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Association between Gestational Hypertension and Obstructive Sleep Apnea: A Case- Control Study

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ABSTRACT

Background & Objective: Gestational hypertension (GH) is considered as one of the important health-related issues of pregnant women. One of the raised problems in the pathogenesis of GH is obstructive sleep apnea (OSA). This study aimed to evaluate associated factors of OSA among an employed pregnant population.

Materials & Methods: In this study, 200 employed pregnant women with GH as the case group and 200 healthy pregnant ones as the control group were enrolled. Blood pressure >140/90 after 20 weeks of gestational age without proteinuria was defined as GH. Chi-square and Mann-Whitney tests were applied for statistical analysis.

Results: Mean ± SD of age and body mass index (BMI) were 32.85 ± 5.45 (years) and 31.85±5.97 (kg/m2) among the case group, respectively. Participants with GH had higher mean BMI, neck circumference, and more frequency of snoring than the control group, which was statistically significant (P<0.012, P<0.025, and P<0.007, respectively). Sales and service occupations consisted the group with the highest frequency of GH.

Conclusion: Participants with GH had higher BMI, snoring, observed apnea, and neck circumference. This observation warrants comprehensive assessment of OSA and related risk factors among patients with GH.

Keywords: Obstructive sleep apnea, Hypertension, Pregnancy

Introduction

One of the most important medical issues during pregnancy is gestational hypertension (GH) **(1)**, reported among 10% of pregnant women. It has been associated with different embryonic and maternal complications such as premature birth, post term baby, fetal death, early detachment of placenta, acute liver and kidney failure, pre and postpartum hemorrhages **(2)**.

Women with GH are at an increased risk of seizure during pregnancy, metabolic syndrome, cardiovascular diseases, and stroke **(3)**. Furthermore, GH, bleeding, and infection are considered as the main causes of mortality during pregnancy **(4)**. Prenatal mortality rate in mothers with GH is five times higher than the ones with normal blood pressure **(5)**.

Although some of the main causes of GH are still uncertain, several risk factors, including the number of births, multiple births, weight gain, chronic kidney disease, chronic hypertension, family history, getting new sexual partner, low age of mother at the time of first pregnancy, pregnancy in ≥40 years old, blood incompatibility, living in high-altitude areas, and inappropriate socio-economic status may influence GH **(3)**. Obstructive sleep apnea (OSA) is also a known risk factor for GH **(6)**.

Pregnancy along with many physiological and hormonal changes affect the structure of sleep **(2)**. Reduced sleep quality is one of the common complaints among pregnant women, especially during the third trimester of pregnancy **(7)**.

Sleep breathing disorders is one of the most common types of sleep problems in pregnant women. This disorder is characterized by frequent upper airway obstruction during sleep, abnormal breathing pattern, frequent hypoxia, and arousals from sleep **(8)**. Anthropometric indices, hormones, and differences in the structure of sleep make pre-menopause women less susceptible to sleep apnea when compared with age-matched men **(9)**. However, the physiological and hormonal changes during pregnancy can cause or exacerbate sleep breathing disorders **(8)**. Thirty percent of people with high blood pressure suffer from sleep-disordered breathing (SDB), and 45-68% of patients with respiratory sleep disorders have high blood pressure **(10)**.

SDB in adults refers to cessation of airflow for more than 10 seconds, which may be due to an upper airway obstruction during sleep, and could lead to increased sympathetic activity because of repeated arousals during sleep and hypoxia **(11)**.

The incidence rate of SDB in pregnant women is 3 to 6 times more common than non-pregnant women **(12)**. The symptoms and signs of SDB include habitual snoring, sleep disruption, neck circumference > 16 inches, high blood pressure, feeling tired, feeling not refreshed after sleep during the day, daytime sleepiness, lack of concentration, and personality change **(2)**.

Since pregnant women experience sleep disturbances and have reduced ability to perform more daily tasks than non-pregnant ones, these symptoms are attributed to their pregnancy and subsequently symptoms of SDB may be overlooked in them. Thus, the presence of these symptoms in pregnant women requires more attention by health care providers **(2)**.

Various factors are involved in occurrence and exacerbation of SB in pregnant women, such as decreasing diameter and dimensions of the upper airway due to inflammation and nasal congestion, increased estrogen and progesterone secretion, increased diaphragmatic effort to increase negative pressure in the upper airway, decrease in the functional residual capacity of lung, a higher supine position to accommodate increased uterine volume, respiratory alkalosis, central chemical stimuli induced by increased progesterone levels, and sleeping to the back **(13)**.

Furthermore, SDB is associated with cardiac, respiratory and hemodynamic problems, such as asphyxia, decreased and increased pulse rate, and fluctuations in systemic and pulmonary arteries and cardiac output. This complication is considered as an independent risk factor for high blood pressure **(14)**. It has been proven that there is an association between SDB and high blood pressure, heart failure, atrial fibrillation, myocardial infarction, brain stroke, and sudden cardiac death. Studies have shown that about half of the these patients have high blood pressure and are resistant to blood pressure reducing drugs **(15)**. Pine *et al.* showed that 26.7% of women in the third trimester of pregnancy suffer from SDB **(16)**.

In the study conducted by Sarberg *et al.*, 7.9% of women in the first trimester and 21.2% of women in the third trimester of pregnancy suffered from sleep apnea **(17)**.

Snoring is one of 7the important symptoms of sleep apnea **(7)**. According to the studies conducted by Bourjeily and O'brien, 35.1% and 34% of women snore in the last trimester of pregnancy, respectively **(9, 18)**.

The obtained results from Sarberg *et al.* showed that snoring rate increased from 7.9% in the first trimester to 21.2% in the third trimester of pregnancy **(17)**.

Snoring and SDB in pregnant women can lead to intolerance of glucose and gestational diabetes, preeclampsia, maternal depression, unplanned cesarean section, intrauterine growth retardation of fetus, preterm delivery, alpha-phytoprotein levels, and low birth weight **(11)** .

Screening pregnant women in terms of sleeping problems and consequently performing more specific tests and treatments can reduce the maternal and fetal complications arising from sleep disturbances.

Available data regarding the prevalence of risk factors of OSA in Iran is limited and obstetricians and physicians in charge of pregnant women overlook sleep problems as one of the causes of adverse maternal and fetus outcomes during pregnancy. Thus, considering the importance of SDB and its adverse outcomes on mother and fetus, the present study was conducted to determine the risk factors for OSA and its association with GH rate among the employed pregnant women **(19)**.

Materials and Methods

This analytical and case-control study was carried out in 2016-2017. The participants were divided into two groups: pregnant women with high blood pressure and the ones with normal blood pressure referring to two Imam Khomeini and Baharloo hospitals (affiliated to Tehran University of Medical Sciences) for prenatal care.

The employed women referring to the prenatal or delivery care centers were asked to participate in the study. GH was defined as a blood pressure higher than 140/90 measured on two separate occasions, more than 6 hours apart, without the presence of protein in the urine and diagnosed after 20 weeks of gestation. The inclusion criteria included pregnant employed women with gestational age of more than 20 weeks.

Participants with the following criteria were excluded: pre-pregnancy history of hypertension, cardiovascular disease in the mother during and before pregnancy, kidney diseases in the mother during pregnancy and before it.

The participants' questionnaire comprised of three parts:

1) A demographic characteristics' questionnaire that was completed for each patient, including age, weight, height, educational level, employment history, and past medical history or disease.

2) Characteristics of participants' pregnancy: gestational age, systolic blood pressure, diastolic blood pressure, and the number of pregnancies.

3) Associated risk factors of OSA using validated STOP-BANG questionnaire in Persian **(20)**, including loud recurring snoring in the sleep, daytime sleepiness, observed apnea during sleep, age >50 years, BMI 35 kg/m², neck circumference > 40 cm, and high blood pressure.

Measurements of height, weight, blood pressure, and neck circumference were performed by the researcher and other questions were asked by interview method.

The study was approved by ethical committee of Tehran University of Medical Sciences, Iran. Oral consent was obtained from all participants.

Collected data were analyzed using SPSS Statistics for Windows, version 16.0 (SPSS Inc., Chicago, Ill., USA). Frequency and percentage were used to describe the data. Data were analyzed using non-parametric Chi-square test. P-value less than 0.05 was considered significant.

Results

In the present study, the mean age of the subjects was 32.54 ± 4.9 years. In addition, 13.75% of the women had BMI >35 and 96.25% of them were graduated from high school and had a higher degree. Smoking was not reported by study participants.

The mean gestational age of mothers did not have a significant difference between the groups of high blood pressure and normal blood pressure. The level of education among the mothers in both groups was not different from each other (Table 1).

The mean BMI of the mothers in both groups did not have a significant difference based on the Mann-Whitney test (31.85 ± 5.97 vs.27.13±3.90, *P*<0.001) (Table 1).

In an adjusted regression model for the risk factors of GH, the case group was more likely to have higher BMI, neck circumference, snoring, and apnea (Table 2). Among the risk factors of sleep apnea, neck circumference >40 cm was more associated with GH (*P*=0.007) (Table 2).

In hypertension group, 41.2% had ≥2 risk factors of sleep apnea (snoring, tiredness, and high BMI and neck circumference) versus 11.9% among the control group (*P*<0.0001).

Table 1. Participants' Characteristics

Variable		Gestational HTN N (%)		Without gestational HTN N (%)		P-value
Age (year)	<=30	60	(30)	67	(33.5)	0.45
	>30	140	(70)	133	(66.5)	
Gestational age (week)	<=28	49	(24.5)	48	(24)	0.90
	>28	151	(75.5)	152	(76)	
BMI (kg/m2)	<35	154	(77)	191	(95.5)	<0.001
	>=35	46	(23)	9	(4.5)	
Education	Pre-diploma	11	(5.5)	4	(2)	0.06
	Post-diploma	189	(94.5)	196	(98)	
NC (cm)	<40	156	(78)	192	(96)	<0.001
	>=40	44	(22)	8	(4)	
Snoring	No	125	(62.5)	172	(86)	<0.001
	Yes	75	(37.5)	28	(14)	
Tiredness	No	96	(48)	101	(50.5)	0.62
	Yes	104	(52)	99	(49.5)	
Observed apnea	No	177	(88.5)	195	(97.5)	<0.001
	Yes	23	(11.5)	5	(2.5)	

HTN: Hypertension, BMI=Body mass index, NC=Neck circumference

Table 2. Logistic regression model of risk factors for sleep apnea and gestational hypertension

Variable	Exp. (B)	P-value	95.0% Confidence Interval
BMI (kg/m2)	2.872	0.012	1.266-6.515
NC (cm)	3.515	0.007	1.407-8.778
Education	0.369	0.106	0.110-1.237
Snoring	1.898	0.025	1.083-3.327
Observed Apnea	3.114	0.035	1.084-8.946

BMI=Body mass index, NC=Neck circumference

Table 3. Occupations of study participants in terms of gestational hypertension

Occupation Group	Total	Gestational Hypertension N (%)	No Gestational Hypertension N (%)
Management, business, finance and administrative occupations	113	40 (20)	73 (36.5)
Occupations in social science, education government service and art and sport	101	39 (19.5)	62 (31)
Sales and service occupation	95	71 (35.5)	24 (12)
Health occupations	91	50 (25)	41 (20.5)

Discussion

In the present study, GH was significantly associated with risk factors of sleep apnea, among which neck circumference had a significant association. Pregnant women employed in management, business, finance, and administrative occupations had the most frequency of GH. Although a higher job stress or BMI may justify this issue, further investigation is required to confirm these results.

Based on the study by Reid *et al.* **(21)** conducted on 34 pregnant women with GH and 26 healthy women, SDB in mothers with GH was reported more than healthy mothers. Furthermore, in the study by Champagne *et al.* **(22)**, 17 pregnant women with GH and 33 mothers with normal blood pressure were examined for SDB. The results of this study showed that 82% of women with GH and 45% of healthy women suffered from SDB.

In the study of Wu *et al.* **(23)**, high blood pressure in patients with apnea was significantly higher.

Based on the study of Franklin, GH in mothers with SDB was more common than mothers with normal blood pressure. Moreover, GH was twice more likely to occur in pregnant women with sleep apnea **(24)**.

The aforementioned findings were consistent with the results of this study. SDB via endothelial dysfunction, oxidative stress, hypoxia induced by sympathetic activity, frequent arousals, and sleep fragmentation leads to high blood pressure **(22)**. In the present study, the mothers with GH were more prone to suffer from SDB. Higher neck circumference, BMI, and snoring were the predicting factors of GH in this study compared to healthy pregnant women. Consistent with the results of present study, Ursavas *et al.* reported neck circumference and higher BMI as predictors of GH. Edema of pregnant women and higher BMI in third trimester of pregnancy may lead to more snoring and subsequently higher risk for SDB **(14)**. In another prospective cohort study on pregnant women, 37% of participants reported development of snoring during pregnancy and indicated that new onset of snoring in pregnancy is significantly associated with GH **(25)**.

Logan *et al.* observed that 60% of patients with OSA had high blood pressure **(26)**. Moreover, Banno *et al.* reported that the blood pressure of healthy subjects decreased during sleep, but the blood pressure of subjects with SDB increased during sleep **(27)**.

Conclusion

Considering that the risk factors of SDB are associated with GH, more attention should be paid to risk factors of sleep apnea and its related symptoms to avoid adverse maternal and fetal outcomes.

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Conflict of Interest

The authors declared no conflict of interest.

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