Maternal Sleep and Related Pregnancy Outcomes: A Multicenter Cross-Sectional Study in 11 Provinces of Iran

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Abstract

Objective: Sleep disturbance during pregnancy is one of the most common maternal complaints. Not only does it play a crucial role in a mother's life, but also it comes with a multitude number of complications. This study aimed at assessing the association between sleep disturbance in pregnancy and maternal and child outcomes.

Materials and methods: This was a multicenter cross-sectional study, conducted on pregnant women across 11 provinces in Iran in 2018. Sleep disturbance as a composite variable was defined using the principal component analysis based on five questions. Abortion, anemia in the first and third trimester, gestational diabetes, gestational age, glucose tolerance test (GTT), fasting blood sugar (FBS), mode of delivery, low birth weight and stillbirth were defined as study outcomes.

Results: Totally, 3675 pregnant women enrolled in the study. Most of the participants (84.5%) reported

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that their sleep duration is less than 8 hours per day. The prevalence of sleep disturbance was 20.7% (95% CI: 19.1, 22.3). After adjusting for maternal age, education, job, place of residency and physical violence, sleep disturbance would increase the odds of abortion (p=0.009), anemia in both first (p=0.001) and third (p=0.003) trimester, gestational age (p=0.049), abnormal FBS (p=0.015) and cesarean section (p<0.001).

Conclusion: Regarding the effect of sleep quality on maternal outcomes, planning and implementing a suitable intervention in the context of primary health care is necessary. Increasing the awareness of mothers, health workers and medical personnel about the suitable quality and quantity of sleep during pregnancy is of great importance.

Keywords: Sleep Wake Disorders; Pregnancy Outcome; Stillbirth; Iran

Introduction

Sleep is a bio-behavioral process that is essential for the human body to have a proper performance (1). It should be noted that sleep does not mean just the absence of waking. But also, during this process, specialized physiological activities occur in the brain and throughout the body. In fact, through this active process, tissue repair, memory stabilization, and homeostatic balance in the body are maintained (2).

Results of several studies have shown that there is a U-shape relationship between the duration of sleep and death; so that seven hours of sleep per day is associated with the lowest mortality rate (3). Evidence indicate a link between sleep disturbances and increased risk of depression, diabetes, obesity as well as all-causes of mortality (3-6).

Sleep disturbances are a common issue during pregnancy so that globally more than 75% of pregnant women experience some form of sleep problems (7). Rising levels of hormones such as progesterone can be responsible for such changes in the quality of sleep in pregnant women (8). In pregnant women, short sleep duration is associated with longer labor times and subsequently increased cesarean section (C-section) rates (9). Along with sleep disorders in pregnant women, risen risk of some complications such as preeclampsia, hypertension, and small for gestational age (SGA) infants have been reported (10, 11). Besides, the quality of life in pregnant women is related to the quality of sleep (12).

Identifying risk factors of developing maternal and fetal adverse outcomes in pregnant women is essential for preventive strategies. There is limited evidence regarding maternal and fetal outcomes in pregnant women with sleep disturbances in Iran. This study was conducted to assess the relationship between sleep disturbance in pregnancy and related pregnancy outcomes in Iran.

Materials and methods

Study design and setting: This was a multicenter cross-sectional study, a part of case control study in 2018 (13), which designed to determine the relationship between sleep disturbance and adverse pregnancy outcomes among mothers referring to the health centers in eleven provinces/cities across Iran including Fars, Hormozgan, Kermanshah, Chaharmahal and Bakhtiari, Hamadan, Kohgiluyeh and Boyer-Ahmad, Yazd, South Khorasan and Golestan provinces and two big cities of Mashhad and Zahedan.

Study population and sampling procedure: In this study, we have tried to sample from different regions of Iran, so we have chosen different provinces for study to enable the generalization of the published results to the entire Iranian population. To this end, all the provinces were divided into four different geographical regions (North, South, East, and West). Then, two health centers as one urban and one rural were selected from each geographical region from two big cities. Lastly, 20 subjects were randomly selected from each health center. Some data, mentioned in the data collection section, were collected by interviewing the mothers and some were also extracted from family health records by using a checklist. Totally, a sample size of 3675 pregnant women was enrolled in the study. Having a health record was an inclusion criterion for our study and those with missing data were excluded in the analysis. Women were invited to interview by telephone.

Data collection methods and tools: The data collection form in this study was a researcher-made checklist that includes the mother's personal information such as age, education, body mass index (BMI), place of residency, occupation, domestic violence, and daily physical activity.

In this study, sleep disturbance was defined by

five questions including the length of sleeping (in an hours), sleep location, having regular sleep, sleep position during the last pregnancy and self-reported sleep status as very good, good, bad and very bad. Sleep disturbance as a composite variable was defined using the principal component analysis (PCA) and was classified as dichotomous variable for analysis. In addition, length of sleeping (in hour) was categorized into two categories as lower than 8 (short sleep) and equal to or more than 8 hours.

Dependent variables (study outcomes) were gestational age (<37 or ≥37 weeks), gestational diabetes mellitus (GDM), maternal anemia in the first or third trimesters (women with hemoglobin level lower than 11 g/dL), low birth weight (lower than 2500 g), abortion, stillbirth, mode of delivery (C-section or vaginal), glucose tolerance test (GTT) and fasting blood sugar (FBS) abnormal. GDM, GTT- and FBS-abnormal in pregnancy were defined according to WHO criteria (14).

Although, based on the Centers for Disease Control and Prevention (CDC), stillbirth is classified into three categories, including early stillbirth (death at 20 to 27 weeks of pregnancy), late stillbirth (death at 28 to 36 weeks of pregnancy) and term stillbirth (death in the 37th or 38th week of pregnancy or at delivery), it was not specific in our study. The stillbirth was collected as a dichotomous variable.

Data analysis: The statistical analyzes used in this study were descriptive analyzes and logistic regression model at a significant level of 5%. In the adjusted models, the odds ratios were adjusted for maternal variables including maternal age, education, job, place of residency, physical activity and domestic violence.

All analyses were done by STATA software version 14 (STATA Corp, College Station, TX).

Ethical considerations: To obtain information on infant mortality and information on household records, after being confirmed at the University, the correspondence was presented to coordinate the universities. All information was kept confidential and was prevented by the name and surname in the reporting phase. Verbal informed consent was obtained from all mothers.

Results

Totally, 3675 pregnant women enrolled in the study. The mean ±SD of maternal age and BMI was 27.2±6.0 and 23.1±4.8, respectively. Mothers with short sleep were significantly older (p<0.001), higher BMI (p<0.005) and less educated (p<0.001). The proportion of short sleep was 20.3, 10.9 and 13.7 percent in participants with primary, secondary, high school and academic education. Short sleep was as common in urban residents as rural ones (p=0.123). Mean ±SD of sleep time was 7.3±2.7 in participants with less than 8 hours sleep which was significantly two hours less than the other group (p<0.001) (Table 1).

Based on the PCA method, the prevalence of sleep disturbance was 20.7% (95% CI: 19.1, 22.3). Most of the participants (84.5%) reported that their sleep duration is less than 8 hours per day. Bad and very bad sleep qualities were reported by 2.8 and 2.8 percent, respectively. Around 40 percent of the participants (38.4%) reported that they have regular sleep very often. Most of the participants reported that they prefer to sleep in dark room (42.5%) and on side position (82.2%) (Table 2).

Table 1: Characteristics of study participants according to sleep duration

	Sleep duration		P-value
	≥ 8 hours	< 8 hours	
Mother's age (year)	26.9±5.8	28.7±6.6	<0.001
BMI*	23.0±4.5	24.0±5.2	<0.002
Job			0.089
Housewife	2815 (85.5)	478 (14.5)	
Employed	159 (81.9)	35 (18.1)	
Self-employed	79 (79.0)	21 (21.0)	
Education			<0.001
Primary	846 (79.7)	215 (20.3)	
Secondary	803 (89.1)	98 (10.9)	
High school and academic	1428 (86.3)	226 (13.7)	
Place of residency			0.123
Rural	1661 (86.1)	269 (13.9)	
Urban	1344 (84.2)	252 (15.8)	
Sleep time (hour)	9.2±2.5	7.3±2.7	<0.001

*Body mass index; data were presented as number (%) for categorical variables and mean±SD for continuous ones.

Table 2: Self-reported maternal sleep during pregnancy

Variable		No.	%
Sleep location	Darkness	1,539	42.2
	Dark and light	1,943	53.3
	Light	125	3.4
	Missing	42	1.2
Sleep position	On side	3,000	82.2
	Supine	595	16.3
	Missing	54	1.5
Quality of sleep	Very good	322	8.8
	Good	2,760	75.6
	Bad	437	12.0
	Very Bad	102	2.8
	Missing	28	0.8
Having regular sleep	Always	465	12.7
	Very Often	1,409	38.6
	Sometimes	1,383	37.9
	Rarely	309	8.5
	Never	53	1.5
	Missing	30	0.8
Sleep duration (hour)	<8	3,082	84.5
	≥8	539	14.8
	Missing	28	0.8

After adjusting for maternal age, education, job, place of residency, daily physical activity and domestic violence, sleep disturbance would increase the odds of abortion by 41 percent (p=0.009).

The odds of anemia in both first (p=0.001) and third (p=0.003) trimesters would increase by 51 and 71 percent, respectively. Sleep disturbance also was associated with gestational age (p=0.049) and C-section (p<0.001).

Sleep disturbance was directly associated with abnormal FBS (p=0.015). It also increased the odds of GGT by 35 percent (p=0.065). Although the odds of low birth weight (LBW) would increase by 28 percent due to sleep disturbance, it did not reach to statistical significance (Table 3).

Discussion

A prevalence of 20.7% was found for sleep disturbance in the Iranian pregnant women. We also found an important relationship between sleep disturbance during pregnancy and some adverse pregnancy outcomes such as abortion, anemia in both first and third trimesters, gestational age, C-section and abnormal FBS, after adjusting for maternal age, education, job, place of residency, daily physical activity and domestic violence.

Table 3: The adjusted odds ratios of the association between sleep disorder (as independent variable) and related pregnancy outcome in Iran

Variable		Adjusted OR (95% CI)*	P-value
Abortion	No	Ref.	-
	Yes	1.41 (1.09, 1.82)	0.009
Anemia in the 3rd trimester	No	Ref.	-
	Yes	1.51 (1.19, 1.92)	0.001
Anemia in the 1st trimester	No	Ref.	-
	Yes	0.71 (0.57, 0.89)	0.003
Gestational age	≥37 weeks	Ref.	-
	<37 weeks	1.31 (1, 1.7)	0.049
Gestational diabetes	No	Ref.	-
	Yes	1.24 (0.8, 1.93)	0.343
GTT	Normal	Ref.	-
	Abnormal	1.37 (0.98, 1.92)	0.065
FBS	Normal	Ref.	-
	Abnormal	1.54 (1.09, 2.18)	0.015
Birth weight (gr)	2500-4000	Ref.	-
	<2500	1.28 (0.99, 1.66)	0.061
Mode of delivery	Vaginal	Ref.	-
	Cesarean	1.59 (1.3, 1.94)	<0.001
Birth outcome	Live birth	Ref.	-
	Stillbirth	0.94 (0.74, 1.19)	0.628

OR: odds ratio; GTT: glucose tolerance test; FBS: fasting blood sugar
*In the adjusted models maternal variables including age, education, job, place of residency, physical activity and domestic violence were adjusted.

Short sleep duration and poor sleep quality are common problems during pregnancy (15). This study was carried out to examine the relationship between poor sleep quality and related pregnancy outcomes. Findings of this study showed that sleep disturbance is associated with preterm delivery which is in accordance with previous studies (16-18). Okun and colleagues found that the level of interleukin-6 (IL-6) was higher in pregnant women with short sleep duration or poor sleep quality (19). They argued that higher level of Cytokines such as IL-6 was related to the initiation of spontaneous pain associated with preterm delivery (19). A number of studies revealed that sleep disorders may lead to impaired natural immune mechanisms (20). Generally, changes in sleep duration vary throughout the pregnancy. As such, sleep duration is shorter compared to the whole day sleep duration. Maternal sleep disruption is commonly due to increased levels of progesterone, nausea, vomiting, frequent urination and anorexia in the first trimester, increased uterus and urinary frequency, heart rate, and fetal movement in the second trimester, and physical changes and disability, trouble falling asleep, and common complaints such as back pain and itching in the third trimester (21-23).

The findings of the present study suggested that the odds of abortion are higher among mothers with sleep disturbance. Also, a sleep duration of 8hrs and lower increase the risk of abortion by four times and two times in the first and second trimester, respectively (24). Louis and colleagues stated that sleep apnea results in the onset of spontaneous delivery and subsequently separation of the placental membranes and abortion (25). Sleep deprivation especially during the first 20 weeks of pregnancy dramatically increase the inflammatory response and trophoblast invasion in the uterus (26). The fact that snoring and difficulty breathing cause sleep deprivation, it can be concluded that low sleep quality can lead to abortion (27).

Our results showed that the odds of cesarean was higher among women with sleep disturbance which was in accordance with previous studies (15, 28). Zafarghandi and colleagues found that sleep duration and the quality were correlated with the mode of delivery (29, 30). As such, pregnant women with longer sleep duration were more likely to give natural delivery. In contrast, Teong and colleagues in a prospective study stated that sleep measure is not a predictive factor for caesarean section (31). Li and colleagues argued that women with poor sleep quality were 1.87, 5.19, and 1.82 times more likely to deliver by cesarean in the first, second and third trimester, respectively (30). However, Evans and colleagues found no significant relationship between sleep quality and duration with the mode of delivery (32). Natural vaginal delivery is a high energy expending process, thus sleep deprivations such as poor-quality sleep and sleep disturbance decrease the ability to perform a perfect labor especially in the last month of gestation (33). The variation in these results may be as a result of sociocultural differences, different measurement methods, and various implications of sleep as well as different sampling method. Furthermore, there are many mediating factors in which cesarean is performed, such as breech presentation, pelvic stenosis, multiple births, third trimester bleeding due to placenta previa, and severe placental abruption, and the umbilical cord prolapse. All these factors may influence the mode of delivery (30, 34). Therefore, further efforts are required to investigate all factors individually.

The findings of the present study showed that the risk of sleep disturbance was higher in the first and third trimester among pregnant women with anemia. Results from studies show that restless leg syndrome is a common disorder among women due to reduced level of hemoglobin and vitamin deficiencies especially during pregnancy. Evidences show that the sleep quality was significantly improved among recovered patients with restless leg syndrome (35).

The number of studies focusing on the sleep disturbance and diabetes is limited and the biological mechanisms affecting sleep disturbance such as short or long sleep duration, poor sleep quality, and gestational diabetes remain unknown. However, some studies have argued that short sleep duration increased the odds of gestational diabetes (36-38), which is consistent with our results. Facco and colleagues in a cohort study reported that after adjusting for age, BMI and race/ethnicity, short sleep duration is associated with gestational diabetes (38). A previous meta-analysis with including five studies showed that sleep disordered breathing increased the risk of gestational diabetes by two times (39). Observational and experimental studies have shown that long or short sleep duration lead to impaired insulin production and glucose metabolism. The mediating factors in this association include increased oxidative stress, increased systemic inflammation, disruption of energy homeostasis, hormone changes in pregnant

women, and physical problems and stress during labor (21, 40-43). However, physical inactivity and sleep deprivation during pregnancy has been shown to be associated with longer sleep duration and dysfunction of glucose metabolism (44).

Besides, the risk of LBW was higher in women with sleep disturbance. Basan et al found no significant relationship between the infant birth weight and sleep disturbance and poor sleep quality (45). A number of studies have shown a significant relationship between low birth weight and maternal sleep disturbance which was not in agreement with the present study (17, 46). In spite the many logical reasons, the relationship between poor sleep quality and LBW is still unclear. For instance, maternal sleep disturbance may be attributed to changes in maternal appetite leading to increased fetal weighing.

According to the findings of the present study, no significant relationship was observed between sleep disturbance and stillbirth and infant mortality. Factors that are significantly associated with sleep disturbance during pregnancy such as high maternal age, ethnicity, tobacco use, anemia, congenital anomaly, maternal medical condition, intrauterine growth restriction, and previous history of adverse pregnancy outcomes were overlapped with the risk factors for perinatal mortality (47, 48). This overlap has formed many reliable biological hypotheses, thus further researches to assess the relationship between sleep disturbance and stillbirth is needed.

The present study had an important limitation. A standard sleep-quality questionnaire was not used. However, we attempted to declare an estimate of sleep disturbance with a large sample among Iranian pregnant women which may increase the generalizability of the study findings.

Conclusion

The findings of the current study revealed that sleep disturbance is a main risk factor for preterm birth, cesarean birth, gestational diabetes, anemia, and LBW. Therefore, awareness of health and medical personnel regarding the quality and quantity of sleep during pregnancy is of great importance and training intervention should be implemented to reduce the adverse outcomes of pregnancy associated with sleep disturbance.

Conflict of Interests

Authors have no conflict of interests.

Acknowledgments

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