The Relation of Sleep Complaints to Respiratory Symptoms in a General Population

Mary E. Klink, M.D.; Russell Dodge, M.D.; and Stuart F. Quan, M.D.

Based on data obtained from the Tucson Epidemiologic Study of Chronic Lung Disease that included body weight, questionnaire responses, and spirometry, we found that among subjects with no respiratory symptoms, 28.0 percent reported insomnia (difficulty initiating or maintaining sleep) and 9.4 percent reported daytime sleepiness. Among subjects with respiratory symptoms, cough and/or wheeze, the rates of sleep complaints increased. With one symptom, 39.1 percent reported insomnia and 12.4 percent reported daytime sleepiness. With both symptoms, the rates were 52.8 percent and 22.8 percent, respectively. Overall, we found significant relationships between rates of respiratory symptoms and sleep complaints (trend $\chi^2 = 73.9, p < 0.001$ for insomnia; trend $\chi^2 = 37.9, p < 0.001$ for daytime sleepiness). In separate analyses, obesity, snoring, and a diagnosis of lung disease also influenced the rate of sleep complaints but, when we employed logistic regression, we found that obesity, respiratory symptoms, gender, and age were the only variables related to the risk of insomnia or daytime sleepiness. (Chest 1994; 105:151-54)

AOD = airways obstructive disease; CI = confidence intervals; DIMS = difficulty initiating or maintaining sleep; EDS = excessive daytime sleepiness; M-H = Mantel-Haenzel; TESOAD = Tucson Epidemiologic Study of Obstructive Airways Disease

Patients with chronic airways obstructive disease (AOD) frequently have complaints of disturbed sleep. On polysomnography, sleep in patients with AOD is characterized by an increase in the number of arousals and a reduction in total sleep time. In a previous study using data from a large general population, we found that subjects with a diagnosis of asthma and chronic bronchitis, chronic bronchitis alone, or emphysema had a higher prevalence of sleep complaints than the rest of the sample population. It is unclear, however, if disturbed sleep in these subjects with AOD is related to severity of airways obstruction, an increase in potentially sleep-disruptive respiratory symptoms, or both. Therefore, we conducted a further analysis to define the relationship among sleep complaints, AOD diagnosis, and pulmonary function.

Methods and Materials

The design of the Tucson Epidemiologic Study of Obstructive Airways Disease (TESOAD) from which these data are derived has been reported in detail previously. Briefly, the study is a stratified random cluster sample of white, non-Hispanic households residing in Tucson, which have been surveyed prospectively at 1- to 2-year intervals starting in 1972. Details of the methods used in the surveys and in data compilation have been published previously, including the development of percent predicted values for spirometric variables.

Because we were interested in an adult population, we included only subjects who were at least 18 years of age at the time of the ninth survey and who had completed that survey’s questionnaire (2,100 subjects). Some subjects did not fill out their questionnaires completely, so slightly fewer subjects were included in some analyses. In addition, only 1,358 subjects who completed questionnaires performed satisfactory spirometry.

During the ninth survey (1984 to 1985), a series of questions concerning sleep were included in the self-administered questionnaire. Subjects were asked if they were troubled by any of the following sleep problems: (1) trouble falling asleep; (2) trouble staying asleep; (3) not enough sleep; (4) waking up too early and not being able to get back to sleep; and (5) falling asleep during the day. As described in our previous report, we combined responses to questions 1 to 4 so that subjects who answered “Yes, still have the problem” to any of these questions were classified as having a complaint of difficulty initiating or maintaining sleep (DIMS). Subjects who answered “Yes, still have the problem” to question 5 were classified as having a complaint of excessive daytime sleepiness (EDS).

Chronic AOD diagnoses were based on questionnaire responses during either the eighth (1984) or ninth survey. Subjects were considered to have asthma, for example, if they answered “Yes, I still have it” to the survey 8 question: “Have you ever had asthma?” Subjects who answered “Yes” to the ninth survey question “Since the last questionnaire, have you had or been treated for asthma?” were also considered to have asthma. Similar questions were asked about emphysema and chronic bronchitis. Based on their responses to these questions, subjects were then assigned to a diagnostic category: (1) asthma; (2) chronic bronchitis; (3) chronic bronchitis with asthma; (4) emphysema with or without asthma and/or chronic bronchitis; or (5) no respiratory disease. All categories were mutually exclusive and the same as we used in a previous report. For some analyses, we pooled the subjects with respiratory disease, labeling them as having AOD. Data from both the eighth and ninth surveys were used to classify subjects as having AOD because the structure of the questions on the ninth survey asked only if the subjects had been treated for AOD since the previous survey. Therefore, we believed that use of data from only the ninth survey would have underestimated the number of subjects with an AOD diagnosis.

We obtained information regarding respiratory symptoms, snoring, and obesity from the ninth survey. As described previously, we considered subjects to have respiratory symptoms if they indicated on the questionnaire that they had cough or sputum production or...
wheezing. No questions, however, distinguished between daytime and nighttime symptoms. We classified subjects as having cough or sputum production if they gave a “Yes” response to any of the four questions asking whether these symptoms occurred in “bad weather” or “regardless of the weather.” We classified subjects as having wheezing if they gave a “Yes” response to a question asking if their chest ever sounded wheezy or whistling apart from when they had a cold or on most days. We also grouped subjects according to whether they reported snoring rarely, on some or most nights, or every night. Many subjects (76%) did not know if they snored, and they were excluded from some analyses.

Subjects were stratified by an index of obesity (body weight divided by height squared) into three groups based on weight and height at the ninth survey: the lowest 25th percentile, the middle 50th percentile, or the highest 25th percentile of the obesity index range for each gender. They also were placed into one of three age groups (<40 years of age, 40 to 64 years of age, and >64 years of age) as in our previous study.1

Spirometry in the ninth survey was performed using a field pneumotachograph device. Validation of the device and generation of predicted values for spirometric values in this population have been described in previous studies.2 For data analysis, we stratified subjects into three categories according to their FEV1/FVC ratios (≤ 60 percent, 60 to 80 percent, and >80 percent).

Statistical methods used include simple χ², trend χ² analyses of stratified data by Mantel-Haentzel (M-H), analysis of variance for parametric variables, and multiple logistic regression performed on SPSS/PC + software. All reported p values are two-tailed with a p value of < 0.05 considered as statistically significant. All aspects of this research have been reviewed and approved by the University of Arizona Human Subjects Committee.

Results

In our first set of analyses, we examined the rates of DIMS and EDS when the subjects were grouped according to their respiratory symptoms. For purposes of comparisons among subjects, we formed three exclusive groups: subjects with no respiratory symptoms; subjects with one symptom (either cough or sputum production or wheezing at least apart from colds); and subjects with both cough or sputum and wheezing apart from colds. Among the subjects with no respiratory symptoms, as shown in Table 1, 28.0 percent reported DIMS and 9.4 percent reported EDS.

Table 2—Prevalence of Sleep Complaints by Snoring and Obesity

<table>
<thead>
<tr>
<th>Snoring History*</th>
<th>No. of Subjects</th>
<th>DIMS</th>
<th>EDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rare</td>
<td>702</td>
<td>28.1</td>
<td>8.4</td>
</tr>
<tr>
<td>Some or most nights</td>
<td>462</td>
<td>35.9</td>
<td>13.9</td>
</tr>
<tr>
<td>Every night</td>
<td>100</td>
<td>40.0</td>
<td>18.9</td>
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tRate of DIMS but not EDS varied significantly among body mass index groups (M-H trend χ² for DIMS = 11.6, p < 0.001; trend χ² for EDS = 3.6, 0.05 < p < 0.1). EDS. Subjects with one symptom had a rate of DIMS of 39.1 percent and a rate of EDS of 12.4 percent. Subjects with both symptoms had a rate of DIMS of 52.8 percent and a rate of EDS of 22.8 percent. These rates were significantly different (trend χ² by M-H = 73.9, p < 0.001 for DIMS; trend χ² by M-H = 37.9, p < 0.0001 for EDS).

As shown in Table 2, analysis of the influence of snoring rate of sleep complaints demonstrated that the more frequently subjects snored, the more likely they were to complain of both DIMS and EDS (trend χ² by M-H = 14.6, p < 0.01 for DIMS; trend χ² by M-H = 10.9, p < 0.05 for EDS). And as shown in Table 2, we also found that the rate of DIMS rose significantly in relation to the obesity index but EDS did not (trend χ² by M-H = 11.6, p < 0.0001 for DIMS; trend χ² by M-H = 3.6, 0.05 < p < 0.1 for EDS).

In Table 3, we arranged the subjects into three groups according to their FEV1/FVC ratios. Although the complaint of EDS was higher in subjects with a ratio less than 60 percent than in the other two groups, neither the frequency of DIMS nor EDS was significantly different.

Table 3—Prevalence of Sleep Complaints Among Subjects Grouped by Percent Predicted Pulmonary Function

<table>
<thead>
<tr>
<th>Percent Predicted Pulmonary Function</th>
<th>No. of Subjects</th>
<th>DIMS</th>
<th>EDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;60</td>
<td>79</td>
<td>35.9</td>
<td>19.5</td>
</tr>
<tr>
<td>60-80</td>
<td>606</td>
<td>35.3</td>
<td>12.3</td>
</tr>
<tr>
<td>&gt;80</td>
<td>553</td>
<td>34.3</td>
<td>11.3</td>
</tr>
</tbody>
</table>

*Rates of sleep complaints did not vary significantly among pulmonary function groups (by M-H trend χ²). DIMS = difficulty initiating or maintaining sleep; EDS = excessive daytime sleepiness.
cantly different among the three groups (trend $\chi^2$ by M-H = 0.17, $p > 0.1$ for DIMS; trend $\chi^2$ by M-H = 2.57, $p > 0.1$ for EDS).

The above analyses suggested that respiratory symptoms as well as a history of snoring and obesity heightened the risk of sleep complaints in our subjects while the degree of airways obstruction did not. To further examine relationships among the above-mentioned variables, we performed logistic regression analyses. For these analyses, we grouped all subjects with asthma, chronic bronchitis, or emphysema into a single disease group (AOD), as in our previous report. Table 4 demonstrates the importance of the various independent variables in the regression model. Wheezing apart from colds independently increased the risk of DIMS as did age, obesity, and male gender. Moreover, neither a diagnosis of AOD (or the individual disease categories) nor severity of airways obstruction was predictive of DIMS. Similarly, cough or sputum production, age, and male gender increased the risk of EDS while a diagnosis of lung disease and airways obstruction did not.

To maximize the number of subjects included in the above logistic regression analyses, we did not include snoring as an independent variable because many of the subjects did not know if they snored (768). Separate analyses of the 1,222 subjects who had values for all the above independent variables and snoring revealed that snoring was a significant risk factor for EDS (odds ratio = 1.48; 95 percent confidence intervals [CI] = 1.13 to 1.94) but not for DIMS.

**DISCUSSION**

Several authors have found that patients with chronic obstructive lung disease have more sleep complaints than controls. Kinsman and his coworkers reported that sleep difficulties ranked third after dyspnea and fatigue in their 146 patients attending pulmonary clinics. Nearly one half of the patients had sleep difficulties “always” or “almost always.” Cormick and his coworkers studied 50 patients with chronic obstructive pulmonary disease (COPD) and found that 36 percent of the patients had difficulty falling asleep and 76 percent reported more than two awakenings each night. Seventy-two percent reported more than two awakenings each night. Seventy-two percent reported more than two awakenings each night. Seventy-two percent reported more than two awakenings each night.

With polysomnography, the investigators found that the patients averaged 15 arousals per hour. They also reported a relation between lower oxygen saturation and arousals.

In this study, we have also found that persons with respiratory disease complain of sleeping poorly. In the present analyses, however, both DIMS and EDS complaints were related to the presence of respiratory symptoms more strongly than to a diagnosis of lung disease or the degree of airways obstruction. In addition, as shown in Table 1, the more symptoms a subject had, the higher the rate of sleep complaints.

Thus, while it is well documented that subjects or patients with pulmonary disease sleep poorly, investigators differ in their explanations of this phenomenon. As mentioned above, Cormick et al suggested that oxygen desaturation, a common occurrence in patients with pulmonary disease, might be the reason their patients slept poorly. In support of that view, Goldstein and coworkers reported that oxygen improved sleep in their patients with COPD. Fleetham and coworkers, however, in a study of 24 patients, found that the reduced sleep time and increased arousals seen in their patients were not improved by treatment with sufficient oxygen to eliminate desaturation below 90 percent. Moreover, when Calverley and coworkers studied 20 patients with COPD, they found that the “pink puffers,” patients with satisfactory oxygen saturations both while awake and when asleep, had more disturbed sleep than the “blue bloaters,” patients with marked oxygen desaturation, especially during sleep.

Because the TESOAD is an epidemiologic survey, we cannot discount the possibility that oxygen desaturation contributed to the disturbed sleep our subjects reported. Nevertheless, other investigators also have reported that symptoms rather than objective measurements of severity of disease correlated with poor sleep. Montplaisir and his associates studied asthmatic patients both while symptomatic with recurrent attacks of wheezing and later after their conditions were improved. These investigators demonstrated that sleep efficiency improved and awake time after sleep onset decreased after their patients’ symptoms were well controlled. In another study that found a relation between symptoms and poor sleep, Stokes and coworkers demonstrated that three of nine young

<table>
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<tr>
<th>DIMS Risk Factor</th>
<th>Odds Ratio</th>
<th>95% CI</th>
<th>EDS Risk Factor</th>
<th>Odds Ratio</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheezing</td>
<td>2.1</td>
<td>1.64-2.70</td>
<td>Cough or sputum</td>
<td>1.70</td>
<td>1.25-2.32</td>
</tr>
<tr>
<td>Female sex</td>
<td>1.46</td>
<td>1.17-1.83</td>
<td>Age</td>
<td>1.68</td>
<td>1.39-2.03</td>
</tr>
<tr>
<td>Age</td>
<td>1.30</td>
<td>1.13-1.49</td>
<td>Male sex</td>
<td>1.37</td>
<td>1.01-1.85</td>
</tr>
<tr>
<td>Obesity</td>
<td>1.21</td>
<td>1.03-1.41</td>
<td></td>
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</tbody>
</table>

*DIMS = difficulty initiating or maintaining sleep; CI = confidence interval; EDS = excessive daytime sleepiness.*
patients with cystic fibrosis had coughing spells associated with sleep disorganization and concluded that symptoms play a role in the disturbed sleep of patients with pulmonary disease.

In our analyses, respiratory symptoms were more predictive of sleep disturbances than either specific diagnoses of respiratory diseases or level of pulmonary function. It is important to note that our study population as well as methodology were much different than that of the investigators mentioned above. We had a large number of subjects and, unlike the small groups of patients studied by others, our subjects had a wide variety of diagnostic labels. Among the 462 subjects with cough or sputum, for example, 273 (59.1 percent) had no current or past diagnosis of airways disease. Conversely, of the 415 subjects with a diagnosis of airways disease, only 45.5 percent (189) complained of cough or sputum. Thus, among the Tucson subjects, respiratory symptoms and diagnostic labels were not closely correlated.

In addition, sleep complaints in our population did not relate to level of pulmonary function. Other investigators have also found that sleep complaints are common among patients with pulmonary disease regardless of their functional impairment. Because there are so many influences on rates of sleep complaints (anxiety, sleeping conditions, use of caffeine and other drugs), it is not surprising that we did not detect a consistent effect of level of pulmonary function.

Previous studies have established that patients with other chronic medical illnesses, such as arthritis or chronic renal disease, have more difficulty initiating or maintaining sleep than healthy people. Based on the above results, it is possible that sleep complaints might correlate better with symptoms that occur commonly in such patients, such as night pain or nocturia, rather than with diagnoses.

In summary, we have found that specific respiratory symptoms, mainly cough or sputum production and wheezing apart from colds, are more predictive of sleep complaints among subjects of a general population than either lung function or a diagnosis of lung diseases.

References
1 Klink M, Quan SF. Prevalence of reported sleep disturbances in a general adult population and their relationship to obstructive airways diseases. Chest 1987; 91:540-46
2 Cormick W, Olson LC, Hensley MJ, Saunders NA. Nocturnal hypoaxemia and quality of sleep in patients with chronic obstructive pulmonary disease. Thorax 1986; 41:946-54
6 Bloom JW, Kaltenborn WT, Quan ST. Risk factors in a general population for snoring: importance of cigarette smoking and obesity. Chest 1988; 93:678-83