Original Research

The Relationship between Snoring and Preeclampsia: A Case-Control Study

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Abstract

Background and Objective: The prevalence of snoring and sleepiness increases during pregnancy and affects maternal health and pregnancy outcomes. Therefore, this study was conducted to assess the association between snoring during pregnancy and the risk of preeclampsia.

Materials and Methods: This case-control study was performed among150 pregnant women with preeclampsia and 150 healthy women referred to health centers and academic hospitals of Mashhad, Iran. Data collection tools included the information form regarding demographic characteristics, clinical signs, and laboratory findings. To evaluate snoring and its severity, the related question in Pittsburgh Sleep Quality Index (PSQI) was applied. Statistical analysis of data was performed by independent t-test, Mann-Whitney, chi-square test, and logistic regression model.

Results: There was significant association between snoring and preeclampsia ($P < 0.001$), so that the mean and standard deviation (SD) of snoring (Likert Scale of 0-3) in patients with preeclampsia was 0.6 ± 1.1, and in non-preeclamptic women was 0.4 ± 0.9. The chance of preeclampsia in women with snoring was 1.73 times more than those without snoring [Odds ratio (OR) = 1.73, confidence interval (CI) 95%: 1.29-2.25].

Conclusion: Snoring is a predicting factor of preeclampsia. Thus, midwives and health workers' attention during pregnancy is recommended.

Keywords: Preeclampsia; Pregnancy; Snoring

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Introduction

Preeclampsia is a pregnancy-related syndrome which causes malfunction of the cardiovascular, hematologic, endocrine, and central nervous system (CNS) in mother. The most important threats to the fetus is caused by decreased uterine and placental blood flow that leads to olygohydramnios, intrauterine growth retardation (IUGR), placental abruption, fetal distress, and fetal death (1). Preeclampsia most commonly occurs at 28-32 weeks of gestation, and about 70 to 85 percent of cases occur in young nulliparous women (2). Prenatal mortality in severe preeclampsia is about 15% and can reach to 60% in cases of eclampsia and hemolysis, elevated liver enzymes, low platelet count (HELLP) syndrome (3).

Several hypotheses such as oxidative stress, vascular endothelial cells dysfunction, inflammation and angiogenesis have been suggested regarding preeclampsia. In addition, factors such as lifestyle, emotional stress, and sleep respiratory disorders may involve in preeclampsia (4-6).

Respiratory disorders lead to periods of hypoxia resulting in oxidative stress and consequently activation of inflammation pathways. There is evidence that inflammation and oxidative stress increase during pregnancy (7). Studies have shown that oxidative stress can cause damage to vascular wall which is seen in pregnant women with preeclampsia (8).

In the study of Gislason et al., snoring was

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significantly associated with high blood pressure in old women (9). Moreover, Loube et al. reported that snoring increases during pregnancy (10). Snoring can be a symptom of increased upper airway resistance. It is a common complaint in patients with obstructive sleep apnea (OSA), a condition which is associated with systemic hypertension and coronary artery disease (CAD). Increased sympathetic nervous system activity during sleep is one of the probable causes of hypertension in patients with sleep apnea. According to the study of Ursavas et al., snoring is a risk factor for pregnancy hypertension, but is not associated with preeclampsia (11). Houyez et al. also showed a significant association between systolic blood pressure and snoring (12), while in the study of Ayrim et al., no association was found between snoring and gestational hypertension (13). In prospective studies conducted by O'Brien et al. (6), Edwards et al. (14), Lee and Caughey (15), Franklin et al. (16), and Izci et al. (17), related breathing problem such as snoring was independently related to gestational hypertension and preeclampsia.

Given the conflicting results associated with snoring and hypertension and also limited studies examining snoring and preeclampsia, the researchers aimed to conduct a study to determine the relationship between self-report snoring and preeclampsia.

Materials and Methods

This case-control study after approval by the Research Ethics Committee of Mashhad University of Medical Sciences, Mashhad, Iran, was performed on 300 pregnant women (150 women with preeclampsia and 150 women without preeclampsia) referred to 12 health centers and 3 academic hospitals of Mashhad City in 2014. The sample size based on a pilot study with confidence coefficient of 95% and power of 80 using the formula of ratios comparison was calculated as 133 cases that increased to 150 women in each group.

Considering the sample loss of 10%, 150 participants were determined for each group. Inclusion criteria included: gestational age of 28 to 40 weeks, age > 18 and < 35 years, singleton pregnancy, no speech, hearing, or mental problems, lack of medical diseases and midwifery problems, body mass index (BMI) < 29, and no stressful events during 6 months ago.

Exclusion criteria included: withdrawal from participation in the study, and use of antihypertensive drugs in the control group. Data were collected using a form for demographic and preeclampsia characteristics. To assess snoring, the question relating to this issue in Pittsburgh Sleep Quality Index (PSQI) was used. Reliability of the tools was confirmed with Cronbach's alpha coefficient of 0.70 (for PSQI). In this questionnaire, various indicators including snoring in the last 4 weeks is answered and its severity is scored from 0 to 3 (18).

The researcher after her introduction explained the objectives and methods of the study, consent form was obtained from the participants and the interviewer completed the questionnaires. The validity of questionnaires was confirmed using content validity.

According to the views of 10 experts, the validity of demographic information form and clinical and laboratory signs of preeclampsia was determined by content validity.

In the control group, at first among 12 health centers, the centers numbered 1, 2, 3, and 12 were randomly selected. Then, proportional to population of the centers, all pregnant women with no preeclampsia, and gestational age of 28 to 40 weeks referred for prenatal care who met inclusion criteria entered the study by convenience sampling method.

In the case group, pregnant women with gestational age of 28 to 40 weeks who were hospitalized in the maternity and midwifery wards of 3 academic hospitals with preeclampsia were included by convenience sampling method. The diagnosis of preeclampsia was confirmed by gynecologist based on systolic blood pressure ≥ 140 mm Hg or diastolic blood pressure ≥ 90 mm Hg along with urinary protein excretion of more than 300 mg in 24-hour urine or ≥ +1 in the urine test strip.

The case and control groups were matched for age, parity, and gestational age. Statistical analysis of data was performed by SPSS software (version 16, SPSS Inc., Chicago, IL, USA). Mann-Whitney test was applied to compare the non-normal quantitative means in two groups with and without preeclampsia; chi-square test was used to compare the qualitative variables between the two groups; independent t-test was used to compare the mean of quantitative variables with normal distribution, and two way analysis of variance (two way ANOVA) was used to assess mean blood pressure between two groups according to snoring score. $P < 0.05$ was considered significant.

Table 1. Distribution of subjects based on maternal age, body mass index (BMI), mother's job, number of delivery, gestational age, hypertension status in preeclampsia and control groups

Variable		Group				Total		P-value
		Preeclampsia		Control				
		N (150)	% (100)	N (150)	% (100)	N (300)	% (100)	
Maternal age (year)	18-20	15	10.00	12	8.00	27	9.00	
	21-25	40	26.70	32	21.30	72	24.00	
	26-30	37	24.70	51	34.00	88	29.30	
	31-35	58	38.70	55	36.70	113	37.70	0.317
	19.8	14	9.30	14	8.00	26	8.70	
BMI (kg/m^2)	19.8-26	95	63.30	7.0	46.70	165	55.00	
	26.1-29.9	41	27.30	68	45.30	109	36.30	0.002
Mother's job	Housewife	141	94.00	144	96.00	285	95.00	
	Employee	7	4.70	4	2.70	11	3.70	
	Student	2	1.30	2	1.30	4	1.30	0.654
Number of delivery	0	52	7.34	63	0.42	115	3.38	
	1	47	3.31	52	7.34	99	0.33	
	≤ 2	51	0.34	35	3.23	86	7.28	0.118
Gestational age (week)	28-30	29	3.19	36	0.24	65	7.21	
	31-34	۳۵	3.23	40	7.26	75	0.25	
	35-37	32	3.21	36	0.24	68	7.22	
	38-40	54	0.36	38	3.25	92	7.30	0.052
Systolic hypertension (mmHg)		Mean ± SD		Mean ± SD				< 0.001
Diastolic hypertension (mmHg)		151.0 ± 17.0		102.0 ± 7.0				< 0.001
		96.0 ± 11.0		62.0 ± 5.1				

BMI: Body mass index

Results

Two groups were matched in terms of age (P = 0.310), parity (P = 0.118), employment state (P = 0.827), and gestational age. So that, mean and standard deviation (SD) of maternal age in the case group were 28.8 ± 5.4 years and in the control group were 27.5 ± 4.9 years. Fifty one (34%) of case group and 57 (38%) of control group were nulliparous. A total of 141 patients (94%) of case group and 164 (96%) of control group were housewives (Table 1).

Regarding snoring score per week, two groups were significantly different in the frequency of snoring score (P = 0.001) (Table 2). The mean and SD of snoring score in patients with preeclampsia were 0.6 ± 1.1 and in non-preeclamptic group were 0.4 ± 0.9, which shows a significant difference between two groups (P < 0.001).

According to the results of two-way ANOVA, the mean systolic blood pressure had significant difference according to the group and severity of snoring. The group and severity of snoring had a significant effect on systolic blood pressure (P < 0.001 and P < 0.001, respectively). There was also a significant mutual effect between these two variables on systolic blood pressure (P < 0.001) (Table 3).

According to the results of two-way ANOVA, the mean diastolic blood pressure had significant difference according to the group and severity of snoring. The group and severity of snoring had a significant effect on diastolic blood pressure (P < 0.001 and P < 0.001, respectively). There was also a significant mutual effect between these two variables on diastolic blood pressure (P < 0.001) (Table 4).

Logistic regression model was applied to determine the simultaneous association between history of abortion, BMI, hemoglobin at second trimester, and snoring with preeclampsia.

Table 2. Distribution of subjects according to snoring score per week in two groups

Snoring per week	Groups				Total		Fisher test
	Case		Control				
	N	%	N	%	N	%	
Never (0)	108	72.0	132	88.0	240	80.0	0.001
Less than once (1)	6	4.0	8	5.3	14	4.7	
Once or twice (2)	12	8.0	4	2.7	16	5.3	
Three or more (3)	24	16.0	6	4.0	30	10.0	

Table 3. Mean and standard deviation (SD) of systolic blood pressure in terms of severity of snoring in two groups of case and control

Severity of snoring per week	Group			
	Case		Control	
	Mean ± SD	N	Mean ± SD	N
Never	151 ±15	108	7.1 ± 102.0	132
< Once	152 ± 15	6	8.0 ± 104.0	8
Once or twice	155 ±22	12	102.0 ± 10.0	4
Three or more	151 ± 22	24	102.0 ± 11.0	6
Total	151± 17	150	102.0 ± 7.0	150
		F	df	P-value
Result of two-way analysis of variance	Total effect	15771.0	1	< 0.001
Group effect		711.0	1	<0.001
Effect of snoring severity		1.0	1	<0.001
Mutual effect		0.0	1	<0.001

SD: Standard deviation; df: Degree of freedom

The results of model showed that BMI, hemoglobin level at second trimester, and snoring were significantly related to preeclampsia. The chance of preeclampsia increased 1.7 times for every one unit increase in snoring score (Table 5).

Discussion

In this study, snoring was shown to be associated with preeclampsia. The findings showed that 28% of patients with preeclampsia and 12% in non-preeclamptic group had self-reported snoring. The odds ratio (OR) for preeclamptics having snoring was 1.73 times [OR = 1.73, confidence interval (CI) 95%: 1.29-2.25], higher than those in the control group.

In the study by Franklin et al., snoring increased during pregnancy (P = 0.001) and it was a risk factor with an OR of 2.03 for high blood pressure (16). In the study of Izci et al., 14-28 percent of pregnant women, 75% of whom with preeclampsia, compared with 4.14% of non-preeclamptic women had snoring in third trimester of pregnancy (17); the results were consistent with our study. The lower results of our study compared with the study of Izci et al. (17) is probably due to differences in study design and the difference in the tools of snoring measurement. The study of Izci et al. was a correlational study and sleep standard questionnaire was used for snoring (17); while our study was a case-control study and to evaluate snoring and its severity, the related questions in PSQI was applied.

Possible mechanisms of increased snoring during pregnancy are enhanced airway resistance due to pharyngeal edema and weight gain, nasal congestion, and rhinitis due to increased estrogen.

In the studies of O'Brien et al. (6), Edwards et al. (14), Lee and Caughey (15), Franklin et al. (16), and Izci et al. (17), sleep-related respiratory disorders and snoring increased during pregnancy with increased risk of gestational hypertension and preeclampsia.

Table 4. Mean and standard deviation (SD) of diastolic blood pressure in terms of severity of snoring in two groups of case and control

Severity of snoring per week		Group			
		Case		Control	
		Mean ± SD	N	Mean ± SD	N
Never		0.00± 96.11	108	0.62 ± 5.00	132
< Once		0.00± 96.8	6	0.62 ± 4.00	8
Once or twice		0.00 ±96.10	12	0.62 ± 10.00	4
Three or more		0.00± 97.11	24	0.00± 62.40	6
Total		0.00 ±96.11	150	0.62 ± 5.10	150
		F	df	P-value	
Result of two-way analysis of variance	Total effect	20846.000	1	< 0.001	
	Group effect	948.000	1	< 0.001	
	Effect of snoring severity	0.000	1	< 0.001	
	Mutual effect	0.009	1	< 0.001	

SD: Standard deviation; df: Degree of freedom

Table 5. Determining the effect of confounding variables on the odds of exposure to risk factors in patients with preeclampsia, a regression model

Variables	P-value	OR	CI 95%
History of abortion	0.127	0.576	1.213-3.222
BMI*(26.1-29.9)	0.023	1.590	1.015-1.174
Hemoglobin level at second trimester	0.011	2.069	0.991-2.839
Snoring	0.001	1.739	1.290-2.250
Age (year)	0.997	1.000	0.952-1.051

BMI: Body mass index; CI: Confidence interval; OR: Odds ratio
* Pre-pregnancy (kg/m^2)

In the study by Loube et al., snoring increased as 14% in pregnant women more than non-pregnant women (10). In a similar study conducted by Franklin et al., on 502 pregnant women, 23% of women reported every night snoring (16). The increased prevalence of snoring during pregnancy is associated with sleep-related respiratory disorders, although the exact cause of sleep-related respiratory disorders during pregnancy is unknown.

In the study by Ursavas et al., snoring was a contributing factor for pregnancy-induced hypertension and not for preeclampsia (11). The findings of current study are inconsistent with the results of Ursavas et al. (11), and this difference may be due to differences in study design, sample size, and data collection tools. The probable cause of the difference between the results of this study and the present study may be the difference in the type of study, the research community, the inclusion and exclusion criteria, and data collection tool. In addition, high blood pressure was reported as one of the side findings; while in the present study, preeclampsia was the main research variable, and it was performed on 150 women with preeclampsia.

In the study by Houyez et al., conducted on 7901 workers of both sexes in Paris, France, no significant association was reported between systolic blood pressure and snoring (12). The difference of the results of that study with our study may be due to differences in study population, age, and criteria for diagnosis of hypertension.

In the study by Ayrim et al., which was performed on 200 pregnant women and 200 women in the control group, no significant relationship was found between snoring and gestational hypertension (13); these findings are not consistent with our study that may be due to differences in study design, sampling time, the difference in the tools used for snoring measurement and differences in study population.

The present study was a case-control study which was performed on pregnant women with gestational age of 28-40 weeks. The risk factors for preeclampsia were considered as exclusion criteria of the study. In this study, as the study of Ursavas et al. (11), hypertension was reported as one of the side findings; while in the present study, preeclampsia is considered as the main research variable.

In the prospective studies of O'Brien et al (6), Edwards et al. (14), and Lee and Caughey (15), sleep-related breathing disorder and sleep respiratory disorders such as snoring are independently related with gestational hypertension and preeclampsia. Respiratory disorders lead to periods of hypoxia and lack of oxygen that cause oxidative stress and activation of inflammatory pathways. There is evidence which shows that inflammation and oxidative stress increases during pregnancy (19). Studies have demonstrated that oxidative stress can cause damage to vascular wall which is seen in preeclampsia (20).

The limitation of this study was using self-report tools to assess snoring, and only the scores which were obtained from the question related to the problem in Sleep Quality Index determined the possibility that these people are at risk for poor quality sleep.

Conclusion

Snoring is associated with preeclampsia. Therefore, screening at childbearing age, especially during pregnancy in women who have snoring is recommended.

Conflict of Interests

Authors have no conflict of interests.

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