Increased Physician-Reported Sleep Apnea*

The National Ambulatory Medical Care Survey

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Background: Despite increased recognition of sleep apnea as a major health problem, little is known about physician practice patterns regarding this condition.

Methods: We used the National Ambulatory Medical Care Survey (NAMCS) data between the years of 1990 to 1998, a weighted estimate of the frequency of physicians’ diagnoses nationwide in their outpatient practices, to address the following questions: (1) has there been an increase in physician reporting of sleep apnea, (2) which physicians reported diagnoses of sleep apnea, and (3) what are the demographic characteristics of patients with diagnoses of sleep apnea?

Results: During this 9-year period, there was a 12-fold increase in the diagnosis of sleep apnea in outpatients, from 108,121 to 1,305,624 diagnoses ($p < 0.001$). Among other primary sleep disorders, only insomnia had an increase in reporting (fourfold, $p < 0.001$). Report of sleep apnea was greatest among primary care providers (37%), pulmonologists (24%), and otolaryngologists (18%). Sleep apnea was reported more often in men than in women (3:1, respectively), and 80% of diagnoses occurred in the following age groups: 30 to 39 years (12%), 40 to 49 years (33%), 50 to 59 years (27%), and 60 to 69 years (12%). Conditions associated with sleep apnea included hypertension (10%), obesity (6%), and COPD (7%). Increased reporting of sleep apnea by NAMCS physicians was associated with increases in the number of accredited sleep laboratories and the number of sleep publications in the medical literature during the period of review ($p < 0.001$).

Conclusion: Sleep apnea is recognized increasingly by physicians. Further investigation is necessary to define those factors that influence physician recognition and reporting of sleep apnea, and approaches associated with optimum patient outcomes.

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Key words: medical literature; sleep apnea; specialist

Abbreviations: NAMCS = National Ambulatory Medical Care Survey; NCHS = National Center for Health Statistics; PCP = primary care provider; PSU = primary sample unit; URI = upper respiratory tract infection

Over the past decade, efforts have been made to improve physicians’ recognition of patients with sleep apnea. Several reports have documented that sleep apnea occurs commonly, with an incidence of 2 to 4% among middle-age adults,1,2 and more frequently among the elderly.3,4 Patients with sleep apnea confront long-term sequelae (hypertension5–7 and cardiopulmonary disorders8–11) and possible increased mortality.12,13 In addition, the problems of potential risk to others (motor vehicle accidents14,15 and industrial catastrophes16) and rising costs of...
medical care underscore the need for early and accurate detection of sleep apnea, and an important opportunity for general health promotion. Despite the impact on patients and community, it has been reported that only approximately 10% of patients with clinically significant sleep apnea syndromes are recognized. A national consensus panel suggested that efforts must be made to educate physicians in order to improve recognition of these patients. Relevant initiatives have included increased hours of medical education dedicated to sleep and sleep-disordered breathing, increased public awareness by television advertisement and forums centered on the dangers of sleep apnea, increased funding to research devoted to physician education regarding sleep and sleep apnea syndrome, and increased reports about sleep problems in the medical literature and lay press. These developments have been accompanied by an increased availability of sleep laboratories and consultative resources for the evaluation of patients with sleep disorders. Despite this progress, it is not known whether any change has occurred in the frequency with which physicians nationwide identify or document this condition. Using a nationwide physician survey database, we asked several simple questions: has there been a change in the number of patients per year in whom physicians report sleep apnea, which specialties have been more likely to report sleep apnea, and what are common demographic characteristics of patients documented with sleep apnea?

**Materials and Methods**

**Database**

The National Ambulatory Medical Care Survey (NAMCS) is a national survey of office-based physicians conducted by the National Center for Health Statistics (NCHS) and the Centers for Disease Control and Prevention. Data from this survey data on individual outpatient office visits is then weighted to reflect national estimates describing the use of ambulatory medical care services in the United States. Using NAMCS data, questions regarding patterns of reporting disease, disease-specific patient characteristics, and diagnoses can be assessed. The physician-patient encounter or outpatient visit is the basic sampling unit for the NAMCS. Nonfederal physicians classified by the American Medical Association or the American Osteopathic Association as fulfilling office-based patient care, and of all physician specialties except anesthesiology, pathology, and radiology were included in the NAMCS. Data collections involved physicians or office staff completing a patient record form providing the reasons for and the duration of the outpatient visit, demographic data, services provided, physician diagnoses, and referral practices. Up to three diagnoses were coded per patient encounter. The diagnoses listed for the purposes of the NAMCS were not dependent on the billing diagnoses, and were not tied to reimbursement. In small practices, 100% of patient visit data were available, while in very large practices 20% of patient visits were sampled randomly.

The data set from 1990 to 1998 contains 372,830 records and provides a weighted estimate representative of 6.2 billion patient visits of office-based physicians in the United States. To obtain these national estimates, each individual record is assigned an inflation factor called the patient visit weight, which is then used to predict the total number of office visits made in the United States. All estimates from the NAMCS are related to the number of patient visits and subject to sampling variability. Representative relative SEs for the 1994 NAMCS are as follows: 8.1% for estimates of 10,000,000 visits, 23.9% for estimates of 1,000,000 visits, 33.6% for estimates of 500,000 visits, and 74.8% for estimates of 100,000 visits. Relative SE rates from other years are similar and can be obtained from NCHS-published information. When considering the reliability of the estimates, the NCHS considers an estimate to be reliable if it has a relative SE of ≤ 30% of the estimate. All data management and analysis described hereafter were performed using software (Statistical Analysis System; SAS Institute; Cary, NC, and Stata; Stata Corporation; College Station, TX). Linear regression using a procedure that takes the sampling variability into account (SAS Proc Survey; SAS Institute) found the degree of difference was due to chance.20 Statistical significance of observed differences was accepted for p < 0.05.

**Sample Design**

NAMCS applies a multistage approach comprised of probability samples of primary sample units (PSUs), physician practices within PSUs, and patient visits within practices. The first stage sample includes 112 counties, group of counties, or county equivalents that make up the total number of PSUs nationwide. The second stage sample consisted of a probability sample of practicing physicians mentioned above. All eligible physicians were stratified by 15 groups: general and family practice, ophthalmology, internal medicine, pediatrics, general surgery, obstetrics and gynecology, cardiovascular diseases, dermatology, urology, psychiatry, neurology, ophthalmology, otolaryngology, orthopedic surgery, and “all other” specialties. The third stage was a selection of patient visits within the annual practice of a sample physician and involved two steps: (1) the total physician sample was divided into 52 approximately equal subsamples that were then randomly assigned to one of the 52 weeks in a survey year; and (2) a systematic random sample of visits was selected by the physician during the assigned week. Sampling rate varied according to a presurvey interview, from 100% for small practices to 20% for very large practices.20 Patient recording includes two forms, a patient log and a patient record completed by the physician with assistance of office staff. The patient log is a sequential list of patients seen in the office during the physician’s assigned reporting week, and functions as a sampling frame from which the medical record form is completed. The data from 1990 to 1998 encompass 372,830 records, providing a weighted estimate representative of 6.2 billion office-based physician visits in the United States.20

**NAMCS Search**

The database was searched with all International Classification of Diseases, ninth revision codes (780.51–780.57) used to describe sleep apnea. Among patients with sleep apnea diagnoses, a further search was conducted for other diagnoses, patient age, and gender. Additionally, a search of other primary sleep disorders was conducted, and all International Classification of Diseases, ninth revision codes for insomnia, parasomnias, restless leg syndrome, and narcolepsy were used, and their reported frequencies as a primary, secondary, and tertiary diagnoses per year were noted.
MEDLINE and Science Citation Index Searches

To determine whether changes in the frequency of reports relating to sleep disorders published in the medical literature had occurred during the period of review, two librarians blinded to the NAMCS data conducted an independent search of the medical literature to best quantify the number of sleep apnea publications and the number of times each report was cited from 1990 to 1998 in the following manner: the medical subject heading “Sleep Apnea Syndromes” was exploded and then limited to human subjects, English-language articles, and articles indexed to the sleep apnea terms as the main focus of the articles. The librarians took the MEDLINE results and limited them by year to determine the number of reports published in each year. In addition, for each article identified in the MEDLINE search, a search of the Science Citation Index on the Web of Science was conducted to identify the number of times each article was cited from 1990 to 1998. A database quantifying the number of citations per article per year was developed.

The trends in the number of publications per year from 1990 to 1998 (MEDLINE search) and the number of citations to these publications per year from 1990 to 1998 (Science Citation Index search) were then compared to the trends of sleep apnea diagnoses per year in the NAMCS data set obtained in the same time period (from 1990 to 1998). In order to assess the relationship between the annual frequencies of events that occurred in the medical literature and those that occurred in the NAMCS survey, Spearman correlation coefficient was calculated.

Number of Accredited Sleep Disorder Centers and Sleep Laboratories

Through their database, the American Academy of Sleep Medicine provided the number of accredited sleep laboratories during the years from 1990 to 1998. The trend in the number of accredited sleep laboratories per year was then compared to the trends of NAMCS-reported sleep apnea diagnoses per year during this period. To assess this relationship, Spearman correlation coefficient was calculated.

RESULTS

Annual Frequencies of Reporting Sleep Apnea and Other Common Diseases

During the 9-year period, we queried the frequency of sleep apnea and common diseases diagnosed yearly and whether there was a change over time. Sleep apnea was noted as a primary, secondary, or tertiary diagnosis in 4.83 million visits (0.8% of the total). There was a 12-fold increase (from 110,000 to 1.3 million, \( p < 0.0001 \)) in the number of sleep apnea diagnoses reported per year (Fig 1). By contrast, the frequencies with which common diseases including upper respiratory tract infection (URI), hypertension, and diabetes mellitus were reported, either as a primary, secondary, or tertiary diagnosis, did not change significantly (mean reporting frequencies: URI, 65 million per year; hypertension, 52.2 million per year; and diabetes mellitus, 69 million per year, respectively) during the same period.

Other sleep disorders, including insomnia, parasomnias, restless legs syndrome, and narcolepsy, were also appraised. The frequencies with which parasomnias, restless legs syndrome, and narcolepsy were reported, either as a primary, secondary, or tertiary diagnosis, did not change significantly. However, the reported frequency of insomnia diagnoses increased by fourfold from 1990 to 1998 (from 801,862 to 2,686,006/yr, \( p < 0.001 \); Fig 2).

Specialty Characteristics of NAMCS Physicians

These participating physicians included primary care providers (PCPs) [internal medicine, family practice, and pediatrics] in 32%, with general surgery, obstetrics and gynecology, and other surgical and nonsurgical subspecialties (excluding anesthesia, pathology, and radiology) accounting for the other 68%. The geographic locations of their practices were in the Northeast (20%), Midwest (24%), South (34%), and West (22%) [NAMCS 1998]. The
specialty distribution of physicians reporting sleep apnea are summarized in Figure 3. Nearly 80% of sleep apnea diagnoses were reported by three groups of physicians: PCPs (37%), pulmonologists (24%), and otolaryngologists (18%). The remaining physicians included neurologists (9%), cardiologists (4%), psychiatrists (4%) and others (4%). These distributions among physician groups reporting sleep apnea were consistent throughout this 9-year period.

Characteristics of Patients With Sleep Apnea

Characteristics of patients reported with sleep apnea are summarized in Table 1. Eighty percent of patients reported with sleep apnea ranged from 30 to 69 years of age. The age ranges included persons 30 to 39 years (12.4%), 40 to 49 years (33%), 50 to 59 years (27%), and 60 to 69 years old (12%) [Fig 4]. Fewer than 5% of patients with sleep apnea diagnoses were > 70 years of age. Patients were predominantly male (71%), white (89%), and included a mean of 16% with cardiovascular disorders, 13% with pulmonary disorders, and 6% with obesity. The most common coexisting cardiovascular disorder was hypertension (10%), and the most common pulmonary disorder was COPD (7%). The frequencies of these comorbid conditions did not change from 1990 to 1998.

Table 1—Characteristics of Patients With Sleep Apnea in the NAMCS Database

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Proportion of Sleep Apnea Patients, %</th>
<th>Frequency, per 100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male/female gender</td>
<td>71/29</td>
<td>34/14</td>
</tr>
<tr>
<td>White/other race</td>
<td>99/11</td>
<td>43/5</td>
</tr>
<tr>
<td>Hypertension</td>
<td>10.2</td>
<td>4.9</td>
</tr>
<tr>
<td>Obesity</td>
<td>6.1</td>
<td>2.9</td>
</tr>
<tr>
<td>Pulmonary disorders</td>
<td>12.8</td>
<td>6.2</td>
</tr>
<tr>
<td>COPD</td>
<td>7</td>
<td>3.4</td>
</tr>
<tr>
<td>Asthma</td>
<td>2.4</td>
<td>1.1</td>
</tr>
<tr>
<td>Respiratory distress</td>
<td>3.4</td>
<td>1.7</td>
</tr>
<tr>
<td>Cardiac disorders</td>
<td>5.6</td>
<td>2.7</td>
</tr>
<tr>
<td>Angīna</td>
<td>1.8</td>
<td>0.9</td>
</tr>
<tr>
<td>Congestive heart failure</td>
<td>1.1</td>
<td>0.5</td>
</tr>
<tr>
<td>Coronary artery disease</td>
<td>1.8</td>
<td>0.9</td>
</tr>
<tr>
<td>Arrhythmias</td>
<td>0.2</td>
<td>0.1</td>
</tr>
<tr>
<td>Cor pulmonale</td>
<td>0.5</td>
<td>0.3</td>
</tr>
<tr>
<td>Hypothyroidism</td>
<td>1.5</td>
<td>0.8</td>
</tr>
</tbody>
</table>

Using the exploded medical subject headings term of Sleep Apnea Syndromes, librarians identified > 2,000 publications in MEDLINE during the period of this NAMCS review. An increase in the annual number of publications regarding sleep apnea was identified, with a > 50% increase (from 202 to 344 articles per year) during the period from 1992 to 1996 published on sleep apnea. The Science Citation Index search showed that inclusive of all surgical and nonsurgical sleep apnea publications, there were > 15,000 citing references with a 21-fold increase in the number of references occurring from 1990 to 1998.

In order to determine whether an association exists between these reporting practices of physicians, the events that occur in the medical literature, and the availability of resources for clinical sleep testing, we compared the number of sleep apnea publications, the number of citations to them, and the number of accredited sleep laboratories with the number of sleep apnea diagnoses reported by the NAMCS physicians per year. There was a strong association ($r^2 = 0.93$, $p < 0.001$) between the number of publications and number of diagnoses of sleep apnea from 1990 to 1998 (Fig 5, top, A). During the same time period, a similar association between references to the sleep apnea publications and diagnosis of sleep apnea by the NAMCS physicians was observed ($r^2 = 0.97$, $p < 0.001$). In addition, the number of sleep laboratories accredited by the Amer-
ican Academy of Sleep Medicine during the period of review increased from 164 to 417/yr. This change also correlated with the changes in NAMCS database regarding sleep apnea reporting (Fig 5, bottom, B; $r^2 = 0.90$, p < 0.001).

**Discussion**

Sleep apnea, a condition of major societal importance, has been estimated to be an as prevalent (2 to 4%) as another common respiratory condition, asthma. The economic cost sleep apnea imposes on our health-care system and society has been estimated in the billions of dollars. Despite this impact, physicians underrecognize the disease. Several measures have been implemented to increase both physician and patient awareness of sleep apnea, but little is known about the frequency of physicians’ documentation and/or reporting of this condition during the past decade. Using a national survey database, we assessed reporting trends of outpatient physicians, the subspecialties they represented, and characteristics of their patients with sleep apnea. We found that a 12-fold increase in the reporting of sleep apnea had occurred from 1990 to 1998, with sleep apnea diagnosed in 0.8% of outpatient office visits. In their classic epidemiologic study, Young et al demonstrated clinically significant sleep apnea in 2% of community dwelling middle aged adults. Several others have substantiated these findings and have suggested that the prevalence may be higher, approximating 5%, and especially noteworthy among special populations (nursing home residents, approximately 40%). Important concerns about the lack of recognition and reporting of this condition have been raised in the past. Young and colleagues suggested that <10% of patients with clinically significant obstructive sleep apnea were recognized. Chart audits in inpatient ward services and ambulatory general medicine clinics have revealed a low frequency of reporting sleep apnea, and clinicians have been shown to infrequently elicit sleep histories during interactions with simulated patients. Despite the low overall rate of reporting, the 12-fold increase in the reporting practice of these physicians over the 9-year period provides some cause for optimism. Moreover, since physicians tend to underdocument, the absolute rate of reporting among physicians in the NAMC survey probably underrepresents the frequency with which sleep apnea was diagnosed and treated. In review of the trends, the greatest increase appears to have occurred from 1992 to 1996 (Fig 1). We suggest that multiple interacting factors in the medical community and community at large may help to account for this reporting trend. Such factors include the increasing availability of sleep consultants and laboratories for sleep testing, more uniformity in the standards in polysomnographic testing for sleep apnea, established effective treatment of this condition, evidence that describes the deleterious impact of untreated sleep apnea on the community, and a rising profile of sleep apnea in the medical literature and lay press. Although our correlative statistics showed an interesting relationship between the presence of sleep apnea reports in the medical literature, rising numbers of accredited sleep labo-
ratories, and the annual frequencies of sleep apnea diagnoses in NAMCS, it should be underscored that a direct, causal relationship is not established. It is likely that the interactions of these and numerous other factors not evaluated contributed to the changes in physician practices reported.

Clinical studies and consensus panels suggest that all health-care providers should be able to recognize and diagnose obstructive sleep apnea, and have delineated physical findings and symptoms associated with sleep apnea, together with the mandate that health-care providers obtain skills in performing sleep histories essential to diagnosis. In recent years, special emphasis has been placed on the roles of PCPs as “gate keepers,” but little is known about the frequency of sleep apnea diagnosis among PCPs and specialists. Radecki and Bruton reported that PCPs were the most common physician group to diagnose insomnia, followed by psychiatrists. During the NAMCS 9-year period, with its 12-fold increase in reporting sleep apnea, the highest frequency of patients receiving diagnoses of sleep apnea was reported by NAMCS PCPs (general practitioners, internists, and family practitioners), rather than subspecialists. This distribution of practice orientation is quite similar to that noted in a multicenter investigation of referral patterns to 19 accredited regional sleep centers. In this national cooperative study, physicians who referred patients to sleep laboratories were most likely to be from internal medicine (37%), pulmonary medicine (17%), and otolaryngology (13.6%). Anecdotal observations suggest that many health-care providers regard sleep apnea as a rare condition that is primarily managed by specialists. Although the valuable input from specialists in patient evaluation, sleep testing, and treatment planning should not be minimized, we believe that the current findings support the concept that sleep apnea is a general medical, rather than an exclusive subspecialty problem, and that ensuring that generalists are prepared optimally to meet this challenge is a priority.

Sleep apnea has been shown to be most prevalent among male patients from 30 to 60 years of age. In the NAMCS patient population, most sleep apnea diagnoses (70%) were made in patients 40 to 59 years of age, especially among men (70%). These age and gender distributions, consistent with previous epidemiologic data, did not change significantly per year during the 9-year period. From a large cohort of two counties within southern Pennsylvania, Bixler and colleagues found after random sampling and eventual polysomnogram testing that the age-specific prevalence of obstructive sleep apnea was greatest in patients 45 to 64 years of age (4.7%). Within the NAMCS, a smaller proportion of sleep apnea diag-

In addition to age, we investigated other factors potentially associated with sleep apnea. Our search strategy specified the top 25 comorbid conditions among patients with sleep apnea. As in other observational studies, the most common comorbid conditions identified in the NAMCS were systemic hypertension and obesity, at 10% and 6%, respectively. Although the precise relationships of sleep apnea to these conditions continue to be clarified, it is interesting to find that this relationship persists in a nationwide cohort of physicians’ reports. The third most common condition identified was obstructive lung disease (5%). Previous studies have identified a relationship between these disorders and a potential synergistic interaction in causing adverse sequelae such as right heart failure. Redline and colleagues noted 28% of children to have obstructive lung disease and sleep apnea. Interestingly, COPD and/or asthma was linked to patients with this sleep disorder. Whether this association in the NAMCS patients reflects a true relationship of sleep apnea to COPD, or that 30% of diagnoses of sleep apnea were made by pulmonologists, is not defined.

Several limitations of the current observations merit comment. Because this prospectively collected NAMCS database is used optimally for annual measures of practice trends among physicians, incidence and prevalence information cannot be assessed appropriately. The use of weighted estimates might either overestimate or underestimate an effect. Hence, the most appropriate use of these data is in determining the changes that occur over time. It is likely that these observations are subject to a variety of biases, particularly regarding selection of physicians and their decisions whether to participate. Participating physicians may have fewer time constraints or more staff support, suggesting a socioeconomic bias. The patient population and their characteristics may reflect similar biases based on physician selection and physician participation, and may be manifest in the patient demographic characteristics in which 20% of reported patients were nonwhite and 30% were women.

Despite these and other limitations, we believe that the NAMCS provides a resource for identifying the trends in the reporting patterns of diverse outpatient physicians nationwide. From this sample representing ambulatory practices in all parts of the United States, there is evidence that, although reporting rates for sleep apnea remain low, a significant increase (12-fold) in the reporting of sleep apnea diagnosis has occurred during past 9 years. A number of factors may be related to this increase,
including greater visibility of sleep apnea in the medical literature, increased resources for sleep testing, and other unappraised factors. Although the reasons for these improvements in clinical reporting of sleep problems are not defined, these observations suggest a positive response on the part of health-care providers to the prevalence and morbidity of these potentially treatable conditions.

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