Journal of Taibah University Medical Sciences (2021) 16(3), 359–364

Taibah University

Journal of Taibah University Medical Sciences

www.sciencedirect.com

Original Article

Prevalence and predictors of sleep deprivation and poor sleep quality and their associated perinatal outcomes during the third trimester of pregnancy

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Received 9 September 2020; revised 9 November 2020; accepted 16 November 2020; Available online 17 December 2020

الملخص

أهداف البحث: لا يؤثر حرمان الأم من النوم فقط على الأمهات الحوامل بل أيضا له تأثيرات عميقة على صحة الجنين. تهدف هذه الدراسة لتقييم مدى انتشار النعاس المفرط أثناء النهار والنوم السيئ والمنبئات لهما.

طرق البحث: أجريت هذه الدراسة المقطعية المستعرضة على السيدات بعد الولادة في مستشفى تعليمي للرعاية الثالثة. أعطي المشاركات استبانة موحدة شبه منظمة تم اختبارها مسبقا. تم تقييم النعاس المفرط أثناء النهار باستخدام مقياس إبوورث للنعاس وتم قياس النوم السيئ باستخدام مؤشر بيتسبرج لجودة النوم.

النتائج: تم تسجيل ٢٢٥ مشاركة، وكان انتشار النعاس المفرط أثناء النهار ٢٩.٣٪ وكان انتشار النوم السيئ ٧٢.٩٪. وكانت العوامل التي ارتبطت ارتباطا كبيرا مع النعاس المفرط أثناء النهار هي العمر الأصغر، وزيادة الوزن، وانخفاض الهيموجلوبين وسكري الحمل. بينما كانت العوامل المرتبطة مع النوم السيئ هي العمر الأصغر، وزيادة الوزن، وانخفاض الهيموجلوبين وسكري الحمل. ولم يوجد ارتباط كبير بين نتائج الفترة المحيطة بالولادة والنعاس المفرط أثناء النهار أو النوم السيئ. بالإضافة لذلك، تم ملاحظة ممارسات النوم السيئة عند المشاركات في الدراسة.

الاستنتاجات: في هذه الدراسة، كان النعاس المفرط أثناء النهار والنوم السيئ سائدا بشكل كبير بين المشاركات وكانت تنبؤاتها الرئيسة العمر الأصغر، وانخفاض الهيموجلوبين، وزيادة الوزن وسكري الحمل.

الكلمات المفتاحية: الحرمان من النوم؛ نظافة النوم؛ النعاس المفرط أثناء النهار؛ جودة النوم؛ الحمل؛ نتائج الفترة المحيطة بالولادة

Abstract

Objectives: Maternal sleep deprivation not only affects the pregnant mother but also has profound effects on the well-being of the foetus. This study aims to assess the prevalence and predictors of excessive daytime sleepiness (EDS) and poor sleep quality (PSQ).

Methods: This was a cross-sectional study conducted among in-patient post-natal women of a tertiary care teaching hospital. A pretested semi-structured standardised questionnaire was administered. EDS was assessed using the Epworth sleepiness scale and PSQ was measured using the Pittsburgh Sleep Quality Index.

Results: A total of 225 participants were enrolled. The prevalence of EDS was 29.3% (95% confidence interval [CI] = 23.5, 35.8) and the prevalence of PSQ was 72.9% (95% CI = 66.6, 78.6). The factors (adjusted odds ratio; 95% CI; *p*-value) that were significantly associated with EDS were age (1.082; 1.019, 3.102; 0.042), being overweight (1.248; 1.012, 3.834; 0.041), low haemoglobin (1.246; 1.007, 4.572; 0.043), and gestational diabetes mellitus (GDM) (1.267; 1.001, 7.239; 0.049). On the other hand, the factors associated with PSQ were young age (1.092; 1.035, 3.763; 0.028), being overweight (1.602; 1.029, 2.995; 0.035), low haemoglobin (1.328; 1.004, 4.963; 0.047), and GDM (1.659; 1.284, 4.112; 0.016). No significant associations were found between perinatal outcomes and EDS or PSQ. Additionally, poor sleep practices were observed in our study participants.

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Peer review under responsibility of Taibah University.

ELSEVIER Production and hosting by Elsevier

 https://doi.org/10.1016/j.jtumed.2020.11.008

Conclusion: In this study, EDS and PSQ were significantly prevalent among participants, and their major predictors were age, haemoglobin, being overweight, and GDM.

Keywords: Excessive daytime sleepiness; Perinatal outcomes; Pregnancy; Sleep deprivation; Sleep hygiene; Sleep quality

Introduction

Sleep is important for one's general wellbeing, and most sleep professionals advocate at least seven to 8 h of sleep every night.[1] However, the sleep duration needed varies with each individual, and it is not possible to define a certain cut-off point for sleep deprivation.[2] Thus, sleep deprivation may be determined merely by the presence of excessive daytime sleepiness (EDS), which is the primary known effect.[2] Sleep deprivation is a lack of sufficient amount of restorative sleep over a period of time, which causes psychiatric or physical symptoms and affects the day-to-day performance of tasks.[3] Globally, sleep duration has been declining across almost all populations.[4] Women spend a great amount of time in their work fields and, at the same time, put a lot of effort into household work; therefore, sleep needs becoming their least priority.[4] Current research indicates that clinically significant insomnia may exist in 17% of pregnant mothers, which is much higher than normal and may also be a contributor to increased mortality.[5]

Sleep quality, on the other hand, concerns the adequacy of sleep or a lack thereof. Long sleep duration with poor sleep quality (PSQ) can still result in sleep deprivation.[6] A systematic review and meta-analysis of 24 studies concluded that 45.7% of n = 11,002 pregnant women experienced PSQ that deteriorated from the second trimester to the third trimester.[6] In addition to physical discomfort, anxiety, and hormonal changes during pregnancy, another important factor that affects sleep is sleep hygiene.[7] Sleep hygiene can be defined as behaviours that are thought to promote better quantity and quality of sleep.[8] The literature suggests that improved sleep hygiene can decrease gestational co-morbidities and improve maternal–foetal outcomes.[7]

Increasing evidence suggests that lack of adequate sleep of good quality can lead to an increase in the plasma levels of pro-inflammatory serum cytokines.[4] This poses an even larger threat for pregnant women, as higher plasma concentrations of these cytokines can lead to a variety of complications in the antenatal, natal, and postnatal period.[4] Additionally, women may perceive an increase in pain and discomfort during childbirth.[9] Maternal sleep deprivation not only affects the pregnant mother but also has profound effects on the well-being of the foetus, in the form of increased risk for prolonged labour, preterm births, and foetal growth restriction.[10] Thus, sleep during pregnancy becomes an important element to be assessed and corrected if there exists a problem. Therefore, we aimed to primarily assess the prevalence of EDS (sleep deprivation) and, secondarily, to assess the predictors of EDS and the prevalence of PSQ and its predictors in our population of pregnant mothers, and to describe the perinatal outcomes.

Materials and Methods

Study design, sample size, and ethics

This was a cross-sectional study conducted during a two-year period (June 2016 to May 2018) in a tertiary care teaching and referral 1350-bed hospital in Bengaluru, south India, which caters to the needs of Bengaluru's metropolitan and suburban and rural regions surrounding Bengaluru in the states of Tamilnadu, Kerala, and Karnataka of south India. Consenting postnatal women admitted to our hospital were recruited for the study. Participants who exhibited post-partum psychosis or were in critical condition were excluded from the study. Assuming an estimated prevalence of sleep deprivation (p) of 57.7%[11] with an absolute precision (d) of 5%, the estimated required sample size using the formula $(Z\alpha)^2pq/d^2$ was 376. Considering that the aforementioned assumption was based on a study conducted in Norway, it was decided a priori that an adaptive approach with a sample size re-estimation design[12] would be followed, using an internal pilot data design[13] when n = 100 participants had been recruited. Thus, the re-estimated sample size after the recruitment of 100 participants, assuming a prevalence p of 17% was 217. To accounting for non-responders, the sample size was increased by 5%, leading to a final target sample size of 227. Simple random sampling using the lottery method was conducted, whereby no more than 3 participants were selected from the birth register per day, and written informed consent was obtained from all the participants. In case of refusals, the next person in the register was selected. In case the participant was illiterate, informed consent was obtained in the presence of an impartial witness. The study was approved by the institutional ethics committee, vide reference number 114/2016.

Assessment tools

A pretested semi-structured standardised questionnaire was administered before the mothers were discharged following delivery. The questionnaire included different sections, to collect data on demography, pregnancy outcomes, EDS, PSQ, risk factors for EDS and PSQ, and sleep hygiene practices. Socio-economic status, occupation, and education were categorised as per the modified Kuppuswamy's scale.[14] As a surrogate marker for sleep deprivation, EDS was assessed using the Epworth sleepiness scale,[15] a scale that asks the respondent to rate on a 4-point scale (0–3) their usual chances of falling asleep while engaged in eight different activities. A total score of 10 or higher indicates a clinically relevant EDS with a specificity of 79.3% and a positive predictive value of 88.0% and mandates a consultation with a sleep medicine specialist.[16] PSQ was measured using the Pittsburgh Sleep Quality Index (PSQI),[17] which consists of 19 items scored on a (0–

3) scale, offering seven component scores and one composite score. The components are subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. The composite PSQI score ranges from 0 to 21, with lower scores indicating better sleep quality.[17] A score exceeding 5 has a diagnostic sensitivity of 89.6% and a specificity of 86.5% in distinguishing good and poor sleepers.[17] Sleep hygiene practices were assessed using a standardised pilot-tested survey, which was reviewed by language experts and sleep medicine experts. The entire questionnaire was translated into Tamil, Telugu, and Kannada with the help of professional translators and the translation was validated using back-translation performed by different translators.

Data management and statistical analysis plan

Data were entered using Epiinfo ver. 7 (Publisher: CDC, United States, 2011) and analysed using the Statistical Package for Social Sciences (SPSS) ver. 20 (Publisher: IBM Corp., United States, 2011). Demographic characteristics were summarised using descriptive statistics. The prevalence of EDS and PSQ were represented by percentages with 95% CIs. The hypothesised predictors for EDS and PSQ were subjected to a univariate analysis using simple binary logistic regression. Predictors with $p < 0.2$ were included in the multivariate binary regression model. Since we hypothesised that lower age and lower haemoglobin were likely to increase the risk for EDS/PSQ, we transformed the variables by multiplying them by -1 to obtain an adjusted odds ratio for a unit decrease in each of the variables. To compare the perinatal outcomes of participants with normal sleep and those with abnormal sleep, we used Chi-squared tests or Fischer's exact tests. The level of significance was set as $p < 0.05$.

Results

The total of 265 participants were screened and 225 participants were finally enrolled. There were 34 participants who did not consent, 5 participants who were in critical condition, and one participant in post-partum depression. The mean (SD) age of the participants was 25.16 (3.98) years and 129/225 (57.3%) were primigravidae. Anaemia was the most common gestational co-morbidity, diagnosed in 46.7% of the participants. The sociodemographic characteristics of our study population are summarised in Table 1. The prevalence of EDS was 29.3% (95% CI = 23.5, 35.8) and that of PSQ was 72.9% (95% CI = 66.6, 78.6). The mean (SD) PSQI score was 6.4 (2.75).

The details of the univariate and multivariate analysis of the predictors of EDS and PSQ are shown in Tables 2 and 3, respectively. At the end of the multivariate

Table 1: Sociodemographic characteristics.

Variable	Category	Total [N = 225 (%)]
Age (years)	Less than 20	11 (4.9)
	20–29	181 (80.4)
	30 & above	33 (14.7)
Participant's Occupation	Housewife	180 (80.0)
	Unskilled labourer	4 (1.8)
	Semi-skilled labourer	2 (0.9)
	Skilled labourer	5 (2.2)
	Farmer, clerk, or shop owner	16 (7.1)
	Semi-profession	6 (2.7)
	Profession	12 (5.3)
Participant's Education	Illiterate	8 (3.6)
	Primary school	5 (2.2)
	Middle school	14 (6.2)
	High school	72 (32.0)
	Post high school diploma	55 (24.4)
	Graduate/postgraduate	47 (20.9)
	Professional	24 (10.7)
Socio-Economic Class	Upper	55 (24.4)
	Upper middle	89 (39.6)
	Lower middle	72 (32.0)
	Upper lower	9 (4.0)
	Lower lower	0 (0.0)
Gestational Co-Morbidities	Diabetes mellitus	32 (14.2)
	Hypertension	15 (6.7)
	Anaemia	105 (46.7)
	Bad obstetric history	15 (6.7)

Table 2: Predictors of excessive daytime sleepiness.

Risk Factors	Univariate analysis		Multivariate analysis	
	OR	p-value	aOR (95% CI)	p-value
Decreasing Age	1.089	0.031	1.082 (1.019, 3.102)	0.042
Being Overweight*	1.189	0.037	1.248 (1.012, 3.834)	0.041
Being Primigravida	1.414	0.139	1.392 (0.897, 6.379)	0.109
Haemoglobin	0.808	0.051	1.246 (1.007, 4.572)	0.043
Gestational Diabetes Mellitus	1.218	0.055	1.267 (1.001, 7.239)	0.049
Gestational Hypertension	0.579	0.410	Not included in the analysis	
Bad Obstetric History	0.351	0.376	Not included in the analysis	
Socio-Economic Status	0.986	0.578	Not included in the analysis	

OR – odds Ratio; aOR – adjusted odds ratio; 95CI – 95% confidence interval.
*BMI $\geq$25 kg/m^2.

Table 3: Predictors of poor sleep quality index.

Risk Factors	Univariate analysis		Multivariate analysis	
	OR	p-value	aOR (95% CI)	p-value
Decreasing Age	0.912	0.024	1.095 (1.032, 3.760)	0.026
Being overweight*	1.667	0.032	1.610 (1.037, 2.987)	0.031
Being Primigravida	1.259	0.144	1.180 (0.735, 6.772)	0.158
Haemoglobin	0.958	0.056	1.350 (1.026, 4.941)	0.042
Gestational Diabetes Mellitus	1.731	0.019	1.699 (1.324, 4.072)	0.012
Gestational Hypertension	0.732	0.584	Not included in the analysis	
Bad Obstetric History	1.025	0.968	Not included in the analysis	
Socio-economic Status	0.973	0.285	Not included in the analysis	

OR – odds ratio; aOR – adjusted odds ratio; 95CI – 95% confidence interval.
*BMI $\geq$25 kg/m^2.

Table 4: Perinatal outcomes.

	Total frequency (N = 225)	Among the sleep-deprived (n = 66)		Among poor quality sleepers (n = 164)	
	n (%)	n (%)	p-value	n (%)	p-value
Premature rupture of membranes	14 (6.2)	6 (9.1)	0.251	8 (4.9)	0.171
Preterm premature rupture of membranes	7 (3.1)	0 (0.0)	0.109	4 (2.4)	0.341
Antepartum haemorrhage	6 (2.7)	1 (1.5)	0.674	6 (3.7)	0.194
Preterm delivery	17 (7.6)	3 (4.5)	0.474	12 (7.3)	0.954
Instrumental delivery/Caesarean section	89 (39.6)	23 (34.8)	0.352	70 (42.7)	0.116
Intensive care unit admission of the neonate	54 (24.9)	16 (24.2)	0.956	42 (25.6)	0.354

analysis, the factors (adjusted odds ratio [aOR]; 95% CI; p-value) that were significantly associated with EDS were age (1.082; 1.019, 3.102; 0.042), being overweight (1.248; 1.012, 3.834; 0.041), haemoglobin (1.246; 1.007, 4.572; 0.043), and gestational diabetes mellitus (GDM) (1.267; 1.001, 7.239; 0.049). Similarly, the factors (aOR; 95% CI; p-value) associated with PSQ were age (1.095; 1.032, 3.760; 0.026), being overweight (1.610; 1.037, 2.987; 0.031), haemoglobin (1.350; 1.026, 4.941; 0.042), and GDM (1.699; 1.324, 4.072; 0.038).

Table 4 shows the occurrence of various perinatal outcomes for both the mother and the neonate along with their association with EDS and PSQ. None of the outcome measures showed a significant association with either EDS or PSQ. A survey on the practices of sleep hygiene followed revealed that 20.4% (46/225) of the participants have night shifts, 71.6% (161/225) do not have a noiseless bedroom, 59.6% (134/225) do not have a completely dark bedroom at night, and 52.9% (119/225) do other work in bed. In the last 4 h before going to bed, 33.3% (75/225) drink coffee, 0.4% (1/225) smoke tobacco, 12% (27/225) are exposed to passive smoking, 1.8% (4/225) consume alcohol, 44.4% (100/225) consume water, and 25.8% (58/225) exercise. A total of 69.3% (156/225) of the participants complained of difficulty falling asleep immediately after going to bed and 30.7% (69/225) reported having afternoon naps longer than 30 min.

Discussion

The prevalence of sleep deprivation as measured by EDS was 29.3% and the prevalence of PSQ was 72.9%. Further, the expectant mothers did not have good sleep practices and sleep environment. Different studies have defined sleep deprivation through various measures. Whatever the definition of sleep deprivation may be, our findings corroborate what has been previously reported in the literature regarding women, irrespective of pregnancy status. A similar study conducted among 370 expectant mothers in the third trimester reported the prevalence of EDS to be 22.2%.[18] Another population-based study from Finland conducted among 12,423 participants of both genders, reported that the prevalence of insufficient sleep was 23.9% in women, where insufficient sleep was defined as a difference of 1 h between the actual sleep duration and the self-reported sleep need.[19] It has also been reported that approximately 25% of women from developed nations mention EDS and 50% have stated that they have driven a vehicle while they were drowsy.[20] The optimal duration of sleep required during pregnancy to avoid EDS is unknown. Studies have reported an increase in total sleep time and a decrease in EDS during the first trimester and the opposite

situation during the third trimester. Overall, there is an increased need for sleep for pregnant compared with non-pregnant women.[4] Thus, identifying lack of sleep using EDS in pregnant mothers could be the second ideal method after objective methods like polysomnography or actigraphy; the use of EDS is the strength of our study.

Regarding sleep quality, almost three-fourths of the participants have PSQ (PSQI > 5). Other studies from across the globe have also reported such a large number of women with PSQ during pregnancy. A study conducted among 102 pregnant women in Turkey has reported that 61% are poor quality sleepers and their mean (SD) PSQI was 7.5 (4.4).[21] Another study conducted among 454 pregnant women from China has reported that 87% of them fulfil the criteria for PSQ.[22] The reason behind this is that the women's body, both physiologically and psychologically, changes drastically over a short time period during pregnancy, thereby resulting in significant alterations in sleep patterns.[23]

For a 1 g% decrease in haemoglobin, the odds that a participant is suffering from EDS or PSQ increase by approximately 25% and 35%, respectively. Iron is known to play a role in the metabolism of monoamines in the brain; hence, iron deficiency leads to impaired monoamine oxidase activity, affecting brain functions.[24] A case–control study conducted among 104 participants with iron deficiency anaemia and 80 controls found that the former's odds of PSQ were three times those of the latter, as assessed by PSQI ($\chi^2 = 13.072$; $p < 0.001$).[25] Iron deficiency is also a well-known risk factor for restless leg syndrome, which also could have affected sleep negatively.[26] India has the highest prevalence of anaemia in the world, with approximately 50% of pregnant women even from higher socioeconomic classes being anaemic.[27] In our study as well, the prevalence of anaemia is quite high (47%). Thus, as a primordial prevention strategy, all pregnant mothers should be screened for PSQ and sleep deprivation, especially in those diagnosed with anaemia, so that bad pregnancy outcomes due to inadequate sleep can be prevented.

Chronic insomnia is a well-established risk factor for poor glycaemic control.[2] We found that EDS and PSQ are associated with a nearly 25% and 70% increase in poor glycaemic control, respectively. These findings are, once again, similar to those from other studies. In a cohort of 686 pregnant women from Singapore, those with PSQ exhibited a 75% increase in the probability of GDM (aOR: 1.75, 95%CI: 1.11, 2.76).[28] A meta-analysis of nine studies involving 9,795 pregnant women reported that sleep-disordered breathing, another well-known cause of PSQ and sleep deprivation, leads to a threefold increase in the odds of GDM (OR: 3.06, 95% CI: 1.89, 4.96).[29] Being overweight is yet another well-known risk factor for PSQ; we found that being overweight (having body mass index [BMI] > 25 kg/m^2) increases the odds of EDS or PSQ by 25% and 61%, respectively. This finding also corroborates the findings of other similar studies. Gay et al.[30] have reported that among 76 pregnant women who gained weight above the recommended maximum, the mean (SD) PSQI was 7.3 (3.3), which was significantly higher than that of those who did not gain weight beyond the recommended weight during their gestational period. Although the mechanism underlying the association between sleep and BMI is largely unknown, it has been postulated that PSQ changes appetite regulation mechanisms, possibly resulting in poor food choices and an increased intake of calories.[31]

The fourth significant predictor of EDS and PSQ that we found was age. For a one-year decrease in age, the probability of EDS or PSQ increases by 8% and 10%, respectively. This finding is easily explainable by the fact that the young generation are undergoing a paradigm shift in lifestyle with regards to extensive use of electronic media and greater academic demands, all of which could potentially lead to PSQ and inadequate sleep.[32] Given the high prevalence of EDS and PSQ, we were not able to prove associations with perinatal outcomes as these events' rates were smaller. We also report that the documented sleep practices were poor for the vast majority of our participants, as seen in other studies,[2] possibly due to the lack of awareness of the ill effects of sleep deprivation and lack of knowledge on good sleep hygiene.

Our study, however, has a few limitations. We were not able to prove associations between the perinatal outcomes and EDS or PSQ. This was probably due to the low event rate and the smaller sample size. We were also unable to delineate the differences with regards to the prevalence of EDS or PSQ in all three trimesters as financial considerations prevented us from conducting a cohort study. For the same reason, we were unable to delineate whether the associations between comorbidities and EDS or PSQ were causative or resultant. Further, EDS and PSQ were measured based on the last month of the third trimester and, hence, the first two months of that trimester may have been slightly different, leading to different findings.

Conclusions

The prevalences of EDS and PSQ were 29.3% and 72.9%, respectively. The significant predictors of EDS and PSQ were age, haemoglobin, being overweight, and GDM. We did not find associations between perinatal outcomes and EDS or PSQ due to the low rate of perinatal outcomes encountered. Poor sleep practices were widely observed among our participants.

Recommendations

We recommend that screening for PSQ among pregnant women should be done as part of routine antenatal care. It should also be mandatory for the treating obstetrician to provide advice regarding improving sleep quality as a lifestyle modification and educate patients on good sleep hygiene.

Source of funding

This work was supported by the undergraduate students' funding from the Research Society, St. Johns National Academy of Health Sciences.

Conflict of interest

The authors have no conflict of interest to declare.

Ethics approval

The study was approved by the institutional ethics committee, vide reference number 114/2016- dated 6th May 2016 ,

and was conducted in accordance with the Declaration of Helsinki and the applicable local rules and guidelines.

Authors contributions

AG and BK were responsible for data collection, data entry, and the initial draft of the manuscript. JPR was responsible for the concept and design, data analysis and interpretation, and the initial draft of the manuscript. AT was responsible for the design, data interpretation, and critical review of the manuscript draft. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

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How to cite this article: Ghante A, Raj JP, Krishna B, Thomas A. Prevalence and predictors of sleep deprivation and poor sleep quality and their associated perinatal outcomes during the third trimester of pregnancy. J Taibah Univ Med Sc 2021;16(3):359–364.