

Comparison of Self- and Spouse Reports of Snoring and Other Symptoms Associated with Sleep Apnea Syndrome

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Summary: We compared self- and spouse reports of snoring and other symptoms of sleep apnea syndrome ascertained from married couples in a community-based survey. Agreement between the two types of report varied between 70–98%, but was modest ($\kappa = -0.01-0.52$) when adjusted for chance. For men, spouse reports yielded higher prevalence rates for snoring and for four other symptoms. For women, estimates of symptom prevalence were consistently lower by spouse report than by self-report. In multivariate analyses, the effect on snoring of gender and obesity increased and of age decreased when spouse reports were compared to self-reports. Snoring, according to spouse reports, was a significant risk factor for ischemic heart disease, but snoring according to self-reports showed a smaller effect and was not statistically significant. Snoring was not associated with hypertension when defined by either self- or spouse report. These observations suggest that questionnaire data of snoring and other symptoms of sleep apnea syndrome may be misclassified in part, and that such misclassification can affect estimates of prevalence and effects. **Key Words:** Snoring—Sleep apnea syndromes—Epidemiologic methods—Hypertension—Cardiovascular diseases.

The assessment of snoring and other symptoms of sleep apnea by self-report is potentially limited because persons may be unaware of their behavior during sleep. During a clinical interview, the patient's symptoms may be verified by the spouse. In epidemiologic studies, reports of snoring have usually been ascertained from questionnaires administered to the subject (1–7). The validity of such reports is a major issue in the interpretation of these studies (8). Two studies have examined the relationship of subjective reports of snoring to objective measures (6,9). The comparability of self- and spouse reports of snoring and other symptoms has not been adequately evaluated.

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We investigated snoring and other symptoms associated with sleep apnea syndrome in a community-based survey of Hispanics in New Mexico (10). Married respondents reported their own symptoms as well as the symptoms of their spouses. In this article, we compare self- and spouse reports of snoring and other symptoms associated with sleep apnea syndrome. We describe the effect of the reporting source (self versus spouse) on estimates of symptom prevalence. We also examine the effect of the reporting source on associations between snoring, its risk factors, and cardiovascular disease.

MATERIALS AND METHODS

The data presented in this report were collected in a cross-sectional survey designed to characterize the prevalence of respiratory disease in a population of Hispanic New Mexicans. The survey was conducted in a small town near Albuquerque, New Mexico. A detailed discussion of the methodology was published elsewhere (11). Of 1,778 adults eligible for the study, 1,278 (71.9%) participated. Of these, 720 were married and provided reports of their spouse's sleep-related symptoms.

Married subjects reported their own as well as their spouse's symptoms. Interviewers questioned subjects and their spouses separately and did not allow them to confer before responding. To minimize the potential for interviewer-introduced bias, the questions and procedures for administering the questionnaires were standardized. Reports of snoring were based on the frequency of "loud snoring" during usual sleep. Other symptoms during sleep included choking or struggling for breath and frequent tossing and turning. Sleepiness was defined by reports of falling asleep after meals, while reading or watching television, when inactive in public places such as in church or school, when working at a place of employment, and as a passenger or driver of a moving vehicle. Respondents were asked to characterize the frequency of each symptom according to the following scheme: "always," occurring every or almost every night or day; "often," less than always but at least once a week; "infrequently," less than once a week; or "never," never during a usual night or day. Additional questions investigated smoking history, current use of high blood pressure medication, and the respondent's history of physician-diagnosed myocardial infarction or angina.

Physical measurements made in the home included blood pressure, weight, and height. Blood pressure was measured with a mercury sphygmomanometer (Baumanometer, W.A. Baum Company, Inc., New York, NY, U.S.A.) according to guidelines established by the American Heart Association (12). A series of three readings was recorded from the right arm after the participant had been seated for 5 min. Diastolic pressures were measured at the fourth Korotkoff sound. Weight was measured with a commercially available bathroom scale while the subject was clothed but not wearing shoes. Standing height without shoes was measured to the nearest inch with a measuring tape applied to a wall.

Unless otherwise specified, responses of "always" and "often" constitute a positive response and "infrequently" and "never" constitute a negative response. For each item, agreement between self- and spouse reports was expressed as the percentage of all subjects. Agreement was also assessed with the kappa statistic, which corrects for agreement by chance (13,14).

Previous analyses of data from this survey showed that age, body mass index (kilograms per square meter), gender, and smoking history were predictors of snoring (10).

In this study, multiple logistic regression was used to assess separately the predictors of self- and spouse reports of snoring. Independent predictors of snoring included in the regression model were age at time of interview, body mass index, gender, and smoking status.

We also used multiple logistic regression to examine the relationships of self- and spouse reports of snoring with hypertension and ischemic heart disease. In these analyses, the presence of hypertension or of ischemic heart disease was the dependent variable, and snoring, age, gender, body mass index, and smoking history were the independent variables. Subjects were classified as hypertensive if the systolic blood pressure was 140 mm Hg or greater, if the diastolic blood pressure was at least 95 mm Hg, or if they reported taking an antihypertensive medication at the interview (15). Respondents were considered to have ischemic heart disease if they reported a physician-diagnosed myocardial infarction or angina. The separate regression analyses for ischemic heart disease and hypertension were performed twice, with the snoring variable based on self-report and on spouse report.

All analyses were performed with standard packages from the Statistical Analysis System (16-18).

RESULTS

This analysis included 360 husband-wife pairs. Table 1 shows selected characteristics of the sample.

According to self-reports, 34% of men and 18% of women snored (Table 2). The prevalence of the other symptoms by self-report ranged from 1.3 to 27.3%. The prevalence of self-reported symptoms varied by gender in four of the nine items: men more frequently reported loud snoring, falling asleep after a meal, and falling asleep at work; women more frequently reported falling asleep as a passenger in a moving vehicle.

Prevalence estimates for snoring and other symptoms varied by reporting source (Table 2). For women, estimates of symptom prevalence were consistently lower by spouse report than by self-report, although the differences were small. For men, spouse reports yielded higher prevalence rates than self-reports for snoring and four other

TABLE 1. Selected characteristics of participants in a survey of a New Mexico community, 1984-5

	Men, % (n = 360)	Women, % (n = 360)
Age group (yr)		
< 40	43.1	50.0
40-64	40.8	38.1
≥ 65	16.1	11.9
Body mass index (kg/m ²)		
< 27.0	59.4	67.6
27.0-29.9	24.1	15.1
30.0-31.9	6.8	6.2
≥ 32.0	9.7	11.1
Smoking status		
never smoked	40.8	63.3
exsmoker	28.6	12.5
current smoker	30.6	24.2
Hypertension	25.4	23.5
Ischemic heart disease	6.9	4.7

TABLE 2. Prevalence of snoring and other symptoms of sleep apnea syndrome by gender of subject and source of report

	Men, %		Women, %	
	Self-report	Spouse report	Self-report	Spouse report
During usual sleep				
snore loudly	33.8	43.0	18.4	17.4
choke or struggle for breath	3.2	6.9	3.4	2.9
toss and turn frequently	23.9	21.6	25.9	13.3
Fall asleep				
after a meal	20.1	26.3	11.7	11.1
reading or watching television	24.6	35.0	27.3	20.1
at church or school	5.6	5.0	3.2	1.5
at work	3.0	1.2	1.3	0.6
as automobile passenger	8.0	11.7	15.7	16.2
as automobile driver	3.5	2.3	2.1	1.2

symptoms. The differences in prevalence rates between self- and spouse reports were greater for men than women.

The overall agreement between self- and spouse-reported symptoms was generally high (Table 3). The percentage agreement was highest for relatively low-prevalence symptoms and was lower for more common symptoms. However, the kappa statistic shows that when adjusted for chance, agreement between self- and spouse reports was modest at best. For snoring, we examined the effects of gender on agreement and disagreement in greater detail (Table 4). For discordant responses, there was a difference between men and women. Women were much more likely to provide a report of snoring for spouses who reported themselves to be nonsnorers.

To further assess the two sources of information on snoring, we examined predictors of snoring in two separate logistic regression models (Table 5). Age, body mass index, gender, and smoking status were the most important predictors of snoring in a logistic model with self-reported loud snoring as the dependent variable. When spouse reports of loud snoring were used as the dependent variable in the same logistic model, the odds ratios for body mass index, gender, and smoking tended to shift upwards, and the effect of age was substantially reduced.

TABLE 3. Agreement between self- and spouse reports of snoring and other symptoms of sleep apnea syndrome by gender of subject

	Men		Women	
	Agreement, %	Kappa ^a	Agreement, %	Kappa
During usual sleep				
snore loudly	70.9	0.39	85.4	0.52
choke or struggle for breath	91.9	0.15	96.1	0.36
toss and turn frequently	75.2	0.30	72.9	0.18
Fall asleep				
after a meal	79.0	0.41	86.4	0.33
reading or watching television	71.6	0.33	76.0	0.34
at church or school	90.8	0.12	96.7	0.25
at work	96.3	0.17	97.7	-0.01
as automobile passenger	87.5	0.27	83.0	0.37
as automobile driver	95.3	0.18	97.2	0.17

^a Kappa represents the percentage agreement after correcting for chance agreement. Fleiss (14) proposes the following interpretation of kappa: 0.75-1.00, excellent agreement; 0.40-0.74, good to fair agreement; -1.00-0.39, poor agreement.

TABLE 4. Analysis of snoring: agreement and disagreement by reporting source and gender of subject

Subjects	%			
	Agree, snores	Self, yes; spouse, no	Self, no; spouse, yes	Agree, does not snore
Men (327) ^a	24.1	9.8	19.3	46.8
Women (295) ^a	11.5	7.8	6.8	73.9

^a Number of respondents.

We also compared the effects of using self- and spouse reports of snoring in logistic models to predict hypertension and ischemic heart disease (Table 6). Hypertension was not associated with either self- or spouse reports of snoring, and the odds ratios for snoring were comparable for the two snoring variables. Ischemic heart disease was significantly associated with spouse reports of snoring; when self-reports were used, the effect of snoring was reduced and was not statistically significant.

In a separate set of analyses, we examined the effect of alternate definitions of snoring (Table 7). Although the percentage agreement and kappa statistic varied somewhat by definition of snoring, chance-adjusted agreement between self- and spouse reports remained modest. The results from logistic models based on alternate definitions of snoring were similar to those described in Tables 5 and 6 (data not shown).

DISCUSSION

In recent years, sleep apnea syndrome has emerged as an important and prevalent clinical problem. Although symptoms are an important element of clinical diagnoses, the validity of reports by patients and their spouses has not been established. For epidemiologic studies, the validity of snoring reports in questionnaires is a major issue (8). We lack an independent standard against which to establish the relative validity of

TABLE 5. Results of multiple logistic regression to assess predictors of snoring, by information source of snoring

Independent variables	Odds ratio ^a	
	Self-report	Spouse report
Age group (yr)		
< 40	1.0 —	1.0 —
40-64	2.4 (1.6-3.6)	1.4 (0.9-2.0)
> 65	1.6 (0.9-2.9)	1.0 (0.6-1.8)
Body mass index (kg/m ²)		
< 27.0	1.0 —	1.0 —
27.0-29.9	1.4 (0.9-2.2)	1.5 (1.0-2.4)
30.0-31.9	1.4 (0.7-2.9)	1.9 (1.0-3.9)
> 32.0	3.0 (1.7-5.5)	3.7 (2.1-6.5)
Gender		
female	1.0 —	1.0 —
male	2.2 (1.4-3.2)	3.4 (2.3-5.0)
Smoking status		
never smoked	1.0 —	1.0 —
exsmoker	1.2 (0.7-2.0)	1.6 (1.0-2.6)
current smoker	2.2 (1.4-3.4)	2.3 (1.5-3.6)

^a 95% confidence interval in parentheses.

TABLE 6. Results of multiple logistic regression to assess self- and spouse reports of snoring as predictors of hypertension and ischemic heart disease

Independent variables ^a	Odds ratio ^b , dependent variables	
	Hypertension	Ischemic heart disease
Self-reported snoring	0.8 (0.5-1.3)	1.4 (0.6-2.8)
Spouse-reported snoring	0.9 (0.6-1.4)	2.1 (1.0-4.4)

^a Other independent variables in the multiple logistic regression model included age, body mass index, gender, and smoking status.

^b 95% confidence interval in parentheses.

self- and spouse reports. Nevertheless, a high degree of concordance between the two data sources would support the validity of self-reported symptoms.

The independence of self- and spouse-reported observations is a key consideration in the interpretation of these data. The questions of snoring and other sleep-related symptoms were phrased, "During your usual sleep, have you noticed or have you been told that you do the following." It is likely that the self- and spouse reports of symptoms are related since many persons may learn about snoring or other symptoms from their spouses. Concern may be raised that the interview itself somehow influenced the responses of the husband-wife pair. Although respondents were, to the extent possible, "blind" to the responses given by their spouses, those conducting the interview were not "blind" to the responses of the husband-wife pair. In designing the study, we standardized the questions and procedures for administering the questionnaires to minimize the potential for interviewer-introduced bias. We doubt that the interview of the spouse influenced the self-report and therefore consider that self-reports of snoring carry the same significance in this as in other studies (1-6).

The discrepancies between self- and spouse reports have implications for the clinical diagnosis of sleep apnea syndrome and for conducting epidemiological investigations of this disorder. Clinicians have recognized that patient- and spouse-derived histories of sleep-related symptoms often differ (19). Our data provide a measure of the extent of this disagreement. In view of the inevitable link between self- and spouse reports, the extent of discordance is remarkable. Because we are not able to determine which type of report has greater validity, we recommend that spouses be routinely queried concerning the sleep-related symptoms of their mates.

The modest agreement between the two sources of information (Tables 3 and 7) implies that questionnaire responses in epidemiological studies may misclassify the symptom status of the subjects. The consequences of misclassification of exposure and

TABLE 7. Agreement between self- and spouse reports of snoring for alternate definitions of snoring

	Men		Women	
	Agreement, %	Kappa ^a	Agreement, %	Kappa
Frequency of snoring				
always or often vs infrequently or never	70.9	0.39	85.4	0.52
always vs infrequently or never	85.6	0.54	95.4	0.62
always vs often, infrequently, or never	85.9	0.44	91.9	0.41
ever vs never	79.2	0.47	72.9	0.46

^a See Table 3 footnote for definition.

disease variables have been described (20). Random misclassification, as anticipated for self- and spouse reports of snoring and other symptoms, may reduce the magnitude of associations between risk factors and the disease of interest. Thus, the greater effect of body mass index on spouse-reported in comparison with self-reported snoring implies less misclassification of the spouse-reported outcome variable. Similarly, in predicting the presence of ischemic heart disease, the odds ratio for spouse-reported snoring was higher than for self-reported snoring.

Our analysis of discordant responses indicates either a tendency of men to underestimate their own or women to overestimate their spouses' snoring (Table 4). Our data do not allow us to distinguish between these alternatives, but a priori we think the listener is more likely than the sleeping subject to provide a valid report. Thus, self-reports of snoring may be biased by gender with more frequent misclassification in self-reports of men. This bias may account for the greater effect of gender on snoring and also of snoring on ischemic heart disease when spouse reports are used in these analyses.

Waller and Bhopal (8) have suggested that different information sources in different studies may partially explain the inconsistent evidence on associations of snoring with various vascular diseases. Our findings demonstrate that the sources of information on snoring and other sleep-related symptoms may affect the findings of epidemiological investigations. Because New Mexico Hispanics represent a unique cultural group, caution should be used in generalizing the results of this study to other populations. We support recommendations (8) for standardized questionnaires for measuring snoring and other symptoms of sleep for clinical and research purposes. The approach to standardization should specify the respondents. Research on self- and spouse reports with comparison to objective measurements is needed, however, to establish the most valid approach to collect information on snoring and other sleep-related symptoms.

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