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Habitual Snoring and Asthma Comorbidity Among Pregnant Women

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Abstract

Background—Obstructive sleep apnea (OSA) or habitual snoring and asthma are known comorbid conditions in men and non-pregnant women. This comorbidity has not been evaluated among pregnant women. We assessed the habitual snoring-asthma relationship among pregnant women.

Methods—A cohort of women (N=1,335) were interviewed during pregnancy, and we ascertained participants' asthma status and collected information about habitual snoring, before and during pregnancy. Logistic regression procedures were used to estimate odds ratios (ORs) and 95% confidence intervals (CIs).

Results—Compared with non-asthmatics, the adjusted OR among asthmatics for snoring before pregnancy was 2.13 (95%CI 1.10–4.12). The odds of snoring during early pregnancy was 1.79-fold (OR=1.79; 95%CI 1.07–3.01). Associations were more pronounced among overweight (≥ 25 kg/m²) asthmatics (OR=5.39; 95%CI 2.27–12.75).

Conclusions—We report a cross-sectional association of habitual snoring and asthma among pregnant women. If confirmed, pregnant asthmatics may benefit from more vigilant screening and management of OSA or habitual snoring during pregnancy.

Keywords

Asthma; Obstructive Sleep Apnea; Sleep Disordered Breathing; Habitual Snoring; Obesity; Pregnancy

INTRODUCTION

Obstructive sleep apnea (OSA), a common sleep-related breathing disorder with snoring as the cardinal symptom, is characterized by repetitive complete or partial occlusion of the upper airway during sleep despite continuing ventilatory effort (1,2). Snoring, which is produced by vibrations of the soft tissues, is a good marker for OSA (3). Obesity, (4)

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COMPETING INTERESTS

The authors declare that they have no competing interests.

pregnancy (5,6) and postmenopausal status (7,8) are well known risk factors of OSA. Asthma, an inflammatory disease of the lower respiratory tract, manifests as intermittent constriction of the bronchial airways with symptoms that are often exaggerated at night (9,10). Investigators have attributed the nocturnal deterioration of asthma symptoms to a number of factors, including alterations in the autonomic tone, changes in hormonal secretion, circadian changes in inflammatory cells and cytokines, and the possible role of acid reflux (9–11).

Hudgel and Shucard (12) and Catterall et al (13) were the first to publish reports documenting the co-occurrence of OSA and asthma; and to describe more frequent and severe hypoxemic episodes particularly during rapid eye movement (REM) sleep. These seminal observations have been corroborated and expanded upon by a large number of studies conducted in men, non-pregnant women, children and adolescents (10,14–17). Fitzpatrick et al, (14) in their community-based study of 1,478 British adults noted that asthmatics were more likely than their unaffected counterparts to report frequent snoring (*i.e.*, ≥ 4 nights a week) and excessive daytime sleepiness. The clinical and public health implications of observed OSA-asthma comorbidity has been underscored by results from studies which indicate that treatment for OSA improves asthma symptoms (18–20), and disease-specific quality of life (21). Collectively, available data indicate that OSA (or habitual snoring) and asthma is likely to have a bidirectional relationship in which each condition has the potential to exacerbate the other. On the basis of available epidemiological and clinical literature, the National Asthma Education and Prevention Program Expert Panel currently recommend evaluating OSA or habitual snoring as a potential contributor to poor asthma control (22).

Prior studies, however, have excluded pregnant women; hence very little is known about the co-occurrence of OSA and asthma in pregnancy. This gap in the literature is particularly troublesome since available evidence suggest: (1) markedly increased prevalence of sleep disordered breathing or snoring during pregnancy (5,23); and (2) increased risks of medical complications of pregnancy including gestational diabetes mellitus and preeclampsia among women who are habitual snorers during pregnancy (24–29). To the best of our knowledge no study has evaluated the co-occurrence of OSA and asthma among pregnant women. We assessed associations of maternal self-reported habitual snoring (a good marker for OSA(3)) before and during early pregnancy with maternal asthma diagnosis prior to pregnancy. We hypothesized that maternal habitual snoring before and during early pregnancy are positively associated with maternal history of asthma.

MATERIALS AND METHODS

Study population and setting

This analysis is based on data collected from a cohort of women attending prenatal care clinics (for routine prenatal care) affiliated with Swedish Medical Center in Seattle, Washington, USA. Eligible women started prenatal care before 20 weeks gestation, were 18 years of age or older, could speak and read English, and planned to carry the pregnancy to term and to deliver at the hospital. At between 8–19 weeks (mean and standard deviation: 16.3 ± 2.6) weeks gestation, participants reported sociodemographic, behavioral, and health characteristics in a structured interview. After delivery, study personnel abstracted data from participants' hospital labor and delivery medical records and clinic records. Between December 2003 and July 2006, 1,393 (83%) of 1,685 approached women consented to participate. We excluded 58 women who did not complete the interview. Thus, 1,335 women remained for analysis. All study procedures were approved by the Institutional Review Board of Swedish Medical Center. All participants provided written informed consent.

Data Collection

Interviewer-administered questionnaires were completed by participants in the analytical population at a mean gestational age of 16.3 weeks. Characteristics assessed using the questionnaire (i.e., self-administered) included maternal age, height, pre-pregnancy weight, reproductive and medical history including her history of asthma, and average nightly sleep duration (before and during early pregnancy). Maternal history of asthma diagnosis was determined by response to the questions “Has a doctor ever told you that you have asthma?” Sleep disordered breathing before and during pregnancy was assessed by asking women about the frequency of snoring during the index pregnancy. Specifically they were asked “Since becoming pregnant, when you are asleep, to the best of your knowledge, have you snored?” Responses were as follows: (i) all of the time, (ii) most of the time, (iii) some of the time, (iv) a little of the time, and (v) none of the time. From this information, we categorized participants as habitual snorers if they reported snoring most or all of the time; all other women were classified as non-snorers. The same question and categorization scheme was used to assess snoring during the year before pregnancy.

Statistical analytical methods

We compared the frequency distribution of sociodemographic, lifestyle, behavioral and medical history characteristics of participants according to whether or not they had received a physician diagnosis of asthma prior to the index pregnancy. All continuous variables are presented as mean \pm standard deviation (30). We used unadjusted and multivariable-adjusted logistic regression models to calculate odds ratios (ORs) and 95% confidence intervals (CIs) of the association between snoring and asthma. Separate models were fitted for snoring before and during pregnancy, respectively. In multivariable models, we adjusted for maternal age (continuous), parity (nulliparous, multiparous), and pre-pregnancy body mass index (continuous). Additional adjustment for the other covariates listed in Table 1 (including maternal cigarette smoking status or history of chronic hypertension) did not substantially change the effect estimates. We evaluated the isolated and joint effect of asthma history and pre-pregnancy overweight status on the odds of snoring before and during pregnancy. We classified women by the joint distribution of prior history of asthma diagnosis (no vs. yes) and pre-pregnancy overweight status (< 25 vs. ≥ 25 kg/m²) resulting in the following categories: lean non-asthmatics (reference); lean asthmatics; overweight non-asthmatics; and overweight asthmatics. All analyses were performed using Stata 9.0 statistical software (Stata, College Station, TX). All reported confidence intervals were calculated at the 95% level. All reported p-values are two-tailed and set at 0.05 levels.

RESULTS

Women with a prior history of physician diagnosed asthma were more likely to be younger, nulliparous, and to be overweight and obese when compared with women who did not have a history of asthma (Table 1). Other characteristics including marital status, annual household income, race/ethnicity, physical activity and multivitamin use during pregnancy were similar for women with and without a history of asthma. The frequency distribution of study subjects according to asthma and snoring status (before and during pregnancy) are summarized in Table 2. Women with a history of asthma were more likely to report snoring most or all of the time before (7.0% vs. 3.2%) and during pregnancy (11.0% vs. 6.4%), as compared with those with no asthma history. Women with a history of asthma were more likely to report habitual snoring before pregnancy (OR=2.32; 95% CI 1.23–4.40) than those without the history (Table 3). After adjusting for maternal age, parity, and pre-pregnancy body mass index, the association was slightly attenuated and remained statistically significant (adjusted OR=2.13; 95% CI 1.10–4.12). Asthmatics were also more likely to

report habitual snoring during pregnancy (adjusted OR=1.79; 95% CI 1.07–3.01), as compared with their non-asthmatic counterparts.

We evaluated the joint effect of asthma history and pre-pregnancy overweight status (Figure 1) and noted that overweight asthmatic had the highest odds of habitual snoring before and during pregnancy, respectively. Compared with lean non-asthmatics, the multivariable-adjusted OR among overweight asthmatics for snoring before pregnancy was 4.71 (adjusted OR=4.71; 95% CI 1.62–13.71). Similarly, overweight asthmatics had a 5.39-fold increased odds of snoring during pregnancy (adjusted OR=5.39; 95% CI 2.27–12.75), as compared with lean non-asthmatics.

DISCUSSION

Approximately 15% of the cohort reported having a medical diagnosis of asthma prior to the study pregnancy. Overall, asthmatics were more likely than non-asthmatics to report habitual snoring before and during pregnancy. The odds of habitual snoring were particularly elevated among overweight asthmatics. Overweight asthmatics had over a 4-fold increased odds of habitual snoring before (adjusted OR=4.71) and during (adjusted OR=5.39) as compared with lean non-asthmatics.

To the best of our knowledge, no epidemiological studies to date have examined the comorbidity of OSA and asthma among pregnant women. Nevertheless, several studies, generally conducted in men and non-pregnant women (10,14–17) and children (17) have examined the co-occurrence of OSA and asthma. Our results corroborate previous reports of increased prevalence of habitual snoring among asthmatics; and extend this literature to include observations of such associations among pregnant women. In a population-based, cross sectional study of 5,424 Swedish adults aged 20–69 years, Larsson et al (31) noted that 10.7% of participants reported snoring as a problem. After adjusting for age, gender and cigarette smoking the authors noted that asthmatics has a 1.62 increased odds of reporting snoring as a problem (OR=1.62; 95% CO 1.16–2.27). In a clinic based study (32) asthmatics were more likely to report frequent snoring (18.5% vs. 8.0%, $p<0.001$) than primary care general internal medicine patients. However, there was no clear evidence of a higher prevalence of snoring or other symptoms of OSA among asthmatics versus the primary care patient comparison group. In another clinic-based study, Teodorescu and et al (10), reported that asthmatic women had a 2-fold greater odds of prevalent OSA (95% CI 1.1–4.1) than men. The authors also noted that the odds of OSA increased with the dose of inhaled corticosteroids (ICSs), a likely surrogate marker of asthma severity. The odds of self-reported habitual snoring were increased 1.11-fold with low-dose ICSs (OR= 1.11; 95% CI 0.31–4.03), 2.59-fold with medium-dose use (OR=2.59; 95% CI 0.96–6.97), and 3.67-fold (OR=3.67; 95% CI 1.34–10.01) with high-dose use (p -for trend=0.004). Results from the Busselton Health Survey (33), a longitudinal study designed to assess risk factors for the incident habitual snoring in Australian adults aged 25–74 years. The authors noted that asthmatics were 2.8-times more likely (OR=2.8; 95% CI 1.4–5.6), than non-asthmatics to begin snoring during the 14-year follow-up period. Finally, results from small clinical studies using polysomnography to objectively assess OSA symptoms revealed higher frequencies of OSA in asthmatics, particularly those patients with difficult-to-control asthma (34). For example, Yigla et al (34), using the respiratory disturbance index (RDI) of ≥ 5 to define OSA, the RDI values were significantly higher in the continuous oral corticosteroid therapy subgroup (21.4 ± 3.4 vs. 11.1 ± 1.6 , $p<0.05$). On balance, evidence from diverse study populations, and research designs document cross-sectional associations between snoring and asthma; and evidence from a longitudinal study suggest that asthma may be an independent risk factor for the development of snoring and suggests that the associations may be causal (33).

The biological mechanisms underlying observed OSA-asthma associations are yet to be fully elucidated. However, investigators have proposed several plausible and compelling hypotheses by which asthma could lead to the development or worsening of OSA (10,34–36). Asthma could deleteriously impact the patency of the upper airway. Frequent nocturnal asthma attacks may result in sleep deprivation and fragmentation of sleep that could lead to increased upper airway collapsibility during sleep (36,37). Some investigators (38,39) have noted that reduction in lung volume during sleep, particularly during REM sleep; and systemic inflammation-related weakening of respiratory muscles (40,41) may account for observed associations. Nasal congestion or the presence of nasal polyps, common in asthmatics, is also thought to lead to increased nasal resistance or obstruction resulting in respiratory disturbances in sleep (40). Recent data reporting a very high prevalence of OSA in a small group of severe asthmatic patients on chronic or intermittent systemic steroids suggests that the use of systemic steroids may increase upper airway collapsibility (34). The observed dose-dependent relationships of ICSs and OSA symptoms (10) may reflect a relationship of asthma severity with OSA, with ICS doses as a mere surrogate of asthma severity.

Several limitations of our study merit discussion and consideration. First, maternal asthma status was based on self-reports made during interviews and on medical records review. Although the questions we used to ascertain maternal asthma status have been widely used in National Health and Nutrition Examination Surveys (NHANES) and other large epidemiological studies (42), and investigators have documented good agreement between asthma classification based on self-reports with information derived from medical records review (43,44), we cannot exclude the possibility of that asthma status was underreported or over reported in our study. Second, maternal habitual snoring before and during pregnancy was obtained from self-report, and thus is likely susceptible to misclassification. However, we note that the use of self-reported snoring as a tool to detect OSA and its symptoms is well established. Investigators have shown that self-reported snoring correlates well with objective findings from nocturnal polysomnography, especially in frequent snorers. Snoring that is infrequent or non-habitual has not been shown to be a useful screen for sleep disordered breathing in large epidemiologic studies (30,45). It was therefore necessary, as we have done in our analysis, to distinguish frequent snorers from infrequent snorers in our study. Lastly, the generalizability of our study may also be limited as our cohort was primarily comprised of Non-Hispanic White and well-educated women. The concordance of our results with those from other studies that have included racially, ethnically and geographically diverse populations, however, serve to attenuate these concerns.

In summary, we found increased odds of habitual snoring before and during pregnancy among pregnant asthmatics as compared with their non-asthmatic counterparts. Observed associations were particularly strong among overweight asthmatics. Despite noted study limitations, our results among pregnant women are consistent with a larger body of work documenting associations between OSA and asthma among men, non-pregnant women and children. Large well designed prospective cohort studies that allow for the comprehensive examination of OSA-asthma comorbidity among pregnant women are warranted. Such studies should include objective assessments of the full spectrum of OSA symptoms and should include comprehensive assessments of environmental, behavioral, and genetic risk factors of asthma and OSA. Enhanced understanding of the epidemiology and shared pathophysiological mechanisms of OSA and asthma are expected to provide important information needed for enhancing the diagnosis and treatment of these disorders in pregnant women.

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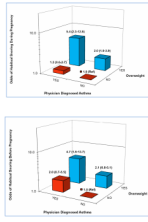


Figure 1.

Adjusted odds ratio (OR) of habitual snoring before pregnancy (a) and during pregnancy (b) according to maternal history of physician diagnosed asthma (yes vs. no) and maternal pre-pregnancy overweight status (<25kg/m² vs. ≥25kg/m²). Reported ORs and (95% confidence intervals (CIs) were adjusted for maternal age, race/ethnicity, and parity

Table 1

Characteristics of the study population according to asthma status, Seattle, Washington, USA, 2003–2006

Characteristics	Physician Diagnosed Asthma		*P-value
	Yes N=200	No N=1,135	
Maternal Age (years)	32.8 ± 4.7	33.4 ± 4.4	0.08
<30	24.5	17.4	0.08
30–34	38.5	42.2	
35–39	31.5	32.4	
≥40	5.5	8.0	
Non-Hispanic white race/ethnicity	13.0	12.1	0.71
Annual household income (US\$)			
<30,000	4.0	1.6	0.10
30,000–69,999	12.0	14.2	
≥ 70,000	78.5	79.8	
Missing	5.5	4.4	
Nulliparous	69.0	57.9	0.003
Parity			
....0	69.0	57.9	0.01
....1	24.5	33.8	
....2+	6.5	8.2	
Education ≤ high school	3.5	2.7	0.55
Unmarried	9.5	8.1	0.51
Pre-gestational diabetes mellitus	2.0	1.1	0.26
Pre-gestational chronic hypertension	4.0	4.1	0.97
Migraine	23.5	18.7	0.11
Mood/anxiety disorders	10.0	6.9	0.12
Family history of diabetes mellitus	14.0	14.6	0.82
Family history of hypertension	50.5	50.3	0.96
Employed during pregnancy	83.0	77.9	0.10
Smoked during pregnancy	3.0	5.5	0.14
No prenatal vitamin	3.0	2.5	0.66
No exercise during pregnancy	5.0	7.8	0.17
Multifetal pregnancy	2.5	3.4	0.49
Pre-pregnancy body mass index (kg/m ²)*	24.6 ± 5.3	23.4 ± 4.5	<0.001
Normal (18.5–24.9)	68.0	70.2	0.02
Lean (<18.5)	1.0	5.2	
Overweight (25–29.9)	20.5	17.5	
Obese (≥30)	10.5	7.1	

Mean ± standard deviation (30)

* P-value from Student t test for continuous variable or from Chi-square test for categorical variables

Table 2

Sleep disordered breathing reported by pregnant women with and without a medical history of asthma, Seattle, Washington, USA, 2003–2006

	<u>Physician Diagnosed Asthma</u>		*P-value
	Yes N=200	No N=1,135	
Sleep Disordered Breathing	%	%	
Snoring before pregnancy			
Never	59.5	63.0	0.05*
A little of the time	17.5	20.3	
Some of the time	14.0	12.5	
Most or all the time	7.0	3.2	
Missing	2.0	1.0	
Snoring during pregnancy			
Never	54.5	57.8	0.01*
A little of the time	17.5	18.3	
Some of the time	12.0	15.4	
Most or all the time	11.0	6.4	
Missing	5.0	2.0	

* P-value from Chi-square test for categorical variables

Table 3

Odds ratios (OR) and 95% confidence intervals (CI) of habitual snoring before and during pregnancy according to maternal history of asthma, Seattle, Washington, USA, 2003–2006

Maternal Snoring	Asthma Diagnosis		Unadjusted OR (95% CI)	Adjusted* OR (95% CI)
	Yes N=200	No N=1,135		
	%	%		
Habitual Snoring Before Pregnancy				
No	91.0	95.9	1.00 (Reference)	1.00 (Reference)
Yes	7.0	3.2	2.32 (1.23–4.40)	2.13 (1.10–4.12)
Habitual Snoring During Pregnancy				
No	84.0	91.5	1.00 (Reference)	1.00 (Reference)
Yes	11.0	6.4	1.86 (1.13–3.08)	1.79 (1.07–3.01)

* Adjusted for maternal age (continuous), parity (categorical), and pre-pregnancy body mass index (continuous) Column percentages do not add up to 100% due to missing values