom; symptomatic women experienced more painful, were less relaxed and less satisfied. Conversely, the women who experienced nocturnal awakenings reported having less pain and being relaxedness. Finally, in the postpartum evaluation, women reporting a longer sleep duration and more sleep loss were more anxious during IOL.

Table 3
The data of The concurrent and The postpartum induction experience questionnaires.

VAS questionnaires	Concurrent induction experience		Postpartum induction experience	
	Median	95 % CI	Median	95 % CI
Satisfaction	15	5–35	11	5–40
Relaxedness	23	10–43	18	6–45
Fear	10	4–24	10	4–21
Anxiety	7	2–16	7	2–17
Stress	11	4–21	10	5–25
General pain	20	10–40	20	13–47
Contraction pain	25	10–45	30	16–65
Frequency of contractions	21	10–42	32	14–52
Bleeding after balloon insertion	5	0–10	7	3–20

VAS = visual analogic scale.
Statistics in VAS variables in concurrent induction experience questionnaire are measured over the time and includes all the assessed time points (1 h, 5 h, 9 h and 13 h).
Number of completed questionnaires in each time-points: concurrent 1h n = 101, 5h n = 89, 9h n = 75, and 13h n = 54; postpartum n = 95.
Lower VAS indicates less negations.

Emerging evidence indicates that maternal sleep disturbances, such as poor general sleep quality, various insomnia symptoms (e.g. including difficulty falling asleep, nocturnal awakenings and too early morning awakenings), and nocturnal breathing problems are frequent during pregnancy, peaking at the end of the pregnancy and at the time of labor [1,2]. This was also true in our study. Sleep disturbances have been found to be associated with negative experiences during pregnancy, including anxiety [19], stress [20], pain [14], and fear of childbirth [7]. Further, women with poor sleep quality have shown to have a longer duration of labor [21]. Accordingly, sleep disturbances could also deteriorate the experience of IOL, an assumption we confirmed both during and after IOL. We found that during IOL, difficulty falling asleep was connected to negations towards IOL, but other insomnia symptoms showed no such associations. Our results were in accordance with the findings of Beebe and Lee (2007) [22], who showed increased pain and discomfort during labor among women experiencing sleep deprivation.

According to previous studies, while insomnia increases quite constantly during pregnancy [1,2,13], sleepiness shows more a U-shaped pattern, as it occurs less in mid-pregnancy compared to early- and late pregnancy [2]. We found that women with more daytime sleepiness felt less contraction pain during IOL. Although being a sporadic and thus possibly changing finding, this was contrary to our expectations. However, sleepiness has been shown to be associated with altered levels of proinflammatory markers [23], which can assist in cervix ripening [24]. This faster ripening of cervix could explain the association between sleepiness and reduced contraction pain.

Our results concerning the experience of IOL assessed postpartum confirmed the association between worse general sleep quality and the experience of higher general pain that found also during IOL. Additionally, waking up too early morning was related to worsen experience of IOL: the women reported more general pain, less relaxation and less satisfaction. However, women with more frequent nocturnal awakenings reported being more relaxedness and experiencing less pain in general. There are several explanations for these contradictory results. Labor is typically loaded with physical and emotional reactions, both in positive and negative directions, experiences of IOL asked retrospectively in postpartum can be affected by these emotions, biasing the results. Notably, the sleep quality was only asked before labor, and not in postpartum and therefore we were unable to evaluate the possible change in sleep quality. Further, 24/95 of The postpartum IOL experience questionnaires were completed by women after they had left the

Table 4
Associations between depressive symptoms and sleep disturbances and experiences of induction of labor in multivariate models.

	Satisfaction		Relaxedness		Fear*	Anxiety		Stress*	General pain		Contraction pain		Frequency of contractions		Bleeding*
	CIOL** β *CI*	PP*** β *CI*	CIOL β *CI*	PP β *CI*		CIOL β *CI*	PP β *CI*		CIOL β *CI*	PP β *CI*	CIOL β CI	PP β *CI*	CIOL β *CI*	PP β *CI*	
EPDS										−0.14 *−0.26 to −0.02*			0.11 *0.01–0.19*		
General sleep quality	0.44 *0.08–0.81*		0.46 *0.13–0.80*						0.47 *0.19–0.76*	0.62 *0.22–1.02*			0.35 *0.06–0.64*		
Sleep disordered breathing										−0.30 *−0.58 to −0.02*					
Sleepiness													−0.13 *−0.25 to −0.01*		
Sleep duration							0.01 *0.001–0.02*								
Sleep loss							0.01 *0.003–0.02*								
Difficulty falling asleep			0.42 *0.11–0.73*						0.50 *0.24–0.76*		0.39 *0.12–0.66*				
Nocturnal awakenings per night				−0.56 *−1.01 to −0.12*						−0.64 *−1.21 to −0.05*					
Too early morning awakening		0.48 *0.02–0.94*		0.63 *0.21–1.05*						0.46 *0.08–0.83*					
Daytime sleepiness											−0.30 *−0.57 to −0.03*				

*No associations in models, **CIOL = Concurrent induction experience questionnaire, ***PP = Postpartum induction experience questionnaire, β = beta coefficient, CI = Confidence interval.
Higher value in EPDS or sleep variables indicates higher depressive symptoms or worse sleep. Higher value in experience of IOL variables indicates worse experience. Multivariate model adjusted by age, BMI, parity, and physical health.

hospital, which could lead to some level of recall bias. In addition, although instructed to evaluate the IOL experience only, it is possible that some women evaluated the labor experience instead. Therefore, our findings must be verified though more research.

There are no previous studies evaluating whether maternal depressive symptoms during pregnancy involve the experience of IOL. However, women with depressive symptoms are shown to experience higher labor pain [12,13], and thus, presumably depressive symptoms, which could also affect the experience of IOL. In addition, the experience of IOL can be affected negatively by fear of childbirth [25], which is more common in women with depressive symptoms [26]. Nevertheless, we found only random associations between depressive symptoms and the experience of IOL. During IOL, women with higher depressive symptoms reported a higher contraction frequency, but they reported less pain in general in postpartum. Importantly, the level of depressive symptoms in our study was low, and therefore, our results cannot be generalized to all women with depression.

Our study has strengths but also some limitations. The data covered depressive symptoms and sleep only in late pregnancy, and so our results cannot necessarily be extrapolated to women with long-term depressive symptoms and sleep disturbances. To asses depressive symptoms and sleep disturbances, we used the EPDS [16] and the BNSQ [17], which are validated and widely used in different populations, also during pregnancy [1,2,4]. The BNSQ contains an inclusive panel of sleep questions and therefore makes it possible distinguish between various insomnia and sleepiness symptoms. Nevertheless, no objectively measured sleep data were collected which limits our interpretation of the results especially regarding the sleep duration and sleep loss. In clinical practice, however, the evaluation of subjective sleep quality normally identifies patients who need further investigation or treatments [27]. One strength of the study was the use of VAS questionnaires to evaluate the experience of IOL similar to some other previous IOL studies [15,28]. The women in our study were healthy with uncomplicated full-term pregnancies. Hence, our results cannot be applied to women with baseline diseases or pregnancy complications. Voluntariness in our study could have led to the exclusion of women with, for example, those with a higher propensity for more negative feelings or fear and anxiety about IOL or labor.

Conclusion

Labor is being induced more frequently. Thus, the experience of IOL is important, not only for the present labor but also for the future labors to prevent for example a fear of childbirth. We conclude that women with sleep disturbances experience more negative feelings towards IOL: they experience more pain, they are less relaxed, and they are less satisfied. Therefore, to improve women's experience od IOL, clinicians should assess the maternal sleep quality, identify sleep disturbances during pregnancy and offer treatment options when necessary. More future follow-up studies recruiting women from in early pregnancy on and with a spontaneous labor comparison group are needed.

Contributions

Henna Haavisto is the principal investigator and author of the paper. Päivi Polo-Kantola and Kirsi Rinne are the leaders and co-authors of the study. Ella Anttila and Elina Ojala are the co-investigators. Terhi Kolari is the statistician of the study.

Ethical approval

The study received approval from the Ethics Committee of the Hospital District of Southwest Finland (3/1801/2016 and 40/1801/2017) and it was registered at clinicaltrials.gov (02793609).

Funding

The study was financially supported by Turku University Hospital (EVO grant, PP-K), The Finnish Medical Foundation (HH) and the University of Turku, the Faculty of Medicine Postgraduate Education Unit PGE and associated doctoral programmers.

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.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ejogrb.2023.01.028.

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