

Allergic and nonallergic rhinitis: the threat for obstructive sleep apnea

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Background: Although allergic rhinitis (AR) is accepted as a risk factor for obstructive sleep apnea syndrome (OSAS), the role of nonallergic rhinitis (NAR) is unknown.

Objective: To compare OSAS in patients with AR vs NAR.

Methods: We performed an observational study in 48 adults with AR and NAR that included a review of rhinitis and sleep symptoms, skin prick test results, self-administered questionnaire (Epworth Sleepiness Scale and 36-Item Short Form Health Survey) findings, and all-night polysomnography records.

Results: The most frequent sleep symptom was snoring. Patients with AR had a significantly longer sleep duration and better sleep efficiency than did those with NAR. Both groups had frequent arousals. OSAS was diagnosed in 36% of patients with AR and in 83% of those with NAR ($P = .001$). Severe OSAS existed only in the NAR group. NAR showed a high correlation with OSAS (odds ratio, 6.4) and with apneas (odds ratio, 0.2). Body mass index, sex, and coexisting asthma did not have any predictable effect on OSAS, but age was correlated with OSAS. The impairment in quality of life was similar in both groups.

Conclusions: Both AR and NAR are risk factors for a high apnea-hypopnea index, and both can predispose to sleep apnea. However, NAR seems to have a greater risk according to impaired polysomnography results and higher Epworth Sleepiness Scale scores. Therefore, patients with rhinitis should be treated not only for nasal symptoms but also for a better quality of sleep.

Ann Allergy Asthma Immunol. 2009;103:20–25.

INTRODUCTION

Obstructive sleep apnea syndrome (OSAS), characterized by repeated episodes of upper airway closure during sleep, has been recognized as a serious health problem for a century. Rhinitis is one of the risk factors for OSAS, after age, obesity, and male sex.¹ Allergic nasal congestion was shown to be another risk factor for moderate to severe sleep-disordered breathing. Studies^{2,3} of rhinitic patients with sleep disturbances have shown that allergic rhinitis (AR) is associated with an increased number of arousals (awakenings) and more daytime sleepiness. Patients with rhinitis who experience frequent snoring followed by apneas may develop OSAS. Patients with AR were 1.8 times more likely to have sleep-disordered breathing in a population study performed via questionnaire and objective laboratory measurement.³ Because a variety of proallergic cytokines are associated with lower quality of sleep, nasal corticosteroids and leukotriene receptor antagonists were shown to have an effect on sleep problems.^{4,5}

It has long been assumed that OSAS and AR lead to deterioration in health-related quality of life (HRQoL) as well.^{6–8} Excessive daytime sleepiness, which can be evaluated using the Epworth Sleepiness Scale (ESS), is the most common manifestation of sleep disorders. However, the impairment in HRQoL or ESS score was prominent only in

severe types of rhinitis, with no relation to the severity of OSAS.^{9,10}

In questionnaire-based studies,^{10,11} rhinitis was associated with an increased risk of difficulties in maintaining sleep. When the investigations included prick tests, AR was thought to be the underlying cause of sleep impairment in asthmatic patients and an independent risk factor for OSAS.^{3,12} However, there is limited information about nonallergic rhinitis (NAR) and OSAS.¹³ We, therefore, aimed to compare the impact of AR and NAR on HRQoL and on sleep disturbances determined by means of polysomnography.

METHODS

An observational study in adults was performed in the Department of Allergic Diseases of Kirikkale University Hospital. Every patient who presented with nasal symptoms was screened and then prospectively randomized. The study was approved by the local ethics committee of Kirikkale University Hospital, and written informed consent was obtained from the study participants.

The study was performed during the grass pollen season, and only patients who had ongoing symptoms were entered into the study. We included female and male patients aged 18 to 60 years with a history of rhinitis for at least 2 years who consented to skin prick testing (SPT) and polysomnography. The exclusion criteria were having infectious or occupational rhinitis or major structural nasal abnormalities; having chronic systemic diseases that could lead to rhinitis; being treated with antihistamines, nasal or oral corticosteroids, or antileukotrienes or with drugs that might affect sleep; and refusing to recruit to the study. Rhinitis was diagnosed if at

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Disclosures: Authors have nothing to disclose.

Received for publication October 15, 2008; Received in revised form February 15, 2009; Accepted for publication February 23, 2009.

least 2 symptoms, including rhinorrhea, sneezing, itching, and anosmia, existed during 2 or more consecutive days for more than 1 hour on most days.¹⁴ All the patients underwent SPTs with a battery of common inhalant allergens, including *Dermatophagoides pteronyssinus*, *Dermatophagoides farinae*, dog, cat, *Blatella*, *Alternaria*, *Aspergillus*, trees mix, grass mix, weed mix, cereals, and latex (ALK, Madrid, Spain). Rhinitis was determined to be allergic when nasal symptoms were accompanied by SPT positivity regarding clinical relevance by means of time and severity, whereas NAR was defined as nasal symptoms with the exclusion of allergy by negative SPT results. Although the diagnosis of rhinitis could not be based on SPT results alone, there were no specific diagnostic tests for the classification of rhinitis. Therefore, in the rhinitis history, correlation of the symptoms during exposure to allergens (identified by SPTs) but not to nonallergic triggers, such as foods, physical or chemical agents, and emotional factors, was regarded as AR. In this regard, the diagnosis of nonallergy was based on rhinitis symptoms in the absence of identifiable allergy (by SPTs), structural abnormality, or sinus disease as determined by physical examination and radiography.¹⁵ Although the NAR group might include several subgroups, such as drug-induced rhinitis, rhinitis with eosinophilic syndrome, and hormonal rhinitis, they were not verified owing to the lack of distinctive criteria and diagnosis and the indistinguishable characteristics of nasal symptoms in the subgroups of NAR.

Sociodemographic data, including age, sex, educational level, and smoking status (never smoked vs active smoker or ex-smoker), and clinical data, including duration, severity (mild vs moderate-severe), persistency (intermittent vs persistent), and occurrence of AR (seasonal vs perennial) based on the Allergic Rhinitis and its Impact an Asthma guidelines, were collected.¹⁴ Patients were asked about sleep problems (eg, snoring during sleep, respiratory pauses, and daytime sleepiness). Asthma was accepted if previously diagnosed by a physician or if at least 200 mL or 12% reversibility was detected in forced expiratory volume in 1 second.¹⁶ All patients with asthma were stable in the proceeding 6 months. Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared. Obesity was defined as a BMI of 30 or higher according to the international classification of adult weight by the World Health Organization expert consultation.¹⁷ Serum samples were tested for total IgE (electrochemiluminescence immunoassay) (Roche Diagnostics, Indianapolis, Indiana) and C-reactive protein (CRP latex) concentrations by means of immunoturbidimetric assays (Roche Diagnostics GmbH, Mannheim, Germany).

Self-administered Questionnaires

The ESS is an 8-item questionnaire with scores ranging from 0 to 24. Higher scores indicate greater daytime sleepiness, and a score of 10 or higher indicates an abnormal level of daytime sleepiness.¹⁸ The Medical Outcomes Study 36-Item Short Form Health Survey (SF-36) was used to evaluate

HRQoL. The SF-36 assesses 8 health measures: physical functioning, limitations due to physical health problems (role physical), bodily pain, general health, vitality, social functioning, limitations due to emotional health problems (role emotional), and mental health, with better health status shown by higher scores. In addition, 2 general domain measures of the SF-36 were used: physical component summary and mental component summary scores.¹⁹ The ESS and the SF-36 have been validated for the Turkish language.^{20,21} The normative Turkish general population data used were previously obtained by randomized testing on 1,279 people selected from a study population of 46,290 people 18 years and older in another study.²²

Evaluation of Sleep

Nighttime polysomnography evaluations were performed using an 8 AC-channel computerized device (SleepScreen; Viasys Healthcare GmbH, Hoechberg, Germany). Electroencephalography and electro-oculography were performed, and the following variables were measured: movement of the chest and abdominal wall, heart rate via an electromyogram, and oronasal air flow using a nasal thermistor (Viasys Healthcare GmbH). Arterial oxygen saturation was evaluated using a pulse oximeter (Healthdyne Technologies, Marietta, Georgia). Patients slept for a minimum of 5 hours in a soundproof, light- and temperature-controlled room. The reports were evaluated by the same sleep medicine specialist. Sleep architecture was evaluated using the standard technique, and the amount of time spent in each sleep stage was expressed as a percentage of total sleep time.¹ Sleep duration was defined as all sleep incurred from sleep onset until morning awakening. Sleep efficiency was defined as the ratio of duration of sleep to total monitoring time. Sleep onset was defined as 2 consecutive 30-second epochs of stage I sleep or 1 epoch of stage II or rapid eye movement sleep. Arousals were defined electroencephalographically according to accepted definitions. Arterial oxygen saturation less than 92% was considered to be desaturation. Sleep was staged according to the standard criteria. Central, obstructive, and mixed-type apneas were recorded. Apnea was defined as the absence of respiratory events lasting at least 10 seconds. The apnea-hypopnea index (AHI) was calculated as the total sum of obstructive hypopneas and apneas plus mixed apneas, divided by the total time of sleep. OSAS was diagnosed when the AHI was greater than 5: 5 to 15 events per hour of sleep was considered as mild, 15 to 30 as moderate, and more than 30 as severe.²³

Statistical Analysis

Statistical analyses were performed using a statistical software package (SPSS version 15; SPSS Inc, Chicago, Illinois). Comparisons regarding categorical variables were made using the χ^2 test, and noncategorical variables were determined using the *t* test in individual with AR and NAR. The effect of combined variables on OSAS, daytime sleepiness, snoring, and apneas (discontinuous variables) were calculated as odds ratios (ORs) with 95% confidence intervals (CIs) using a

multiple logistic regression model after adjustment for potential confounders. As confounders, the model included age, sex, obesity (BMI ≥ 30), AR, and asthma. $P < .05$ was considered statistically significant.

RESULTS

A total of 48 adults (mean [SD] age, 39.6 [12.7] years; 60% women) were evaluated (Table 1). Twenty-five patients with AR and 23 with NAR matched for age and sex were randomly enrolled. The BMI varied from 17 to 35, with an almost equal distribution of normal weight, overweight, and obese. Almost one-third of the patients with AR were sensitive to house dust mites, and 64% were sensitive to pollens. Although the duration of rhinitis was similar in both groups, patients with AR had mainly moderate to severe, seasonal, and persistent symptoms, whereas almost all the patients with NAR had mild, perennial, and intermittent symptoms ($P < .001$). Comorbid asthma prevalence was similar, with no statistically significant differences in severity, pulmonary function, or serum IgE and C-reactive protein levels.

Evaluation of Sleep

The mean (SD) duration of sleep symptoms was similar in patients with AR and NAR (3.3 [3.4] years and 4.33 [3.2] years, respectively) (Table 2). The most frequent sleep symptom was snoring, followed by daytime sleepiness and apnea; the latter was significantly higher in the NAR group. Likewise, more patients in the NAR group had ESS scores higher than 10 compared with those in the AR group ($P = .001$).

In the night polysomnography records, although within the reference range, the AR group had a longer sleep duration and higher sleep efficiency than the NAR group ($P = .02$ and $P = .01$, respectively). Mean sleep onset, arousal index, and desaturation index values were similar in both groups ($P > .05$), whereas both groups had frequent arousals (compared

with norms). In the evaluation of sleep stages, the only significant difference found was for rapid eye movement sleep, with an increase in 77% of patients with NAR ($P = .02$) (data not shown). Patients with NAR had a significantly higher mean (SD) AHI (12.19 [11.16]) than those with AR (6.46 [7.26]) ($P = .04$). Thirty-six percent of the AR group and 83% of the NAR group were found to have OSAS ($P = .001$). OSAS was mainly mild to moderate in AR, with no severe disease, whereas mild sleep apnea was nonsignificantly more prevalent in patients with NAR. In multiple logistic regression analysis with adjustment for confounders, obesity, sex, and asthma did not have any predictable effect, but age was correlated with OSAS (OR, 1.1; 95% CI, 1.0–1.2; $P = .01$) (Table 3). NAR showed a high correlation not only with OSAS (OR, 6.4; 95% CI, 1.22–33.42; $P = .02$) but also with apneas (OR, 0.2; 95% CI, 0.01–1.0; $P = .04$).

Quality of Life

All 8 SF-36 subscale scores were significantly impaired in the study groups compared with the normative Turkish general population data (Fig 1). Mean SF-36 subscale scores, except the physical functioning score, were higher in patients with AR than in patients with NAR, with no significant difference ($P > .05$). Likewise, 2 general domain measures of the SF-36, physical component summary and mental component summary scores, were found to be similar in both groups. There was no correlation between any domains of the SF-36 and the severity of OSAS or rhinitis.

DISCUSSION

The present study describes the clinical characteristics and polysomnography respiratory indices in a sample of 48 patients with physician-diagnosed rhinitis. Although we showed that AR and NAR may predispose to sleep apnea, NAR was more likely to be correlated with OSAS than was AR accord-

Table 1. Characteristics of Individuals With AR and NAR

Characteristics	AR group (n = 25)	NAR group (n = 23)	Total (N = 48)	P value
Age, mean (SD), y	35.32 (13.34)	44.26 (10.48)	39.6 (12.7)	.05
Sex, M/F, %	36/64	43/57	40/60	.59
BMI, mean (SD)	25.34 (5.06)	28.65 (4.27)	26.93 (4.94)	.02
BMI, No. (%)				.14
<30	20 (80)	14 (61)	34 (71)	
≥ 30	5 (20)	9 (39)	14 (29)	
Duration of rhinitis, mean (SD), y	8 (5.47)	6.52 (4.82)	7.23 (5.2)	.32
Seasonal/perennial rhinitis, %	60/40	4/96	33/67	<.001
Intermittent/persistent rhinitis, %	16/84	91/9	52/48	<.001
Mild/moderate-severe rhinitis, %	24/76	87/13	54/46	<.001
Asthma, No. (%)	10 (40)	4 (17)	14 (29)	.08
Asthma severity, mild/moderate-severe, %	50/50	25/75	43/57	.39
FEV ₁ , mean (SD), % of predicted	81.10 (15.12)	92.76 (11.21)	88.13 (14.2)	.06
FEV ₁ /FVC, mean (SD)	77 (12.84)	82.15 (10.04)	79.91 (11.37)	.29
Total IgE, mean (SD), IU/mL	167.17 (124.54)	128.41 (132.08)	154.25 (125.92)	.46
CRP, mean (SD), mg/L	0.51 (0.80)	0.56 (0.67)	0.54 (0.72)	.84

Abbreviations: AR, allergic rhinitis; BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); CRP, C-reactive protein; FEV₁, forced expiratory volume in 1 second; FVC, forced vital capacity; NAR, nonallergic rhinitis.

Table 2. Prevalence of Sleep Symptoms and Polysomnography Results in Patients With AR and NAR

Variable	Laboratory norms ^a	AR group (n = 25)	NAR group (n = 23)	P value
Sleep symptoms				
Duration of sleep symptoms, mean (SD), y	NA	3.3 (3.4)	4.33 (3.2)	.28
Snoring, No. (%)	NA	21 (84)	22 (96)	.18
Daytime sleepiness, No. (%)	NA	7 (28)	10 (43)	.26
Apnea, No. (%)	NA	3 (12)	9 (39.)	.03
ESS score >10, No. (%)	NA	4 (16)	15 (65)	.001
Polysomnography results				
Sleep duration, mean (SD), h	5–7	5.5 (0.38)	5.14 (0.59)	.02
Sleep efficiency, mean (SD), % of time asleep	80–93	89.16 (2.83)	85.85 (5.16)	.01
Sleep onset, mean (SD), min	0–60	1.64 (4.53)	3.38 (7.76)	.34
Arousal index, mean (SD), /h	<10	20.02 (11.45)	16.91 (8.88)	.31
Desaturation index, mean (SD), /h	<15	14 (25.4)	11.77 (12.95)	.48
AHI mean (SD), events/h	<5	6.46 (7.26)	12.19 (11.16)	.04
OSAS diagnosed, No. (%)	NA	9 (36)	19 (83)	.001
Severity of OSAS, No. (%)				
Mild	NA	4 (44)	14 (74)	.01
Moderate	NA	5 (56)	3 (16)	.04
Severe	NA	0	2 (10)	.001

Abbreviations: AHI, apnea-hypopnea index; AR, allergic rhinitis; ESS, Epworth Sleepiness Scale; NA, not applicable; NAR, nonallergic rhinitis; OSAS, obstructive sleep apnea syndrome.

^a From Chokroverty.¹

Table 3. Multiple Regression Analysis of Risk Factors for Self-reported Sleep Symptoms

Risk factors	OR (95% CI) ^a			
	OSAS	Snoring	Apneas	Daytime sleepiness
Age	1.1 (1.0–1.2) ^b	1.1 (0.9–1.1)	1.0 (0.9–1.1)	1.0 (0.9–1.1)
BMI ≥30	0.04 (0.1–9.8)	0.8 (0.6–1.3)	0.9 (0.8–1.1)	1.0 (0.8–1.2)
NAR	6.4 (1.22–33.42) ^b	0.2 (0.1–3.1)	0.2 (0.01–1.0) ^b	0.5 (0.1–2.3)
Asthma	1.8 (0.4–10.2)	0.1 (0–1)	0.2 (0.02–1.0)	0.4 (0.1–1.9)
Sex	1.5 (0.3–7.4)	2.8 (0.1–3)	0.4 (0.1–1.7)	0.8 (0.1–3.9)

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); CI, confidence interval; NAR, nonallergic rhinitis; OR, odds ratio; OSAS, obstructive sleep apnea syndrome.

^a After adjustment for independent variables.

^b $P < .05$ for the relationship between the variables.

ing to impaired polysomnographic variables, frequent sleep symptoms, and higher ESS scores. Previous studies suggested that AR was a potential etiologic factor for sleep disturbances, but only 1 study¹³ addressed OSAS in NAR with eosinophilia syndrome. To our knowledge, the present study is not only the first to evaluate rhinitis in relation to sleep but also shows that patients with NAR are at higher risk for OSAS than are those with AR.

A possible explanation for the increased impairment of sleep in NAR could be that these patients had more perennial symptoms, whereas patients with AR had more seasonal symptoms. Furthermore, the relatively older age of patients with NAR could affect these results. Clinical impressions increase the probability of OSAS, but not all of the risk factors guarantee OSAS and not all patients with OSAS have these features, although they were diagnosed during a sleep study. In the literature,^{24,25} specificity for the risk factors of OSAS was found to be 63% on the basis of clinical features.

Despite the association shown between obesity and OSAS in population samples,¹² there was no predictable effect of increased BMI on OSAS, presumably due to the small size of the study group. Likewise, asthma coexisted with neither snoring nor OSAS.

The importance of this study was the use of objective measures (eg, polysomnography), which helps to explain by which mechanism rhinitis affects sleep. We found that the impairments evident via polysomnography and questionnaires were concordant between AR and NAR. The differentiating symptom of OSAS was the higher frequency of apnea in patients with NAR vs AR. Likewise, significantly higher ESS scores were reported in the NAR group, indicating worse sleep quality.

Although sleep symptoms could be a guide, clinical history alone is not enough to establish a definitive diagnosis. Therefore, objective polysomnography is a gold standard test in the diagnosis of OSAS.^{1,23} In the present study, all the patients

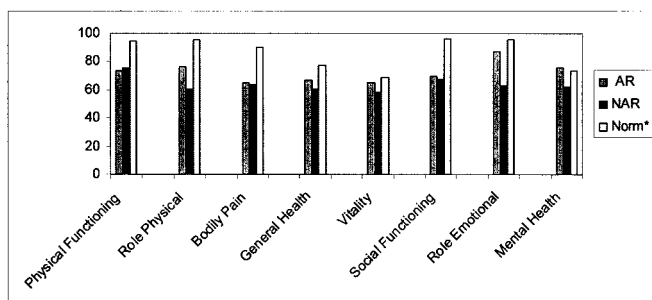


Figure 1. Comparisons of health-related quality of life using the 36-Item Short Form Health Survey (SF-36) subscale scores in allergic rhinitis (AR) and nonallergic rhinitis (NAR) vs population norms. Patients with AR and NAR have similar SF-36 subscale scores ($P > .05$), but these scores are lower than age-adjusted Turkish population normative data ($P < .05$). *The normative Turkish general population data were obtained from another study.²²

had frequent arousals 2 times more than the norm and an AHI that was higher than 5 events per hour. Furthermore, although the AHI was greater in patients with NAR than in patients with AR, both are defined as mild to moderate sleep apnea by the American Academy of Sleep Medicine criteria and, thus, are both clinically significant.²³ Furthermore, the NAR group had a shorter sleep duration and lower sleep efficiency than the AR group. The finding in healthy subjects of frequent obstructive apneas and hypopneas when breathing orally rather than nasally shows the importance of the nose irrespective of allergic inflammation.²⁶

A potential criticism of this study is the lack of a control group. The primary aim was to compare the sleep disturbances in allergic and nonallergic types of rhinitis and in controls, but the budgetary limitations did not permit us to do this.

Data from studies^{6,7,9} of patients with allergy and sleep disorders showed that rhinitis affects QoL, predominantly mental health. In this study, HRQoL, measured using the SF-36, was impaired in all patients compared with normative Turkish general population data. All the domain scores, except physical functioning, were lower in patients with NAR ($P > .05$). This could be due to a higher prevalence of OSAS in the NAR group rather than being attributed to an allergy component, as Rydén et al²⁷ reported similar somatic and psychosocial complaints with a limitation of psychosocial effects in patients with AR and NAR. Stuck et al⁹ showed that seasonal AR leads to impairment in QoL, depending on the severity of the disease. However, this impairment was not found to be associated with polysomnography records.⁹

No correlation of HRQoL with severity of OSAS or rhinitis in the present study could be due to the nonhomogenous distribution of the severity of these states or the lack of patients with very high AHI values. Another possible explanation could be that the SF-36 is a generic questionnaire that is not specific to any disease. Concordant with the present results, Gülbay et al²⁸ found no significant correlation be-

tween severity of OSAS and SF-36 scores, concluding that QoL depends on a variety of collaborative factors.

In this first study to compare AR and NAR, subjective and objective variables revealed that both types of rhinitis are risk factors for a high AHI; however, NAR is more likely to be correlated with OSAS according to impaired polysomnography results, frequent sleep symptoms, and higher ESS scores. The impairment in HRQoL was higher in NAR, with accompanying impairment in sleep.

In conclusion, the results of this study suggest that both rhinitis types can predispose to sleep apnea; however, non-allergic patients seem to have a greater risk. Therefore, patients with both types of rhinitis should be treated not only for nasal symptoms but also for a better quality of sleep.

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