ORIGINAL ARTICLES

# Differences in Clinical and Polysomnographic Variables Between Male and Female Patients With Sleep Apnea-Hypopnea Syndrome

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**OBJECTIVE: The aim of this study was to compare the clinical, anthropometric, and polysomnographic characteristics of a broad group of patients with sleep apnea-hypopnea syndrome according to sex.**

**PATIENTS AND METHODS: The study, conducted in 6 Spanish university hospitals, included consecutive patients attended from 2003 through 2005 with an apnea-hypopnea index greater than 5. Groups were formed according to sex and then stratified into age subgroups of younger (≤45 years) and older patients (>45 years) for further comparison.**

**RESULTS: The study included 2464 men and 424 women. Women were older (mean [SD] age, 56 [12] years vs 51 [12] years), weighed more (body mass index, 31 [6] kg/m² vs 30 [5] kg/m²), and had a larger hip circumference (119 [15] cm vs 111 [12] cm) and smaller neck circumference (38 [3] cm vs 42 [9] cm) than men (*P*<.001 in all cases). The degree of daytime sleepiness (Epworth scale) and the apnea-hypopnea index were similar in both groups, although women had a longer sleep latency (23 [28] minutes vs 27 [32] minutes; *P*<.004) and a higher mean oxygen saturation (92% [4%] vs 91% [5%]) and minimum oxygen saturation (78% [11%] vs 75% [12%]; *P*<.0001) than men. On stratification by age, only weight differences between men and women were observed in the younger group whereas the older group also showed differences in oxygen saturation during sleep.**

**CONCLUSIONS: Women with sleep apnea-hypopnea are more overweight than men and tend to seek medical attention at an older age. The clinical and polysomnographic variables were generally similar for men and women—the only differences were that sleep latency was longer and hypoxemia during sleep was more accentuated in women.**

**Key words:** *Sex. Polysomnography. Sleep apnea syndrome.*

## Influencia del sexo en las variables clínicas y polisomnográficas del síndrome de apneas del sueño

**OBJETIVO: Comparar, en una cohorte amplia de pacientes con síndrome de apneas-hipopneas durante el sueño, las características clínicas, antropométricas y polisomnográficas en función del sexo.**

**PACIENTES Y MÉTODOS: En el estudio, realizado en 6 hospitales universitarios españoles, se incluyó a pacientes consecutivos con un índice de apneas-hipopneas del sueño mayor de 5 h⁻¹, que fueron evaluados entre 2003 y 2005. Se dividieron en función del sexo y, posteriormente, en función de la edad: pacientes jóvenes (≤ 45 años) y adultos (> 45 años).**

**RESULTADOS: Se ha estudiado a 2.464 varones y 424 mujeres. Las mujeres eran mayores (edad media ± desviación estándar: 56 ± 12 frente a 51 ± 12 años; p < 0,0001), pesaban más (índice de masa corporal: 31 ± 6 frente a 30 ± 5 kg/m²; p < 0,0001) y presentaban una mayor circunferencia de cadera (119 ± 15 frente a 111 ± 12 cm; p < 0,0001) y una menor circunferencia de cuello (38 ± 3 frente a 42 ± 9 cm; p < 0,0001) que los varones. El grado de somnolencia diurna (escala de Epworth) y el índice de apneas-hipopneas eran similares en ambos grupos, aunque el de mujeres presentaba una latencia de sueño más larga (23 ± 28 frente a 27 ± 32 min; p < 0,004) y una saturación de oxígeno media (un 92 ± 4 frente a un 91 ± 5%) y mínima menor (un 78 ± 11 frente a un 75 ± 12%; p < 0,0001) que los varones. Al diferenciar los grupos por edad, en el grupo de jóvenes sólo se mantenían las diferencias ponderales, mientras que entre los adultos reaparecían las diferencias en los valores de saturación nocturna.**

**CONCLUSIONES: Las mujeres con síndrome de apneas-hipopneas durante el sueño son más obesas que los varones y consultan a una edad más avanzada. Desde el punto de vista clínico y polisomnográfico, no hay grandes diferencias en función del sexo. Únicamente la latencia de sueño es superior y la hipoxemia nocturna más acentuada.**

**Palabras clave:** *Sexo. Polisomnografía. Síndrome de apneas del sueño.*

Study financed by the Spanish Health Research Fund (Fondo de Investigaciones Sanitarias de España) (Grant 0300022*), the National Institute for Health (Grant HL65270), the Children's Foundation Endowment for Sleep Research, an award from the Commonwealth of Kentucky Challenge for Excellence Trust Fund to David Gozal, and the CIBER for Respiratory Diseases (CibeRes).

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Manuscript received April 17, 2007. Accepted for publication May 20, 2008.

## Introduction

Sleep apnea-hypopnea syndrome (SAHS) is characterized by excessive sleepiness and cognitive-behavioral, breathing, cardiac, metabolic, and inflammatory disorders caused by repeated episodes of upper airway obstruction during sleep.[1] These episodes are measured by polysomnographic studies that allow nighttime events to be linked with daytime clinical manifestations.

SAHS affects between 2% and 4% of the adult population and the ratio of male-to-female sufferers ranges from 2:1 to 4:1 in the United States.[2,3] In Spain, the prevalence of SAHS, defined as an apnea-hypopnea index (AHI) greater than 10, associated with excessive daytime sleepiness,[4] is 3.4% in men and 3% in women. However, in clinical practice, the ratio of men to women ranges from 6:1 to 10:1.[5,6] It is not clear why there is such a large difference between the population-based prevalence and implied prevalence based on demand for sleep laboratory consultations. Some studies suggest it may be related to perception of symptoms, access to the health care system, or social factors. Shepertycky et al[7] suggested that women with SAHS have a more complex clinical picture on diagnosis, with associated depression, insomnia, and hormone imbalances. Such conditions could mask symptoms of SAHS and so women would be referred to other health care specialists. Quintana-Gallego et al,[8] in a single-center study in Spain, found that certain sociocultural factors could explain why women seek care for this condition less often.

The aim of our study was to compare the clinical, anthropometric, and polysomnographic characteristics of a broad sample of patients with SAHS throughout Spain. A demonstration that differences between men and women do exist could help us understand why sleep laboratory caseloads differ by sex.

## Patients and Methods

### *Patients*

The study included 2888 patients attended from 2003 through 2005 in the following Spanish hospitals: Hospital Arnau de Vilanova in Lleida, Hospital Txagorritxu in Vitoria, Hospital Son Dureta in Palma de Mallorca, Hospital Virgen del Rocío in Seville, Hospital General Yagüe in Burgos, and Hospital San Pedro de Alcántara in Cáceres. According to the polysomnographic findings, all patients had an AHI greater than 5. Younger patients were defined as those aged 45 years or less, and older patients as those aged over 45 years. Patients with chronic diseases (eg, chronic obstructive pulmonary disease, liver cirrhosis, thyroid dysfunction, rheumatoid arthritis, chronic renal failure, major psychiatric disorder) or narcolepsy were excluded as were those who were prescribed sleep drugs or antidepressants. The study was approved by the ethics committee of the participating centers and all patients signed an informed consent document once they had been explained the aim of the study.

TABLE 1
**Demographic and Anthropometric Characteristics**[a]

| | Men (n=2464) | Women (n=424) | *P* |
|---|---|---|---|
| Age, y | 51 (12) | 56 (13) | <.0001 |
| BMI | 30 (5) | 31 (6) | <.0001 |
| Neck circumference, cm | 42 (9) | 38 (3) | <.0001 |
| Hip circumference, cm | 111 (12) | 119 (15) | <.0001 |
| Systolic BP, mm Hg | 132 (33) | 133 (20) | NS |
| Diastolic BP, mm Hg | 80 (11) | 79 (12) | NS |
| Epworth score | 11 (4) | 11 (5) | NS |

[a]Results are expressed as means (SD). Abbreviations: BMI, body mass index; BP, blood pressure; NS, not significant.

### *Polysomnographic Assessment*

Diagnosis of SAHS was established by recording an overnight polysomnogram. In all centers, the sleep studies included the following variables: oronasal airflow (pressure catheter and thermistor), chest and abdominal movements, pulse oximetry, electrocardiogram, submental and anterior tibial electromyogram, electrooculogram, electroencephalogram (C3-A2, C4-A1), and body position. Apnea was defined as lack of airflow for more than 10 seconds; hypopnea as a significant decrease in flow for at least 10 seconds, accompanied by an arousal or oxygen desaturation of more than 4%; and AHI as the number apneas or hypopneas per hour of sleep. The stages of sleep were assessed according to the criteria of Rechtschaffen and Kales.[9] Sleep latency was defined as the time between switching off the light and the first 30 seconds of stage 1 sleep (start of sleep), while efficiency of sleep was defined as the duration of nighttime sleep, expressed as the percentage of the total amount of time spent in bed. Arousals were defined according to the working group of the American Sleep Disorders Association.[10]

### *Assessment of Excessive Daytime Sleepiness*

Excessive daytime sleepiness was evaluated using the validated Spanish version[11] of the Epworth scale,[12] a self-administered questionnaire containing 8 items, each with a 4-point scale. The questionnaire evaluates daytime sleepiness in patients with sleep disorders.

### *Statistical Analysis*

The SPSS statistical package, version 10.1 for Windows (SPSS, Chicago, Illinois, USA) was used for the statistical analysis. The results were presented as means (SD) or absolute numbers and percentages. Quantitative variables were compared using the *t* test for independent samples. Qualitative variables were compared using the $\chi^2$ test. Statistical significance was set at $P<.05$.

## Results

### *Clinical and Anthropometric Characteristics*

Of the 2888 patients included, 2464 were men and 424 were women (male-to-female ratio of 6:1). That ratio was 10:1 in the group of younger patients (under 45 years) and 5:1 in the group of older patients.

Statistically significant differences in age, body mass index (BMI), and neck and hip circumference were found. Daytime sleepiness and blood pressure readings were similar in men and women (Table 1).

*Polysomnographic Variables*

No significant differences between male and female patients were found for most of the polysomnographic variables. The number of respiratory events (assessed by the AHI), total sleep time and sleep efficiency, and percentage of time in rapid eye movement (REM) and non-REM stages were similar for both sexes. However, sleep latency was significantly longer and oxygen saturation significantly lower in women than in men (Table 2).

On stratification of men and women into subgroups of younger and older patients, differences were maintained in BMI (Tables 3 and 4), while it is noteworthy that there were no differences between men and women for any of the polysomnographic variables in the younger group. However, in the older group, statistically significant differences between men and women were maintained for sleep latency and saturation values (Tables 3 and 4).

TABLE 2
**Polysomnographic Variables**[a]

| | Men (n=2464) | Women (n=424) | *P* |
|---|---|---|---|
| TST, min | 332 (66) | 324 (68) | NS |
| Sleep latency, min | 23 (28) | 27 (32) | .004 |
| Sleep efficiency, % | 76 (27) | 75 (16) | NS |
| Arousal index | 35 (28) | 34 (25) | NS |
| Stage 1+2, % | 84 (12) | 85 (12) | NS |
| Stage 3+4, % | 9 (11) | 9 (11) | NS |
| REM, % | 5 (3) | 4 (3) | NS |
| AHI | 35 (25) | 32 (26) | NS |
| Minimum $SaO_2$, % | 78 (11) | 75 (12) | <.0001 |
| Mean $SaO_2$, % | 92 (4) | 91 (5) | <.05 |

[a]Data are expressed as means (SD).
Abbreviations: AHI, apnea-hypopnea index; NS, not significant; REM, rapid eye movement; SaO2, arterial oxygen saturation; TST, total sleep time.

TABLE 3
**Polysomnographic Variables in Young Patients (≤45 Years)**[a]

| | Men (n=658) | Women (n=65) | *P* |
|---|---|---|---|
| Age, y | 36 (5) | 36 (6) | NS |
| BMI | 30 (6) | 34 (10) | .007 |
| Epworth score | 12 (4) | 12 (5) | NS |
| TST, min | 343 (63) | 341 (55) | NS |
| Sleep latency, min | 20 (24) | 22 (23) | NS |
| Sleep efficiency, % | 81 (34) | 80 (13) | NS |
| Arousal index | 33 (30) | 30 (27) | NS |
| AHI | 32 (26) | 28 (30) | NS |
| Stage 1+2, % | 80 (14) | 86 (13) | NS |
| Stage 3+4, % | 13 (13) | 10 (12) | NS |
| REM, % | 5 (3) | 3 (3) | NS |
| Minimum $SaO_2$, % | 80 (11) | 81 (11) | NS |
| Mean $SaO_2$, % | 93 (4) | 93 (6) | NS |

[a]Results are expressed as means (SD).
Abbreviations: AHI, apnea-hypopnea index; BMI, body mass index; NS, not significant; REM, rapid eye movement; $SaO_2$, arterial oxygen saturation; TST, total sleep time.

TABLE 4
**Polysomnographic Variables in Older Patients (>45 Years)**[a]

| | Men (n=1806) | Women (n=359) | *P* |
|---|---|---|---|
| Age, y | 57 (8) | 60 (9) | <.0001 |
| BMI | 31 (5) | 33 (7) | <.0001 |
| Epworth score | 11 (5) | 11 (5) | NS |
| TST, min | 327 (67) | 321 (70) | NS |
| Sleep latency, min | 24 (29) | 29 (34) | .009 |
| Sleep efficiency, % | 74 (23) | 74 (16) | NS |
| Arousal index | 35 (27) | 34 (24) | NS |
| AHI | 35 (25) | 33 (25) | NS |
| Stage 1+2, % | 85 (12) | 85 (12) | NS |
| Stage 3+4, % | 8 (11) | 9 (11) | NS |
| REM, % | 5 (3) | 5 (3) | NS |
| Minimum $SaO_2$, % | 78 (11) | 74 (12) | <.0001 |
| Mean $SaO_2$, % | 92 (4) | 91 (5) | .033 |

[a]Results are expressed as means (SD).
Abbreviations: AHI, apnea-hypopnea index; BMI, body mass index; NS, not significant; REM, rapid eye movement; $SaO_2$, arterial oxygen saturation; TST, total sleep time.

## Discussion

The study results highlight that women with SAHS are older and more overweight than men, although men did show certain features of central obesity associated with SAHS (neck circumference). SAHS was diagnosed much more frequently in men, with a male-to-female ratio of 6:1.The severity of SAHS, assessed by the AHI, and the percentage of time in different stages of sleep were the same for both sexes. Only sleep latency was slightly higher and oxygen desaturation slightly greater in women.

Our study confirmed the results of other studies in the sense that the male-to-female ratio in the clinical series was much greater than might be expected from population-based studies.[5-7] This discrepancy has been explained by sex-related differences in the perception of symptoms, as well as sociocultural factors.[7]

Other investigators have also noted that women are older than men when they seek care.[8,13] Quintana-Gallego et al[8] suggested that the women in their study were older at the time of diagnosis because of a higher prevalence of sleep-disordered breathing after menopause. Similarly, Vagiakis et al[13] concluded that older age and associated hormonal changes are factors that predispose women to onset of the disease. These affirmations are consistent with the results of our study, where women with SAHS were older than men and their age suggested they were postmenopausal. This hypothesis was supported by the observation that the male-to-female ratio was 10:1 in the younger group of patients, whereas in the group of those over 45 years (which would include postmenopausal women) the ratio was 5:1.

The only symptom evaluated in our study was daytime sleepiness. In both groups, the degree of sleepiness was mild. The lack of significant differences on the Epworth scale might be explained by the fact that disease severity, as well as sleep structure and total sleep time, were similar for both sexes.

Obesity is a factor that predisposes individuals to SAHS. Nevertheless, some authors such as Quintana-Gallego et al[8] claim that the distribution of body fat is a stronger predictor of SAHS than BMI itself. Thus, although women have a higher BMI, SAHS severity (assessed by the AHI) did not differ between men and women. In the Wisconsin cohort study, for each range of AHI scores, women had a higher BMI.[2] The patients in our study had a high BMI, and women a higher BMI than men. Our findings are consistent with other studies that found that women were more overweight than men.[8,14,15]

Although most studies show significant AHI differences between the sexes, with men having more severe SAHS, we found no significant differences in this index.[7,14-16] This discrepancy with those studies may be attributable to the older age of the patients in our sample or to differences in the criteria for diagnosing SAHS.[16] It is important to highlight that desaturation is greater in women than men. While this may be related to differences in the characteristics of the respiratory events (higher percentage of apneas or longer duration), the most likely explanation is that desaturation is related to the greater degree of obesity and the stronger protective effect of female hormones. In the younger group, there were no differences in desaturation between men and women, perhaps because the stimulating effect that hormones have on breathing may play a protective role at those ages.

Men and women therefore show similar clinical manifestations and polysomnographic results. However, the ratio of men to women in our case series is 6:1, while the prevalence of SAHS in men and women is evenly balanced in the general population. The difference between men and women in terms of seeking medical care is probably related to social and cultural factors in a health system like Spain's, which is universal and free. It may be that the social role of women and a less conscientious attitude towards looking after their health contribute to their lower demand for health care. In some respects, it would be another example of social discrimination suffered by women.

In short, women seek medical care for SAHS at an older age than men. Of the clinical variables studied, only BMI was greater in women; other clinically significant differences were not observed. Polysomnographic variables were similar for men and women, except for greater sleep latency and lower minimum and mean oxygen saturation in women.

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