Association of Asthma-Related Symptoms With Snoring and Apnea and Effect on Health-Related Quality of Life*

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Objectives: This study aimed to investigate the association of asthma-related symptoms with snoring and apnea, and to assess their effects on health-related quality of life (HRQL).

Design: Population-based cross-sectional study.

Subjects and methods: A total of 10,224 parents and grandparents of students from 14 randomly selected primary schools in city center were asked to answer questionnaires sent by their children. All subjects were questioned for asthma-related symptoms, sleep-related disorders (snoring and apnea), and for HRQL using the Respiratory Questionnaire, Sleep and Health Questionnaire, and Short Form-12 (SF-12) Health Survey, respectively.

Results: The overall response rate to questionnaires was 97.7%, and all analysis was performed on 7,469 subjects (3,920 women and 3,549 men) who provided sufficient responses to questions. There were 2,713 subjects who reported asthma-related symptoms. The snoring and the observed apnea were more prevalent in subjects with asthma-related symptoms (54.0% vs 41.4%; odds ratio [OR], 1.7; 95% confidence interval [CI], 1.5 to 1.8; \( p < 0.001 \)) than those without asthma-related symptoms (16.7% vs 7.0%; OR, 2.7; 95% CI, 2.3 to 3.1; \( p < 0.001 \)), respectively. Asthma-related symptoms were found to be associated with snoring (OR, 1.5; 95% CI, 1.3 to 1.6; \( p < 0.001 \)) and observed apnea (OR, 2.2; 95% CI, 1.8 to 2.5; \( p < 0.001 \)) after adjusting for gender, age, body mass index, income, education, and smoking. Also, HRQL was found to be adversely affected by asthma-related symptoms, snoring, and observed apnea (\( \beta = -0.26, p < 0.001; \beta = -0.07, p < 0.001; \) and \( \beta = -0.08, p < 0.001 \), respectively, for SF-12 overall score) after adjusting for other confounding factors.

Conclusion: Present data suggest that there is a link between the sleep-related breathing disorders and asthma-related symptoms. Moreover, the presence of snoring and observed apnea in individuals with asthma-related symptoms causes further impairment in HRQL. The effects on HRQL of coexistence of these three disorders should be supported by clinical studies.

(CHEST 2005; 128:3358–3363)

Key words: apnea; asthma; quality of life; snoring

Abbreviations: BMI = body mass index; CI = confidence interval; HRQL = health-related quality of life; MCS = mental component summary; OR = odds ratio; PCS = physical component summary; SF-12 = Short Form-12

During the last quarter century, the increasing prevalence, morbidity, economic burden and, in some countries, mortality from asthma have generated worldwide concern.1–3 Asthma is an expensive chronic disease that today affects at least 5% of the population.4 One of the main objectives of health care in asthma should be preserving a satisfactory health-related quality of life (HRQL), which has become an essential part of health outcome measurement in chronic disorders.5,6 Information on the impact of chronic diseases on HRQL can make health services more patient centered.7 Numerous factors including psychological state,8 gender,9 low income,10,11 level of education,12 comorbidity,13 seriousness of illnesses,14 and age15 might lead to a reduced HRQL in chronic diseases. Although many asthmatic patients may suffer from more than one disorder, the effect of concomitant disorders on HRQL is largely unknown.
Sleep apnea and obstructive snoring are sleep-related breathing disorders that are intimately associated during sleep. Snoring occurs in at least 20% of the population; 50% of the 50-year-old men snore.16,17 Most snorers are “simple” or “nonapneic,” as the prevalence of snoring is much higher than that of sleep apnea.18 There is a continuous spectrum from simple to disease-causing snoring, ranging from merely disturbing noises to pharyngeal obstructions and breathing pauses.19 There is much better evidence that snoring is an important cause of sleepiness, even in the absence of conventional sleep apnea.20 Much has been written about the effect of sleep apnea on HRQL, but the effects of snoring and observed apnea are unknown. Asthma, snoring, and observed apnea may independently impair HRQL of an individual. However, it is not well known how their association affects HRQL. In the present study, we aimed to determine if there is an association of asthma-related symptoms with apnea and snoring, and to identify the effects of concomitant disorders—snoring and observed apnea—on HRQL in subjects with asthma-related symptoms.

MATERIALS AND METHODS

Subjects

The first epidemiologic survey for the prevalence of respiratory symptoms and other diseases in Kirikkale, Turkey, was conducted in October 2004. A total of 10,224 parents and grandparents of students from 14 randomly selected primary schools in city center were asked to answer questionnaires sent via their children and to return their responses again via their children. The parents were questioned for asthma-related symptoms, sleep-related disorders (snoring and apnea), and for HRQL by three different questionnaires. All subjects signed informed consent forms, and the Local Ethics Committee approved the study.

Assessment of Asthma-Related Symptoms

We assessed asthma-related symptoms using the Respiratory Questionnaire.21,22 The eight questions selected from this questionnaire are as follows: (1) Have you ever had asthma? (2) Do you still have it? (3) Was it confirmed by a doctor? (4) Have you had wheezing or whistling in your chest at any time during the last 12 months? (5) Have you felt chest tightness or been breathless when the wheezing noise was present? (6) Have you had wheezing or whistling in your chest at any time during the last 12 months? (7) Were these breathing symptoms brought on or made worse by exposure to any of the following: exercise or exertion; dust, smoke, or fumes? (8) Do you often wake up several times a night with trouble breathing or coughing? Definite asthma was defined as positive responses to first three questions (American Thoracic Society questions 20A, 20B, and 20C3).23 Probable asthma was defined as positive responses to questions 4 and 5. This category excludes those with a current asthma diagnosis, as defined above. Possible asthma was defined as positive responses to the question 6 and to one of questions 7 and 8. This category of possible asthma excludes those with definite or probable asthma.

Assessment of Sleep-Related Disorders

We assessed sleep related disorders—apnea and snoring—by the Modified Sleep and Health Questionnaire.24 The two selected questions from this questionnaire are as follows concern the following: snoring intensity over the last month: “During the last month, how has your snoring been?” 5-point scale: (0) I have never snored; (1) only slightly louder than heavy breathing; (2) about as loud as mumbling or talking; (3) louder than talking; (4) extremely loud: can be heard through a closed door; and (5) do not know; and observed apneas: asked to roommate/bed partner: “At night, do you notice that your roommate/bed partner stops breathing?” (5-point frequency scale): (0) never; (1) rarely, less than once a week; (2) sometimes, one or twice a week; (3) frequently, three to four times a week; (4) almost always, five to seven times a week; and (5) not sure. Concerning the presence of observed apnea or snoring on a 5-point scale, we defined 0 = no, 1 to 4 = yes, and 5 = excluded.

Assessment of HRQL

The Short Form 12 (SF-12) Health Survey was used to assess HRQL in this study. The SF-12 is an abbreviated form of the Short Form-36 Health Survey, which can be used for large-scale health measurement and monitoring. It consists of 12 items that are used to calculate summary measures for physical and mental health. The higher the score, the better the person’s health and functioning.25,26 Scores are constructed so that the mean for the general population is set at 50 with a SD of 10.

Statistical Analysis

Data are presented as the mean ± SD unless otherwise indicated. Comparisons between subjects with and without asthma-related symptoms were performed using χ² test for categorical variables and Student t test for continuous variables. Prevalence odds ratios (ORs) and their 95% confidence intervals (CIs) were calculated with the Mantel-Haenszel method. Logistic regression was used to calculate ORs and 95% CIs for the associations between asthma-related symptoms (no = 0, yes = 1) and age; gender (female = 0; male = 1); body mass index (BMI) [< 30 kg/m² = 0; ≥ 30 kg/m² = 1], income (> $200 or €155 monthly = 0; < $200 or €155 monthly = 1), education (none = 0; primary school = 1; secondary school = 2; high school = 3); smoking (never smoked = 0; former/current smokers = 1); observed apnea (no = 0; yes = 1); and snoring (no = 0; yes = 1). Significance of differences between nonoverlapping case groups of only one, two, all or none of asthma-related symptoms, snoring, and observed apnea was assessed by multivariate analysis of variance for HRQL scores. Multiple linear regression analysis was performed with the scores of HRQL as the dependent variable, and observed apnea, snoring, asthma-related symptoms, gender, age, BMI, education, and income as predictor variables. Statistical analysis were performed using a statistical software (SPSS for Windows, Version 10.01; SPSS, Chicago, IL). p < 0.05 was assumed to be statistically significant.

RESULTS

Of 10,224 parents and grandparents (mean age ± SD, 44.1 ± 11.6 years; range, 20 to 104 years) of primary school students, 9,986 returned the questionnaires, which correspond to the overall response rate of 97.7%. A total of 2,517 subjects were further
Table 1—Characteristics of the Subjects With and Without Asthma-Related Symptoms*

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>With Asthma-Related Symptoms (n = 2,713)</th>
<th>Without Asthma-Related Symptoms (n = 4,756)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, yr</td>
<td>45.7 ± 12.3†</td>
<td>43.1 ± 10.7†</td>
</tr>
<tr>
<td>Female gender</td>
<td>1,549 (57.1)†</td>
<td>2,371 (49.9)†</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>422 (16.3)†</td>
<td>411 (8.6)†</td>
</tr>
<tr>
<td>Primary school</td>
<td>1,650 (60.8)†</td>
<td>2,522 (53.0)†</td>
</tr>
<tr>
<td>Secondary school</td>
<td>471 (17.4)†</td>
<td>1,289 (27.1)†</td>
</tr>
<tr>
<td>High school</td>
<td>150 (5.5)†</td>
<td>534 (11.2)†</td>
</tr>
<tr>
<td>Monthly income</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;$2000 or €155</td>
<td>2,333 (86.0)†</td>
<td>3,779 (79.5)†</td>
</tr>
<tr>
<td>Smoking</td>
<td>1,053 (38.8)†</td>
<td>1,580 (33.2)†</td>
</tr>
<tr>
<td>BMI, kg/m²</td>
<td>27.0 ± 4.6†</td>
<td>26.1 ± 4.0†</td>
</tr>
<tr>
<td>Snoring</td>
<td>1,465 (54.0)†</td>
<td>1,971 (41.4)†</td>
</tr>
<tr>
<td>Apnea</td>
<td>452 (16.7)†</td>
<td>331 (7.0)†</td>
</tr>
</tbody>
</table>

*Data are given as mean ± SD or No. (%).
†p < 0.001 for comparison between subjects with and without asthma-related symptoms.

Discorded from the study because of their responses of “do not know” and/or “not sure” to the questions related to snoring (n = 1,228) and apnea (n = 951), and due to incomplete response to the SF-12 (n = 338). All analyses were performed on 7,469 subjects (mean age, 44.0 ± 11.5 years; range, 20 to 104 years; 3,920 women and 3,549 men).

There were 2,713 subjects reporting asthma-related symptoms. Table 1 shows the characteristics of the subjects with and without asthma-related symptoms. The snoring and observed apneas were more prevalent in the subjects with asthma-related symptoms than in those without (p < 0.001; OR, 1.7 [95% CI, 1.5 to 1.8; p < 0.001]; and OR, 2.7 [95% CI, 2.3 to 3.1], respectively) [Table 1]. Logistic regression model showed significant associations between asthma-related symptoms and snoring (OR, 1.5; 95% CI, 1.3 to 1.6; p < 0.001) and apnea (OR, 2.2; 95% CI, 1.8 to 2.5; p < 0.001) and after adjusting for gender, age, BMI, smoking, income, and education.

All subjects were classified into eight nonoverlapping case groups based on the presence of asthma-related symptoms, snoring, and observed apnea: asthma alone, snoring alone, apnea alone, asthma plus snoring plus apnea, asthma plus snoring, asthma plus apnea, snoring plus apnea, and none (control group). Table 2 shows SF-12 physical component summary (PCS), mental component summary (MCS), and overall scores in these case groups. When compared to control group PCS, MCS, and overall SF-12 scores were lower in all other groups, except MCS score in apnea alone group (Table 2).

Association of asthma-related symptoms with snoring or apnea further decreased HRQL scores, except MCS score for asthma plus apnea group, when compared to asthma-related symptoms alone. Moreover, subjects with asthma-related symptoms associated with both snoring and apnea had even worse HRQL scores than those with asthma-related symptoms alone and asthma-related symptoms plus snoring.

The predictors for SF-12 overall, PCS, and MCS scores after adjusting for gender, age, BMI, smoking, income, and education in multivariate linear analysis are shown in Table 3. HRQL was found to be adversely affected by asthma-related symptoms, snoring, and observed apnea after adjusting for possible confounding factors.

**Discussion**

The results of the present study demonstrate that the snoring and observed apnea are more prevalent in subjects with asthma-related symptoms than in

Table 2—Quality-of-Life Scores on SF-12 for Nonoverlapping Case Groups of Asthma-Related Symptoms, Snoring, and Observed Apnea*

<table>
<thead>
<tr>
<th>Groups</th>
<th>Patients, No.</th>
<th>SF-12 PCS Score</th>
<th>SF-12 MCS Score</th>
<th>SF-12 Overall Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>2,691</td>
<td>53.9 ± 11.0</td>
<td>50.5 ± 12.0</td>
<td>52.2 ± 10.1</td>
</tr>
<tr>
<td>Asthma alone</td>
<td>1,160</td>
<td>45.3 ± 12.7†</td>
<td>43.6 ± 12.7†</td>
<td>44.5 ± 11.3†</td>
</tr>
<tr>
<td>Snoring alone</td>
<td>1,734</td>
<td>52.8 ± 11.3†§</td>
<td>49.7 ± 12.0†</td>
<td>51.2 ± 10.3†§</td>
</tr>
<tr>
<td>Apnea alone</td>
<td>94</td>
<td>50.6 ± 12.6†§</td>
<td>48.5 ± 12.5†§</td>
<td>49.5 ± 11.3†§</td>
</tr>
<tr>
<td>Asthma plus snoring plus apnea</td>
<td>364</td>
<td>39.9 ± 13.9†§</td>
<td>39.5 ± 12.5†</td>
<td>39.7 ± 11.8†</td>
</tr>
<tr>
<td>Asthma plus snoring</td>
<td>1,101</td>
<td>44.0 ± 12.6†§</td>
<td>42.8 ± 12.5†§</td>
<td>43.4 ± 11.1†§</td>
</tr>
<tr>
<td>Asthma plus apnea</td>
<td>88</td>
<td>41.2 ± 13.5†§</td>
<td>41.4 ± 12.7†</td>
<td>41.3 ± 12.3†§</td>
</tr>
<tr>
<td>Snoring plus apnea</td>
<td>237</td>
<td>49.3 ± 11.7†§</td>
<td>45.8 ± 12.8†§</td>
<td>47.6 ± 10.7†§</td>
</tr>
</tbody>
</table>

*Groups are nonoverlapping including cases with only one, two, all, or none of asthma-related symptoms, snoring, and observed apnea. Data are given as mean ± SD.
†Compared to control, p < 0.05.
‡Compared to asthma alone, p < 0.05.
§Compared to asthma plus snoring plus apnea, p < 0.05.
those without. The significant association among these three disorders in logistic model also provide additional evidence for relation. These observations suggest a causal relationship between asthma-related symptoms with snoring and observed apnea. An increased prevalence of snoring and self-reported apnea in asthmatic subjects has been reported previously in a few studies.\textsuperscript{27-28} Sleep-related disorders other than snoring and apnea, such as difficulty in inducing and maintaining sleep and daytime sleepiness, were also reported to be associated with asthma.\textsuperscript{29-30} However, Klink and Quan,\textsuperscript{31} in an epidemiologic study, found a significant relationship between disorders of initiating and maintaining sleep and excessive daytime sleepiness with chronic bronchitis, concomitant asthma and chronic bronchitis, and emphysema, but not asthma as a solitary diagnosis. They thought that the asthma-only subjects in that study represented persons with more intermittent asthma whose significant symptom-free intervals allowed them to report a normal prevalence of initiating and maintaining sleep and excessive daytime sleepiness. Other studies\textsuperscript{32-33} also indicated possible association between the obstructive sleep apnea syndrome and nocturnal asthma. The above-mentioned studies, in convenience with the present study, suggest a link between asthma and sleep-related disorders. There are a number of potential mechanisms by which asthma and snoring might be linked. For example, an increased drive to breathe asleep during active asthma could lead to increased upper airway suction pressures and thus to snoring. Alternatively, worsening of gastroesophageal reflux induced by snoring may also trigger asthma.\textsuperscript{34} Nevertheless, the link between asthma and snoring might be simply due to asthmatics being more likely to have upper airway inflammation (ie, rhinitis) in turn predisposing them to snoring. But the definite mechanisms for the association of asthma with snoring, and observed apnea remain to be explained. A better understanding of these mechanisms may provide additional success in the management of asthma.

The present study also indicates that coexistence of asthma-related symptoms, snoring, and observed apnea further impairs HRQL than disorder alone. However, asthma-related symptoms have more adverse effects on HRQL than snoring and apnea according to multivariate analysis. Furthermore, coexistence of these three disorders leads to similar impairment in physical and mental health. To our knowledge there is no previous epidemiologic study investigating the effect of co-occurrence of asthma-related symptoms with snoring and observed apnea on HRQL. However, few population-based data regarding the impact of asthma on HRQL in the adult population are available. Adams et al\textsuperscript{35} reported that asthma had an adverse impact on HRQL on both SF-12 PCS and SF-12 MCS scales in a population-based study. In another study\textsuperscript{36} in the adult population, participants with self-reported current asthma reported significantly more age-adjusted physically and mentally unhealthy days, days with activity limitation, and unhealthy physical or mental days in the last 30 days than participants who never had asthma. Two studies by Loth et al\textsuperscript{37,38} indicated that the male snorers had significantly worse quality of life than their healthy counterparts. In another study,\textsuperscript{39} they also showed that snoring men have a poor quality of life, comparable to that of patients with chronic diseases such as hypertension, growth hormone deficiency, myocardial infarction, and COPD. In these studies, in spite of the use of different measures, asthma and snoring were shown to adversely affect HRQL. Although it is not known how observed apnea affects HRQL on the base of population, a number of clinical studies\textsuperscript{40-44} in patients with a diagnosis of sleep apnea support the
present epidemiologic findings indicating impairment in HRQL. In addition, difficulty in initiating and maintaining sleep, and excessive daytime sleepiness were also shown to be strongly associated with reduced quality of life even after adjusting for confounding variables. Based on these data, therefore, studies on HRQL in asthma should take into account the presence of snoring and apnea because coexistence of these three disorders may increase impairment in HRQL. Moreover, effective treatment of each of these disorders can be expected to provide further improvement in HRQL. Potential limitations of our study are, like some other epidemiologic studies, that the presence of asthma-related symptoms, snoring, and observed apnea was determined from patients’ self-reports, and no quantification of pulmonary functions was available.

In conclusion, although the presence of asthma-related symptoms is a risk factor for snoring and observed apnea or the converse, when one of these disorders is diagnosed, clinicians should consider the possible presence of the others. The presence of snoring and observed apnea that are frequently associated to asthma should be recognized to further impair HRQL in both physical and mental dimensions. Clinical studies will provide a better understanding of the effects on HRQL of this association.

References
5 Greiner W, Graf von der Schulenberg JM, Bergmann KC. Quality of life of adult asthma patients. Pneumologie 1999; 53:283–288
7 Lam CL, Lauder IJ. The impact of chronic diseases on the health-related quality of life (HRQOL) of Chinese patients in primary care. Fam Pract 2000; 17:159–166
19 Ullner E, Soler M. From simple snoring to sleep apnea syndrome-clinical spectrum. Ther Umsch 2000; 57:430–434
26 Ware J Jr, Kosinski M, Keller SD. A 12-Item Short-Form Health Survey. Medical Care 1996; 34:220–233
31 Klink M, Quan SF. Prevalence of reported sleep disturbances in a general adult population and their relationship to obstructive airways disease. Chest 1987; 91:540–546
45 Baldwin CM, Griffith KA, Nieto FJ, et al. The association of sleep-disordered breathing and sleep symptoms with quality of life in the Sleep Heart Health Study. Sleep 2001; 24:96–105