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ORIGINAL ARTICLE

Allergic and Nonallergic Rhinitis: Can We Find the Differences/Similarities between the Two Pictures?

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The diagnostic challenge of rhinitis is to determine the etiology, specifically whether it is allergic or nonallergic. We therefore evaluated the general features of patients with allergic (AR) and nonallergic rhinitis (NAR), as well as health-related quality of life (HRQoL). The study group consisted of 323 patients (201 F/122 M) with a mean age of 31.79 ± 12.64 years. Almost two thirds of the population had AR (63.5%). Neither the demographic characteristics nor the duration of rhinitis was different between the two groups. Total immunoglobulin E was significantly higher in AR. Although both groups displayed a mild-intermittent rhinitis profile, patients with AR had more seasonal and NAR had more perennial symptoms ($p = 0.01$). Frequency of nasal obstruction was comparable in both groups, whereas patients with AR significantly complained of rhinorrhea (86.8%), followed by nasal obstruction, sneezing, and nasal itching compared with the NAR group. Conjunctivitis and sinusitis were more prominent in the AR than NAR group ($p = 0.01$). However, the prevalences of asthma and bronchial hyperreactivity were not different, as well as the other allergic or systemic comorbidities. Furthermore, the impairment in HRQoL was similar in both groups, using a generic questionnaire- Short form-36 (SF-36). In conclusion, although the allergy test results still remain the only relevant difference, the diagnosis of NAR is important as it has many differences/similarities with AR and is seen almost half as often as AR in patients with chronic rhinitis.

Keywords allergic rhinitis, atopy, HRQoL, nonallergic rhinitis, SF-36

INTRODUCTION

Chronic rhinitis, which is defined as the inflammation of the nasal mucosa, can be roughly classified into two distinct groups from a practical point of view. Allergic rhinitis (AR) is defined as nasal symptoms induced by an immunoglobulin E (IgE)-mediated inflammation after allergen exposure. Patients with nonallergic rhinitis (NAR) have nasal symptoms with no proven allergy (1, 2).

Although AR is the most common form of rhinitis that affects more than 20% of adults, the prevalence of NAR is unknown owing to inconsistent definition and lack of descriptive studies (3). Furthermore, there is still no single valid test for the diagnosis of NAR as specific immunological, functional, radiological, and clinical assessments are required (2).

The symptomatology of NAR may resemble that of allergic rhinitis, but it has a higher prevalence of sinusitis comorbidity (4). Not only presenting symptoms of allergic and nonallergic rhinitis are often indistinguishable from one another, but also the differential diagnosis of NAR is quite extensive. In addition, NAR frequently occurs in atopic situation and presents as mixed rhinitis, as 44% of patients with AR may have concomitant nonallergic component (3). Recently a study conducted in adolescents and adults had addressed the clinical and demographic features of AR and NAR (5).

Failure in the diagnosis and in the treatment of NAR has significant consequences, including health-related quality of life (HRQoL). Although understanding of pathophysiology and pharmacology of rhinitis has increased within recent

years, few studies have examined the impact of rhinitis on HRQoL to assess the burden of a disease as perceived by the patient. AR affects mental QoL, predominantly associated with impaired sleep and increased irritability (6). However, few data are available on the HRQoL of patients with NAR (7).

More importantly, improvements in the clinical awareness and treatment of rhinitis may reduce the risk of asthma. Therefore, differentiation between the various rhinitis subtypes should be done to select an optimal treatment strategy to produce fewer symptoms, improve quality of life, prevent comorbidities, and prevent behavioral and psychological disturbances (8).

The aim of the present study was to understand the general characteristics of rhinitis with or without allergy in a group of patients who seek medical help. We also analyzed HRQoL, as well as the factors that may interact with rhinitis.

METHODS

This was a retrospective study of 478 consecutive and unselected patients who were referred to the outpatient tertiary clinic of Kirikkale University Hospital for the evaluation of allergy/asthma. Briefly, 379 patients who had rhinitis were detected and a total of 323 subjects with skin prick tests (SPTs) were included into the study. Rhinitis was diagnosed if the patients had a history of at least two of the above symptoms: nasal itching, sneezing, rhinorrhea, and/or obstruction for more than 4 days a week and for more than 4 weeks a year (9). Patients with concomitant nasal polyposis, septal deviation if severe enough to cause persistent nasal obstruction, rhinitis medicamentosa, and those who were pregnant or lactating were excluded.

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AR was defined as nasal symptoms accompanied by SPT positivity with clinical relevance, whereas NAR was defined as nasal symptoms with negative SPTs. The severity of rhinitis was classified as "intermittent"/"persistent" or "mild"/"moderate-severe" proposed by the Allergic Rhinitis and its Impact on Asthma (ARIA) guidelines (9). Asthma diagnosis was made according to the American Thoracic Society criteria with symptoms of episodic wheezing, cough, and shortness of breath responding to bronchodilators, and reversible airflow obstruction documented in at least one previous pulmonary function study (10). Itchy episodes of the eye and postnasal drainage were recorded. The diagnosis of Samter triad was established under provocation challenges with aspirin and/or nonsteroidal anti-inflammatory drugs in suspected patients. Paranasal computed tomography was used to define nasal polyps. Chronic urticaria was diagnosed if an acute attack was reported during the last 2 years. Food and drug allergy were diagnosed with oral or skin provocation tests as previously described (11, 12). Systemic diseases—cardiovascular, gastrointestinal, and metabolic—were determined according to the medical records.

SPTs were performed with a battery of common inhalant allergens (ALK, Madrid, Spain). Histamine hydrochloride 10 mg/mL and phenolated glycerol-saline served as positive and negative controls. However, in some selected patients intradermal tests were essential to exclude false-negative reactions and to detect relevant allergen(s). The reaction was regarded as positive if the mean wheal diameter was at least 3 mm. Serum total IgE level and blood eosinophilia were measured. C-reactive protein (CRP)-Latex was determined by immunoturbidimetric assays (Roche Diagnostics, GmbH, Mannheim). Nonspecific provocation challenge was performed with methacholine by 5-breath dosimeter technique. Bronchial hyperreactivity (BHR) was expressed as the dose producing a 20% decrease in forced expiratory volume in 1 second (FEV₁).

The Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36) was used for determining HRQoL. The SF-36 questionnaire includes 36 items and assesses 8 health concepts as measures of physical and mental health (13). In addition to 8 separate scales, two general domain measures were used: physical component summary (PCS) and mental component summary (MCS) scores. Higher scores represent better health status. The SF-36 had been validated for the Turkish language (14) and normative data of Turkish general population we used were obtained by randomized testing on 1,279 people selected from a study population of 46,290 people (15). The protocol for this study was approved by the hospital ethics committee.

Statistical Analysis

Statistical analysis was performed using SPSS statistical software, version 15.0 (SPSS Inc, Chicago, IL). Intergroup comparisons were made using the χ^2 test for categorical variables and the student T test for quantitative variables. $p < 0.05$ was regarded as statistically significant.

TABLE 1.—Demographic and functional characteristics of patients with allergic rhinitis (AR) and non allergic rhinitis (NAR).

	AR (n = 205)	NAR (n = 118)	p
Age (year)*	31 ± 13	33 ± 13	0.14
Female/male (%)	59/41	67.8/32.2	0.11
Smokers (%)	13.7	17.8	0.31
BMI (kg/m ²)*	25 ± 5.5	25 ± 5.1	0.99
Education (year)*	10 ± 8	8.5 ± 3.7	0.02
Family atopy (%)	53.2	37.3	0.01
Total IgE (IU/mL)*	261 ± 359	126 ± 172	0.01
Blood eosinophilia (% of leukocyte)*	2.7 ± 2.5	3 ± 2.6	0.58
C-reactive protein (mg/L)*	0.3 ± 0.4	0.4 ± 0.5	0.58

BMI = body mass index; *mean ± standard deviation.

RESULTS

The Characteristics of the Study Population

A total of 379 patients with rhinitis were enrolled; however, SPTs were missing in 56 subjects. Therefore, data from 323 patients with a mean age of 31.7 ± 12.6 years were included in the study. 62.2% were female and 37.8% were male.

AR versus NAR

Most of the patients were diagnosed as AR (205, 63.5%), whereas NAR was diagnosed in 118 patients (36.5%), with no difference between the age, gender, BMI, cigarette smoking, eosinophilia, and CRP measurement (Table 1). Total serum IgE levels and family history of atopy were significantly higher in subjects with AR ($p = 0.01$), and they were likely to be more educated ($p = 0.02$).

The average duration of rhinitis was 6.2 ± 5.4 and 5.3 ± 4.6 years in the AR and NAR groups respectively, with no significant difference. More than half of the patients with AR had seasonal-mild-intermittent symptoms, whereas nonallergic patients had significantly more perennial-mild-intermittent rhinitis ($p = 0.01$). Patients with AR were mainly sensitized with pollens, followed by house dust mites (69% and 45%), and had rhinorrhea, frequent nasal itching, and sneezing, compared to NAR group ($p = 0.04$, $p = 0.02$, and $p = 0.01$, respectively) (Table 2). Both the prevalence of nasal obstruction and hyposmia were comparable between the groups. Prior nasal surgery was more frequent in patients with NAR than AR group ($p = 0.06$) as well as in those with coexisting asthma (data not shown).

Almost one third of the groups had doctor-diagnosed asthma. But neither the prevalences of asthma and BHR, nor the systemic diseases were significantly different. The duration of asthma was significantly higher in the allergic type of rhinitis than NAR (2.3 ± 5 and 1.4 ± 3.3 years, $p = 0.04$). Almost two thirds of the individuals with asthma in each group had persistent symptoms. Subjects with AR were found to have significantly more eye symptoms and sinusitis ($p = 0.01$). Other comorbidities did not differ between the AR and the NAR groups ($p > 0.05$) (Table 3).

HRQoL

The mean scores of the SF-36 subscales, except physical functioning, were higher in AR than in patients with NAR,

TABLE 2.—Comparison of symptoms between allergic (AR) and nonallergic (NAR) groups.

	AR	NAR	<i>p</i>
Duration of rhinitis (year)*	6.2 ± 5.4	5.3 ± 4.6	0.13
Seasonal/perennial	61/39	13/87	0.01
Intermittent/persistent	58/42	86/14	0.01
Mild/Moderate-severe	57/43	84/16	0.01
Nasal obstruction	84.4	88.1	0.35
Rhinorrhea	86.8	78	0.04
Nasal itching	57.6	44.1	0.02
Sneezing	74.5	54.2	0.01
0–3/day	25.4	45.8	
4–7/day	24.9	33.1	
>8/day	49.8	21.2	
Hyposmia	17.6	15.3	0.59
Nasal operation	7.8	14.4	0.06

All the prevalence(s) are expressed as percentage of the group except *: mean ± standard deviation.

with no statistically significance. Likewise, PCS and MCS scores were found to be similar between the two groups (Figure 1).

DISCUSSION

Although the differential diagnosis of various rhinitis forms is presumptively based on the symptoms and the history of triggers, confirmation of AR requires documentation of specific IgE reactivity. On the contrary, NAR has similar symptomatology without identifiable specific allergic sensitivity. NAR is a general term for a number of various and not well-defined nasal conditions of partly unknown etiology and pathophysiological mechanisms. It is important to differentiate NAR from rhinitis of allergic etiology because of its high prevalence. Once the diagnosis is established, an appropriate treatment plan tailored to a specific diagnosis should be designed (1, 16–18).

We showed that AR was almost twice as often as NAR in an outpatient clinic (n: 205/118, 1.7/1). This is somewhat less than the distribution of AR and NAR (3:1) in western Europe. In a community-based Danish survey, 77% of the population with rhinitis had AR, whereas 23% had NAR (5). A high prevalence of self-declared rhinitis symptoms (39.3%) was found in the Belgian population, and AR was approximately three times more prevalent than noninfectious nonallergic rhinitis (NINAR) (19). In both studies, patients were recruited using a screening questionnaire. Conversely, our group consisted of individuals who sought help for their symptoms related to rhinitis. Gender distribution was not different between the patients with allergic or nonallergic

rhinitis in consistent with the survey from Sweden (20). Likewise, neither the mean age nor the duration of rhinitis as expressed by years was different between the two groups. The wide age range in the present study (10–66 years) may partly explain this feature. Among the individuals with chronic rhinitis, the percentage of nonallergic etiology was shown to increase with age. Although NAR is even more than 60% beyond the fifth decade of life, AR is uncommon in elderly patients (4, 21).

Despite the fact that the ARIA guideline was developed mainly for AR, we preferred to classify patients with NAR according to the same definitions to compare the characteristics of these two groups in terms of duration and severity of symptoms. All patients had mostly mild-intermittent symptoms, but allergic rhinitis was significantly more persistent-severe in the present study. Our patients with NAR complained of perennial symptoms, while subjects with allergic symptoms showed more seasonal predominance, as expected. On the contrary, subjects with NAR had more persistent but equally severe symptoms compared to AR group in the Danish survey. Patients with AR displayed more persistent and moderate/severe ARIA profile than NINAR as reported by Bachert et al. (5, 19).

In addition, overall symptomatology in NAR was significantly less than that of AR, as was the case that AR patients had a greater number of symptoms, in the Belgian survey. In our study, nasal obstruction was the leading symptom in NAR, whereas rhinorrhea was the prominent symptom followed by sneezing and itching in AR. Likewise, NAR was shown to be a prevalent condition, which was characterized by severe symptoms, most prominently rhinorrhea and nasal congestion, in the community-based sample. Sneezing and itchy eyes were the dominant complaints in the AR group within particular season (5).

In our study, the diagnosis of NAR was made when allergy, major nasal structural abnormalities, and infections had been excluded. However, patients with NAR were more likely to have previous nasal operations ($p = 0.06$). NAR may also be expressed as a condition of increased perception to irritants and to environmental changes (22). Moreover, the significance of symptom exacerbation by nonallergic triggers in the setting of AR remains to be determined. Although we did not specifically explore hyperreactivity against environmental irritants, neither the detailed history nor nonspecific BHR was found to be different between the two groups.

The prevalence of conjunctivitis and sinusitis were more frequent in AR. But no other allergic comorbidity including asthma and systemic diseases was shown to be different in our study population. Suzuki et al. found that type I allergic reaction had a significant role in the pathogenesis of sinusitis in AR (23).

Another important aspect of this study was the investigation of HRQoL in the whole group. We have shown that all the domains—but physical functioning—of SF-36 in patients with AR were insignificantly higher than the NAR group. Rhinitis can greatly affect a patient's quality of life and exerts a tremendous societal burden in terms of both its direct and indirect costs. There are many reports revealing the HRQoL in patients with AR and relatively few studies in patients with NAR, but there is no investigation that assessed the relative

TABLE 3.—Prevalence* of other diagnosis and comorbidities in the study groups.

	AR	NAR	<i>p</i>
Asthma	33.7	26.3	0.17
BHR	5.9	9.3	0.42
Conjunctivitis	63.4	39.8	0.01
Sinusitis	75.1	54.2	0.01
Urticaria	23.9	23.7	0.98
Food allergy	9.8	9.3	0.9
Drug allergy	15.2	13.6	0.69
Systemic diseases	14.7	18.6	0.36

* All the prevalence(s) are expressed as percentage of the group.
BHR = Bronchial hyperreactivity.

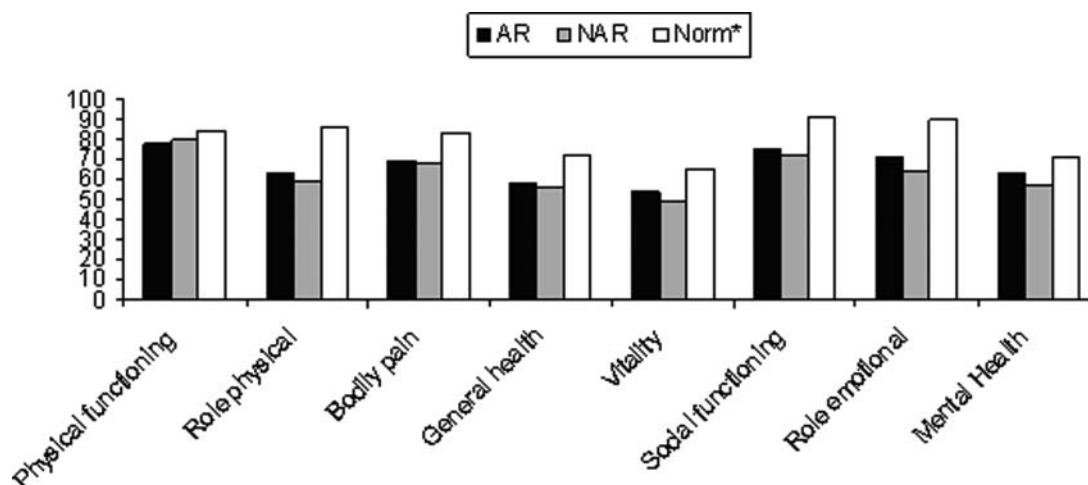


FIGURE 1.—Comparison of mean ($\pm$ standard deviation) health-related quality of life using SF-36 subscale scores in allergic and nonallergic rhinitis with population norms. AR and NAR patients have similar levels of SF-36 subscale scores ($p > 0.05$), which are lower than Turkish population norm data.

burden of both disease states in a single population (7, 24). Therefore, this is first study, at least to our knowledge, that evaluates both forms. Data from studies of patients with allergy show that rhinitis predominantly affects mental quality of life (6). However, AR was associated neither with mental nor with physical HRQoL as was found in the NAR group in our study. The adverse effects of rhinitis were reported to be substantially limiting, particularly women reporting more severe psychosocial effects. In contrast, we found that NAR impaired quality of life equally as in subjects with AR, in both genders. The limitation of this current study was the lack of a control group. However, when compared to the results of the subjects with no chronic diseases in the Turkish population, the impairment in HRQoL in this study group was significant (15).

This retrospective investigation was performed to test whether there were certain points that would be helpful in the differentiation of allergic and nonallergic rhinitis. In this respect, it is not only hard to explain the conflicting findings but also to compare the results with those of previous studies with different methodology. Among the potential functional abnormality seen in NAR is the local production of IgE in the nasal mucosa (25). This explanation may lead to many similarities between allergic and nonallergic forms of rhinitis.

Over the last decade, the united airway concept has emphasized the need to take the entire respiratory system into account when treating asthma (9, 26). To achieve this goal, a consensus on the definitions of rhinitis and rhinitis subtypes including mixed rhinitis, nonallergic triggers that best define NAR, and updating guidelines for the interpretation of specific IgE must be necessary (27).

In conclusion, the answer to the question in the title is not that easy. AR and NAR are quite similar from a clinical viewpoint and the allergy test negativity still remains the only relevant difference. However, our findings stress the importance of definitive diagnosis before the early and appropriate management of NAR as well as AR. Further investigations with larger populations are needed to determine to which extent AR and NAR has similarities as well as differences.

REFERENCES

- Settipane, Russell A. Demographics and epidemiology of allergic and non-allergic rhinitis. *Allergy Asthma Proc* 2001; 22:185–189.
- van Rijswijk JB, Blom HM, Fokkens WJ. Idiopathic rhinitis, the ongoing quest. *Allergy* 2005; 60:1471–1481.
- Settipane RA, Charnock DR. Epidemiology of rhinitis: allergic and nonallergic. *Clin Allergy Immunol* 2007; 19:23–34.
- Sanico A, Togias A. Noninfectious, nonallergic rhinitis (NINAR): considerations on possible mechanisms. *Am J Rhinol* 1998; 12:65–72.
- Mølgaard E, Thomsen SF, Lund T, Pedersen L, Nolte H, Backer V. Differences between allergic and nonallergic rhinitis in a large sample of adolescents and adults. *Allergy* 2007; 62:1033–1037.
- Stuck BA, Czajkowski J, Hagner AE, Klimek L, Verse T, Hörmann K, Maurer JT. Changes in daytime sleepiness, quality of life, and objective sleep patterns in seasonal allergic rhinitis: a controlled clinical trial. *J Allergy Clin Immunol* 2004; 113:663–668.
- Hellgren J. Quality of life in nonallergic rhinitis. *Clin Allergy Immunol* 2007; 19:383–387.
- Nassef M, Shapiro G, Casale TB. Respiratory and Allergic Disease Foundation. Identifying and managing rhinitis and its subtypes: allergic and nonallergic components—a consensus report and materials from the Respiratory and Allergic Disease Foundation. *Curr Med Res Opin* 2006; 22:2541–2548.
- Bousquet J, Khaltaev N, Cruz AA, Denburg J, Fokkens WJ, Togias A, Zuberbier T, Baena-Cagnani CE, Canonica GW, van Weel C, Agache I, Ait-Khaled N, Bachert C, Blaiss MS, Bonini S, Boulet LP, Bousquet PJ, Camargos P, Carlsen KH, Chen Y, Custovic A, Dahl R, Demoly P, Dougui H, Durham SR, van Wijk RG, Kalayci O, Kaliner MA, Kim YY, Kowalski ML, Kuna P, Le LT, Lemiere C, Li J, Lockey RF, Mavale-Manuel S, Meltzer EO, Mohammad Y, Mullol J, Naclerio R, O'Hehir RE, Ohta K, Ouedraogo S, Palkonen S, Papadopoulos N, Passalacqua G, Pawankar R, Popov TA, Rabe KF, Rosado-Pinto J, Scadding GK, Simons FE, Toskala E, Valovirta E, van Cauwenberge P, Wang DY, Wickman M, Yawn BP, Yorgancioglu A, Yusuf OM, Zar H, Annesi-Maesano I, Bateman ED, Ben Kheder A, Boakye DA, Bouchard J, Burney P, Busse WW, Chan-Yeung M, Chavannes NH, Chuchalin A, Dolen WK, Emuzyte R, Grouse L, Humbert M, Jackson C, Johnston SL, Keith PK, Kemp JP, Klossek JM, Larenas-Linnemann D, Lipworth B, Malo JL, Marshall GD, Naspitz C, Nekam K, Niggemann B, Nizankowska-Mogilnicka E, Okamoto Y, Orru MP, Potter P, Price D, Stoloff SW, Vandenplas O, Viegi G, Williams D; World Health Organization; GA(2)LEN; AllerGen. Allergic rhinitis and its impact on asthma (ARIA) 2008 update (in collaboration with the World Health Organization, GA²LEN and AllerGen). *Allergy* 2008; 63: (suppl 86):8–160.

10. American Thoracic Society. Standards for diagnosis and care of patients with chronic obstructive pulmonary diseases (COPD) and asthma. *Am Rev Respir Dis* 1987; 136:225–244.
11. Bindslev-Jensen C, Ballmer-Weber BK, Bengtsson U, Blanco C, Ebner C, Hourihane J, Knulst AC, Moneret-Vautrin DA, Nekam K, Niggemann B, Osterballe M, Ortolani C, Ring J, Schnopp C, Werfel T; European Academy of Allergology and Clinical Immunology. Standardization of food challenges in patients with immediate reactions to foods. *Allergy* 2004; 59:690–697.
12. Aberer W, Bircher A, Romano A, Blanca M, Campi P, Fernandez J, Brockow K, Pichler WJ, Demoly P; European Network for Drug Allergy (ENDA); EAACI interest group on drug hypersensitivity. Drug provocation testing in the diagnosis of drug hypersensitivity reactions: general considerations. *Allergy* 2003; 58:854–863.
13. Ware JE, Sherbourne CD. The MOS 36-Item Short-Form Survey (SF-36) I. Conceptual framework and item selection. *Med Care* 1992; 30:473–483.
14. Kocyigit H, Aydemir O, Olmez N. Kisa. form-36 (KF-36)'nin Türkçe versiyonunun güvenilirliği ve geçerliliği. *İlaç ve Tedavi Dergisi* 1999; 12:102–106.
15. Demiral Y, Ergor G, Unal B, Semin S, Akvardar Y, Kivircik B, Alptekin K. Normative data and discriminative properties of short form 36 (SF-36) in Turkish urban population. *BMC Public Health* 2006; 6:247.
16. Fokkens W. Outpatient therapy for nonallergic rhinitis. *Clin Allergy Immunol* 2007; 19:363–373.
17. Berger WE, Schonfeld JE. Nonallergic rhinitis in children. *Curr Allergy Asthma Rep* 2007; 7:112–116.
18. Dykewicz MS. Clinical approach to diagnosis and treatment of nonallergic rhinitis. *Clin Allergy Immunol* 2007; 19:335–350.
19. Bachert C, van Cauwenberge P, Olbrecht J, van Schoor J. Prevalence, classification and perception of allergic and nonallergic rhinitis in Belgium. *Allergy* 2006; 61:693–698.
20. Olsson P, Berling N, Bellander T, Stjärne P. Prevalence of self-reported allergic and non-allergic rhinitis symptoms in Stockholm: relation to age, gender, olfactory sense and smoking. *Acta Otolaryngol* 2003; 123:75–80.
21. Crawford WW, Gowda VC, Klaustermeyer WB. Age effects on objective measures of atopy in adult asthma and rhinitis. *Allergy Asthma Proc* 2004; 25:175–179.
22. Brandt D, Bernstein JA. Questionnaire evaluation and risk factor identification for nonallergic vasomotor rhinitis. *Ann Allergy Asthma Immunol* 2006; 96:526–532.
23. Suzuki M, Watanabe T, Suko T, Mogi G. Comparison of sinusitis with and without allergic rhinitis: characteristics of paranasal sinus effusion and mucosa. *Am J Otolaryngol* 1999; 20:143–150.
24. Rydén O, Andersson B, Andersson M. Disease perception and social behaviour in persistent rhinitis: a comparison between patients with allergic and nonallergic rhinitis. *Allergy* 2004; 59:461–464.
25. Rondón C, Romero JJ, López S, Antúnez C, Martín-Casañez E, Torres MJ, Mayorga C, R-Pena R, Blanca M. Local IgE production and positive nasal provocation test in patients with persistent nonallergic rhinitis. *J Allergy Clin Immunol* 2007; 119:899–905.
26. Leynaert B, Bousquet J, Neukirch C, Liard L, Neukirch F. Perennial rhinitis: an independent risk factor for asthma in nonatopic subjects: results from the European Community Respiratory Health Survey. *J Allergy Clin Immunol* 1999; 104:301–304.
27. Kaliner MA. A novel and effective approach to treating rhinitis with nasal antihistamines. *Ann Allergy Asthma Immunol* 2007; 99:383–390.