Gender and Obstructive Sleep Apnea Syndrome, Part 1: Clinical Features

Fotis Kapsimalis MD1 and Meir H. Kryger, MD, FRCPC2

1Respiratory Medicine Department, Thriasio General Hospital of Elefsina, Athens, Greece; 2Sleep Disorders Centre, St. Boniface General Hospital Research Centre, Section of Respiratory Diseases and Department of Medicine, University of Manitoba, Winnipeg, Manitoba, Canada

Summary: In the two decades after obstructive sleep apnea syndrome (OSAS) was described, it was considered a disease primarily of males. As a result, for many years, epidemiologic studies of the general population examining the prevalence of OSAS included only males and investigators examined almost exclusively males in their pathophysiology studies. It has been widely recognized that OSAS in women is not as rare as it was originally believed. Whereas early studies of clinic populations suggested that females made up about 10% or less of OSAS cases, later studies of the general population suggest that about a third of all cases are females. This suggests that there may be clinical under-recognition of OSAS in females. We explore the reasons for the male predominance of OSAS, and the clinical under-recognition in females by examining differences in clinical presentation and polysomnography findings between male and female patients.

Key words: Sleep apnea; gender; sex; hormones; control of breathing; obesity

INTRODUCTION

IN THE DECADES FOLLOWING THE FIRST CLINICAL DESCRIPTIONS OF ABNORMALITIES OF BREATHING DURING SLEEP,1-3 medical specialists became progressively more concerned about these disorders. The most widely studied sleep breathing disorders include: obstructive sleep apnea syndrome, central sleep apnea syndrome, Cheyne-Stokes breathing syndrome and sleep hypoventilation syndrome.4 The upper-airway resistance syndrome, (UARS) results from cyclical increases in upper-airway resistance leading to brief arousals and daytime sleepiness.5 Whether UARS is a distinct syndrome or a variant of OSAS has been a matter of debate.6,7 When obesity leads to hypoventilation, the term obesity-hypoventilation syndrome or the Pickwick Syndrome is often used. Sleep-disordered breathing or sleep-related breathing disorder are terms commonly used to describe all these disorders.

Obstructive sleep apnea syndrome (OSAS), the most common of this group of disorders, is a condition in which there are repeated episodes of upper-airway obstruction during sleep. The physiologic mechanisms that terminate the obstruction lead to sleep fragmentation. The nocturnal symptoms of this syndrome include snoring and apneas witnessed by the bed partner. The main daytime symptom is excessive sleepiness.8 OSAS has been the most widely studied sleep breathing disorder, and it is the only one for which there exists a body of epidemiologic data. This report will therefore focus on OSAS, but will mention UARS where published data warrants inclusion.

OSAS may have several important effects on public health. It has been suggested that sleep breathing disorders are associated with many common health problems such as arterial hypertension,9,10 ischemic heart disease,10,11 cardiac arrhythmias,12 and stroke.12,13 OSAS is also associated with a poor quality of life and poor work or school performance.15,16

The early epidemiological studies of OSAS included only men until 1993, when Young et al. for first time included women in a large study of prevalence of OSAS in a general population sample.17 (Table 1) The likely reason for women being omitted from epidemiological studies was because reports from clinics in the 1970s and 1980s suggested that OSAS was primarily a disease of males and review articles from that era stated that the male:female ratio for the disorder varied from 60:1 to 10:1.18 More recent studies on general populations have reported a male:female prevalence ratio only of about 2:1 to 3:1. The reason for the now demonstrated higher prevalence of OSAS in females has not been widely investigated. One hypothesis that has been put forth is the possibility that women have different manifestations from men and are missed on this basis leading to a gender bias.19 Another documented unintentional possible bias is that some researchers may study mainly males in diseases that affect both genders.19,20 For example, even some recent epidemiologic studies of OSAS had only male subjects,21,22 and an CPAP compliance report only included male subjects.23 In some reports this may be due to the study being done at an institution that deals primarily with males (e.g., hospitals that treat military veterans).24

Another unintended bias facing female patients is related to the criteria used by agencies approving use of CPAP treatment. For example, the major government funder in the USA required an apnea index of 30 for CPAP treatment reimbursement. In some studies (see below section "PSG findings") the average female with OSAS had an apnea index of less than 30 and therefore would have been denied treatment. In April 2002 new guidelines for reimbursement approved treatment if apnea hypopnea index was between greater than 15 or if AHI were greater than 5 in the presence of sleepiness, impaired cognition, mood disorders or insomnia, or documented cardiovascular disease (http://www.hcfa.gov/coverage/8b3-bbb2.htm; accessed April 5, 2002). This now made bias based on gender less likely.

We will address the influence of gender in sleep-disordered breathing. First, we will review gender differences in the clinical
setting, prevalence, symptoms, and polysomnographic (PSG) findings. Second, in an accompanying review, we discuss possible pathophysiologic mechanisms that could explain the male predominance of this disease. Possible factors that have been proposed and investigated include obesity, fat distribution pattern, upper-airway function, control of breathing, and the influence of hormones.

The Clinical Evidence on Gender Prevalence in OSAS

In the mid 1950s, the two classical case reports that linked awake hypoventilation and obesity described one male patient each. An abstract published about the same time described four cases, but the gender of the cases was not mentioned. The disorder became known as the Pickwick Syndrome although the term obesity hypoventilation (OHS) eventually became more frequently used. In the mid to late 1960s, three groups published sleep findings in this type of patient and the concept of sleep breathing abnormalities causing symptoms began and culminated in a symposium in Rimini in 1972 called "Hypersomnia and Periodic Breathing." Almost all the cases described up to that point in time were males and most had the OHS.

By the mid 1970s it should have been apparent that women could have these disorders. Two papers reported that Pickwick Syndrome patients had a very high mortality. In one, 12 of 22 patients were females; in the other 7 of 10 were females. It soon became apparent that awake hypoventilation was not a sine qua non of sleep breathing disorders, and variations of the name "obstructive sleep apnea syndrome" became widely used.

The range reported by clinics for the percent of OSAS cases made up by women is very broad, varying from 0% to 35% (Table 2). For example, Lugaresi et al. in 1978 reported that females made up 6.5% of a clinical series. In 1977, Guilleminault et al. reported a series with no females, and the same group in 1978 reported that women represented only 4% of their OSAS cases and in 1988 reported that females made up about 12% of cases. It is, therefore, not entirely surprising that OSAS became a “male” disorder and authors stated that the male:female ratio was 60:1 to 10:1. By modern standards the case series were all fairly small at a time when there was almost no clinical recognition of the disorder. Guilleminault et al. in 1977 stated that it took about three years to diagnose 25 OSAS cases. The fact that OSAS was a disorder of males was extrapolated from small numbers of patients referred to clinics.

Some more recent studies from clinics have reported a larger proportion of females. Leech et al. in a clinical population study of 118 OSAS patients reported that there were 41 women (35%). Data from the clinical sleep laboratory of one of the authors (MK) of this review show that over the last decade the proportion of females referred for (Figure 1) and diagnosed (Figure 2) with OSAS were remarkably constant. For the entire decade the values were 27% (male:female ratio= 2.7) and 23% respectively (male:female ratio= 3.4).

There have been few reports that have rigorously examined the prevalence of OSAS and UARS in a group of patients thought to have a sleep breathing disorder. Mohsenin found that of 130 consecutive patients found to have a sleep breathing problem (OSAS or UARS), 60% were males and 40% were females. Males with a sleep breathing disorder were three times more likely to have OSAS (73% of the males) than UARS (27% of the males). In contrast, females with a sleep breathing disorder were more likely to have UARS (63% of the females) than OSAS (37% of the females). This suggests that male:female ratio for sleep breathing disorders may be closer to 1.5:1.

In summary, clinical studies show a higher prevalence of male OSAS cases than female OSAS cases although the gender-related differences are much less than once believed. If one includes

<table>
<thead>
<tr>
<th>First author</th>
<th>Year</th>
<th>Men (No)</th>
<th>Women (No)</th>
<th>% Women</th>
<th>M:F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guilleminault</td>
<td>1977</td>
<td>25</td>
<td>0</td>
<td>0</td>
<td>nm</td>
</tr>
<tr>
<td>Lugaresi</td>
<td>1978</td>
<td>29</td>
<td>2</td>
<td>6.5</td>
<td>14.5</td>
</tr>
<tr>
<td>Block</td>
<td>1979</td>
<td>20</td>
<td>3</td>
<td>13.0</td>
<td>6.7</td>
</tr>
<tr>
<td>Guilleminault</td>
<td>1978</td>
<td>48</td>
<td>2</td>
<td>4.0</td>
<td>24.0</td>
</tr>
<tr>
<td>Kales</td>
<td>1985</td>
<td>43</td>
<td>7</td>
<td>14</td>
<td>6.1</td>
</tr>
<tr>
<td>Guilleminault</td>
<td>1988</td>
<td>225</td>
<td>27</td>
<td>10.7</td>
<td>8.3</td>
</tr>
<tr>
<td>Leech</td>
<td>1988</td>
<td>77</td>
<td>41</td>
<td>34.7</td>
<td>1.9</td>
</tr>
<tr>
<td>Hoffstein</td>
<td>1993</td>
<td>235</td>
<td>40</td>
<td>14.5</td>
<td>5.9</td>
</tr>
<tr>
<td>Lavie</td>
<td>1997</td>
<td>1456</td>
<td>164</td>
<td>10.1</td>
<td>8.9</td>
</tr>
<tr>
<td>Kapsimalis#</td>
<td>2002</td>
<td>1888</td>
<td>549</td>
<td>22.5</td>
<td>3.4</td>
</tr>
</tbody>
</table>

% women is the percentage of all OSAS cases made up by females; M:F is number male cases divided by number of female cases; #The data for Kapsimalis is extracted from data presented in Figure 2; nm; not meaningful.
UARS cases, the gender differences appear to be even less.

The Epidemiologic Evidence on Gender Prevalence in OSAS

Epidemiological studies of sleep apnea that involve the general population suggest that OSAS is much more common in females than had been suggested by reports from clinics. About 2% of adult females may have OSAS. Clinics have generally reported male:female ratio of OSAS of about 6:1 or greater. General population epidemiological studies suggest the ratio is only 2-4:1. This suggests that there is a clinical under-recognition of OSAS in females.

Young et al. reported a random general population sample of 602 men and women of middle age and showed a male:female ratio of about 2:1 for undiagnosed sleep apnea, which would suggest that about 33% of the apnea population is made up of females. Ohayon et al.’s data also suggested that about 30% of cases are females.

We are not aware of community-based epidemiologic studies of UARS.

In summary, OSAS is not rare in women. Although the predominance of males is much less than previously described, epidemiological data suggests that individuals with a clinical presentation of OSAS are still twice as likely to be male. Possible reasons for this difference and the overall under-recognition of OSAS in women are discussed in the following sections.

Impact of Gender on Symptoms of OSAS

Possible explanations for the clinical under-recognition of OSAS women might be that women have different symptoms, different severity of symptoms, or they underreport their symptoms. Another possibility is that women are referred less frequently to the sleep clinics for laboratory evaluation. Women could have different manifestations of sleep apnea and current indications for referral and performing a study would fail to evaluate and diagnose their disorder. Thus, it is important to know

---

Table 3—Clinical differences between male and female OSAS patients

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snoring, gasping, observed apnea</td>
<td>+++</td>
<td>+</td>
</tr>
<tr>
<td>Sleepiness</td>
<td>+++</td>
<td>++</td>
</tr>
<tr>
<td>Morning headaches</td>
<td>+</td>
<td>+++</td>
</tr>
<tr>
<td>Features of depression</td>
<td>+</td>
<td>++</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Obesity</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI</td>
<td>++</td>
</tr>
<tr>
<td>Upper body fat distribution</td>
<td>++++</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hormonal status and apnea prevalence</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Male vs. premenopausal female</td>
<td>+++</td>
</tr>
<tr>
<td>Male vs menopausal female</td>
<td>++++</td>
</tr>
<tr>
<td>Male vs menopausal female on HRT</td>
<td>++++</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Craniofacial features</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Retrognathia</td>
<td>+</td>
</tr>
<tr>
<td>Posterior airway space</td>
<td>++</td>
</tr>
<tr>
<td>Enlarged tongue</td>
<td>++</td>
</tr>
<tr>
<td>Long soft palate</td>
<td>++</td>
</tr>
<tr>
<td>Inferior position of hyoid bone</td>
<td>+</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Co-morbidities</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial hypertension</td>
<td>+</td>
</tr>
<tr>
<td>Ischemic heart disease</td>
<td>++</td>
</tr>
<tr>
<td>Depression</td>
<td>+</td>
</tr>
<tr>
<td>COPD</td>
<td>++</td>
</tr>
<tr>
<td>OHS</td>
<td>+</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PSG Findings</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Apnea frequency</td>
<td>++</td>
</tr>
<tr>
<td>Hypopnea frequency</td>
<td>+</td>
</tr>
<tr>
<td>Length of apnea episodes</td>
<td>+</td>
</tr>
<tr>
<td>Oxygen desaturation</td>
<td>+</td>
</tr>
<tr>
<td>NREM apneas frequency</td>
<td>+</td>
</tr>
<tr>
<td>REM apneas frequency</td>
<td>+</td>
</tr>
<tr>
<td>Arousal frequency</td>
<td>+</td>
</tr>
</tbody>
</table>

The number of +s is a qualitative index comparing findings in males and females. For example BMI is greater in females with OSAS than in males, but upper body fat distribution is more common in males with OSAS.
whether gender-related symptom differences exist that might contribute to a clinical under-recognition of OSAS in females.

Several studies examined the symptoms reported by male and female OSAS patients. Redline et al. found that women report the classic symptoms of OSAS less frequently than men. They examined two groups: a laboratory (or clinical) sample and a community sample. The laboratory sample was a group of 36 patients (5 females, 31 males) with confirmed OSAS (apnea-hypopnea index (AHI)>15), who had been referred to a sleep laboratory. The community sample of OSAS was made up of 65 cases (24 females, 41 males) found in 353 neighbors and relatives of the laboratory sample. In the clinical sample, the symptoms of snoring, snorting, gasping, witnessed apnea, and daytime somnolence were equally present among a majority of both men and women with laboratory-diagnosed OSAS. On the other hand, in the community sample, males were two to threefold more likely to report their symptoms than the females, even after adjusting for the level of apneic activity. Clinicians may rely more on self-reported apnea and the quantitative aspects of snoring—symptoms that have been associated with apneic activity in predominant male populations. The authors suggested that reliance on self-reported apnea may contribute to under-recognition of apneic activity in women. Ambrogetti et al. reported similar findings as Redline et al. in a study of sleep apnea symptoms in a clinically based population with OSAS. Forty percent of female patients did not report apnea, choking, or restless sleep while almost all males did.

In contrast, Young et al. in a community-based sample of 551 men and 388 women, reported that the symptom profile of women with OSAS was similar to that of men. The analysis showed that women with mild (AHI from 5 to <15) and more severe (AHI of >15) sleep apnea generally report the same symptoms (loud snoring, snorting, breathing pauses) as do men with the same degree of sleep apnea severity. There were no unique symptoms for women. The same study showed that daytime fatigue (60.8% vs. 49.1%), morning headaches (12.5% vs. 3.3%), anxiety, and signs of depression (6.6% vs. 2.7%) are more frequently reported by women regardless the severity of OSAS. Similar findings were reported by Ambrogetti et al. Pillar et al. found that women report symptoms of fatigue, insomnia, tension, and use of sedatives more frequently than men. In contrast, men with OSAS report excessive daytime sleepiness more frequently than women. Thus, women may be misdiagnosed as having depression and have a delayed diagnosis of OSAS more frequently than men. A very recent study that looked at what OSAS patients were being treated for before their OSAS diagnosis, found that female patients were two times more likely to be treated for depression than male patients perhaps because the classic symptoms of apnea could be misinterpreted to represent depression. The presentation of women with the more atypical symptoms, in addition to the classic symptoms, could make physicians turn to other diagnostic possibilities.

One might conclude that either women fail to seek help for sleep apnea or medical care providers fail to respond to these symptoms. In fact, women with OSAS are heavier users of health care resources and see doctors more often before OSAS is confirmed than male patients. Instead, women might be more symptomatic at lower AHI of 2 to less than 5 events/h. This may be due to a higher prevalence of UARS in women.

Guilleminault et al. studied the presentation of UARS in 334 women, aged 18 years and older, and compared them to 100 men with the syndrome. Most of the women with UARS had an AHI less than 5. The presenting symptom was tiredness or fatigue in 83% of cases and sleepiness in only 13% of cases. The most interesting finding was that 43% of premenopausal women in the group had amenorrhea or dysmenorrhea. Symptoms of depression were also reported in 40.5% of cases. A more recent report from this group suggests that 56% of UARS cases are females and insomnia is a common complaint. Mohsenin reported that subjective sleepiness was similar in males and females with UARS; the degree of sleepiness in UARS was similar to that seen in OSAS patients in both genders.

In summary, the reasons for differences in OSAS prevalence between clinical population studies and community sample studies might be differences in symptom reporting between men and women, with possible misinterpretation of symptoms by health providers who have a low awareness of the possibility of OSAS in females because of the male stereotype.
Obesity

Female OSAS patients are much more obese than male patients.\(^{17,19,35,36,43}\) Obesity seems to be the dominant factor for the appearance of OSAS in women when matched with men for age and the degree of sleep disturbance.\(^{35}\) In the Wisconsin Sleep Study Cohort, women had a higher BMI than men did at each level of respiratory disturbance index (RDI). Women with an RDI of 15 or more had mean BMI of 41.4 \(\text{kg/m}^2\) compared with 33.3 \(\text{kg/m}^2\) for men.\(^{19}\)

There is evidence that obesity is greater in younger, compared to older, patients with OSAS, especially in females. In the study of Redline et al.\(^{44}\) BMI was higher among younger females (<55 years of age) than males (41 \(\text{kg/m}^2\) vs 35 \(\text{kg/m}^2\)). BMI was similar among older males and females with OSAS (30.8 vs 31). The younger men with OSAS were heavier than older men, (35.1 vs. 30.8) but there were more marked differences between younger and older females (41 vs. 31). Thus, in this study there are older women with OSAS who are not morbidly obese. Other factors, such as age and changes in female hormonal status, may play a role in the appearance of OSAS in women (see below).

Bixler et al. in a epidemiologic study of OSAS in women found that prevalence was higher in postmenopausal women than in premenopausal women (3.9% vs 0.6%) and obesity was more marked in premenopausal women than in postmenopausal women.\(^{42}\) All premenopausal women and postmenopausal women on hormone replacement therapy (HRT) who had OSAS were obese with BMI>32.3 \(\text{kg/m}^2\). In contrast only 49.4% of OSAS (AHI>15) postmenopausal women without HRT were obese. Many studies found that premenopausal women with OSAS are more obese than the postmenopausal women.\(^{35,44,50}\) Thus obesity is characteristic of young females with OSAS.

Rajala et al.\(^{51}\) in a study of OSAS in a population with morbid obesity (BMI>40) found that the occurrence of OSAS was higher in men than in women (76.9% vs 71.1%) despite their similar BMI. Guilleminault et al.\(^{35}\) also reported that premenopausal women had more severe OSAS than postmenopausal women despite their similar degree of obesity. Thus, obesity could not itself be the only risk factor of sleep apnea in women.

Guilleminault et al.\(^{49}\) in their study of UARS in women reported that most of the women with UARS (AHI<5) were not obese, while women with AHI>15 had a high BMI. Most of them were premenopausal. Thus, women did not have to be morbidly obese in order to develop a sleep breathing disorder.

In summary, female OSAS patients as a group are more obese than male patients, and obesity is more marked in premenopausal OSAS patients than in postmenopausal patients. Females patients with UARS are generally not obese.

Fat Distribution

Millman et al.\(^{52}\) examined fat distribution measurements (triceps and subscapular skin folds, the sum of skin folds, waist circumference) and BMI in 25 out of 65 women diagnosed with OSAS and compared them to 45 men with OSAS. Men had larger subscapular skin fold thickness, waist to hip ratio, and neck circumference. These findings confirm the upper-body obesity pattern that is characteristic of males.\(^{53,54}\) They demonstrated that although women with SDB are more obese than the general female population, upper-body obesity is also an important risk factor of sleep apnea severity in women. Men had more severe apnea at an equivalent degree of obesity, as measured by BMI. This might reflect a greater degree of upper-body fat distribution in men compared to women.

In contrast, Guilleminault et al.\(^{49}\) found that although women with AHI>15 were more obese and had large neck circumference, most of the women with the UARS (AHI<5) were younger, not obese, and had a small neck circumference. Men with UARS had larger necks than women. Thus, other factors, such as anatomical and structural abnormalities, may explain the appearance of SDB in these women.

In summary, although men with OSAS are less obese than females with OSAS, the distribution of fat (e.g., the greater upper-body fat distribution and fat in the neck) may in part explain the greater prevalence of OSAS in males.

Craniofacial Abnormalities

Patients with OSAS can be subdivided into three different groups: 1) a population with clear craniofacial anatomic abnormalities and no obesity; 2) a population with morbid obesity and no abnormal craniofacial measurements; and 3) a population with a combination of both to a varying degree.\(^{56}\)

Male OSAS patients have been shown to have certain craniofacial abnormalities when compared to normal subjects. The most frequently reported are a small posteriorly placed mandible (retrognathia), a narrow posterior airway space (PAS), an enlarged tongue and soft palate, and an inferiorly positioned hyoid bone (measured with the mandibular plane-hyoid bone distance (MP-H)).\(^{57}\)

Guilleminault et al.\(^{35}\) described certain cephalometric variables in women. In this study, women with OSAS were found to have a longer soft palate, a longer MP-H, and a smaller PAS than control women. These findings were not dependent on hormonal influence because the findings were the same when only premenopausal OSAS women were compared to the control group. When OSAS women were compared to OSAS men, they had shorter soft palates than men. The MP-H distance was similarly abnormal in both men and women. Thus, women, according to the authors, either have less upper-airway anatomic abnormalities or require greater body fat infiltration before they have reduction in PAS. Craniofacial abnormalities were not sufficient to explain the male predominance because they are present in both men and women.

Wilhoit et al.\(^{50}\) reported that premenopausal women with OSAS have upper-airway anatomic abnormalities more frequently than postmenopausal women and men with OSAS. Lee et al. in a cephalometry study showed that Caucasian men and women have different posterior airway space and different MP-H distance (low position of hyoid bone).\(^{58}\)

Guilleminault et al.\(^{49}\) found abnormal craniofacial features in 45% of 338 women with UARS. Women with mild apnea (<5 events/h) had certain characteristics such as a narrow hard palate, overjet, triangular chin, and class II malocclusion. These women were not generally overweight, and these anatomical abnormalities might predispose to the UARS. About 32% of patients in a large series of UARS reported later by the same group were of East Asian origin, suggesting that the findings might reflect local demographics.\(^{7}\)

In summary, differences in craniofacial anatomy may play a
role the differences in the prevalence of OSAS in males and females. Further studies are required to determine whether morphometric features explain the apparent high percentage of UARS cases made up by females. It is possible that there occurs clinical under-recognition of UARS in males.

Hormonal Status and Age

Normal women have a reduction in apnea/hypopnea index from already low normal values during pregnancy in spite of increasing weight and worsening of lung mechanics. Even obese women seem protected from developing OSAS during pregnancy. These findings suggest that there is a protective effect perhaps related to the high level of circulating progesterone during pregnancy.

Early reports suggested that OSAS in females occurs exclusively in postmenopausal women, and premenopausal women were protected by the female hormones. The majority of OSAS women are postmenopausal and older than OSAS men. The prevalence of sleep apnea was similar in premenopausal (0.6%) and postmenopausal women on hormone replacement therapy (HRT). Post-menopausal women without HRT had a higher prevalence of 2.7% which was similar to that of men (3.9%) but still significantly less than men when adjusted for age and BMI. Thus, menopause is a significant risk factor for sleep apnea suggesting that female sexual hormones appear to reduce the risk for OSAS. Dancey et al. confirmed the high prevalence of OSAS in postmenopausal women and found that most OSAS female patients are postmenopausal.

In summary, female hormones may reduce the risk of developing OSAS. Reduction of the levels of female hormones as occurs with menopause is a risk factor for the development of OSAS in women or may result in the worsening of an already present sleep breathing disorder.

Comorbidities

OSAS patients commonly are diagnosed with other medical conditions. These include arterial hypertension, congestive heart failure, cardiac arrhythmias, obstructive airways disease, and depression.

Obesity hypoventilation syndrome seems to be at least as common in females as males. Smith et al. reported what OSAS patients were being treated for in the five years before OSAS diagnosis. Female OSAS patients were twice as likely to be diagnosed with depression and COPD than male OSAS patients; but men were more likely to be diagnosed with ischemic heart disease. This might be explained by the differences in fat distribution, smoking, and hormonal environment. A previous study also reported that COPD was more common in women with OSAS. There do not appear to be gender-related differences in the association of SDB with arterial hypertension.

In summary, there are gender-related differences in comorbidity in OSAS patients. Female OSAS patients are more frequently diagnosed with depression and COPD than male OSAS patients and seem equally likely to have OHS. Male OSAS patients are more likely to have been diagnosed with ischemic heart disease.

PSG Findings

Leech et al. found among 118 OSAS patients (77 men and 41 women) that women, although they have similar frequency of respiratory events, have more hypopneas rather than frank apneas (70% of events vs. 50% in men), and when apneas are present they tend to be shorter than in men (14 vs. 18 sec).

Another recent study that examined the influence of age and gender on duration and frequency of sleep apnea events, found that men had more frequent apneas only in stage 2 but not in REM sleep, and this difference was diminished with increased age. Also, the duration of events increased with age in both men and women, but men had slightly longer apnea events than women and more severe oxygen desaturation. In stage 2 sleep, only in men, the frequency of apnea was significantly related to BMI. In REM sleep, more frequent apnea events for both men and women were related to increased BMI. In stage 2 sleep women with a greater BMI had slightly shorter apnea events. In REM, apnea duration increased with BMI but significantly only in men. Thus in men, an increase in frequency and duration of apnea events (either in stage 2 or REM) is associated with an increase in BMI.

O'Connor et al. in a clinical study categorized patients as having one of three main patterns of apnea that were mutually exclusive: 1) supine OSA that occurred almost exclusively while the patient was supine; 2) non-position related OSA; and 3) REM-related when the apneas occurred almost exclusively in REM sleep. This group reported that women had most of their events during REM sleep and 62% of female OSAS patients were categorized as being in the REM-related apnea group compared to 24% of men being categorized in the REM-related apnea group. This difference was not age or weight dependent. During NREM sleep men had a higher apnea/hypopnea index than females, while during REM, the apnea/hypopnea index was similar in men and women. Supine and non-position related apnea were more common in males than females with OSAS.

Smith et al found that the average AHI of 174 females with OSAS was 28 (43). Mohsenin (37) reported PSG findings in 130 consecutive patients with sleep breathing disorders (OSAS and UARS). AHI was lower in female than male OSAS patients (24 versus 62). In males the arousal index was much higher in those with OSAS than UARS (70 versus 20). In females the difference between OSAS and UARS was less marked (36 versus 24). Males and females with UARS had similar arousal indices.

In summary, PSG findings are different in male and female OSAS patients. In general, apnea is less severe and more likely to be REM-related in female than male OSAS patients. Sleep fragmentation as measured by arousal index was similar in male and female patients with UARS.

Summary

OSAS prevalence is higher in men than women, although the predominance of males is much less than previously described. Females with OSAS as a group have less severe apnea even though they are more obese than men with OSAS. The impact of UARS on the overall prevalence and gender distribution of sleep breathing disorders is not clear since large community-based epidemiologic studies on UARS have not been reported. OSAS is more frequent in postmenopausal women than premenopausal women. Premenopausal women with OSAS are heavier than postmenopausal females. The marked difference in the male:female ratio for OSAS in clinical populations versus gener-
al population studies suggest that OSAS in women is often unrecognized because females with OSAS may under-report their symptoms and sometimes their symptoms may lead to an alternate diagnosis such as depression.

REFERENCES


