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Diagnostic indicators of sleep apnea in older women and men: A prospective study☆

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Abstract

Objective: The purpose of the present prospective study of older adults was to (1) explore the nature and frequency of sleep disorder in a sample of self-identified, sleepy/tired individuals and (2) compare symptom presentation of women and men who were subsequently diagnosed with sleep apnea/hypopnea. **Method:** Participants were 112 community-based older adults self-identified with daytime sleepiness, fatigue, or insomnia. They underwent medical examination and overnight polysomnographic recording. Sleep quality, daytime sleepiness, fatigue, psychological adjustment, and perceived health were evaluated by self-report measures. **Results:** Results indicated (1) a very high rate of sleep disorder identified by the self-selection process, (2) a male-to-female ratio of 1.2 to 1 for diagnosed apnea/hypopnea syndrome, (3) similar severe apnea signs and symptoms reported by both men and women, and (4) virtually no differences in psychological adjustment and few perceived differences in health limitations between men and women. (5) Female participants with sleep apnea/hypopnea could not be distinguished from participants with insomnia only on the basis of reported symptom presentation alone. **Conclusion:** Our findings suggest a strategy for identifying individuals for referral to a sleep laboratory. The findings also underline the diagnostic importance of medically unexplained complaints of daytime fatigue or sleepiness in older adults for the diagnosis and, ultimately, the effective management of sleep apnea and its attendant health risks.

Keywords: Diagnosis; Sleep apnea; Symptom presentation

Introduction

Sleep apnea and the respiratory disorders related to it are very common in the older population and significantly underdiagnosed [1,2]. Individuals with sleep apnea are often unaware of the nighttime symptoms of this condition and complain of daytime symptoms such as fatigue and sleepiness. This makes the diagnosis difficult for primary care physicians who are rarely trained in sleep medicine [3]. The importance of accurate diagnosis is enhanced when one considers that untreated sleep apnea has serious implications for health and quality of life and that it is eminently treatable. Definitive diagnosis depends on polysomnography (PSG), usually requiring costly overnight laboratory testing. Because family practitioners are the primary sources of referral to sleep laboratories, there is a need for clear practice guidelines to identify patients who are likely to have sleep apnea as well as other sleep problems [3,4].

Prevalence rates and sex ratios

Typical population estimates of sleep apnea for middle-aged adults is less than 10%, increasing to 20–60% in older

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adults, depending on the sample and assessment method [1,5–7]. There is generally a discrepancy between population prevalence rates and referral rates to sleep laboratories. For example, in a Swedish epidemiological survey, fewer than 20% of those reporting obvious apnea signs (problem snoring and witnessed apneas) had ever been referred to a sleep clinic [8].

Women, in particular, may be underrepresented in referrals for PSG evaluation. Prevalence estimates based on population sampling of middle aged adults have reported men approximately three times more likely than women to have sleep apnea [9–11]. Typical rates of referral by primary care physicians to a sleep laboratory, however, have tended to average about 9.5:1 [9] and more recent estimates have improved to about 7.5:1 [12]. This suggests an important underrepresentation of women in referrals to sleep laboratories. In the Swedish sample, of those exhibiting apnea signs [8], the ratio of men to women who had been referred to a sleep clinic was 1.25:1.

The situation for older adults is even less clear. The sex difference in population prevalence of sleep apnea/hypopnea syndrome (SAHS) diminishes with age [10,13], as the protective advantage of estrogen is diminished for postmenopausal women [13–15].

One explanation offered in the literature about why women with sleep disorders are not identified as readily as men are at the primary care level is that men have more severe apnea than women do [10,16–20]. Another is that office-based diagnostic standards have been developed on men and, therefore, may not be appropriate for women [9,12]. The typical case definition of sleep apnea is that it occurs in sleepy, obese males who snore loudly. Women with sleep apnea may have been overlooked in the referral process because they may experience different symptom clusters than men do or because they may present their symptoms in the context of general health complaints or psychological maladjustment [12].

These possibilities and interpretations from diverse sources underline the need for a single, multidimensional survey of symptom characteristics in men and women with sleep disorders that can be used to develop distinct diagnostic profiles for use in primary care.

The present study

To explore why women are less likely than men to be referred for PSG, the present study investigated, in a prospective design, sleep disorder in a sample of community dwelling older men and women who have never been diagnosed with a sleep disorder. The purpose was twofold. The first is to investigate the presence and type of sleep disorder in older individuals with self-identified, unexplained daytime sleepiness or fatigue or nocturnal sleep difficulties. Such symptoms are more accessible to the patients themselves than are snoring or breathing events while asleep. Second is to test the hypothesis that women, unlike men, present sleep apnea/hypopnea symptoms in the context of other aspects of psychological and physical health. A difference in symptom presentation might suggest a basis for differential referral to sleep laboratories.

Method

Participants

Participants were recruited from the community through media publicity consisting of press releases, presentations, and mailings to seniors groups and notices in community clinics and residences for older adults. The publicity advertised a research study for older individuals suffering from “daytime fatigue or sleepiness or insomnia”. We chose not to distinguish between “sleepy” and “fatigued” because people have trouble differentiating the two concepts, as do most existing measures. It offered a comprehensive evaluation through interviews, questionnaires, as well as medical and polysomnographic assessment.

Selection criteria were as follows: aged 50 and over, community resident, and sufficient cognitive and language skills to complete the measures in English or French (the two official languages used in Montreal). Exclusion criteria included major illness (i.e., any illness which would account for daytime fatigue and sleepiness) or drug use known to cause daytime fatigue, sleepiness, or insomnia (as determined by our team physician), current clinically significant psychological or psychiatric disorder, dementia, parasomnias, or severe sleep phase disorder [determined by the research team according to *DSM-IV* [21], the Beck Depression Inventory (BDI; [22]), and the International Classification of Sleep Disorders [23,24]].

The final sample consisted of 88 participants (40 men and 48 women) who responded to this advertising procedure. Although 126 individuals began the research protocol, 17 dropped out after completing the questionnaires but before the visit with the team respirologist. A further 17 dropped out prior to going to the sleep laboratory. The 34 participants (17 men and 17 women) who dropped out before completing their PSG study did not differ significantly from completers on age or income satisfaction. Dropouts had more years of education than did the completers [M=16.2 vs. 14.0, $F(1,112)$=4.7, P=.032]. The mean age of the 88 participants who completed the protocol was 64.5 (range=50–88, S.D.=9.34).

Measures

Sleep

Structured sleep and medical history. A modified version of the clinical instrument developed by Lacks [25] provides information on obstructive sleep apnea, restless legs syndrome/periodic limb movement disorder (RLS/PLMD),

narcolepsy, parasomnias, physical disorders, sleep phase disorder, medication use, and use of hypnotics and sedatives. Most questions require a yes/no answer, with prompts in case of suspected difficulty. This measure has been successfully used in our previous studies of sleep and aging [26–28].

Sleep questionnaire. This is a modified version of the retrospective questionnaire used in previous investigations [26,29]. It asks participants to self-define as having an insomnia problem and inquires about both qualitative and behavioral aspects of typical sleep experiences, including bedtimes and arising times, hours slept per night, sleep onset latency (SOL), wake after sleep onset (WASO), and sleep quality and satisfaction.

Sleepiness and fatigue

Stanford Sleepiness Scale [30]. This frequently used measure of daytime sleepiness provides a measure of affective evaluation. It consists of a seven-point Guttman-scaled item ranging from 1 (*feeling active and vital; alert; wide awake*) to 7 (*lost struggle to remain awake*). Respondents select the one option that best describes how sleepy they feel, most days. The scale's authors indicate that alternate forms reliability yielded an agreement of 88%. Concurrent validity data show that the measure is reasonably highly correlated with vigilance (r=.68) and memory test (r=.47) scores.

Epworth Sleepiness Scale. This brief self-administered retrospective questionnaire of the behavioral aspects of sleepiness was constructed by Johns [31] to evaluate self-reports of sleep tendency. Participants rate how likely they are to doze off or fall asleep in eight different situations commonly encountered in daily life on a four-point scale (0=*never doze off*, 3=*high chance of dozing*). Scores are summed and vary from 0 to 24. This measure has high 5-month test–retest reliability in "normals" (r=.82), as well as high internal consistency (Cronbach's α=.88). Scores are not correlated with Stanford Sleepiness Scale scores [32,33].

Fatigue Severity Scale [34]. This nine-item scale assesses "disabling fatigue". The scale's authors report psychometric information which shows that the measure is internally consistent and largely independent of depressive symptoms. The single score differentiates controls (mean=2.3, S.D.=0.7) from lupus (mean=4.7, S.D.=1.5) and multiple sclerosis patients (mean=4.8, S.D.=1.3) and can predict clinically anticipated changes in fatigue over time. In addition, it has been successfully used in insomnia research [35].

Chalder Fatigue Scale [36]. This is an 11-item self-rating scale developed to measure the severity of experienced fatigue. The original version provided four response options: 1, "not at all"; 2, "no more than usual"; 3, "more than usual"; and 4, "much more than usual". This was revised for clinical use in our laboratory to use a six-point Likert scale where 1=*strongly disagree* and 6=*strongly agree*. The measure has subscales to evaluate two kinds of fatigue: physical and mental. A total fatigue score is obtained by summing all items. Subscale scores can be obtained by summing scores on the physical fatigue and on the mental fatigue items. The test's authors have shown that the measure has good reliability (r=.86 for physical fatigue, and r=.85 for mental fatigue) and high internal consistency as measured by Cronbach's α (.89). Validation coefficients for the scale, using the Revised Clinical Interview Schedule as applied to individuals with Chronic Fatigue Syndrome, were sensitivity 75.5 and specificity 74.5 [36].

Psychological adjustment

Beck Depression Inventory (BDI-II; [37])

The 21-item BDI is one of the most frequently used measures of depression. As in the original version, on the current revision, too, items are scored on a four-point scale (0–3); scores are summed and produce a range from 0 to 63. Higher scores indicate greater depression. A score over 20 is usually considered indicative of clinical depression, while scores of 13 or less are generally considered nondepressed. Scores from 14 to 19 are generally considered "mildly depressed". Beck et al. report excellent psychometric properties for the scale (internal consistency: r=.92; test–retest reliability: r=.93).

Spielberger State-Trait Anxiety Inventory—Form Y2 (STAI; [38])

This frequently used measure consists of two 20-item self-report scales for measuring trait and state anxiety. In the present investigation, only trait anxiety was evaluated. The trait measure asks people to describe how they generally feel on four-point Likert-type scales (1=*almost never*, 4=*almost always*). Scores range from 20 to 80. Norms are provided for males and females. Higher scores indicate greater anxiety. Psychometric properties of this scale, including reliability, internal consistency and validity, have been shown to be very good [38].

Eysenck Personality Questionnaire—Revised-Short (EPQ-R; [39])

This is a 48-item revision of the well-known Eysenck Personality Inventory (EPI) of Eysenck and Eysenck [40]. This reliable, valid, and empirically based questionnaire is among the most frequently used measures of personality [41]. Of interest to the present investigation are the dimensions of neuroticism and extraversion–introversion. Higher scores indicate greater neuroticism and extraversion.

Brief Symptom Inventory (BSI; [42])

A 53-item self-report psychological symptom inventory, the BSI has subscales for nine symptom dimensions (e.g., depression and anxiety) and three global indices. Norms are provided for males and females. It is a brief version of the SCL-90 (L.R. Derogatis, unpublished data, 1977)—a frequently used instrument with acceptable reliability and validity. Validation data indicate correlations from .92 to

.98 between the symptom dimensions and global indices of the BSI and the SCL-90 [42]. Lower scores indicate better adjustment.

Perceived health status

SF-36 Health Survey [43]

The 36-item SF-36 was constructed to survey health status in the Medical Outcomes Study. It was designed for use in clinical practice and research and assesses eight health domains: (1) limitations in physical activities because of health problems; (2) limitations in social activities because of physical or emotional problems; (3) limitations in usual role activities because of physical health problems; (4) bodily pain; (5) general mental health (psychological distress and well-being); (6) limitations in usual role activities because of emotional problems; (7) vitality (energy and fatigue); and (8) general health perceptions. The survey was constructed either for self-administration or for administration by a trained interviewer. Ware et al. [43] report reliability data from studies carried out on both patient and nonpatient samples. Reliability of the subscales ranged from .64 to .96 among different reference groups. The SF-36 has demonstrable validity in that the subscales were found to correlate with ability to work, utilization of health services, as well as other mental health and quality of life measures. Higher scores indicate better perceived health-related functioning. Canadian norms are reported by Hopman et al. [44].

Procedure

The research protocol was approved by the research ethics committees of both the SMBD-Jewish General Hospital and the Mount Sinai Hospital of Montreal. All participants gave informed consent.

Following a telephone screening interview, participants underwent the following three-stage process: a 2-h structured interview and questionnaire session (sampling sleep patterns, daytime sleepiness and fatigue, as well as psychological adjustment using the measures described above); a 30-min assessment by the team respirologist (to evaluate medical reasons for nighttime and daytime complaints); and one night of PSG in a sleep laboratory to evaluate breathing and/or movement disorders.

A nocturnal PSG assessment was carried out in a supervised sleep laboratory from 10 p.m. to 7 a.m. Monitoring included three leads EEG, EOG, bilateral anterior tibialis, and chin EMG, ECG, pulse oximetry, nasal and oral airflow with thermistor and nasal pressure cannulae, and respitrace bands for the measurement of respiratory effort [45]. All signals were acquired on a digital data management system (Sandman, Nellcor-Puritan Bennett & Tyco, Ottawa, Canada). One polysomnographic technologist with 10 years of experience manually scored the studies blind as to the results of symptom assessments. Sleep stages were first scored in 30-s epochs according to standard criteria [46]. Next, EEG arousals were scored according to standard current consensus criteria [47]. An apnea event was scored when there was a cessation of breathing for 10 or more seconds. An hypopnea was defined a priori as an event lasting at least 10 s with a decrease of >50% from a baseline in the amplitude compared with the mean of the largest three breaths over the previous four epochs, or a lesser reduction in airflow signal amplitude accompanied by either at least a 3% desaturation or an EEG arousal [48]. Leg movements, apnea events, and associated arousals were scored manually according to the scoring rules established by the Atlas Task Force of the American Sleep Disorders Association [49]. The cut-off criterion for defining a case with significant apnea/hypopnea as well as periodic limb movements was 10 or more events per hour of EEG sleep.

A diagnosis of insomnia was made based upon the exclusion of significant medical illness, the effects of chronic medication or alcohol use, or major psychiatric disorder as determined by both assessments by the study physician and the study psychologist team according to the *DSM-IV* [21] and the International Classification of Sleep Disorders [23]. This also included, as pertinent, ancillary testing for thyroid disease, anemia, renal failure, metabolic illness, hypoxemia, active cancer, central nervous system disease, and heart failure. Usually, this involved confirmation of the diagnosis with follow-up over several months and review of written sleep diaries.

Where physiologically based sleep disorders were diagnosed, the participant was followed and offered treatment by the sleep clinic. In cases where other medical, psychiatric, psychological, or insomnia disorders were diagnosed, appropriate referrals were made.

Results

Diagnostic categories

The numbers and percentages of diagnoses for the physiological sleep disorders and for insomnia are presented in Table 1. It can be seen that all participants had either physiological sleep disorders, insomnia, or both. Ninety-two percent of respondents (44 females, 37 males) were diagnosed with insomnia; 73% of the women and 88% of the men were diagnosed with SAHS. Most of them had insomnia as well. Smaller percentages were found to have only RLS/PLMD or only insomnia. Our self-referral recruitment yielded a very high percentage of physiological sleep disorders.

Of the possible six sample categories, the diagnostic information suggested that there were three major groups into which participants in our sample fell: men and women with SAHS (i.e., SAHS alone or with coexisting RLS/PLMD) and women with insomnia only. The two female and four male participants with RLS/PLMD only and the

Table 1
Diagnostic categories: frequencies and percentages for women and men

Diagnostic category	Women ($n=48$)		Men ($n=40$)	
	N	%	*N*	%
Apnea/Hypopnea syndrome (SAHS)	31	64.6	27	66.7
Restless legs syndrome/periodic limb movement disorder (RLS/PLMD)	2	4.2	4	10.2
Both SAHS and RLS/PLMD	4	8.3	8	20.5
Insomnia only	11	22.9	1	2.6

single male participant with insomnia only were excluded from further analyses because of their small numbers.

The sample characteristics for the three groups are included in Table 2. Analysis of variance comparisons (ANOVA) on age, education, marital status, and income satisfaction show that the three groups differed significantly only on one variable: Men were significantly more likely to be living with a partner [$\chi^2(2)=7.2$, $P=.03$].

Sleep-related symptoms in men and women with SAHS

To examine possible differences between men and women with SAHS, multivariate ANOVA (MANOVA) comparisons (males/females) were carried out on groups of dependent variables. Because the MANOVA is a conservative test, we also carried out univariate one-way ANOVAs. The sample size for each of the two SAHS groups is 35, so that using a one-way between-groups ANOVA design, an α of .05 and β of .2, we should be able to detect a moderate difference between the two groups (.6 of a standard deviation). For ordinal data, Chi-square tests for a sample size of 35 has sufficient power to detect a difference of 50%, with a Pearson's coefficient of contingency of .45. In the tables, scores of women with insomnia are provided for comparison only.

Sleep apnea/hypopnea characteristics evaluated via PSG

For the MANOVA on PSG scores, the dependent variables were respiratory arousals, respiratory disturbance index (RDI), and oxygen saturation levels (average and minimum) during sleep. The MANOVA was not significant. One-way ANOVAs also showed no significant differences between men and women with SAHS on any of the polysomnographic variables (Table 3).

Table 2
Demographic characteristics of participants

Demographic variable	Sleep apnea/hypopnea syndrome		Insomnia only
	Women (n=35)	Men (n=35)	Women (n=11)
	Mean (S.D.)	Mean (S.D.)	Mean (S.D.)
Age	64.6 (10.3)	63.3 (7.4)	59.8 (6.4)
Body mass index	29.5 (7.8)	27.8 (4.7)	25.8 (4.7)
Education (years)	14.7 (4.5)	13.7 (5.9)	12.9 (2.6)
Income satisfaction rating[a]	4.2 (2.1)	5.0 (2.5)	5.0 (3.0)
Marital status (% living with partner)	48.6	77.1	45.5

Insomnia only scores provided for comparison—statistical tests did not include this group.

[a] Rating: 1=*inadequate*, 9=*more than adequate*.

Table 3
PSG data

Polysomnography index	Sleep apnea/hypopnea syndrome		Insomnia only
	Women (n=35)	Men (n=35)	Women (n=11)
	Mean (S.D.)	Mean (S.D.)	Mean (S.D.)
Respiratory arousal index (/h)	25.3 (18.2)	30.1 (16.6)	7.1 (2.9)
Respiratory disturbance index	28.4 (18.9)	35.7 (22.7)	7.4 (3.2)
SpO2 basal during sleep	95.4 (3.1)	95.6 (2.8)	96.1 (1.9)
SpO2 basal minimum	87.7 (4.4)	88.3 (5.3)	90.3 (8.0)

Insomnia only scores provided for comparison—statistical tests did not include this group.

Self-reported sleep

Both parametric (MANOVA and ANOVA) and non-parametric analyses (Chi square) were carried out to examine differences on self-reported sleep variables between men and women with SAHS. Frequencies, means, and standard deviations for 12 behavioral sleep parameters, 2 qualitative sleep parameters, and 6 sleep-related daytime parameters may be seen in Table 4.

The MANOVA, ANOVAs, and Chi-square tests on behavioral sleep parameters revealed no significant differences between men and women with apnea/hypopnea syndrome. This includes the classic apnea symptoms, such as snoring and waking unable to breathe. Comparisons on sleep parameters, such as SOL and WASO were also not significantly different.

Similarly, the MANOVA and the ANOVAs on qualitative sleep parameters (i.e., perceived sleep quality and sleep satisfaction) showed no significant differences between men and women with SAHS. Both groups reported moderately poor sleep quality and moderate dissatisfaction with their sleep.

The MANOVA and the ANOVAs on the four daytime functioning parameters that evaluated daytime sleepiness and fatigue also showed no significant differences between men and women with SAHS. It is noteworthy that an examination of the means suggests that substantially fewer women with insomnia only (approximately 1/3) endorsed feeling sleepy or exhausted during the day than either men or women with sleep apnea/hypopnea (approximately 3/4).

Psychological functioning

Means and standard deviations for the psychological adjustment and personality measures are presented in Table 5. The MANOVA and ANOVAs on the measures of psycho-

Table 4
Self-report of sleep and daytime parameters

Variables	Sleep apnea/hypopnea syndrome		Insomnia only
	Women (*n*=35)	Men (*n*=35)	Women (*n*=11)
Behavioral sleep parameters			
Do you snore? (% yes)	78.8	71.4	45.5
Do you wake up in the middle of the night feeling unable to breathe? (% yes)	22.9	27.3	8.6
Do you wake up with a headache? (% yes)	28.6	25.7	27.3
Do you wake up with a dry mouth? (% yes)	54.3	54.3	36.4
Do your legs bother you after you go to bed at night? (e.g., cramps, jerking movements, crawling sensations)? (% yes)	31.4	28.6	27.3
Do you have insomnia? (% yes)	57.1	57.1	54.5
I have difficulty falling asleep at bedtime (% yes)	40.0	42.9	36.4
After falling asleep, I wake up during the night and have difficulty getting back to sleep (% yes)	62.9	62.9	90.9
I wake up too early in the morning and cannot get back to sleep (% yes)	45.7	54.3	54.5
I do not feel refreshed when I get up in the morning (% yes)	68.6	57.1	63.6
At bedtime, how long does it usually take you to fall asleep? Mean (S.D.) (h)	0.81 (.84)	0.68 (.71)	1.0 (1.3)
How many hours do you usually sleep per night? Mean (S.D.)	6.3 (1.9)	5.7 (1.8)	6.0 (2.4)
Qualitative sleep parameters (MANOVA)			
Generally, what is the quality of your sleep? Mean (S.D.) (1, *very poor,* to 10, *very good*)	4.8 (2.8)	4.4 (2.2)	4.5 (2.5)
Generally, how satisfied are you with your sleep? Mean (S.D.) (1, *very dissatisfied*, to 10, *very satisfied*)	4.5 (2.9)	4.1 (2.6)	4.0 (2.4)
Daytime parameters (MANOVA)			
Are you sleepy during the day? (% yes)	74.3	82.9	36.4
Epworth Sleepiness Scale[a] mean (S.D.)	8.5 (5.4)	9.7 (5.5)	7.5 (5.1)
Stanford Sleepiness Scale[a] mean (S.D.)	3.5 (1.5)	3.3 (1.5)	2.7 (1.3)
Are you exhausted during the day? (% yes)	77.1	68.6	36.4
Fatigue Severity Scale[a] mean (S.D.)	4.0 (1.6)	3.8 (1.1)	3.7 (1.8)
Chalder Fatigue Scale[a] mean (S.D.)	3.5 (1.2)	3.3 (1.1)	3.2 (1.4)

Insomnia only scores provided for comparison—statistical tests did not include this group.
[a] Higher scores indicate worse functioning.

logical adjustment and personality showed no significant differences between men and women with SAHS.

Perceived health

The MANOVA comparing men and women with SAHS on the eight perceived health functioning subscales on the SF-36 Health Survey was also not significant. The means and standard deviations are available in Table 6. On this variable, however, the ANOVAs show significant differences on four subscales: Women reported lower satisfaction with physical functioning, body pain, general health, and vitality. Notably, available norms for this age group tend to show lower scores for women than for men; therefore, interpretation of present findings needs to take this into account [43,44].

Table 5
Personality and psychological adjustment

Psychological measure[a]	Sleep apnea/hypopnea syndrome		Insomnia only
	Women (*n*=35)	Men (*n*=35)	Women (*n*=11)
	Mean (S.D.)	Mean (S.D.)	Mean (S.D.)
Spielberger Trait Anxiety Inventory	40.4 (9.4)	40.9 (9.4)	43.4 (13.2)
Brief Symptom Inventory: global severity index	0.72 (0.56)	0.66 (0.45)	0.81 (0.69)
Beck Depression Inventory (total)	12.2 (8.8)	9.4 (6.4)	13.2 (12.3)
Eysenck Personality Inventory: neuroticism	5.5 (2.8)	4.8 (3.5)	7.0 (3.5)
Eysenck Personality Inventory: extraversion	7.5 (3.6)	6.2 (3.0)	6.4 (4.4)

Insomnia only scores provided for comparison—statistical tests did not include this group.
[a] Higher scores indicate greater anxiety, overall psychological symptomatology, depression, neuroticism, and extraversion.

Discussion

Two important findings emerged from our data: (1) the utility of identification of sleep disorders by self-selection and (2) the unexpected absence of sex differences in symptomatology.

Identification of sleep disorders by self-selection

When older individuals from the community respond to publicity recruiting sleepy/tired people who may sleep poorly and who are sufficiently motivated to undergo a medical evaluation and a night at a sleep laboratory, then most of these individuals will likely be found to have a physiological sleep disorder on polysonmography. When recruited in this way, our data show that, in fact, 77% of women and 98% of men had a readily diagnosed sleep disorder other than insomnia. SAHS, with or without RLS/

Table 6
Perceived health functioning (SF-36 Health Survey)

	Sleep apnea/hypopnea syndrome				Insomnia only
	Women (n=34)	Men (n=34)	Univariate test women vs. men		Women (n=11)
Subscale[a]	Mean (S.D.)	Mean (S.D.)	F(1,67)	Significance	Mean (S.D.)
Physical functioning	68.1 (25.8)	81.2 (14.8)	7.143	.009	75.5 (30.5)
Role physical	47.1 (43.8)	68.4 (41.3)	3.693	.059	59.1 (39.2)
Bodily pain	63.1 (26.4)	75.5 (22.2)	4.001	.050	71.0 (20.4)
General health	63.7 (17.5)	73.3 (16.3)	4.584	.036	71.5 (17.8)
Vitality	40.9 (19.9)	52.1 (19.0)	4.950	.029	57.7 (29.2)
Social functioning	66.9 (27.2)	76.8 (25.9)	2.452	.122	72.7 (34.4)
Role emotional	60.8 (44.5)	71.6 (37.7)	0.947	.334	81.8 (34.5)
Mental health	68.0 (18.7)	70.7 (18.7)	0.582	.448	65.8 (31.2)

Insomnia only scores provided for comparison—statistical tests did not include this group.
[a] Higher scores indicate better perceived health functioning.

PLMD, was the most likely; this was true for 73% of females and 88% of males in the sample. Clearly, our self-selection approach resulted in a large proportion of individuals with physiologically based, medically treatable sleep disorders.

It is known that, even in the general population, only 10% to 20% of apnea patients are diagnosed [2,8]. Our recruitment procedure may have been a limitation in terms of population representativeness, but, apparently, a strength in identifying a sample of people at high risk for sleep disorder. The results suggest that posters in physicians' offices may be used to help identify people at risk for sleep disorders such as sleep apnea/hypopnea and RLS/PLMD who should be referred for PSG.

With respect to insomnia, there was a substantial overlap in symptom presentation in sleepy/tired older men and women with and without sleep apnea/hypopnea. This makes diagnostic discrimination based on self-reported symptom clusters impossible. Our data show that a substantial percentage of women who had only insomnia endorsed classic apnea signs such as snoring (46%), breathing problems at night (27%), and daytime sleepiness (36%), while those diagnosed with SAHS reported high frequencies of insomnia problems (57%) and fatigue (77%).

It is noteworthy that all three groups (i.e., men and women with SAHS and women with insomnia only) showed scores in the clinically relevant range on measures of psychological maladjustment. For example, both groups of women had Beck Depression scores in the mildly depressed range, as well as Spielberger anxiety scores greater than one standard deviation above the normed mean. BSI scores (a measure of psychopathology) were also somewhat elevated for all three groups.

Sex differences

Sex ratio

The recruitment method used in the present study resulted in more women than men being referred to the sleep laboratory as well as a ratio of men to women with diagnosed SAHS of 1.2 to 1. It is not clear to what extent our sex ratio reflects population frequencies, especially as our sample contained a greater proportion of women with apnea/hypopnea than has been found in most previous studies. While it is has been reported that the sex difference in prevalence of sleep disorders decreases in the older population [10], the present study was not an epidemiological one; the participants were screened for major untreated illness and were self-selecting for sleep-related symptoms.

Sex-related similarities and differences in presentation of complaints

The hypothesis that women with sleep apnea/hypopnea experience different symptom clusters from men was not supported. In contrast with other reports in the literature [10,13], women and men in our sample who were diagnosed with apnea/hypopnea syndrome did not differ in the nature or the severity of their symptoms, as evaluated by either PSG or by the usual behavioral indices such as snoring, excessive daytime sleepiness, and perceived impairment of daytime functioning. Our findings also did not support the contention that women present their apnea symptoms within a context of psychological maladjustment. Although negative findings cannot be conclusive, the lack of significant differences between males and females on most of the 42 variables evaluated in this study certainly suggests that this lack of difference is real. However, these findings must also be taken in the context that the lack of sex differences may reflect the characteristics of the present sample and not the general population.

What do our findings imply with respect to sex bias or sex difference in the diagnosis of women with sleep apnea? This study documents that, when these are explicitly elicited, women do present the classic apnea signs and symptoms within a context of insomnia, as do men. Moreover, the women in our sample with sleep apnea/hypopnea did not differ significantly from the men on the severity of polysomnographic apnea/hypopnea indices. There also was no indication that women are more "neurotic" or more generally psychologically maladjusted than men are.

While the results suggest a "sex bias", it is premature to conclude this. The demographics of our sample indicated

that the men were more likely to have a partner than the women do. This may reflect a characteristic of older adults that might enhance reporting of apnea symptoms. When perceived health status was examined, the results of univariate analyses did suggest that women were less satisfied with their physical functioning, general health, and vitality. According to normative Canadian [44] and U.S. [43] data, a male/female difference of about five points is to be expected on many SF-36 subscales. Thus, while men and women with SAHS showed no significant differences in reported apnea symptoms, perhaps the differences in the way they perceived their health functioning affected the way they discussed specific symptoms with their doctors. Whether men and women differ in the presentation of their symptoms in the doctor's office must be verified directly.

The results of our study cannot explain why sleep apnea/hypopnea, in general, and particularly in women, is under diagnosed. Therefore, the appropriate next step is to address the following questions in a sample recruited from actual primary care physicians' consulting rooms: (a) How many of their older patients have daytime sleepiness or fatigue/insomnia complaints? (b) Do such patients present these complaints to their doctors? (c) Do physicians routinely inquire about daytime fatigue/sleepiness and nocturnal sleep problems? and (d) How do they deal with such complaints? We are currently evaluating these questions in our laboratory.

We were unable to distinguish men from women with SAHS. Women with SAHS and women with only insomnia appear to have overlapping symptoms. Thus, a clinical implication of our findings may be a startlingly simple diagnostic formula for the medical practitioner: If older patients, male or female, experience medically unexplained daytime sleepiness or fatigue and also agree to further tests, including overnight PSG, they are at substantial risk for physiologically based sleep disorder. The probability of diagnosing a treatable apnea/hypopnea is high. More accurate diagnosis of sleep apnea can lead to effective management of a condition which, left untreated, has serious health and quality of life implications.

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