Associations Between Gender and Measures of Daytime Somnolence in the Sleep Heart Health Study

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Study Objectives: To examine the relationship of gender to subjective measures of sleepiness, including the Epworth Sleepiness Scale (ESS), in a community-based population.

Design: A cross-sectional study.

Setting/Participants: Multicenter Sleep Heart Health Study participants (N = 6,440, 52% women) recruited from ongoing cohort studies.

Interventions: N/A.

Measurements: Scores from the ESS, Sleep Heart Health Study daytime sleepiness and feeling unrested questions, polysomnography results (respiratory disturbance index at 4% desaturation), as well as data on difficulty initiating and maintaining sleep, insufficient sleep, sedative use, alcohol use, cardiovascular or respiratory disease, frequent awakening due to leg cramps.

Results: Women reported feeling sleepy as often as men did (odds ratio [OR] = 1.06; confidence interval [CI], 0.86-1.32), but women were less likely to have an ESS score > 10 (adjusted OR = 0.77; CI, 0.66-0.90) and more likely to report feeling unrested (adjusted OR = 1.39; CI, 1.14-1.69) than men. In men, the ESS score was more strongly correlated with reports of feeling unrested or sleepy compared to women.

Conclusions: Men and women answer questions on sleepiness differently. Findings indicate that using the ESS to detect subjective sleepiness is more likely to identify men with sleepiness. Since the ESS is more strongly related to other subjective measures in men, the ESS may be a more sensitive measure of subjective sleepiness in men than in women.

Key Words: Daytime sleepiness; Epworth Sleepiness Scale; feeling unrested; insufficient sleep, gender; measurement construction; respiratory disturbance index

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INTRODUCTION

DAYTIME SLEEPINESS IS OFTEN A RESULT OF NOCTURNAL SLEEP PROBLEMS, SUCH AS SLEEP-DISORDERED BREATHING (SDB), INSOMNIA, AND RESTLESS LEGS SYNDROME. Prevalence rates for daytime sleepiness in the United States population have been estimated to range from 3% to 13%. Daytime sleepiness has been associated with poorer health outcome and quality of life, poor cognition, greater limitations in instrumental activities of daily living, and higher rates of work and automobile-related accidents.

Although daytime sleepiness can be assessed objectively by means of the Multiple Sleep Latency Test or the Maintenance of Wakefulness Test, these approaches are costly and time consuming. The Epworth Sleepiness Scale (ESS) has been the most commonly used subjective measure of daytime sleepiness in the clinical and research settings, particularly with objective measures of SDB.

Recent studies are suggesting, however, that men and women may report daytime sleepiness in different ways, which could obscure a diagnosis of SDB, particularly for women. Gender has been shown to have a greater influence on the ESS score than did objective measures of SDB severity or mean sleep latency even after adjusting for confounding variables. Distribution of ESS scores and sleepiness items from the Sleep Heart Health Study (SHHS) Sleep Habits Questionnaire differed by gender. It has been suggested that reports of tiredness, fatigue, or reduced energy, more commonly reported by women, be considered as important as complaints of sleepiness when diagnosing SDB. Little prior research has investigated relationships between gender and differing subjective measures of sleepiness. The intent of this study is to examine the relationship of gender on the ESS and 2 questions from the SHHS regarding daytime sleepiness and unrefreshing sleep.

MATERIALS AND METHODS

Subjects

Participants are enrolled in the multicenter SHHS, an investigation of SDB as a risk factor in the development of cardiovascular disease. The design and methods of this study have been described in depth elsewhere. The study population includes 6,440 men and women 40 years of age and older. Participants who underwent in-home polysomnography to determine the presence of SDB were recruited from the following studies: the Atherosclerosis Risk in Communities Study, Cardiovascular Health Study, Framingham Heart Study, Strong Heart Study, New York Hypertension Cohorts, and Tucson Epidemiologic Study of Airways Obstructive Diseases and the Health and Environment Study. Subjects from all participating sites were provided with informed voluntary human subjects’ consent through their respective institutional review boards. Persons receiving home oxygen therapy, with tracheostomy, or being treated for obstructive sleep apnea with continuous positive airway pressure or oral devices were excluded from the study, as any of these conditions could serve as confounding variables in outcome or could result in technical difficulties in obtaining in-home polysomnography. The SHSS participants were slightly younger (63
versus 65 years), had more years of education (14.1 versus 13.7 years), were more likely to smoke (34% versus 23%), had higher ESS scores, slightly higher systolic and diastolic blood pressures (127.6/73.9 versus 127.3/71.1), and slightly higher body mass index (BMI; 28.5 versus 27.5 kg/m²) than the overall parent cohorts.27

Demographics, Sleep, Behavioral Health Questionnaires

Participants completed demographic data (gender, age, ethnicity, marital status, and education) and the SHSS Sleep Habits Questionnaire.23 The Sleep Habits Questionnaire contained questions regarding sleep habits and smoking status, as well as cardiovascular and respiratory problems. Height and weight were also measured directly to determine BMI. Two questions related to sleepiness and feeling unrested were also assessed using the Sleep Habits Questionnaire. The 2 somnolence statements, “Feel excessively (overly) sleepy during the day” and “Feel unrested during the day, no matter how many hours of sleep you had,” were rated on a 5-point Likert scale from “Never” to “Almost Always.” These 2 somnolence questions were adapted from the Wisconsin Sleep Cohort Study Sleep Survey28 for use in the SHHS.29 These somnolence questions are widely used (eg, the World Health Organization Multinational Monitoring of Trends and Determinants of Cardiovascular Diseases)30 and have shown consistent correlations with variables that contribute to daytime sleepiness, including snoring,30 apnea-hypopnea index categories,28,31 and nasal congestion.32 The statements “Not getting enough sleep,” “Trouble falling asleep,” “Wake up during the night and have difficulty resuming sleep,” and “Wake up too early in the morning and be unable to resume sleep” were rated on the same 5-point Likert scale. The last 3 statements were combined to create the category “insomnia.” Frequent snoring was defined as present in participants who reported snoring frequently or more often (>3 nights a week). Absence of snoring was defined as participants who reported less frequent snoring or who denied current or ever snoring.

The ESS was used as the primary measure to assess subjective daytime sleepiness20 in this multicenter study. The ESS, slightly modified in wording for clarity and grammatical correctness for use in the SHHS,25,29 is an 8-item self-administered questionnaire used for rating, on a scale of 0 to 3, the likelihood of dozing in each of 8 daily situations. Scores are tallied across the 8 items, with an ESS score greater than 10 used to represent an abnormal level of daytime sleepiness.3,22

The ESS is a unitary scale with a Cronbach α of 0.88 and rest–rest test-reliability over 5 months of r = 0.82.33 The scale can distinguish between patients with excessive daytime sleepiness and normal subjects; it shows a small but significant association with the Multiple Sleep Latency Test in some studies,21,24-29 but not others.23 Similarly, the ESS score is associated with the rate of apneas and hypopneas in subjects in some,21-22 but not all studies.36

Excessive daytime sleepiness and feeling unrested responses were dichotomized using the 5-point Likert scale for the Sleep Habits Questionnaire questions described above, such that “Almost Always,” and “Frequently” represented a positive response, while “Sometimes,” “Rarely,” and “Never” were considered the absence of these symptoms. The 3 statements that comprise insomnia, alone and in combination, as “Almost Always,” and “Frequently” were rated on the same 5-point Likert scale from “Never” to “Almost Always.” The methods for ensuring scorer reliability are detailed in a report by Redline,26 and results of an early formal scoring reliability study were reported by Whitney.37

Statistical Analyses

All analyses were performed using SPSS data-analysis software (SPSS for Windows: base system user’s guide, release 6.0, SPSS Inc. 1993). Characteristics of subjects were compared by gender using analysis of variance (ANOVA) for continuous variables (results did not differ when the Mann-Whitney test was done for variables that did not appear to be normally distributed) or the χ² test for categorical variables. Statistical significance was defined as P < .01.

The association between gender and each measure of sleepiness, insomnia, and insufficient sleep (dependent dichotomous variables) were modeled independently using standard logistic regression techniques. All models were adjusted for available covariates that may be potential confounding variables. Potential confounding variables were identified by means of bivariate analysis to have an association between sleepiness, or insomnia, or sleep deprivation and gender (significance at P < .10). Since all variables identified by this method were plausible confounding variables based on consideration of potential causal pathways, they were included in logistic regression modeling. A bivariate correlation procedure was done to compute Spearman’s correlation coefficient for the daytime somnolence and insufficient sleep measures to assess how these measures are related.38-39 Linear regression was done to determine differences in men’s and women’s measurement correlations for the ESS with the sleepiness, feeling unrested, and insufficient sleep measures from the SHHS Sleep Habits Questionnaire.
RESULTS

Characteristics of the SHHS Population

Characteristics of the SHHS population by gender are shown in Table 1. Women comprised 52.8% of the sample. Men reported more years of education. More men reported themselves to be non-Hispanic White, whereas the African American group was comprised of more women. Men were significantly more likely to have a greater frequency of cardiovascular disease than women. Women, however, were significantly more likely to have a greater frequency of respiratory disease. While women were significantly more likely to report sedative use, men were significantly more likely to report consuming more than 2 alcohol beverages per week. There were no differences between groups for age, BMI, or hypertension prevalence.

Daytime Somnolence, SDB and Sleep Symptoms in the SHHS Population

Means and percentages for the 3 daytime somnolence measures and levels of SDB (RDI 4%) are included in Table 1. Men were significantly more likely to report an abnormal ESS score (>10) compared to women (29.7% to 20.8%, respectively). Conversely, women were significantly more likely to report feeling unrested during the day compared to men (20.5% to 15.1%, respectively). Women were also more likely to report daytime somnolence when the dichotomized ‘sleepy or unrested’ questions are combined compared to men (24% to 19.3%, respectively); however, no differences between men (12.7%) and women (13.7%) were noted when analyzing the sleepiness question separate from feeling unrested.

Men were significantly more likely to be classified by polysomnography into mild (32.7% to 24.6%), moderate (15.7% to 8%), and severe (9.3% to 3.5%) SDB categories compared to women. Frequent snoring was also significantly more likely to occur among men than women. Conversely, women were significantly more likely to report awakening with leg cramps compared to men (12.1% to 8.7%, respectively). Women were significantly more likely to report sleep-onset (19.8% to 10.5%) or sleep-maintenance problems (24.1% to 16.6%), as well as early morning awakening with difficulty returning to sleep (20.4% to 15.2%, each P < .001). Women were more likely to indicate any one of these 3 sleep symptoms, collectively referred to as difficulty initiating or maintaining sleep, or insomnia (35.1% to 25.7%, P < .001); women also had increased reporting of insufficient sleep compared to men (20.6% to 15.5%, P < .001). There were no differences in the average amount of nighttime sleep between men and women during the week (7 hours) or on weekends (7.4 hours).

The ESS and Gender

The distribution of the ESS scores stratified by gender is displayed in Figure 1. The mean ESS score for men was 8.3 (SD = 4.6) and for women 7.3 (SD = 4.2). The ESS score was examined in more detail to determine gender differences in score distributions and individual item responses.

Response rates by gender for each ESS question are shown in Table 2. Men were significantly more likely to report dozing or falling asleep in 7 of the 8 situations. The only situation in which men did not report a higher propensity to doze or fall asleep was while riding as a passenger in a car. Over half of each of the groups indicated a moderate or high likelihood of dozing or falling asleep while resting in the afternoon or while watching television, while 3% of the men and 2% of the women reported that this would happen while stopped for a few minutes in traffic.

Sleepiness Logistic Regression Results

The associations between gender and the ESS score, feeling unrested, and sleepiness questions are shown in
Table 3. After adjusting for possible confounding variables, logistic regression results indicated that an ESS score > 10 was significantly associated with gender (adjusted OR = 0.77; CI, 0.66-0.90 for women). This was also true for feeling unrested (adjusted OR = 1.39; CI, 1.14-1.69 for women). In contrast, the question regarding daytime sleepiness was not significantly associated with gender (adjusted OR = 1.06; CI, 0.86-1.32 for women) (Table 3).

**Difficulty Initiating and Maintaining Sleep by Gender**

Following adjustment for possible confounding variables, logistic regression results indicated that difficulty falling asleep (adjusted OR = 2.04; CI, 1.70-2.44), staying asleep (adjusted OR = 1.60; CI, 1.38-1.86), early morning awakening (adjusted OR = 1.46; CI, 1.22-1.74), or any of the 3 difficulty initiating or maintaining sleep (insomnia) symptoms (adjusted OR = 1.56; CI, 1.37-1.79) were all found to be significantly associated with female gender (Table 4).

**Insufficient Sleep by Gender**

Findings for insufficient sleep by gender are shown in Table 4. After adjusting for possible confounding variables identified in the bivariate analysis, insufficient sleep was significantly associated with female gender (adjusted OR = 1.48; CI, 1.24-1.77).

**Measurement Correlations Across all SHHS Participants**

A bivariate correlation procedure was done to compute Spearman correlation coefficients for the 3 daytime somnolence measures and insufficient sleep across all subjects and separately for men and women (Table 5). The correlation coefficients for the 3 measures used in the SHHS (feeling unrested, excessively sleepy, insufficient sleep) ranged from .469 to .611 (P < .01), suggesting moderate to high degrees of correlation among these measurement constructs. The correlation coefficients for the ESS score with the insufficient sleep variable suggests little correlation between these measurement constructs for men.

**Measurement Correlations for Women**

The correlation coefficient of .179 for the ESS score with the insufficient sleep variable suggests low to moderate correlation among these measurement constructs.

<table>
<thead>
<tr>
<th>Sleep Symptoms</th>
<th>Unadjusted OR</th>
<th>95% CI</th>
<th>Adjusted OR</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty initiating sleep†</td>
<td>2.09</td>
<td>1.81-2.42*</td>
<td>2.04</td>
<td>1.70-2.44*</td>
</tr>
<tr>
<td>Difficulty maintaining sleep††</td>
<td>1.60</td>
<td>1.41-1.81*</td>
<td>1.60</td>
<td>1.38-1.86*</td>
</tr>
<tr>
<td>Early morning awakening†††</td>
<td>1.43</td>
<td>1.25-1.62*</td>
<td>1.46</td>
<td>1.22-1.74*</td>
</tr>
<tr>
<td>DIMS‡</td>
<td>1.56</td>
<td>1.40-1.74*</td>
<td>1.56</td>
<td>1.37-1.79*</td>
</tr>
<tr>
<td>Insufficient sleep‡‡</td>
<td>1.41</td>
<td>1.24-1.61*</td>
<td>1.48</td>
<td>1.24-1.77*</td>
</tr>
</tbody>
</table>

* P < .01
* * P < .001
†Covariates: respiratory disturbance index (RDI) with 4% desaturation, respiratory disease, frequent awakening from leg cramps, frequent snoring, race.
††Covariates: RDI 4%, respiratory disease, frequent awakening from leg cramps, sedative use, cardiac disease, alcohol use, race, and education level.
†††Covariates: respiratory disease, frequent awakening from leg cramps, sedative use, cardiac disease, education level, race, and habitual snoring.
‡Covariates: respiratory disease, frequent awakening from leg cramps, sedative use, alcohol use, car.
‡‡Covariates: RDI 4%, respiratory disease, frequent awakening from leg cramps, sedative use, habitual snoring, alcohol use, and race.
‡‡‡Covariates: RDI 4%, respiratory disease, frequent awakening from leg cramps, sedative use, habitual snoring, alcohol use, and race.
OR refers to odds ratio; CI, confidence interval; DIMS, disorders of initiating and maintaining sleep.

Table 2—Prevalence of moderate or high (score of 2 or 3) chances of dozing off for each Epworth Sleepiness Scale scenario

<table>
<thead>
<tr>
<th>Epworth Sleepiness Scale Scenario</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading</td>
<td>50.9</td>
<td>44.6‡</td>
</tr>
<tr>
<td>Watching television</td>
<td>58.6</td>
<td>53.8‡</td>
</tr>
<tr>
<td>Sitting in a public place</td>
<td>21.5</td>
<td>15.3‡</td>
</tr>
<tr>
<td>Riding in a car</td>
<td>24.2</td>
<td>27.8‡</td>
</tr>
<tr>
<td>Resting</td>
<td>66.8</td>
<td>58.6‡</td>
</tr>
<tr>
<td>Talking</td>
<td>3.9</td>
<td>2.5‡</td>
</tr>
<tr>
<td>After lunch</td>
<td>24.8</td>
<td>17.5‡</td>
</tr>
<tr>
<td>Stopped in traffic</td>
<td>3.0</td>
<td>2.1*</td>
</tr>
</tbody>
</table>

χ² test *P < .05; †P < .001; ‡P < .0001

Table 3—Unadjusted and adjusted odds ratios for the association between female gender and each of the 3 somnolence variables (males were the reference category)

<table>
<thead>
<tr>
<th>Somnolence Variables</th>
<th>Unadjusted OR</th>
<th>95% CI</th>
<th>Adjusted OR</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESS score &gt; 10††</td>
<td>0.62</td>
<td>0.55-0.70**</td>
<td>0.77</td>
<td>0.66-0.90*</td>
</tr>
<tr>
<td>SHHS feeling unrested††</td>
<td>1.44</td>
<td>1.27-1.64**</td>
<td>1.39</td>
<td>1.14-1.69*</td>
</tr>
<tr>
<td>SHHS daytime sleepiness†††</td>
<td>1.09</td>
<td>0.95-1.27</td>
<td>1.06</td>
<td>0.86-1.32</td>
</tr>
</tbody>
</table>

* P < .01
‡‡‡P < .001
†Covariates: respiratory disturbance index (RDI) with 4% desaturation, respiratory disease, frequent awakening from leg cramps, frequent snoring, race.
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OR refers to odds ratio; CI, confidence interval; ESS score; Epworth Sleepiness Scale; SHHS, Sleep Heart Health Study.

**Measurement Correlations for Men**

Mean scores for each of the measures for men were 8.3 (SD = 4.56) for the ESS score, and 2.48 (SD = 1.04), 2.40 (SD = 0.98), and 2.48 (SD = 1.06) for feeling unrested, excessively sleepy, and insufficient sleep variables, respectively (Table 5). The correlation coefficients among the questions used in the SHHS ranged from .483 to .612 (P < .01), suggesting moderate to high correlations among these constructs for men. Correlation coefficients were .230 for insufficient sleep, .272 for feeling unrested and .385 for daytime sleepiness (each P < .01), suggesting low to moderate correlations among these measures with the ESS score for men.

**Measurement Correlations for Women**

Mean scores for each of the measures for women were as follows: ESS score 7.26 (SD = 4.23), and feeling unrested 2.65 (SD = 1.08), excessively sleepy 2.47 (SD = 0.99), and insufficient sleep 2.65 (SD = 1.10). The correlation coefficients among the questions used in the SHHS for women ranged from .454 to .608 (P < .01), suggesting moderate to high degrees of correlation among these constructs (Table 5). Correlation coefficients for the unrested and sleepiness questions with the ESS score were .233 and .345 (each P < .01) respectively, which suggests low to moderate correlations between these constructs for women respondents. The correlation coefficient of .155 for the ESS score with insufficient sleep suggests that these 2 measures are unrelated and/or assessing different constructs of abnormal daytime sleepiness for women respondents.

**Linear Regression Findings for Measurement Correlations by Gender**

Linear regression was performed with the ESS score as the dependent variable and gender, sleep, unrested or insufficient sleep, and interaction term as independent variables. Linear regression results for the ESS score and each of the 3 measures used in the SHHS (daytime sleepiness, feeling unrested, insufficient sleep) indicated that women overall have lower ESS scores than men. Furthermore, among men, a 1-unit increase in the sleepiness measure is associated with a 1.8-unit increase in the
unrested despite adequate sleep replicates other studies. The significant association between female gender and their increased reports of feeling unrested as defined by questions from the Sleep Habits Questionnaire may be indicative of a more expansive vocabulary for describing daytime sleepiness that should not be overlooked when diagnosing women with SDB. Furthermore, the statistically significant linear regression interaction terms indicate that the relationship between sleepy or unrested variables and ESS is different for men and women, which supports our hypothesis that the ESS is not as good a measure of sleepiness in women. Results suggest that a single daytime sleepiness question, as in the SHHS Sleep Habits Questionnaire, may serve as a parsimonious measure of SDB-related daytime sleepiness for both men and women.

Our findings indicate that women are significantly more likely to report sleep symptoms, including difficulty falling asleep, staying asleep, early morning awakening, or insufficient sleep, compared to men. These sleep symptoms were significantly associated with reports of sedative use, cardiovascular or respiratory disease, and frequent awakening from leg cramps. Prior studies have indicated that women are frequently more likely to report physical symptoms compared to men. In a PRIME-MD 1000 study, for example, women had higher symptom complaints, including fatigue and insomnia, that were independent of psychiatric comorbidity. Other researchers have reported associations between sleep symptoms and higher reports of both physical and mental health problems. The increased physical-symptom reporting by women may extend to the various ways in which women might perceive and experience daytime sleepiness, such as tiredness, feeling unrested, low energy, lack of vigor, and fatigue. Several researchers have posited various hypotheses for differences in the ways in which men and women experience and report symptoms. It would be of interest for future sleep research studies to examine potential biomarkers that may be relevant to gender differences in reported symptoms, such as neopterin, proinflammatory cytokines, and hypothalamic-pituitary-adrenal axis hormones, cortisol and corticotropin. Insufficient sleep was significantly more likely to be reported by women and, notably, was the only subjective sleep symptom to be significantly independently associated with an RDI 4% desaturation, an objective measure of SDB. Insufficient sleep, often related to sleep deprivation, was recently found to be associated with greater healthcare usage. It has also been suggested that partial prolonged sleep deprivation could worsen SDB. The finding for higher rates of insufficient sleep in women, and the significant linear regression interaction term indicating that the relationship between insufficient sleep and the ESS score differs by gender, further supports our hypothesis that the ESS score may not be an adequate or appropriate measure of sleepiness in women. Studies have suggested a gender difference in the diagnosis of SDB related to a difference in symptom reporting by men and women. Insufficient sleep needs to be examined further as a potential distinguishing characteristic of SDB in women.

The correlation coefficient noted for the ESS score and the feeling-unrested question did not correlate to any great degree, suggesting that these 2 measures could be assessing different attributes of “sleepiness.” This finding may also lend support to the idea that women may be describing “sleepiness” with a broader taxonomy. Sleepiness-measurement construction studies should be undertaken to explore the concordance between the ESS, the questions used in the SHHS, and a third measure, such as the SF-36 vitality scale. These measurement studies should compare subgroups of men and women with varying levels of SDB with and without comorbid conditions in order to assess the degree to which SDB severity and/or the number and types of comorbidities affect the concordance of these measures. For example, Rinaldi’s finding that the heterogeneous nature of the sleepiness concept related with the Multiple Sleep Latency Test necessitates questionnaires tailored to different study populations. Future clinical and research studies that utilize the Multiple Sleep Latency Test or Maintenance of Wakefulness Test should include the sleepiness questions, as described above, in addition to the ESS in order to compare associations between these objective and subjective measures of sleepiness.

**DISCUSSION**

Findings from this study indicate that men and women answer sleepiness questions differently. Our results suggest that using the ESS to detect subjective sleepiness is more likely to identify men. Since the ESS has been noted to be associated with other subjective measures in men, the ESS may be a more sensitive measure of subjective sleepiness in men than in women. Notably, the finding for women feeling more unrested despite adequate sleep replicates other studies. The significant association between female gender and their increased reports of feeling unrested as defined by questions from the Sleep Habits Questionnaire may be indicative of a more expansive vocabulary for describing daytime sleepiness that should not be overlooked when diagnosing women with SDB. Furthermore, the statistically significant linear regression interaction terms indicate that the relationship between sleepy or unrested variables and ESS is different for men and women, which supports our hypothesis that the ESS is not as good a measure of sleepiness in women. Results suggest that a single daytime sleepiness question, as in the SHHS Sleep Habits Questionnaire, may serve as a parsimonious measure of SDB-related daytime sleepiness for both men and women.

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**Limitations**

The cross-sectional nature of this work cannot infer a causal relationship between the independent variables with the outcome measures. One of the exposure variables used in this study was the RDI 4%, which provides a general indicator of the frequency of respiratory events as well as the degree of intermittent desaturation and arousal. The RDI was chosen because it provides a highly reproducible index that is commonly used to classify disease severity. This RDI 4% has been shown to be highly correlated with other routinely used RDIs, defined using different criteria for linked desaturation and arousal. The absolute magnitude of RDI may vary substantially with RDI definition, however, and care must be taken when extrapolating findings from this study to other settings such that potential differences in cutoff values are considered. This factor is particularly relevant when comparing subjective measures of sleepiness with objective measures of SDB, such as the RDI 4%. Future studies should also systematically assess other objective SDB indexes (arousal indexes, sleep architecture) to determine if they are more strongly predictive of daytime sleepiness.

This study represents a retrospective evaluation of an SHHS data set that was collected to answer questions other than the ones asked in this manuscript. As such, we were limited by the subjective measures of sleepiness and covariate data that had been collected. For example, data on potential confounding variables, such as menopause status and daily work schedule, were not available. In addition, the final SHHS cohort

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**Table 5—Spearman correlation coefficients for 3 somnolence measures and insufficient sleep by all respondents and by gender**

<table>
<thead>
<tr>
<th></th>
<th>ESS score</th>
<th>Sleepy</th>
<th>Unrested</th>
<th>Insufficient Sleep</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>All Subjects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ESS (n = 6203)</td>
<td>.90</td>
<td>.337</td>
<td>.240</td>
<td>.179</td>
</tr>
<tr>
<td>Sleepy (n = 6355)</td>
<td>.359*</td>
<td>1.00</td>
<td>.611</td>
<td>.469*</td>
</tr>
<tr>
<td>Unrested (n = 6356)</td>
<td>.240*</td>
<td>.611*</td>
<td>1.00</td>
<td>.500*</td>
</tr>
<tr>
<td>Insufficient sleep (n = 6330)</td>
<td>.179*</td>
<td>.469*</td>
<td>.500*</td>
<td>1.00</td>
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<tr>
<td><strong>Men</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ESS (n = 2938)</td>
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<td>.385</td>
<td>.272</td>
<td>.230</td>
</tr>
<tr>
<td>Sleepy (n = 2993)</td>
<td>.385*</td>
<td>1.00</td>
<td>.612</td>
<td>.485*</td>
</tr>
<tr>
<td>Unrested (n = 2997)</td>
<td>.272*</td>
<td>.612*</td>
<td>1.00</td>
<td>.511*</td>
</tr>
<tr>
<td>Insufficient sleep (n = 2983)</td>
<td>.230*</td>
<td>.485*</td>
<td>.511*</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Women</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>ESS (n = 3265)</td>
<td>.90</td>
<td>.345</td>
<td>.233</td>
<td>.155</td>
</tr>
<tr>
<td>Sleepy (n = 3362)</td>
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<td>1.00</td>
<td>.608</td>
<td>.454*</td>
</tr>
<tr>
<td>Unrested (n = 3359)</td>
<td>.233*</td>
<td>.608*</td>
<td>1.00</td>
<td>.485*</td>
</tr>
<tr>
<td>Insufficient sleep (n = 3347)</td>
<td>.155*</td>
<td>.454*</td>
<td>.485*</td>
<td>1.00</td>
</tr>
</tbody>
</table>

*P < .01 (2-tailed)

ESS refers to Epworth Sleepiness Scale.
reflected the selection biases inherent in the parent cohorts in addition to the selection criteria used for the SHHS and is not necessarily representative of the general population. Participants agreed to participate in at least 2 health studies (parent and SHHS), which may indicate that the participants are more health conscious than is the general population. The characteristics of this cohort are provided (Table 1).

Conclusions

A subjective report of daytime sleepiness is a prominent symptom in SDB, a disorder primarily diagnosed in men. It has not been until recently, however, that gender differences in daytime sleepiness and SDB have been addressed in the sleep literature.2,3,24,29,50,53 Future studies will need to more thoroughly explore the different ways in which men and women describe their daytime-sleepiness experiences, develop valid and reliable subjective measures of sleepiness that are free of gender and ethnic differences, and determine any associations between these subjective reports and objective measures of SDB. In the meantime, the ESS should not be considered the definitive or only measure for assessing daytime sleepiness, particularly for women. For example, based on the unadjusted OR in this study, women would be 38% less likely to have an abnormal ESS score and 44% more likely to report feeling unrested than would men. Clinically, if these measures are used to identify sleepiness in men and women, large differences in the percentage of men or women would be identified depending on which measure is used. Women should be questioned in more depth as to the ways in which they might be experiencing sleepiness during the day, using terms such as “tired,” “fatigued,” “unrested,” or “no pep or energy” so as not to overlook a potential diagnosis of obstructive sleep apnea syndrome.

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REFERENCES


