Background: Allergic rhinitis (AR) is common and has been shown to impair social life and sleep. Patients with severe symptoms may have more sleep disturbances than those with a mild form of the disease, but this has never been assessed using a validated tool. The objective of our study was to assess, in patients with AR, whether duration and severity of AR are associated with sleep impairment.

Methods: A nationwide controlled cross-sectional epidemiological study was carried out. A representative sample of 260 French ear, nose, and throat and allergy specialists enrolled 591 patients with AR of at least 1 year’s duration. Sleep disorders, sleep quality, and AR were assessed using validated tools (Sleep Disorders Questionnaire, Epworth Sleepiness Scale, and Score for Allergic Rhinitis). The severity of AR was assessed using the Allergic Rhinitis and its Impact on Asthma classification.

Results: All dimensions of sleep were impaired by AR, particularly by the severe type. Sleep was significantly more impaired in patients with severe AR than in those with the mild type. The duration of AR (intermittent or persistent) had no effect on sleep.

Conclusion: These data underline the close relationship between AR and sleep and highlight the need for clinicians, particularly general practitioners, to be attentive in this respect.

Arch Intern Med. 2006;166:1744-1748

Author Affiliations: Centre du Sommeil et de la Vigilance de l’Hôpital Dieu, Assistance Publique Hôpitaux de Paris, Paris, France (Dr Léger); Épidémiologie des Maladies Allergiques et Respiratoires, Institut National de la Santé et de la Recherche Médicale, Paris (Dr Amnes-Maesano); Service de Pneumologie, Hôpital Cochin, Assistance Publique Hôpitaux de Paris (Dr Carat); Service d’Otorhino-laryngologie, Hôpital Henri Mondor, Assistance Publique Hôpitaux de Paris, et Centre Hospitalier de Créteil, Créteil, France (Mr Rugina); GlaxoSmithKline, Marly-le-Roi, France (Drs Chanal, Pribil, and El Hasnaoui); and Centre Hospitalo Universitaire and Hôpital Arnaud de Villeneuve, Montpellier, France (Dr Bousquet).
Sleep Impairment) to assess the importance of sleep impairment in AR according to its severity and duration.

**METHODS**

The DREAMS was a controlled cross-sectional study performed with a sample of patients with AR who were being treated by an allergist or ear, nose, and throat specialist. The description of the study and the characteristics of the patients have been published previously. The participating clinicians were randomly selected from all regions of France to rule out any geographic or seasonal parameter and to take into account the population distribution in the country (stratification for geographical area). Each clinician had to include the first patients (at least 2 patients) who presented with AR and who met the inclusion criteria.

This study was approved by the national authority for epidemiological database studies (Commission Nationale Informatique et Liberté), and under the French regulatory system, individual consent was not required for this kind of study.

**SUBJECTS**

Inclusion criteria were that patients—men or women—had to be aged 18 to 50 years, have AR of at least 1 year’s duration, and have a score of 7 or higher on the self-administered Score for Allergic Rhinitis questionnaire (see the following subsection). Exclusion criteria were the presence of grade III or IV nasal polyps and/or major nasal septum deviation.

A control group of individuals without AR was matched for age, sex, and geographical area with the first 2 patients selected by the physicians. They were selected from among men and women who were being treated at general practitioners’ clinics.

**ESTABLISHING AR**

The Score for Allergic Rhinitis is a validated diagnostic tool. A score of 7 or greater, the threshold used in the study described herein, has been shown to provide satisfactory discrimination between patients with AR and those without AR. The Score for Allergic Rhinitis questionnaire was completed by patients, and a score was assigned by the clinician. Clinicians completed a standardized questionnaire that covered demographics (their own and those of their patients) and patient characteristics.

Information recorded for each patient included the following: socioeconomic status category, smoking habits, type of AR (according to the Allergic Rhinitis and Its Impact on Asthma [ARIA] classification), symptoms and duration of AR, concomitant allergic disorders (ie, previously diagnosed), therapeutic treatment of patients with AR, and ongoing treatment of concomitant diseases (responses included use of anxiolytic drugs, hypnotics, antimigraine agents, and nonsteroidal anti-inflammatory drugs).

The recently developed ARIA classification of AR was first proposed by the World Health Organization in 1999 and 2001. ARIA classifies AR according to the duration of the episodes (eg, intermittent or persistent) and their severity in terms of symptoms and quality of life (mild or moderate to severe).

**ASSESSMENT OF SLEEP**

Sleep disorders and sleepiness were assessed by self-administered questionnaires: the Sleep Disorders Questionnaire, French version (known as Hotel Dieu—42 [HD-42]), and the Epworth Sleepiness Scale score. The HD-42 is a 42-item questionnaire based on the Stanford Sleep Questionnaire and Evaluation of Wakefulness. The French version has been validated in several epidemiological studies. It covers sleep habits; sleep disorders; alertness during the daytime; and psychobehavioral items on mood, memory, and sexual behavior.

Sleep disorders were defined using the categories items and criteria as shown in Figure 1. All but 1 of the items are derived from questions and possible responses in the HD-42. The selection of sleep disorders was based on 2 reference documents: the International Classification of Sleep Disorders and the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Revised (DSM-IV-R).

The HD-42 also collected data on 5 specific sleep complaints: difficulties in falling asleep, frequent nocturnal awakenings, early awakenings, poor-quality sleep, and feeling a lack of sleep. The sleep complaints are essentially drawn from the International Classification of Sleep Disorders and the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Revised (DSM-IV-R) definition of insomnia. Severe insomnia was defined as the presence of at least 2 sleep complaints according to the DSM-IV-R definition. In addition, the minimum criteria from the International Classification of Sleep Disorders for insomnia, idopathic hypersomnia, snoring, and sleep apnea were used. Information was also collected on duration of sleep disorders. The Epworth Sleepiness Scale, a self-administered questionnaire, is a subjective tool constructed and tested in the early 1990s; it has been validated against objective tests such as the Multiple Sleep Latency Test.

**STATISTICAL ANALYSIS**

We performed data management and statistical analysis by using the SAS software package (version 8; SAS Institute Inc, Cary, NC). Descriptive analyses for qualitative variables included number,
frequency, and the 95% confidence interval, whereas quantitative variables were analyzed in terms of mean value, standard deviation, and median and extreme values. Collected data were analyzed for the total population and by subgroups of type and severity of AR (intermittent or persistent; mild or moderate to severe).

We created a logistical model for each type of sleep disturbance. A general linear model was used to study the relation between severity of AR and sleep symptoms. For description of quantitative variables, the Kruskal-Wallis test with Bonferroni-Dun post hoc analysis was used.

We determined predictive factors for sleep impairment by using logistic regression analysis after adjustment for potential confounders (sex and age). The associations were then expressed using odds ratios. A step-by-step selection of sociodemographic and clinical criteria was performed by using a univariate approach ($\chi^2$ or Fisher exact test for nonordinal qualitative variables, Kruskal-Wallis test for ordinal data, and analysis of variance or Kruskal-Wallis test for quantitative variables).

## RESULTS

From May to September 2002, a total of 828 patients were evaluated by clinicians. Following verification of criteria, 591 of these patients, recruited by 360 clinicians, were retained for the analysis and thus constituted the DREAMS population. There were 502 subjects in the control group.

### DESCRIPTION OF THE STUDY POPULATIONS

The mean (SD) age of patients with AR (47% of whom were men) was 33.9 (9.2) years; most (77.6%) of the patients were nonsmokers. No significant difference was found between patients and the control group in sex distribution. In both populations, most subjects were living in an urban area rather than a rural area; this difference was more marked in the control group but did not reach statistical significance (78.2% vs 73.8%; $P=.09$). The mean (SD) body mass index (calculated as weight in kilograms divided by height in meters squared) was not significantly different between the 2 groups (23.6 [2.8] in patients with AR vs 24.2 [3.7] in the control group).

The only significant difference between the DREAMS population and the control group was in smoking habits (there was a higher percentage of smokers among the control group [$P=.047$]) and in the socioeconomic category (a significantly lower percentage of manual workers among patients with AR [$P<.001$]). The distribution of patients with AR according to the ARIA classification shows that in this study, persistent moderate to severe AR was the most frequent type (59.4%). A total of 85% of patients with AR were receiving a treatment for their disease. Asthma was a comorbidity in 24.4% of patients with AR compared with only 1.7% of the control group ($P<.001$).

### IMPACT OF AR ON SLEEP QUALITY

Table 1 shows the prevalence of sleep complaints and sleep disorders in patients with AR (total and ARIA-classified) and the control group. Among patients with insomnia (n=191), the influence of the type and severity of AR on sleep complaints and disorders was analyzed; this showed a significant impact of the AR severity ($P<.001$), but not of its frequency, on insomnia (Figure 2). In other words, patients with mild (intermittent or persistent) AR did not have insomnia more often than the control group, and only subjects with moderate to severe AR had insomnia more often than the control group. A similar finding was observed for severe insomnia ($P<.001$), hypersomnia ($P<.001$), respiratory arrest ($P=.02$), observed apnea, sleepiness ($P=.03$), and regular use of sedative agents ($P=.009$) (not all data shown in Table 2). Compared with the control group, patients with AR reported significantly more use of sedative drugs and alcohol consumption ($P=.003$ and $P<.001$, respectively).

**Table 1. Prevalence of Sleep Complaints and Sleep Disorders According to the Type of Allergic Rhinitis (AR) (ARIA Classification)**

<table>
<thead>
<tr>
<th>Complaint or Disorder</th>
<th>59 With Mild Intermittent AR</th>
<th>81 With Mild Persistent AR</th>
<th>100 With Moderate to Severe Intermittent AR</th>
<th>351 With Moderate to Severe Persistent AR</th>
<th>591 Total</th>
<th>502 Patients in Control Group*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insomnia</td>
<td>14.6</td>
<td>14.3</td>
<td>40.5</td>
<td>42.8</td>
<td>35.8</td>
<td>16.0</td>
</tr>
<tr>
<td>Severe insomnia</td>
<td>10.6</td>
<td>10.3</td>
<td>27.0</td>
<td>27.2</td>
<td>23.2</td>
<td>10.4</td>
</tr>
<tr>
<td>Sleep apnea syndrome</td>
<td>15.6</td>
<td>22.7</td>
<td>33.7</td>
<td>36.9</td>
<td>32.6</td>
<td>24.3†</td>
</tr>
<tr>
<td>Other</td>
<td>Regular use of sedatives</td>
<td>3.5</td>
<td>4.8</td>
<td>14.4</td>
<td>7.2</td>
<td>7.7</td>
</tr>
</tbody>
</table>

Abbreviations: ARIA, Allergic Rhinitis and Its Impact on Asthma; ESS, Epworth Sleepiness Scale.

*Except where noted, $P<.001$ for total patients with AR vs control group.

†$P=.003$ for total patients with AR compared with control group.
IMPACT OF AR ON SNORING AND APNEA

Snoring was significantly more often reported in patients with AR than in the control group \( (P<.001) \). Based on the minimum subjective criteria (snoring loudly every night and daytime sleepiness), sleep apnea syndrome seemed also to be more prevalent in patients with AR than in the control group \( (3.8\% \text{ vs } 0.5\%; \ P<.001) \).

IMPACT OF AR-INDUCED POOR QUALITY OF SLEEP ON EVERYDAY LIVING

A total of 43.7\% of patients with AR reported a feeling of fatigue on awakening despite a normal night’s sleep. Headache at awakening, anxiety, and depression as contributing factors of sleep problems and daytime somnolence were significantly more frequently reported by patients with AR than by the control group \( (P<.001) \).

Severity of AR had an adverse effect on memory \( (P=.01) \) and mood \( (P=.003) \). Compared with the control group, significantly more patients with AR reported memory impairment and decreased sexual activity \( (P<.01) \).

The severity of AR significantly influenced the mean duration of nocturnal sleep during the week and weekends \( (P=.001 \text{ and } P=.002, \text{ respectively}) \), the frequency of daytime sleepiness \( (P=.04) \), the time necessary to fall asleep \( (P<.001) \), and the necessary intake of sedative drugs \( (P=.009) \).

![Figure 2. Distribution of the population of patients with insomnia who also have allergic rhinitis (AR) (n=19) according the type of Allergic Rhinitis and Its Impact on Asthma classification. NS indicates nonsignificant impact of AR frequency on insomnia.](image)

### Table 2. Predictive Factors for Sleep Disturbances in Allergic Rhinitis (AR)*

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Insomnia OR (95% CI)</th>
<th>( P ) Value</th>
<th>Severe Insomnia OR (95% CI)</th>
<th>( P ) Value</th>
<th>Hypersomnia OR (95% CI)</th>
<th>( P ) Value</th>
<th>Sleep Apnea OR (95% CI)</th>
<th>( P ) Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severity of AR (moderate to severe vs mild)</td>
<td>4.04 (2.37-7.22)</td>
<td>&lt;.001</td>
<td>2.67 (1.46-4.24)</td>
<td>.001</td>
<td>2.11 (1.29-3.58)</td>
<td>.004</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Type of AR (persistent vs intermittent)</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>4.36 (1.88-17.58)</td>
<td>.03</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Treatments†</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anxiolytics</td>
<td>5.44 (2.30-14.42)</td>
<td>&lt;.001</td>
<td>6.31 (2.69-15.76)</td>
<td>&lt;.001</td>
<td>NS</td>
<td>NS</td>
<td>6.14 (1.12-25.62)</td>
<td>.02</td>
</tr>
<tr>
<td>Hypnotics</td>
<td>NS</td>
<td>NS</td>
<td>3.97 (1.68-10.14)</td>
<td>.002</td>
<td>NS</td>
<td>NS</td>
<td>6.14 (1.12-25.62)</td>
<td>.02</td>
</tr>
<tr>
<td>Antimigraine agents</td>
<td>NS</td>
<td>NS</td>
<td>3.97 (1.68-10.14)</td>
<td>.002</td>
<td>NS</td>
<td>NS</td>
<td>6.14 (1.12-25.62)</td>
<td>.02</td>
</tr>
<tr>
<td>Asthma</td>
<td>1.75 (1.07-2.84)</td>
<td>.03</td>
<td>NS</td>
<td>NS</td>
<td>6.14 (1.12-25.62)</td>
<td>.02</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

*Abbreviations: CI, confidence interval; NS, nonsignificant; OR, odds ratio.

†Adjusted OR for sex and age (profile likelihood, 95\% CI); profile>\( \chi^2 \).

†Treatment with nonsteroidal anti-inflammatory drugs was a nonsignificant predictive factor.

The analyses identified several factors predictive for sleep disorders in patients with AR. Table 2 presents the factors with significant predictive value for insomnia, severe insomnia, hypersomnia, and sleep apnea.

The severity of the disease was found to be highly correlated with all types of sleep disorders whereas some concomitant medications were predictive for certain types (use of anxiolytic drugs, for example, showed strong correlation with insomnia and severe insomnia).

Male sex showed a high correlation with sleep apnea \( (\text{odds ratio, } 5.9; 95\% \text{ confidence interval, } 2.0-22.4; \ P=.003) \), whereas asthma was correlated with severe insomnia \( (\text{odds ratio, } 1.75; 95\% \text{ confidence interval, } 1.07-2.84; \ P=.03) \). Age, smoking habits, and residence (urban vs rural) did not have any predictive value.

### COMMENT

The present controlled epidemiological study provides important information on the relationship of AR to sleep complaints and sleep disorders. The study was conducted following strict methods and using validated tools (questionnaires) that allowed precise characterization of the study population in terms of respiratory status and sleeping status. However, questionnaires may be insufficient to assess accurately some sleep disorders (eg, sleep apnea) that require confirmation by night polygraphy or polysomnography.†

It is known that AR adversely affects quality of life, but to our knowledge, prior to the study described herein, the frequency and pattern of sleep disorders in the population with AR had never been determined. Moreover, this study also addresses the consequences of sleep disorders on everyday living.

The results show a significant impact of AR on all dimensions of sleep quality and, consequently, a lower quality of life as reflected by more somnolence; daytime fatigue and sleepiness; and impaired memory, mood, and sexuality, with a significantly increased consumption of alcohol and sedatives in cases compared with the control group. Our findings are consistent with other published observations.† A limitation of this study is that...
we did not consider the potential influence of cofactors such as anxiety and depression or comorbidities such as asthma on sleep quality. The focus of this study was not on the mechanisms that link AR with altered sleep but rather to examine whether frequency and severity of AR were associated with sleep impairment. Disorders other than AR, such as comorbid disorders (eg, obstructive sleep apnea and asthma) may also have an impact on sleep quality. Therefore, comprehensive treatment of sleep disturbances in patients with AR will likely require a multimodal approach. Although the duration of AR (intermittent or persistent) had no effect on most of the evaluated parameters, the severity of the disease had a significant influence on all considered aspects.

It is important to state that possible bias in the selection and in the interview of patients may have influenced the results of the study. Patients who have AR and who have been specifically interviewed about sleep may recall their troubles more intensively than the control group interviewed in the general population. However, it seems difficult to avoid this bias in a study focused on AR, which demands a high quality of diagnosis made by ear, nose, and throat and allergy specialists. Another possible bias is that patients seen by specialists may have more medical disorders and therefore more sleep disorders than patients seen by general practitioners. But the French social security system allows patients to visit specialists as easily as general practitioners, and sleep disorders are one of the main complaints expressed by patients of general practitioners. It seems thus unlikely that patients of ear, nose, and throat specialists have more sleep problems due to other diseases than do patients of general practitioners. General practitioners, as well as pulmonary; allergy; and ear, nose, and throat specialists, have to be made aware of the relationship between AR and sleep disorders. Our findings suggest that patients consulting for their AR should be routinely questioned about their sleep quality and existing daytime somnolence. This could lead to early detection and treatment of sleep disorders in these patients. The onus is on health care professionals to make the link between AR and sleep problems in their patients. Treating AR or other nasal symptoms may improve dramatically the quality of sleep. In the long term, such a strategy would have positive repercussions on a societal level; for example, the numbers of road and work accidents would be reduced. Considering the high incidence of AR and the high rate of associated sleep disorders, the issue is one of public health.

Accepted for Publication: June 8, 2006.

Correspondence: Damien Leger, MD, Centre du Sommeil et de la Vigilance, Hôtel Dieu de Paris, 1 Place du Paris Notre Dame, 75181 Paris, CEDEX 04, France (damien.leger@htd.aphp.fr).

Financial Disclosure: Drs Chanal, El Hasnaoui, and Pribil are remunerated employees of GlaxoSmithKline Laboratory under a scientific collaboration contract.

Funding/Support: This study was supported by the Department of Epidemiology, GlaxoSmithKline Laboratory.

Additional Information: The authors have participated in the study design, results analysis, and study analysis with no distinction between them in terms of implication in the study.

REFERENCES


