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Prevalence of Symptoms and Risk of Sleep Apnea in Primary Care*

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Background: **To obtain prevalence estimates for key symptoms and features that can indicate the presence of obstructive sleep apnea (OSA) in a broad range of primary care settings.**
Design: **Cross-sectional survey.**
Setting: **Forty offices and clinics in the United States, Germany, and Spain.**
Participants: **Consecutive patients who were > 15 years of age, regardless of the reason for the visit.**
Measurements: **We collected demographic information, prevalence of self-reported chronic snoring, sleepiness, obesity (body mass index [BMI] > 30), hypertension, and calculation of OSA risk, and we also compared results between the United States and Europe.**
Results: **There was a 78% return rate for 8,000 surveys (mean age, 51 years; age range, 15 to 98 years; 52% women). One third of participants (32%) had a high pretest probability for OSA, with a higher rate in the United States (35.8% of 3,915 participants) than in Europe (26.3% of 2,308 participants; p < 0.001; age-matched and sex-adjusted odds ratio [OR], 1.37; 95% confidence interval [CI], 1.16 to 1.61). Sleepiness (32.4% vs 11.8%, respectively; p < 0.001) followed by obesity and/or hypertension (44.8% vs 37.1%, respectively; p < 0.01) contributed to the OSA risk difference between participants in the United States and Europe, as frequent snoring and breathing pauses were similarly reported (44%). A high pretest probability for OSA was more often present in men than in women (37.9% vs 27.8%, respectively; p < 0.005; OR, 1.96; CI, 1.59 to 2.88) and in those that were obese (*ie*, BMI, ≥ 30 kg/m^2), a condition that is generally more common in the US population than in the European population (27.9% vs 17.2%, respectively; p < 0.01).**
Conclusions: **Primary care physicians in the United States and Europe will encounter a high demand for services to confirm or manage sleep apnea, sleepiness, and obesity.**
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Key words: hypertension; obesity; questionnaire; sleep apnea; snoring

Abbreviations: BMI = body mass index; CI = confidence interval; OR = odds ratio; OSA = obstructive sleep apnea

Sleep-disordered breathing, in particular obstructive sleep apnea-hypopnea syndrome, is independently associated with car crashes involving drivers who fall asleep,[1] hypertension,[2] a 4-year risk of developing hypertension,[3] myocardial infarction,[4] and cardiovascular events of all causes.[5] Variations in the rates for obstructive sleep apnea-hypopnea syndrome depend on age, gender, and obesity.[6–8] The community prevalence of symptoms and/or signs of obstructive sleep apnea (OSA) vary by region[9] and by country.[10,11] For instance, in one state in the United States (*ie*, Wisconsin), an elevated apnea index along with symptoms were present in 2 to 4% of a middle-aged working population,[12] while in a similar population in Spain it was present in 0.8 to 2.2%.[13]

The recognition of and the demand for resources to manage sleep apnea begins with a patient report or physician questions about key symptoms and signs, including persistent snoring, sleepiness, and the presence of obesity and hypertension.[10,14] Most often this occurs in primary care offices. There is some evidence that the prevalence of OSA in primary care offices is higher than in the community.[15] For instance, among five Cleveland, OH, adult primary care offices, the prevalence rate for snoring, sleepiness, and a high pretest probability for OSA was approximately 30%.[16] This difference between community-based and clinic prevalence occurs because primary care practices are enriched for obesity, hypertension, and complaints like fatigue. Yet many primary care patients with signs and symptoms, or findings of sleep apnea in community surveys are undiagnosed.[9,16,17] All of these clinical prevalence reports were based on isolated US populations, and used different instruments and methods. A uniform collection of key symptoms in a wider spectrum of primary care practices would permit a more general idea of the needs for diagnostic planning or physician education in the management of sleep apnea, and of sleep disorders in general.

The purpose of this study was to perform a standardized survey of primary care outpatients from a diverse socioeconomic range of practice settings to elicit the frequency of symptoms and risk factors for sleep apnea, as well as a composite score for a high pretest probability for finding OSA. The design for the collection of data in both the United States and Europe also permitted analyses that might indicate geographic or cultural factors that affect the presentation and prevalence of such risk factors in primary care medicine.

Materials and Methods

The survey was conducted over a 2-year period (from 1997 to 1999) in 40 offices and clinics. Local Sleep in Primary Care Study Group members with expertise in pulmonary and sleep medicine identified one to two offices or clinics where a physician had practiced adult general medicine for ≥ 4 years (range, 4 to 12 years) and had handled 2,000 to 4,000 patient visits per year. These local experts explained the aim and procedures to the physicians and their staffs. Questionnaires were distributed in batches of 200 per study site. Twenty-six US sites (Midwest, 7 sites; eastern seaboard, 19 sites) and 14 European sites (Germany, 8 sites; Spain, 6 sites) participated in the study. There was a wide range of geographic, social, and ethnic profiles (data available on request).

The intention was that office staff would hand out copies of the questionnaire to consecutive patients ≥ 15 years of age who visited the physician for any reason. The patient was asked to complete the questionnaire in the office. Each site kept the original of the questionnaire and returned a copy of the responses (without patient identifiers) to the local study group specialist, who then sent the form for data entry (to Cleveland, OH). The practitioner could contact the local specialist to address questions or concerns about specific patients but was not obligated to do so. To be considered for analysis, questionnaires had to be dated within 3 weeks of distribution, and originals had to be returned to the local study group member within 1 month.

The instrument, called the Berlin Questionnaire, was developed in 1996, and its origin and use in primary care has been reported previously.[16,18] It is a self-report instrument that is focused on a set of known symptoms and clinical features associated with sleep apnea. One introductory question and four follow-up questions concerned snoring, witnessed apneas, and the frequency of such events. Three questions addressed daytime sleepiness, with a sub-question about drowsy driving. One question asked for a history of high BP. Patients were to provide information on age, weight, height, and sex. Body mass index (BMI) was calculated from the self-reported patient information on weight and height. Bilingual physicians translated the Berlin Questionnaire from its original English version into German and Spanish. Translations were performed from the other languages back into English by other bilingual physicians and were consistent with the intent of the original version.

Prior to its use in this study, the questionnaire was piloted to 20 bilingual patients in Germany and in Spain, who, after filling out the native language version, were also given the English version. Symptom attribution and risk grouping were similar. In addition, the reliability of self-reporting was tested in 142 subjects for age, height, weight, the presence or absence of hypertension, and the calculation of BMI for risk grouping. These self-reported data were compared to those from medical chart reports. There was a 99% concurrence in age within 1 year. In 99% of surveys, there was confirmation of the self-reported data on hypertension and a concurrence with the office chart (within 5%) for data on height (94%) and weight (93%). A 4% error also occurred in assignment to the BMI > 30-group, and a 1% error occurred in the assignment for risk grouping in the category for obesity/hypertension (*ie*, category 3, see below).

Risk grouping for high risk and lower risk for OSA were based on responses grouped into three categories. In category 1, a positive score for risk was defined as *frequent* symptoms (*ie*, "more than three to four times per week" or "almost every day") in the questions about snoring and witnessed apneas. In category 2, a positive score for risk was *frequent* symptoms in two or more questions about awakening sleepy, waketime sleepiness, and/or drowsy driving. In category 3, a positive score for risk was defined as a self-report of high BP and/or of height/weight information giving a BMI of > 30 kg/m^2. To score "high" for OSA, an individual's questionnaire must have had positive scores in two of the three categories, or in all three. Those patients who denied having symptoms with such frequency, who did not report symptoms to permit risk assessment (see "Results" section), or who qualified in only one category were placed into a lower risk group.[16,18]

The relationship of risk grouping for a high pretest probability was previously shown to have a positive predictive value of 89% and a likelihood ratio of 3.79 for a subsequent finding of a respiratory disturbance index > 5 on a sleep study.[16] The RDI of > 5 along with symptoms is the current threshold value for initiating therapy for sleep apnea.[18,19] In a study of 350 patients in Germany (RA-S; unpublished results) that was performed prior to this study, results were similar to those previously reported with regard to risk grouping and pretest probability for an apnea-hypopnea index of > 5 using the German version of the

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questionnaire. No testing against sleep studies was performed for the Spanish questionnaire prior to this study, but subsequent data suggest a positive predictive value of > 90% for an apnea-hypopnea index of > 5 in that population as well (RA-S; unpublished results).

Statistical Analysis

Data were entered into analysis files (SPSS, version 8.0 for Windows; SPSS, Inc; Chicago, IL). Files were transferred via secured Internet connection for analysis at the University of Ulm. Statistical evaluations were carried out using a statistical software package (SAS; SAS Institute; Cary, NC).

Frequency distributions and proportions were used to describe categoric variables and the mean ± SD of quantitative variables among sites. This provided the primary data for the determination of prevalence rates for self-reported symptoms and risk factors, as well as for risk scores. Another outcome was the possible difference in the answers and risk scores between Europe and the United States. Another related intent was to analyze differences, if any, between genders in regard to risk scores. For this purpose, logistic regression analysis was applied. After proper dichotomization, the answers and scores formed the outcome variables in separate logistic models. To facilitate interpretation, some independent variables were transformed, as follows: continent (Europe/United States); gender (male/female); BMI (< 30 kg/m^2 vs ≥ 30 kg/m^2); hypertension (yes/no); region (north/south); and age. The age grouping was performed using the following cutoffs: young persons (< 35 years); middle-aged persons (35 to 55 years); and older persons (> 55 years). The age groups were chosen arbitrarily to provide roughly equal groups and yet capture climacteric events in women. When assessing the adjusted influence of continent and gender on the answers and scores, additional possible effect modification by the main covariates (*eg*, age, gender, obesity, and hypertension) was accounted for by entering corresponding interaction terms into the logistic model, including interaction between continent and, when examined, gender itself.

Rate differences between continents and between genders were calculated by odds ratios (ORs) and the corresponding 95% confidence intervals (CIs). In some instances, analysis was restricted to subgroups identified by significant interactions between the variables. Statistical significance meant that the p value of the corresponding statistical test was < 0.05.

Results

Of the 8,000 distributed questionnaires, 6,223 forms (78%) were entered for analysis. The response rate varied among sites, as follows: 3 of 26 US sites, 40 to 50%; 2 of 14 European sites, 48% and 54%; all remaining sites, 70 to 98% (data available on request). The elimination of sites with a response rate of < 50% did not significantly alter the results and so were left in the final analysis. The major reason for a low response rate was a failure to distribute/return copies. The return rate did not significantly differ with geographic or socioeconomic profiles of the sites ($p > 0.05$). US and European populations reported similar ages, gender distributions, and instances of high BP, but self-reported obesity (*ie*, BMI ≥ 30 kg/m^2) was significantly more common in the US population than in the European population (27.9% vs 17.2%, respectively; $p < 0.01$). Those individuals with inadequate data were assigned to a negative-risk or low-risk category. This effect was small, as only 1.1% of individuals did not provide enough answers to the questions about category 1, 2% did not provide answers to questions about sleepiness (category 2), and 3.2% gave no response to the questions about history of high BP or provided enough information about height and weight to estimate BMI. This exclusion therefore resulted in some minor underestimation of the prevalence of categories and OSA risk.

Responses and Categories

The rates for categories 1 to 3 and OSA risk varied among the sites (Table 1). Overall, category 2 (sleepiness), in particular, differed between continents. The US population reported generally higher rates than their European counterparts in frequency of "not rested after sleep" (36% vs 16%, respectively; $p < 0.001$) and in "waketime tiredness" (39% vs 14%, respectively; $p < 0.001$). US patients were more likely than European patients to report drowsy driving (17% vs 7%, respectively; $p < 0.001$), but the differences diminished with increasing age, as follows: young patients: OR, 2.94; 95% CI, 2.01 to 4.29; middle-aged patients: OR, 2.17; 95% CI, 1.65 to 2.86; and older patients: OR, 1.62; 95% CI, 1.12 to 2.34. In Europe, those in Spain reported less sleepiness than those in Germany (OR, 0.43; 95% CI, 0.31 to 0.59). Equally dividing the US population along a north-south axis resulted in the finding that those in the southern United States also reported somewhat less sleepiness than those in the north (OR, 0.77; 95% CI, 0.58 to 1.03).

Comparing category scores between continents (Fig 1), only category 1 (snoring) was different when examined with regard to age groups. The rate for US respondents was higher in the younger age grouping, but the rate for European respondents was higher in the older age grouping. As a history of high BP is part of category 3, it followed that those reporting high BP were much more likely to be in the high pretest probability for OSA than those who did not report it (OR, 5.60; 95% CI, 4.68 to 6.71). However, when the data set was adjusted for age and obesity, a report of high BP was positively correlated with symptom category 1 (snoring: OR, 1.30; 95% CI, 1.11 to 1.52) and with a minor effect on symptom category 2 (sleepiness: OR, 1.17; 95% CI, 0.97 to 1.43).

Gender Effects

Male and female respondents did not differ with respect to age (men, 51.3 ± 17.0 years; women,

Table 1—*Risk Factors and Functional Sleepiness Among Study Regions**

Geographic Region	Patients at High Risk for OSA		Patients Qualifying for Symptom Category 1		Patients Qualifying for Symptom Category 2		Patients Qualifying for Symptom Category 3		Patients Who Report Drowsy Driving	
	%	No.	%	No.	%	No.	%	No.	%	No.
United States (n = 3,915)	35.8	1,403†	43.3	1,695‡	32.4	1,267§	44.8	1,755‖	17.7	693¶
Ashland, OH (n = 99)	42.4	42	41.4	41	32.3	32	48.5	48	17.2	17
Cleveland, OH (n = 736)	37.9	279	42.0	309	31.5	232	50.3	370	18.6	137
Louisville, KY (n = 81)	66.7	54	63.0	51	53.1	43	64.2	52	24.7	20
Milton-Quincy, MA (n = 148)	55.4	82	54.1	80	42.6	63	57.4	85	18.2	27
Naples, FL (n = 143)	36.4	52	42.7	61	35.7	51	39.9	57	21.7	31
Springfield, MA (n = 216)	19.9	43	46.3	100	33.3	72	34.7	75	12.5	27
Stuart, FL (n = 375)	43.5	163	45.1	169	21.1	79	68.8	258	4.0	15
Washington, DC (n = 2,037)	32.4	661	41.8	851	33.2	676	38.0	773	20.0	407
Wilmette, IL (n = 80)	33.8	27	41.3	33	23.8	19	46.3	37	15.0	12
Europe (n = 2,308)	26.3	607	43.5	1,005	11.8	272	37.1	855	7.1	163
Germany										
Leipzig (n = 393)	23.2	91	35.6	140	7.9	31	44.0	173	4.8	19#
Mindelheim (n = 141)	30.4	43	45.4	64	22.0	31	31.9	45	19.9	28
Wuerzburg/Darmstadt (n = 625)	27.2	170	48.8	305	17.4	109	35.0	219	8.0	50
Ulm (n = 96)	44.8	43	55.2	53	30.2	29	46.9	45	8.3	8
Spain										
Madrid (n = 1,053)	24.7	260	42.1	443	6.8	72	35.4	373	5.5	58**
Total (n = 6,223)	32.3	2,010	43.4	2,700	24.7	1,539	41.9	2,610	13.8	856††

*Patients who could not be categorized because of missing data were considered not to qualify for a particular symptom category.
†Denotes significantly different from European population ($p < 0.001$); however, there are significant interactions with gender ($p < 0.05$), obesity ($p < 0.001$), and report of hypertension ($p < 0.001$).
‡Denotes significantly different from European population ($p < 0.05$); however, there are significant interactions with age ($p < 0.001$).
§Denotes significantly different from European population ($p < 0.001$); however, there are interactions with region (north/south; $p < 0.01$).
‖Denotes significantly different from European population ($p < 0.01$).
¶Denotes significantly different from European population ($p < 0.001$); however, there are interactions by region ($p < 0.005$) and history of hypertension ($p < 0.005$).
#A total of 23.6% did not answer that question.
**A total of 10.1% did not answer the question.
††A total of 5.5% did not answer the question.

50.2 ± 17.7 years) or reporting a history of high BP (men, 29.6%; women, 26.4%). The mean BMI in men was 28.0 ± 5.4 kg/m^2, and in women, 27.1 ± 6.4 kg/m^2. There were no gender differences with regard to BMI > 30 (men, 24.8%; women, 24.0%).

Differences in symptom frequencies and OSA risk between men and women are presented in Tables 2 and 3. Men were more likely to report frequent snoring and breathing pauses (OR, 1.92; 95% CI, 1.61 to 2.29). Men more often reported drowsy driving (OR, 2.08; 95% CI, 1.61 to 2.69), but women were more likely to complain about fatigue in the morning and during the daytime. Women were more likely than men to qualify as being positive for symptom category 2 (OR, 1.83; 95% CI, 1.48 to 2.25). For those with a BMI of > 30, US men had a higher likelihood for OSA than women (OR, 1.66; 95% CI, 1.22 to 2.27). However, not considering age, for those with a BMI of < 30 kg/m^2, the OR was 1.13 (95% CI, 0.90 to 1.43).

High OSA Risk

In the United States, a high score was present more often than in Europe, an observation that was true for both men and women (Fig 2). Young US patients, both men and women, had the highest likelihood of qualifying as being positive compared with their European counterparts. In those patients > 55 years of age, there was no continental difference (Table 3). A higher probability of finding OSA in the US population was present if the analysis was restricted to being positive in both category 1 (snoring) and category 2 (sleepiness) [United States, 16.4%; Europe, 6.7%; $p < 0.001$), without regard to category 3.

Discussion

This is the first large data set providing information collected by a standardized protocol on snoring, sleepiness, and other features associated with sleep

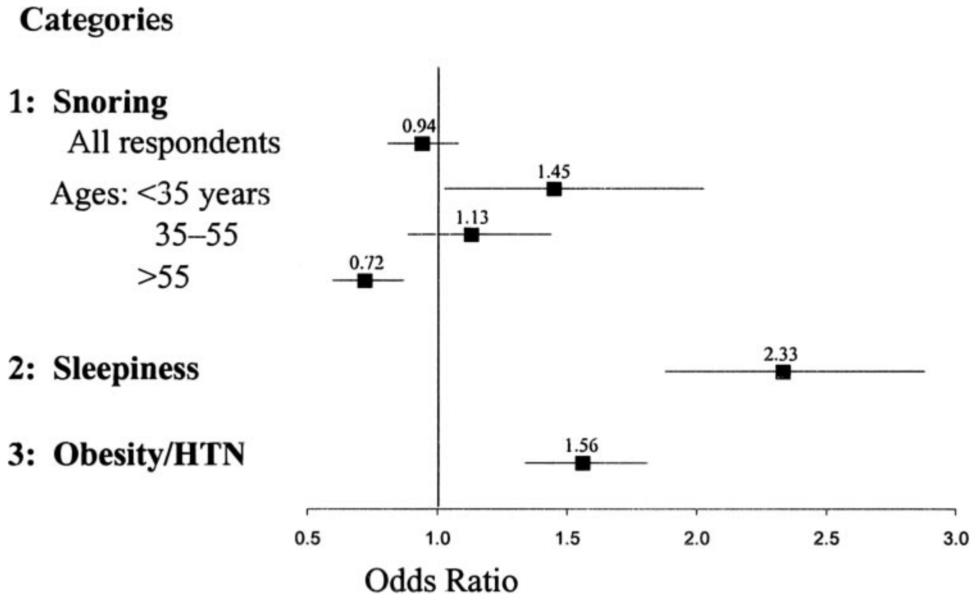

FIGURE 1. OR comparisons between US and European patients according to category. Age showed a significant effect only on reports in category 1 (*ie*, snoring and sleep behavior). An OR > 1 indicates that the US population is greater, and an OR < 1 indicates that the European population is greater. Bars represent CIs.

apnea across many primary care sites. The results confirmed a widespread distribution of patients with a surprisingly high rate of reported frequent sleepiness and drowsy driving, behaviors that pose individual and societal risks. Approximately one third of patients reported symptoms and risk factors with a high likelihood for finding sleep apnea if referred for testing. The major feature of the difference in a high-risk profile for OSA between Europe and the United States was sleepiness, the second feature was obesity, while the self-report of frequent snoring was common (approximately 4 in 10 patients) and was similarly present at US and European sites. In this population, the rate of high risk for OSA was high in both men (approximately 37%) and women (approximately 27%).

A self-report of snoring was generally as common in the United States as in Europe, and by itself this is emerging as a health issue.[11] The occurrence of snoring is a predictor of a subsequent diagnosis of hypertension[3] and of diabetes 10 years later,[20,21] even after adjustment for previously well-described risk factors such as obesity. In our cross-sectional study, aging qualitatively and quantitatively altered differences in self-reports of snoring between continents, independent of daytime tiredness or obesity, but we collected no information that permits us to gain insight into the greater European rate when patients were older (*ie*, > 55 years of age). Possibilities include an age-related decline in informative bed partners, European "survivors" who have the opportunity to snore, or differences in the reporting of this herald of sleep.

Men had a higher composite score for OSA, and this score resulted from reports of snoring and observed apnea, rather than of sleepiness. In regard to sleepiness, women reported twice as much sleepiness as men, but men reported more experience with drowsy driving. Gender differences previously have been attributed to disease expression or reporting bias.[22,23] Of interest, between genders there was no difference in the rate of OSA risk (approximately one in four), when analyses were restricted to individuals with a BMI of < 30. Hence, gender and obesity may not be definitive features on which a primary care practitioner should base recognition profiles, especially if one considers the real possibility of underreporting by women.[22,23]

Excessive daytime sleepiness is an important feature in the diagnosis of obstructive sleep apnea-hypopnea syndrome, but OSA is not the only cause for this symptom. A report[24] from a large Japanese population, but without reference to latitude or sleep disorders, identified factors of unhealthy lifestyle, poor general health, and urban living as predictors of daytime sleepiness. In our study, sleepiness was not just an urban phenomenon, as it increased with age. Among US and European sites, there were differences in sleepiness and drowsy driving. North-south regions differed in the frequency of reported sleep-

Table 2—*Distribution of Responses According to Gender and Continent*

Questions	Men				Women			
	United States		Europe		United States		Europe	
	No.	%	No.	%	No.	%	No.	%
Category 1								
Do you snore?	1,690		1,042		2,011		1,218	
Yes	1,144	67.7	684	65.6	921	45.8	553	45.4
No	387	22.9	282	27.1	769	38.2	493	40.5
Do not know	159	9.4	76	7.3	321	16.0	172	14.1
Snoring loudness	1,148		689		933		570	
Loud as breathing	408	35.5	203	29.5	506	54.2	253	44.4
Loud as talking	363	31.6	251	36.4	243	26.1	212	37.2
Louder than talking	158	13.8	136	19.7	96	10.3	68	11.9
Very loud	219	19.1	99	14.4	88	9.4	37	6.5
Snoring frequency	1,207		720		1,022		616	
Almost every day	474	39.3	295	41.0	285	27.9	177	28.7
3–4 times/wk	215	17.8	137	19.0	135	13.2	82	13.3
1–2 times/wk	266	22.0	167	23.2	226	22.1	184	29.9
1–2 times/mo	127	10.5	72	10.0	139	13.6	91	14.8
Never or almost never	125	10.4	49	6.8	237	23.2	82	13.3
Does your snoring bother other people?	1,321		765		1,221		712	
Yes	905	68.5	514	67.2	558	45.7	329	46.2
No	416	31.5	251	32.8	663	54.3	383	53.8
How often have your breathing pauses been noticed?	1,473		865		1,560		913	
Almost every day	75	5.1	32	3.7	32	2.1	7	0.8
3–4 times/wk	42	2.9	36	4.2	11	0.7	5	0.5
1–2 times/wk	42	2.9	53	6.1	23	1.5	17	1.9
1–2 times/mo	72	4.9	50	5.8	30	1.9	19	2.1
Never or almost never	1,242	84.3	694	80.2	1,464	93.8	865	94.7
Category 2								
Are you tired after sleeping?	1,665		1,034		1,993		1,215	
Almost every day	329	19.8	94	9.1	571	28.7	145	11.9
3–4 times/wk	183	11.0	49	4.7	264	13.3	70	5.8
1–2 times/wk	289	17.4	109	10.6	381	19.1	128	10.5
1–2 times/mo	279	16.7	117	11.3	294	14.7	139	11.5
Never or almost never	585	35.1	665	64.3	483	24.2	733	60.3
Are you tired during waketime?	1,676		1,029		1,998		1,209	
Almost every day	369	22.0	85	8.3	572	28.6	132	10.9
3–4 times/wk	207	12.3	50	4.9	315	15.8	78	6.5
1–2 times/wk	358	21.4	124	12.0	426	21.3	143	11.8
1–2 times/mo	325	19.4	135	13.1	364	18.2	153	12.7
Never or almost never	417	24.9	635	61.7	321	16.1	703	58.1
Have you ever fallen asleep while driving?	1,671		989		1,989		1,060	
Yes	383	22.9	119	12.0	279	14.0	43	4.1
No	1,288	77.1	870	88.0	1,710	86.0	1,017	95.9
Asleep driving frequency?	835		324		783		282	
Almost every day	11	1.3	2	0.6	15	1.9	2	0.7
3–4 times/wk	12	1.5	1	0.3	16	2.0	5	1.8
1–2 times/wk	37	4.4	7	2.2	28	3.6	2	0.7
1–2 times/mo	102	12.2	29	8.9	76	9.7	10	3.5
Never or almost never	673	80.6	285	88.0	648	82.8	263	93.3
Category 3								
Do you have high blood pressure?	1,663		1,028		1,993		1,212	
Yes	511	30.7	304	29.6	534	26.8	330	27.2
No	1,035	62.3	676	65.7	1,361	68.3	843	69.6
Do not know	117	7.0	48	4.7	98	4.9	39	3.2
BMI > 30 kg/m^2?	1,578		1,022		1,858		1,184	
Yes	513	32.5	170	16.6	565	30.4	221	18.7
No	1,065	67.5	852	83.4	1,293	69.6	963	81.3
Has your weight changed?	1,684		1,040		2,009		1,208	
Increased	813	48.3	211	20.3	1,157	57.6	271	22.4
Decreased	291	17.3	102	9.8	353	17.6	149	12.4
No change	580	34.4	727	69.9	499	24.8	788	65.2

Table 3—*Risk Factors and Functional Sleepiness Between Genders**

Patients	Patients at High Risk for OSA		Patients Qualifying for Symptom Category 1		Patients Qualifying for Symptom Category 2		Patients Qualifying for Symptom Category 3		Patients Who Report Drowsy Driving	
	%	No.	%	No.	%	No.	%	No.	%	No.
Men (n = 2,750)	37.9	1,043†	57.5	1,580‡	20.7	569§	44.8	1,232‖	18.3	502¶
Women (n = 3,272)	27.8	911	32.0	1,046	28.0	915	40.0	1,308	9.8	322
Total (n = 6,223)#	32.3	2,010	43.4	2,700	24.7	1,539	41.9	2,610	13.8	856

*Patients who could not be categorized because of missing data were considered not to qualify for a particular symptom category.
†Difference from the opposite gender depends on obesity ($p < 0.01$), continent ($p < 0.05$), and history of hypertension ($p < 0.05$).
‡Difference from the opposite gender ($p < 0.001$).
§Difference from the opposite gender ($p < 0.001$).
‖Difference from the opposite gender depends on age ($p < 0.001$).
¶Difference from opposite gender ($p < 0.001$); modified ($p < 0.005$) by region ($p < 0.005$).
#Includes 201 patients who gave no information on their gender.

iness (category 2), suggesting differences in health, perception, attitude, or sleep behavior in northern and southern latitudes. The frequency of reports of drowsy driving in the present study (range across all sites, 4 to 22%) are cause for concern because such active sleepiness is not only a major proximate cause of car crashes,[1] but also is a marker for personal accidents and workplace errors.[25]

The study design permitted intercontinental comparisons. Compared to European patients, US patients reported an overall higher frequency of daytime sleepiness, as well as a higher composite score for OSA. Different among genders and independent of continent were sleepiness (women more than men) and score for OSA (men more than women). US women reported symptoms for OSA more than their European counterparts, while rates for US and European men were more similar. Difference between genders and a higher European rate of frequent snoring/breathing pauses diminished with age. Reports of drowsy driving were not uncommon, but these also diminished with age and were more common in US patients. We found obesity and recent weight gain to be more prevalent in the United States than in Europe, which is consistent with the current literature.[26,27] However, obesity was second place to sleepiness as a factor in the generally high rate for OSA risk.

The Berlin Questionnaire does not capture all information that a physician might want or seek, nor

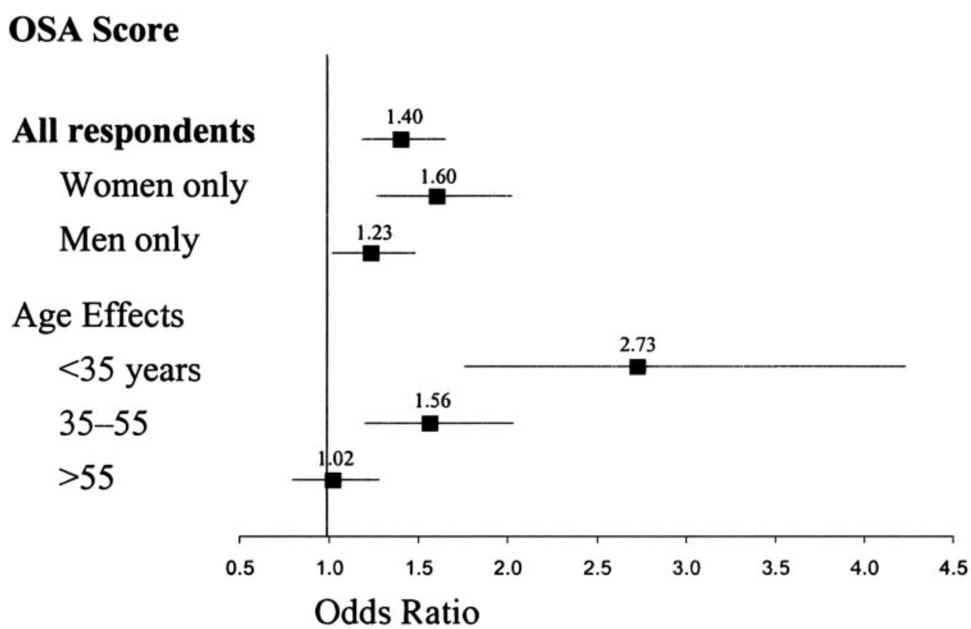

FIGURE 2. OR comparisons between US and European patients with regard to an OSA score for high pretest probability. An OR > 1 indicates that the US population is greater; and an OR < 1 indicates that the European population is greater. Bars represent CIs.

does it substitute for direct measurements of breathing during sleep.[28,29] The self-report format had advantages of convenience, simplicity, and cost, and may be more uniform in presentation compared to face-to-face screening or a physician-obtained patient history. We used questions in the three languages to reduce the variations in meaning further.

The study did not include information on the utility of the questionnaire in regard to patient outcome. Also, we did not require specialist referral or sleep studies, which might have created some barriers and bias, including that of access and cost, and a more limited sample. The data justify a more detailed look at risk stratification and clinical decisions on the diagnosis and treatment of sleep disorders in both the United States and Europe.

There are other potential limitations to consider. This study was not randomized by the choice of the practice site or the patients surveyed in each practice. As a result, there may be bias with regard to interest or other effects on the reporting of symptoms. The diversity of practice plans, styles of practice, interests of the individual practitioner, patient utilization practices, and time of the survey, alone or in combination, might have influenced patient reports or produced variability among sites, but the similarities across continents and the correspondence to other community surveys of health in terms of such features as obesity mitigate these concerns to some extent. We did not independently confirm or refute reports of snoring or sleepiness. However, the concordance among patient reports and bed-partner reports is reported to be sufficiently high[30] to believe that there might not be overreporting of these symptoms.

In summary, this study is the first large survey of primary care practices that has used a standardized approach and has obtained rather high prevalence values for key symptoms and features that might result in a referral for evaluation of OSA. These international cross-sectional data find a considerable rate for risk factors such as sleepiness and obesity, for which one might envision behavioral interventions that would reduce the composite risk for OSA. The data appear to justify more attention to issues related to cost-effective case finding, severity of disease and prognosis, and the need for and efficacy of the treatment of sleep disorders in primary care systems in both the United States and Europe.

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Appendix

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