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Original Article

Obstructive Sleep Apnea Syndrome in the Sao Paulo Epidemiologic Sleep Study

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ABSTRACT

Objective: To estimate the prevalence of Obstructive Sleep Apnea Syndrome (OSAS), using current clinical and epidemiological techniques, among the adult population of Sao Paulo, Brazil.
Methods: This population-based survey used a probabilistic three-stage cluster sample of Sao Paulo inhabitants to represent the population according to gender, age (20–80 years), and socio-economic status. Face-to-face interviews and in-lab full-night polysomnographies using a nasal cannula were performed. The prevalence of OSAS was determined according to the criteria of the most recent International Classification of Sleep Disorders (ICDS-2) from American Academy of Sleep Medicine (2005).
Results: A total of 1042 volunteers underwent polysomnography (refusal rate = 5.4%). The mean age ± SD was 42 ± 14 years; 55% were women and 60% had a body mass index > 25 kg/m^2. OSAS was observed in 32.8% of the participants (95% CI, 29.6–36.3). A multivariate logistic regression model identified several independent and strong associations for the presence of OSAS: men had greater association than women (OR = 4.1; 95% CI, 2.9–5.8; $P < 0.001$) and obese individuals (OR = 10.5; 95% CI, 7.1–15.7; $P < 0.001$) than individuals of normal weight. The adjusted association factor increased with age, reaching OR = 34.5 (95% CI, 18.5–64.2; $P < 0.001$) for 60–80 year olds when compared to the 20–29 year old group. Low socio-economic status was a protective factor for men (OR = 0.4), but was an associated factor for women (OR = 2.4). Self-reported menopause explained this increased association (age adjusted OR = 2.1; 95% CI, 1.4–3.9; $P < 0.001$), and it was more frequent in the lowest class (43.1%) than either middle class (26.1%) or upper class (27.8%) women.
Conclusions: This study is the first apnea survey of a large metropolitan area in South America identifying a higher prevalence of OSAS than found in other epidemiological studies. This can be explained by the use of the probabilistic sampling process achieving a very low polysomnography refusal rate, the use of current techniques and clinical criteria, inclusion of older groups, and the higher prevalence of obesity in the studied population.

1. Introduction

Obstructive Sleep Apnea Syndrome (OSAS) is a significant public health problem associated with hypersomnolence, accidents, cardiovascular morbidity, cognitive impairment, anxiety, depression, and metabolic dysfunction [1–5].

OSAS can be influenced by both genetics and the environment, and it is important to determine the prevalence of OSAS in specific populations. Although OSAS has been studied in North America, Europe, Asia, Australia, and India, no comprehensive studies have been conducted in South America [6–14].

Earlier studies estimated that between 3.7% and 26% of the population has an Apnea-Hypopnea Index (AHI) above 5. The prevalence of OSAS, defined by AHI frequency and the presence of hypersomnolence, has been estimated to range from 1.2% to 7.5% [6–14]. These wide variations are partly the result of the lack of homogeneity in epidemiologic studies. Some studies, for example, were performed in pre-selected population groups (e.g., state agency employees, industrial employees, or clinically referred patients) and included a high number of subjects who were suspected of having OSAS because of their snoring frequency [15]. Moreover, some earlier studies did not include subjects over 60 years of age [6,9–14]. Many studies were conducted before the development of the nasal cannula and used a thermistor to record airflow during sleep, which is a less sensitive device to detect abnormal sleep respiratory events. Finally, earlier investigations did not use the most recent criteria for OSAS diagnosis from the International Classification of Sleep Disorders (ICSD-2, 2005) of the American Academy of Sleep Medicine (AASM) [16]. Previously, significant daytime sleepiness and strictly scored apneas and

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hypopneas (AHI > 5) were required to establish the final clinical diagnosis of OSAS. The definition of OSAS has been changed with the introduction of ICSD-2, including symptoms besides daytime sleepiness in association with an AHI between 5 and 15 or an AHI equal to or higher than 15 obstructive events per hour of sleep regardless of the presence of any complaints.

The aim of the present study, which used current clinical and epidemiologic techniques and procedures, was to estimate the prevalence of OSAS according to age, gender, socio-economic status, and Body Mass Index (BMI) in a probabilistic sample representative of the adult population of Sao Paulo, Brazil.

2. Methods

2.1. The population under investigation

Sao Paulo, Brazil is the largest city in the southern hemisphere [17] and had a population of 10,886,518 in January 2008. Studies of genetic markers indicating ancestry have found that there are high levels of ethnic admixture in this population [18].

The protocol for this study was approved by the Ethics Committee for Research of the Universidade Federal de Sao Paulo (CEP 0593/06) and was registered with ClinicalTrials.gov (number NCT00596713). Selected volunteers read and signed an informed consent form.

The methodological details of the "Sao Paulo Epidemiologic Sleep Study" are described elsewhere [19].

2.2. Sampling procedures

This single-center study involved 1101 individuals in the city of Sao Paulo. This sample size was established to allow prevalence estimates with 3% precision [20]. To obtain a representative sample of the inhabitants of Sao Paulo according to gender, adult age (20–80 years old), and socio-economic status, we used a three-stage cluster sampling technique with unequal selection probability [21]. This is the same conceptual framework used for the North American National Health Surveys [20]. The first stage was designed to ensure the representation of individuals with different levels of wealth. For this purpose, we proportionally selected 96 districts from the four homogenous socio-economical regions of Sao Paulo. In the second stage, 11 households were selected in each sector. Finally, in the third stage of sampling, all of the eligible inhabitants of each selected house were arranged according to age (youngest to oldest), and after that, a subject was selected using a pre-established table specific for each selected house. Pregnant and lactating women, people with physical or mental impairments that prevented self-care, individuals who were younger than 20 or older than 80 years of age, and people who worked every night were not included in the household drawing. Substitutes were chosen if the target individual could not be contacted (after three attempts), refused to participate, was prevented from participating by a family member, or was unable to participate because of travel plans, scheduling conflicts, or a hospitalization. Substitutes were chosen from the household next door following the same random selection criteria described above. As described elsewhere [19], 165 volunteers were substituted to reach the total sample size. A test of homogeneity [22] to assess differences in age, gender, and socio-economic status was conducted, and no statistically significant differences were observed between the original volunteers and the substitutes ($P < 0.05$). Based on these results, we concluded that the substitution did not introduce a significant selection bias. A total of 1042 volunteers underwent PSG at the Sleep Institute; few volunteers (5.4%) refused the PSG test. Age ($P = 0.11$), gender ($P = 0.55$), and socio-economic status ($P = 0.38$) distributions did not significantly differ between the volunteers who accepted PSG recording and those who refused.

A generated weight variable was applied to match the sample by gender, age group, and socio-economic status, with the demographic projections for the city inhabitants in 2007. These projections were derived from the 2000 city census (Table 1).

2.3. Home and in-lab data gathering

Socio-economic information and demographic data were collected face-to-face in home interviews, and the Pittsburgh Sleep Quality Index [23] and Berlin Questionnaire [24] were also administered. The volunteers were then invited to participate in an in-lab, full-night PSG. Less than two weeks later, volunteers went to the sleep lab, and the Epworth Sleepiness Scale [25] and Chalder Fatigue Scale [26] were administered by trained psychologists. Weight and height were measured, and an in-lab, full-night PSG was performed. The following morning, a blood sample was collected that was used to analyze each participant's genetic ancestry. Subjects with a BMI between 25 and 30 kg/m^2 were identified as overweight; those with a BMI higher than 30 kg/m^2 were considered to be obese. The Brazilian Economic Classification Criteria [27] was used to define socio-economic status. "High" status was defined as a household with an annual income above US$15,961; "mid" status households had an annual income between US$4561 and US$15,960, and "low" status households had an annual income of less than US$4,560.

2.4. Clinical assessment

OSAS was diagnosed according to the criteria of the International Classification of Sleep Disorders (ICSD-2) proposed by AASM [16]. Subjects were diagnosed with OSAS if they had an AHI between 5 and 14.9 and presented with at least one of the following complaints: loud snoring, daytime sleepiness, fatigue, and breathing interruptions during sleep. Subjects with an AHI equal to or

Table 1
Distributions of gender, age, socio-economic status, and body mass index category for a probabilistic sample ($n = 1042$) of Sao Paulo inhabitants.

	Freq.	%	[a]Census projections (%)
Gender			
Women	576	55.3	53.6
Men	466	44.7	46.4
Age in years			
20–29	236	22.6	25.1
30–39	248	23.8	24.2
40–49	254	24.4	21.1
50–59	166	15.9	15.5
60–69	88	8.4	9.0
70–80	50	4.8	5.0
Socio-economic status			
High	305	27.7	–
Mid	689	62.6	–
Low	107	9.7	–
Participation in the work force			
Non-worker	263	25.2	–
Worker	779	74.8	–
BMI category[b]			
Normal	417	40.1	–
Overweight	400	38.4	–
Obese	224	21.5	–

[a] Population projection for inhabitants of Sao Paulo city in 2007, according to census 2000.
[b] Normal = body mass index (BMI) < 25 kg/m^2; Overweight = BMI between 25 and 30 kg/m^2; Obese = BMI > 30 kg/m^2.

higher than 15 were diagnosed with OSAS regardless of whether they had any additional complaints.

Loud snoring was assessed using the second question of the Berlin Questionnaire for sleep apnea [24]: a positive response included snoring that was "louder than talking" or "very loud – can be heard in adjacent rooms." Daytime sleepiness was assessed using the Epworth Sleepiness Scale [25] and the eighth question of the Pittsburgh Sleep Quality Index [23]; Epworth scores higher than nine and/or frequencies greater than once a week according to the Pittsburgh Index were considered to be positive. Fatigue was assessed with the Chalder Fatigue Scale [26], and scores higher than four were considered to be positive. Breathing interruptions were assessed using the fifth question of the Berlin Questionnaire [24] and were considered to be positive when the frequency was "higher than once a month."

2.5. Polysomnography

A full-night PSG was performed using a digital system (EMBLA® S7000, Embla Systems, Inc., Broomfield, CO., USA) at the sleep laboratory during the subject's habitual sleep time. The following physiological variables were monitored simultaneously and continuously: four channels for the Electroencephalogram (EEG); two channels for the electrooculogram; four channels for the surface electromyogram (submentonian region, anterior tibialis muscle, masseter region, and seventh intercostal space); one channel for an electrocardiogram; airflow detection via two channels through a thermocouple (one channel) and nasal pressure (one channel); respiratory effort of the thorax (one channel) and of the abdomen (one channel) using inductance plethysmography; snoring (one channel) and body position (one channel); oxy-hemoglobin saturation (SpO_2); and pulse rate. Four trained technicians visually scored all PSGs according to standardized criteria for investigating sleep [28]. EEG arousals and leg movements were scored according to the criteria established by the AASM Manual for Scoring Sleep and Associated Events [29]. Apneas were scored and classified following the recommended respiratory rules for adults suggested by the AASM Manual, and hypopneas were scored according to the alternative rules [29]. A registered PSG technologist randomly selected and rescored the sleep stages of 4% of the PSGs in order to verify their accuracy (agreement rate of 93.3 ± 5.1%, $\kappa = 0.91 \pm 0.03$).

2.6. Statistical analysis

Estimates of OSAS prevalence and model coefficients were generated using pseudo likelihood maximization; this procedure allowed the estimate to be expanded from the sample population to the entire Sao Paulo population. Estimates for variability and precision, as well as for confidence intervals, used Taylor series linearization to avoid underestimation bias [20,21].

Multivariate logistic regression models were used to analyze the adjusted associations and interactions among the variables. All analyses were performed with STATA 10 software (Stata Survey Data Reference Manual, STATA Corporation, Texas, 2007).

3. Results

The distributions of gender, age, socio-economic status, and BMI among the sample of Sao Paulo residents ($n = 1042$) were similar to the demographic projections of the 2000 census (Table 1). Women constituted 55% of the study population, 75% of the population participated in the work force, and 59.9% of the subjects were overweight or obese (BMI > 25 kg/m^2).

Weighted prevalence estimates of OSAS symptoms show that 55% of the population experiences sleepiness, 38.9% fatigue, 20.5% report snoring, and 29.2% breathing interruptions.

AHI lower than 5 was present in 61.8% of the subjects; 21.3% presented with an AHI between 5 and 14.9, and 16.9% had an AHI that was higher than or equal to 15. Table 2 shows that AHI scores higher than or equal to 15 was more common among older individuals and men. Overweight and obese subjects of both genders were also more likely to have an AHI over 15, as were men with a high socio-economic status and women who were not in the workforce (Table 2).

Fig. 1 shows the frequency of complaints used in the AASM (ICSD-2) [16] classification of OSAS by category of AHI. A total of 29.5% of volunteers who presented with an AHI between 5 and

Table 2
Weighted frequencies (%) and 95% confidence intervals of AHI categories by gender, age group, socio-economic status, participation in the work force, and body mass index categories for a probabilistic sample ($n = 1042$) of Sao Paulo inhabitants.

	Men			Women		
AHI	<5	5 to < 15	⩾15	<5	5 to < 15	⩾15
Total	53.5 (48.4–58.5)	21.7 (18.5–25.2)	24.8 (21.0–29.1)	69.4 (65.7–72.5)	20.9 (17.9–24.3)	9.6 (7.4–12.3)
Age groups						
20–29y	83.8 (77.2–88.7)	12.4 (8.7–17.5)	3.8 (1.3–10.4)	98.6 (96.9–99.3)	1.4 (0.6–3.1)	0
30–39y	61.7 (53.5–69.2)	22.3 (16.8–29)	16 (11.2–22.4)	80.1 (70.7–87.1)	16.9 (10.4–26.4)	2.9 (1.4–6.1)
40–49y	35.4 (27.1–44.7)	29.4 (22.7–37.2)	35.2 (27.1–44.4)	72.2 (65.7–77.9)	21.5 (15.6–28.8)	6.3 (3.8–10.1)
50–59y	39.4 (26.7–53.7)	30.4 (21.1–41.7)	30.2 (19.8–43.1)	51.4 (43.3–59.5)	29.9 (24.4–36.2)	18.6 (12.5–26.7)
60–69y	28.4 (17.9–41.9)	19.3 (8.7–37.5)	52.3 (37.4–66.8)	27.9 (17.5–41.4)	35.9 (23.1–51.1)	36.2 (22.3–52.9)
70–80y	4.1 (1.4–11.7)	11.1 (5.2–41.7)	84.7 (70.7–92.7)	5.9 (2.9–11.5)	71.3 (51.8–85.2)	22.8 (11.3–40.6)
Socio-economic status						
High	44.1 (36.8–51.7)	24.6 (18.5–31.9)	31.3 (26.5–36.6)	73.5 (65.4–80.2)	15.7 (10.7–22.2)	10.9 (7.4–13.1)
Mid	55.8 (49.8–61.6)	21.8 (18.3–25.8)	22.4 (17.6–27.9)	69.6 (65.4–73.5)	21.4 (17.4–26.1)	8.9 (6.4–12.5)
Low	70.8 (59.1–80.3)	8.5 (4.9–14.3)	20.7 (12.2–32.9)	56.0 (37.6–72.9)	33.0 (17.7–52.9)	10.9 (4.8–22.9)
Participation in the work force						
Workers	54.6 (50.1–59.1)	22.2 (18.9–25.8)	23.2 (19.6–27.2)	76.1 (71.6–80.1)	17.6 (14.4–21.3)	6.2 (4.6–8.4)
Non-workers	48.8 (36.8–61)	19.5 (12.8–28.6)	31.7 (21.2–44.5)	55.6 (49.1–6)	27.8 (21.9–34.7)	16.5 (11.3–23.4)
BMI categories[a]						
Normal	71.6 (64.8–77.6)	17.6 (14.1–21.9)	10.7 (6.1–18.1)	89.3 (85.5–92.1)	8.1 (5.7–11.4)	2.6 (1.6–4.2)
Overweight	52.9 (45.5–60.3)	25–8(20.1–32.5)	21.2 (16.5–26.7)	64.8 (58.5–70.6)	26.1 (20.5–32.5)	9.1 (5.7–14.2)
Obese	15.1 (10.5–21.4)	22.2 (16.7–29.0)	62.6 (54.5–70.2)	43.8 (35.0–52.9)	34.4 (25.9–43.9)	21.8 (16.6–28.2)

AHI: apnea-hypopnea index.
[a] Normal = body mass index (BMI) < 25 kg/m2; Overweight = BMI between 25 and 30 kg/m^2; Obese = BMI > 30 kg/m^2.

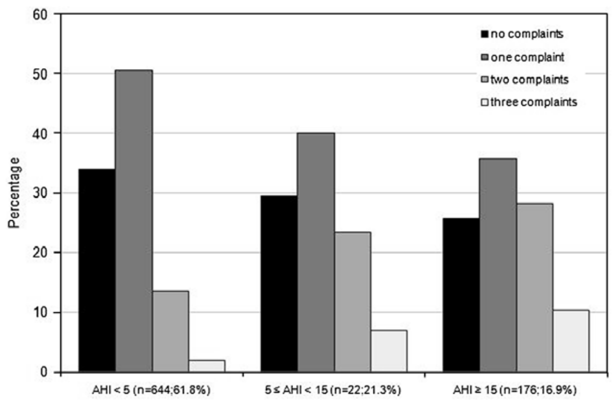

Fig. 1. Frequencies (%) of sleep complaints (loud snoring, daytime sleepiness, fatigue, and breathing interruptions) considered in the classification of Obstructive Sleep Apnea Syndrome according to the American Academy of Sleep Medicine (ICSD-2, 2005), separated by categories of AHI, in a probabilistic sample (n = 1042) representative of Sao Paulo inhabitants.

15 did not have any complaints and were not included in the OSAS group. If an AHI above 15 had been the only criterion used to diagnose OSAS (ICSD-2), only 16.9% of the studied population would have been identified with OSAS. The frequency of subjects with OSAS decreased proportionally as other complaints were included.

Table 3 shows that one in three (32.8%) Sao Paulo residents met the criteria for OSAS. The prevalence estimates are higher among men and increase in both genders with age. OSAS was also more prevalent in overweight and obese subjects of both genders. The higher prevalence of OSAS in women with a low socio-economic status suggests that gender and socio-economic status may interact. OSAS tends to be more prevalent among people who do not participate in the work force, and such differences are even greater when working and non-working women are compared.

In order to quantify the independent participation of each explanatory variable in the distribution of OSAS, a logistic model was fitted. Table 4 shows that gender, age, and BMI were identified as independent and strong associated factors for the presence of OSAS. When these variables were controlled, participation in the work force was not an independent associated factor for OSAS. To explain the different prevalence trends of OSAS in men and women of different socio-economic groups, the interaction term was studied in the multivariate model. Low socio-economic status was a protective factor for males (OR = 0.4), but was an associated factor for females (OR = 2.4). After fitting logistic models to explain the relationship between gender and socio-economic status among women, the self-report of menopause was identified as an explanatory factor for the increased association (age adjusted OR = 2.1; 95% CI, 1.4–3.9; $P < 0.001$). Self-reported menopause was more common among low-class women (43.1%) than among middle-class (26.7%) or upper-class (27.8%) women.

Table 4
Multivariate logistic regression final model for Obstructive Sleep Apnea Syndrome in a probabilistic sample (n = 1042) representative of Sao Paulo inhabitants.

	OR (95% CI)	*P*-value
Gender		
Women	1	
Men	4.1 (2.9–5.8)	0.00
Age in years		
20–29y	1	
30–39y	3.9 (2.6–5.8)	0.00
40–49y	6.6 (4.1–10.6)	0.00
50–59y	10.8 (6.9–16.8)	0.00
60–80y	34.5 (18.5–64.2)	0.00
Socio-economic status and women		
High and women	1	
Mid and women	1.4 (0.7–1.9)	0.61
Low and women	2.4 (1.0–6.3)	0.057
Socio-economic status and men		
High and men	1	
Mid and men	1.0 (0.6–1.8)	0.00
Low and men	0.4 (0.1–0.9)	0.04
Participation in the work force		
Workers	1	
Non-workers	0.9 (0.6–1.4)	0.89
BMI category[a]		
Normal	1	
Overweight	2.6 (1.9–3.7)	0.00
Obese	10.5 (7.1–15.7)	0.00

[a] Normal = body mass index (BMI) < 25 kg/m2; Overweight = BMI between 25 and 30 kg/m^2; Obese = BMI > 30 kg/m^2.

Table 3
Weighted prevalence estimates (%) and 95% Confidence Intervals (CI) of Obstructive Sleep Apnea Syndrome by gender, age group, socio-economic status, participation in the work force, and body mass categories for a probabilistic sample (n = 1042) of Sao Paulo inhabitants.

OSAS	Total	Men	Women
Total	32.9 (29.6–36.3)	40.6 (35.7–45.7)	26.1 (22.5–30.1)
Age groups			
20–29y	7.4 (4.9–10.8)	13.4 (8.7–20.0)	1.4 (.7–3.1)
30–39y	24.2 (18.9–30.4)	31.7 (24.1–40.4)	17.6 (10.9–27.1)
40–49y	37.7 (31.9–43.8)	58.9 (49.3–67.7)	18.5 (14.6–23.3)
50–59y	49.2 (40.7–57.7)	55.9 (42.1–68.8)	43.9 (35.9–52.4)
60–69y	60.2 (49.3–70-1)	55.9 (40.7–70.2}	63.4 (48.5–76.2)
70–80y	86.9 (78.4–92-5)	88.7 (77.8–94.7}	85.8 (71.3–93.6)
Socio-economic status			
High	35.5 (29.8–41.5)	48.0 (40.9–55.2)	22.4 (16.4–29.8)
Mid	31.5 (28.0–35.1)	38.9 (33.1–45.1)	25.3 (21.9–30.0)
Low	35.6 (24.5–48.6)	26.1 (17.2–37.4)	43.2 (26.4–61.7)
Participation in the work force			
Workers	30.1 (27, 33.3)	39.6 (34.9, 44.6)	19.9 (16.1, 24.6)
Non-workers	40.1 (33.8, 47.9)	44.7 (33.2, 56.8)	38.5 (31.1, 46.5)
BMI categories[a]			
Normal	14.6 (10.9–19.2)	21.2 (14.7–29.5)	8.4 (5.7–12.2)
Overweight	34.5 (30.1–39.1)	41.6 (35.6–47.9)	27.9 (21.8–34.9)
Obese	64.1 (50.4–70.3)	80.8 (71.2–87.8)	52.2 (43.1–61.2)

[a] Normal = body mass index (BMI) < 25 kg/m2; Overweight = BMI between 25 and 30 kg/m^2; Obese = BMI > 30 kg/m^2.

4. Discussion

This is the first population-based survey of OSAS prevalence carried out in a probabilistic sample representative of a large metropolitan area. The study used comprehensive techniques and procedures and had a very low participant refusal rate (5.4%). The refusal group did not differ significantly from the final sample group in regard to age, gender, socio-economic status, or subjective sleep quality [19]; the prevalence estimates can therefore be assumed to be free from selection bias. In addition, this is the first OSAS population study in South America where high levels of ethnic mixture are reflected in the individual ancestry estimates based on genetic markers.

This estimated prevalence of OSAS in this study is 5–10 times higher than prevalence rates found in similar studies [30]. There are several possible explanations for this significant difference. This study used a nasal cannula with a pressure transducer rather than the thermistors used in earlier population surveys. Studies have found that the nasal cannula detects, on average, 16% more respiratory events than thermistors [31–33]. In addition, this study diagnosed OSAS according to the most recent AASM criteria [16] rather than less sensitive criteria that consider only excessive diurnal somnolence and AHI frequency [6–14]. If 16% fewer respiratory events had been detected and somnolence had been used as the only diagnostic criterion for OSAS, the prevalence estimate of OSAS in this study would have dropped from 32.82% to 18.06%. For hypopnea definition, we adopted the criteria made by the AASM Manual Steering Committee that recommends the use of the alternative rule in all prospective epidemiological and outcome studies [34]. Ruehland and colleagues [35] showed that the use of the recommended rule of the AASM Manual [29] for AHI definition instead of the alternative one can decrease AHI values. Thus, in our study, the use of the recommended rule would decrease OSAS prevalence estimates.

The methodological innovations adopted in our study do not allow us to compare the derived prevalence estimates with those from previous studies. But, interestingly, in the present study, the prevalence of AHI > 5 events per hour of sleep for men and women were quite similar to the prevalence for men and women having an AHI > 15 in the study performed by Young and colleagues in 2003 [6]. It is not unlikely that the populations are similar in both studies and that the difference in AHI cut-offs can be explained by the difference in the operational definitions of the respiratory events [35].

Earlier epidemiological studies used different sample and recruitment procedures that may have underestimated the prevalence of OSAS. Many of these studies examined a portion of the population and applied the prevalence to the entire population [6–14]. There is a potential for bias when patients are sampled from a population and the results are extrapolated back to the total group. This happens when samples are taken from a population of workers or from a sample of all snoring subjects with a sub-sample of non-snoring subjects. Four earlier epidemiological studies examined samples of public and private workers [6,10,11,14], a group with less morbidity than the general population [36]. In addition, earlier population studies recruited subjects by phone or mail; these practices could compromise the clinical assessment and adherence to the study protocol [6–14], resulting in higher drop-out rates (from 15.6% [14] to 87.0% [11]).

Previous studies did not include the same age groups or proportions of overweight and obese individuals as our study. Most of the earlier studies did not include individuals over the age of 70 [6,9–14]; since older populations have a higher prevalence of OSAS [7,8], this may have led to underestimates of the prevalence. Finally, a higher proportion of individuals in our sample were overweight or obese (59.9%). Other studies have found that overweight individuals have a 2.33-fold [12] to 5.70-fold [14] higher association with OSAS than those with a normal weight. In our sample, the association with OSAS was 2.6-fold higher among overweight subjects and 10.5-fold higher for obese subjects.

Many of our findings confirmed the results of earlier studies; the prevalence of OSAS was estimated to be higher among males, to increase with age, and to be higher among overweight and obese subjects [6–13]. According to the adjusted odds ratios of the multivariate logistic regression, male gender, obesity, and an older age were independent associated factors for OSAS. The interaction between gender and socio-economic status was explained by the higher proportion of menopausal women with low socio-economic status, an effect also identified by Udwadia and colleagues [14].

In summary, the Sao Paulo Epidemiologic Sleep Study estimated that the OSAS prevalence is higher than the figures reported by previous epidemiological studies. This can be explained by the probabilistic sampling process, the low PSG refusal rate, the use of a nasal cannula, the adoption of the most recent AASM criteria for OSAS diagnosis, the inclusion of more susceptible older groups, and the higher prevalence of obesity in the studied population.

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