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The International Study of the Allergic Rhinitis Survey: outcomes from 4 geographical regions

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ABSTRACT

Background: Allergic rhinitis (AR) is a global health problem and is characterised by one or more symptoms, including sneezing, itching, nasal congestion and rhinorrhea.
Objective: We investigated the features of AR and the physician's approach to the management of AR patients in four geographical regions.
Methods: In this cross-sectional study, a questionnaire survey concerning AR was completed by Honorary and Corresponding Members of the Italian Society of Rhinology from different countries among 4 world geographical regions—Asia, Europe, the Americas, and Africa.
Results: The prevalence of AR was reported to be 15%–25%. Children and adolescents, as well as young adults, were the age groups more affected by AR with comorbidities of asthma, sinusitis, conjunctivitis, and nasal polyposis. Nasal symptoms of AR were more intense in the spring (51.92%) and autumn (28.85%). The most common aero-allergens were pollen and mites (67.31%), animal dander and pollutants (23.08%), and fungal allergens (21.15%). Allergen-specific immunotherapy was prescribed for both perennial and seasonal allergens (32.69%) via sublingual swallow (46.15%) and subcutaneous (32.69%) routes. For the AR patients, the most prescribed drugs were intranasal corticosteroids (86.54%) and oral H_1-antihistamines (82.69%).
Conclusion: A network of experts can improve our knowledge concerning AR epidemiology, and together with guidelines, could assist practitioners and otolaryngologists in standardising the diagnosis and treatment of AR.

Keywords: Allergic rhinitis; Allergens; Treatment; Allergen specific immunotherapy; Sublingual immunotherapy; Subcutaneous immunotherapy

INTRODUCTION

Allergic rhinitis (AR) is a global health problem and one of the most common conditions seen by otolaryngologists. AR is characterised by one or more symptoms, including sneezing, itching, nasal congestion and rhinorrhea [1], and it may be classified by the temporal pattern

Author Contributions

Conceptualization: Desiderio Passali. Data curation: Desiderio Passali. Formal analysis: Desiderio Passali. Investigation: Desiderio Passali. Project administration: Desiderio Passali, Cemal Cingi, Paola Staffa, Francesco Passali, Nuray Bayar Muluk, Maria Luisa Bellussi. Resources: Desiderio Passali, Cemal Cingi, Paola Staffa, Francesco Passali, Nuray Bayar Muluk, Maria Luisa Bellussi. Supervision: Desiderio Passali, Cemal Cingi, Paola Staffa, Francesco Passali, Nuray Bayar Muluk, Maria Luisa Bellussi. Validation: Desiderio Passali. Writing - original draft: Desiderio Passali, Cemal Cingi, Paola Staffa, Francesco Passali, Nuray Bayar Muluk, Maria Luisa Bellussi. Writing - review & editing: Desiderio Passali, Cemal Cingi, Paola Staffa, Francesco Passali, Nuray Bayar Muluk, Maria Luisa Bellussi.

of exposure to a triggering allergen (seasonal, perennial/year-round or episodic), frequency (intermittent or persistent) and severity of symptoms (mild or severe). The traditional classification system that divides AR into seasonal and perennial AR has limitations because the pollen season is dependent on geographic location and climatic conditions. When the pollen season is year-round, as in tropical locations, it is difficult to distinguish between symptoms provoked by pollens and mites [2].

The correlation between AR and conjunctivitis, atopic dermatitis or asthma risk is well known. However, few epidemiological data exist regarding the distribution, etiological risk factors and natural history of AR. Several national and multinational studies are improving our knowledge of the prevalence of rhinitis, possible risk factors and its associated age, geographical and temporal distribution, but many of these studies were epidemiologic surveys that were dependent on self-reported AR and most concerned seasonal allergic reactions [3].

Although the capacity of pollens to sensitise is hypothetically universal, the nature and amount of pollen change with the geographic zone, temperature and climate [3-6]. Patients and medical providers occasionally diagnose AR based on clinical history and physical examination, but AR symptoms are not always different from other causes of nasal inflammation or blockage, and allergy testing can then be performed to verify the diagnosis.

Although AR therapy is based—when possible—on allergen avoidance, symptomatic pharmacotherapy and immunotherapy, few of these therapeutic options are routinely available worldwide. Therefore, the aim of the current study was to investigate the perception of the epidemiological aspects and habits in the diagnosis and therapy of AR among experts in rhinology worldwide.

MATERIALS AND METHODS

This international cross-sectional survey study involved responses from experts in rhinology worldwide. This study is continued according to the Declaration of Helsinki.

Questionnaire

A panel of experts, based on guidelines and literature analysis, prepared a questionnaire of 24 points of interest/questions specifically dedicated to ear, nose, and throat (ENT) specialists and particularly to rhinology experts. The questionnaire ("yes/no" or multiple-choice answers) investigated the perception of the epidemiological aspects of the pathology. Providing more than one answer to a question was permitted (**Table 1**).

Method

The questionnaires were mailed electronically to 88 ENT specialists worldwide, who were randomly selected from the Honorary and Corresponding Members of the Italian Society of Rhinology. They were more than 70 specialists from 70 different countries (the website http://www.societaitalianarinologia.it was accessed, and then "S.I.R." was selected followed by "Honorary Members and Correspondents"). The selected experts were ENT specialists who are internationally recognised as authorities in the field of rhinology and/or who direct departments or clinics in which nose functional surgery and rhinology are the major sources of employment.

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Table 1. Allergic rhinitis survey results

Item	Number/total number (%)
1) Which is the prevalence of allergic rhinitis in your country?	Answer not given: 2 (3.85)
1. 5%	7/52 (13.46)
2. 15%	15/52 (28.85)
3. 25%	19/52 (45.24)
4. 35%	5/52 (9.62)
5. >35%	5/52 (9.62)
2) The prevalence of allergic rhinitis in your country is:	Answer not given: 2 (3.85)
1. In dubious increase	10/52 (19.23)
2. Steady	4/52 (7.69)
3. Decreasing	0/52 (0)
4. Surely increasing	36/52 (69.23)
3) The increasing prevalence. can be attributed to:	Answer not given: 3 (5.77)
1. Changing in lifestyle	24/52 (46.15)
2. Increased exposure to allergens. irritants and pollutants	37/52 (71.15)
3. Early exposure to allergens. irritants and pollutants	12/52 (23.08)
4. Decreasing of some viral and/or bacterial infections	7/52 (13.56)
4) Which are the age groups more often affected by allergic rhinitis?	Answer not given: 1 (1.92)
1. Children and adolescents	23/52 (44.23)
2. Young adults	22/52 (42.31)
3. Old age	0/52 (0)
4. All age groups	13/52 (25.00)
5) The comorbidities more frequently reported in patients with allergic rhinitis are:	Answer not given: (1.92)
1. Asthma	41/52 (78.85)
2. Conjunctivitis	21/52 (40.38)
3. Sinusitis	30/52 (57.69)
4. Otitis media	5/52 (9.62)
5. Nasal polyposis	19/52 (36.54)
6) Which specialist would more likely be consulted by a patient with allergic rhinitis?	Answer not given: 0 (0)
1. Primary care physician	19/52 (36.54)
2. Allergologist	20/52 (38.46)
3. Pulmonologist	8/52 (15.38)
4. Otorhinolaryngologist	36/52 (69.23)
5. Ophtalmologist	1/52 (1.96)
7) In which period of the year nasal symptoms are more intense?	Answer not given: 1 (1.92)
1. Spring	27/52 (51.92)
2. Summer	8/52 (15.38)
3. Autumn	15/52 (28.85)
4. Winter	7/52 (13.46)
5. Throughout the whole year	14/50 (26.92)
8) Which are the most common aero-allergens in your country?	Answer not given: 0 (0)
1. Mites	35/52 (67.31)
2. Pollen	35/52 (67.31)
3. Animal danders	12/52 (23.08)
4. Pollutants	12/52 (23.08)
5. Insects	1/52 (1.92)
6. Fungal allergens	11/52 (21.15)
9) Which symptoms are more often complained by patients with allergic rhinitis?	Answer not given: 0 (0)
1. Rinorrhea	47/52 (90.38)
2. Nasal blockage	49/52 (94.23)
3. Hypo-anosmia	15/52 (28.85)
4. Snoring, sleep problems	9/52 (17.31)
5. Chronic cough	7/52 (13.46)
6. Sedation	1/52 (1.92)
7. Asthma and conjunctivitis	14/52 (26.92)
10) Do you perform prick test?*	Answer not given: 0 (0)
1. Yes	24/52 (46.15)
2. No	28/52 (53.85)

*For questions 10–16, only 24 of 52 of the participants (46.15%) performed the prick test. However, to avoid confusion, the responses related to the prick test in questions 11–16 were also rated in the 52 total participants. If the responses were rated in only the prick test performing group (24 participants), the rates would be different. Readers should consider this issue.

(continued to the next page)

Table 1. (Continued) Allergic rhinitis survey results

Item	Number/total number (%)
11) If you answered yes, which kind of pollens do you test?*	Answer not given: 29/52 (55.77)
1. *Betula verucosa* or Betulaceae mix	7/52 (13.46)
2. Cupressacee	6/52 (11.54)
3. Grass mix	17/52 (32.69)
4. *Artemisia vulgaris*	8/52 (15.38)
5. Oleacee	5/52 (9.62)
6. *Parietaria officinalis*	8/52 (15.38)
7. *Platanus occidentalis*	7/52 (13.46)
8. *Ambrosia eliator*	8/52 (15.38)
9. Other (specify)	2/52 (3.85) (poplar)
12) Which kind of mites do you test?*	Answer not given: 25 (48.08)
1. *Dermatophagoides pteronyssimus* and *Dermatophagoides farinae*	27/52 (52.92)
2. *Euroglyphus maynei*	2/52 (3.85)
3. *Lepidoglyphus denstructor*	0 (0)
4. *Blomia tropicalis* and *Blomia kulagini*	2 (3.85)
5. Other (specify)	0 (0)
13) Which of these animal allergens do you test?*	Answer not given: 24/52 (46.15)
1. Cat (felix domesticus)	27/52 (51.92)
2. Dog (canis familiaris)	27/52 (51.92)
3. Horse	5/52 (9.62)
4. Other (specify)	3/52 (5.77)
14) Which kind of fungal allergens?*	Answer not given: 27/52 (51.92)
1. *Alternaria alternata*	23/52 (44.23)
2. *Cladosporium album*	15/52 (28.85)
3. Other (specify)	4/52 (7.69)
15) Do you test insect allergens too?*	Answer not given: 35/52 (67.31)
1. Cockroach (Blatella sp.)	17/52 (32.69)
2. Other (specify)	3/52 (12.50)
16) When do you consider positive a skin prick test?*	Answer not given: 27/52 (51.92)
1. Wheal size>3 mm after 15'	19/52 (36.54)
2. Regardless of the diameter, on comparison with the positive control	10/52 (19.23)
3. Regardless of the diameter, on comparison with the negative control	1/52 (1.92)
4. Other (specify)	1/52 (1.92)
17) Do you prescribe the measurement of serum total and specific IgE after skin prick test?	Answer not given: 11/52 (21.15)
1. Yes	23/52 (44.23)
2. No	18/52 (34.62)
18) Which other diagnostic test do you prescribe in allergic rhinitis patients?	Answer not given: 9/52 (17.31)
1. Rhinomanometry	21/52 (40.38)
2. Nasal mucociliary clearance	9/52 (17.31)
3. Computed tomography	25/52 (48.08)
4. Olfactory tests	11/52 (21.15)
5. Nasal cytology	16/52 (30.77)
6. Nasal provocation test	13/52 (25.00)
19) In your experience. nasal cytology is useful for:	Answer not given: 12/52 (23.08)
1. Differential diagnosis between allergic and non allergic or infective rhinitis	20/52 (38.46)
2. Follow-up of the pathology and evaluation of the treatment response	6/52 (11.54)
3. Not useful	18/52 (34.62)
20) Do you perform nasal cytology in your outpatient?	Answer not given: 2/52 (3.92)
1. Yes	16/52 (30.77)
2. No	34/52 (65.38)
21) Do you perform nasal provocation test?	Answer not given: 2/52 (3.85)
1. Yes	14/52 (26.92)
2. No	36/52 (69.23)
22) If you answered yes, when do you suggest nasal provocation test?	Answer not given: 37/52 (71.15)
1. Mismatch clinical history and allergy outcomes	13/52 (25.00)
2. Occupational rhinitis	8/52 (15.38)
3. Other (specify)	3/52 (5.77)

*For questions 10–16, only 24 of 52 of the participants (46.15%) performed the prick test. However, to avoid confusion, the responses related to the prick test in questions 11–16 were also rated in the 52 total participants. If the responses were rated in only the prick test performing group (24 participants), the rates would be different. Readers should consider this issue.

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Table 1. (Continued) Allergic rhinitis survey results

Item	Number/total number (%)
23) Do you prescribe allergen specific immunotherapy?	Answer not given: 2/52 (3.85)
1. Yes, for perennial allergens	6/52 (11.54)
2. Yes, for seasonal allergens	7/52 (13.46)
3. Yes, for both kind of allergens	17/52 (32.69)
4. No	22/52 (42.31)
24) Which route of administration do you prefer for immunotherapy?	Answer not given: 18/52 (34.62)
1. Intranasal	7/52 (13.46)
2. Sublingual-swallow	24/52 (46.15)
3. Subcutaneous	17/52 (32.69)
25) Which kind of symptomatic drugs do you prescribe in allergic patients?	Answer not given: 1/52 (1.92)
1. Oral H_1-antihistamines	43/52 (82.69)
2. Intranasal corticosteroids	45/52 (86.54)
3. Intranasal corticosteroids and intranasal antihistamine	18/52 (34.62)
4. Systemic corticosteroids	10/52 (19.23)
5. Antileukotrienes	21/52 (40.38)
6. Nasal douches with hypertonic solution	11/52 (21.15)
7. Nasal douches with isotonic solution	15/52 (28.85)
8. Nasal douches with hyaluronic acid	1/52 (1.92)
9. Other (specify)	3/52 (5.77)

*For questions 10–16, only 24 of 52 of the participants (46.15%) performed the prick test. However, to avoid confusion, the responses related to the prick test in questions 11–16 were also rated in the 52 total participants. If the responses were rated in only the prick test performing group (24 participants), the rates would be different. Readers should consider this issue.

They were asked to respond according to their personal experience, considering the national guidelines for the topic and opinion of a cohort of colleagues. The questionnaires were sent from the beginning of December 2014 to the end of January 2015, and 52 responses were returned. All of the participants were approved to participate in the study. The study was conducted according to the rules outlined in the Declaration of Helsinki.

For evaluation of the survey, for each of the questions (Q1–Q25), the percentage of each option was calculated. For some questions, more than one option was selected by the participants.

RESULTS

Among the 52 interviewed ENT specialists, the territorial distribution was the following: 38.5% for Asia (Central Asia, 1.9%; Southern Asia, 9.6%; Western Asia, 11.5%; Eastern Asia, 9.6%; South-eastern Asia, 5.8%), 38.5% for Europe (Central Europe, 5.8%; Southern Europe, 13.5%; Eastern Europe, 11.5%; Northern Europe, 3.8%; Europe-Asia, 3.9%), 13.5% for the Americas (Central America, 7.7%; South America, 3.8%; North America, 1.9%), and 7.7% for Africa (Central Africa, 1.9%; Southern Africa, 1.9%; Northern Africa, 3.8%) (**Table 2**).

The results of the AR survey are listed below.

Q1) What is the prevalence of allergic rhinitis in your country?

The prevalence of AR was reported to be 15%–25% by most of the participants.

Q2) The prevalence of allergic rhinitis in your country is:

The prevalence of AR was mentioned as "surely increasing" by 69.23% of the participants.

Q3) The increasing prevalence can be attributed to:

The increasing prevalence could be attributed to "increased exposure to allergens, irritants and pollutants" (71.15%), "change in lifestyle" (46.15%), "early exposure to allergens, irritants and pollutants" (23.08%), and "decrease in some viral and/or bacterial infections" (13.56%).

Table 2. Territorial distribution of the ENT specialists among geographic regions

Continent	Territorial distribution (%)
Africa	7.7
Central Africa	1.9
Southern Africa	1.9
Northern Africa	3.8
America	13.5
Central America	7.7
South America	3.8
North America	1.9
Asia	38.5
Central Asia	1.9
Southern Asia	9.6
Western Asia	11.5
Eastern Asia	9.6
South-Eastern Asia	5.8
Europe	38.5
Central Europe	5.8
Europe-Asia	3.9
Southern Europe	13.5
Eastern Europe	11.5
Northern Europe	3.8

ENT, ear, nose, and throat.

Q4) What are the age groups more often affected by allergic rhinitis?
Children and adolescents, as well as young adults, were the age groups more affected by AR; the prevalence rates were reported to be 44.23% and 42.31% of the participants, respectively.

Q5) The comorbidities more frequently reported in patients with allergic rhinitis are:
Asthma (78.85%), sinusitis (57.69%), conjunctivitis (40.38%), and nasal polyposis (36.54%) were the most frequently reported comorbidities in AR patients.

Q6) Which specialist would more likely be consulted by a patient with allergic rhinitis?
Allergic rhinitis patients would likely consult an otorhinolaryngologist (69.23%) initially, followed by an allergologist (38.46%) and primary care physician (36.54), in that order.

Q7) In which period of the year are nasal symptoms more intense?
Nasal symptoms of AR were more intense in the spring (51.92%), in autumn (28.85%), and throughout the year (26.92%). However, in the summer (15.38%) and winter (13.46%), the symptoms were not intense.

Q8) Which are the most common aero-allergens in your country?
The most common aero-allergens were pollen and mites (67.31%), animal dander and pollutants (23.08%), and fungal allergens (21.15%).

Q9) Which symptoms are more often complained by patients with allergic rhinitis?
The symptoms more frequently complained about by AR patients were nasal blockage (94.23%) and rhinorrhea (90.38%). Other symptoms were hypo-anosmia (28.85%), asthma and conjunctivitis (26.92%), snoring, sleep problems (17.31%), and chronic cough (13.46%).

Q10) Do you perform the prick test?
The prick test was performed by 46.15% of the participants.
For questions 10–16, only 24 of 52 of the participants (46.15%) performed the prick test. However, to avoid confusion of the results, the responses related to the prick test in questions 11–16 were also rated among the 52 total participants. If the answers were rated in only the prick-test performing group (24 participants), the rates would be different. The readers should consider this issue (**Table 1**).

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Q11) If you answered "yes" to Q10, which types of pollens do you test?

The tested pollens by the participants in the prick test included grass mix (32.69%), *Artemisia vulgaris, Parietaria officinalis* and *Ambrosia eliator* (15.38%), *Betula verucosa* or Betulaceae mix and *Platanus occidentalis* (13.46%), Cupressacee (11.54%), and Oleacee (9.62%).

Q12) Which types of mites do you test?

The tested mites were mainly *Dermatophagoides pteronyssimus* and *Dermatophagoides farina* (52.92%). Forty-eight percent of the participants did not answer this question.

Q13) Which of these animal allergens do you test?

The tested animal allergens were cat (Felix domesticus) and dog (Canis familiaris) (51.92%) allergens. Forty-six percent of the participants did not answer this question.

Q14) Which types of fungal allergens do you test?

The tested fungal allergens were *Alternaria alternata* (44.23%) and *Cladosporium album* (28.85%)

Q15) Do you test insect allergens too?

Cockroach (Blatella sp.) was the most frequently tested insect allergen (32.69%).

Q16) When do you consider a skin prick test to be positive?

The skin test was considered positive when the wheal size was >3 mm after 15 minutes (36.54%) or regardless of the diameter, on comparison with the positive control (19.23%).

Q17) Do you prescribe the measurement of total serum and specific IgE after the skin prick test?

After the skin prick test, total serum and specific IgE mesaurements were prescribed by 44.23% of the participants.

Q18) Which other diagnostic tests do you prescribe in allergic rhinitis patients?

Computed tomography (CT) (48.08%), rhinomanometry (40.38%), nasal cytology (30.77%), and the nasal provocation test (25.00%) were the other diagnostic tests performed in AR patients. The olfactory test (21.15%) and nasal mucociliary clearance (17.31%) were other tests that are not frequently used for this purpose.

Q19) In your experience, nasal cytology is useful for:

Nasal cytology was useful for the "Differential diagnosis between allergic and nonallergic or infective rhinitis" according to 38.46% of the participants. However, 34.62% of the participants considered nasal cytology as "not useful".

Q20) Do you perform nasal cytology in your outpatient?

Nasal cytology was performed by 30.77% of the participants.

Q21) Do you perform the nasal provocation test?

The nasal provocation test was performed by 26.92% of the participants.

Q22) If you answered "yes," when do you suggest the nasal provocation test?

The nasal provocation test was suggested for the conditions of "mismatch clinical history and allergy outcomes" (25.0%) and "occupational rhinitis" (15.38%).

Q23) Do you prescribe allergen-specific immunotherapy?

Allergen-specific immunotherapy was prescribed for both perennial and seasonal allergens (32.69%) or only for seasonal allergens (13.46%) and perennial allergens (11.54%).

Q24) Which route of administration do you prefer for immunotherapy?

The preferred immunotherapy administration routes were the sublingual-swallow (46.15%), subcutaneous (32.69%), and intranasal (13.46%) routes.

Q25) Which types of symptomatic drugs do you prescribe in allergic patients?

For AR patients, the most prescribed drugs were intranasal corticosteroids (86.54%), oral

H_1-antihistamines (82.69%), antileukotrienes (40.38%), intranasal corticosteroids and intranasal antihistamines (34.62%), nasal douches with isotonic solution (28.85%), nasal douches with hypertonic solution (21.15%), and systemic corticosteroids (19.23%). Nasal douches with hyaluronic acid were prescribed by 5.77% of the participants.

DISCUSSION

The prevalence of AR changes with genetics, epigenetics, and environmental exposure in complex ways not fully understood [3], and the prevalence has been cited as 10% to 30% of adults and up to 40% of children [7]. Our results showed that the prevalence of AR was reported as 15%–25% by most of the participants, and it was stated to be "surely increasing" by 69.23% of the participants. The opinions of participants regarding the reasons for the increasing prevalence of AR are "increased exposure to allergens, irritants and pollutants," "change in lifestyle," and "early exposure to allergens, irritants and pollutants." It was reported that many causative agents have been linked to AR, including pollens, molds, dust mites, and animal dander. In many parts of the world, pollen allergy is very common; however, in Eastern Asia, Latin America, and tropical areas, mite allergy is more common [3].

AR is a multifactorial disease with genetic as well as environmental factors influencing disease development [8]. Sensitisation to allergens may occur in early life [9]. Young maternal age, markers of fetal growth [10, 11], multiple gestation [12], mode of delivery [13], prematurity [14], low birth weight [15], growth retardation [16], hormones during pregnancy [17], and perinatal asphyxia [18] were all inconstantly related to the risk of developing allergic diseases or rhinitis [18].

Our results showed that children and adolescents, as well as young adults, are the age groups more affected by AR. As a child's immune system develops between the first and fourth years of life, those with an atopic predisposition begin to express allergic disease with a clear Th_2 response to allergen exposure, resulting in symptoms. In pediatric AR, two or more seasons of pollen exposure are generally needed for sensitisation; thus, allergy testing to seasonal allergens (trees, grasses, and weeds) should be conducted after the age of 2 or 3 years. Sensitisation to perennial allergens (animals, dust mites, and cockroaches) may manifest several months after exposure [19].

AR is an organ-specific manifestation of allergic disease. As such, it coexists with other organ-specific disorders that have a common allergic basis. Therefore, AR is rarely found in isolation but has been frequently associated with comorbid disorders [20]. In our study, the comorbidities of AR were asthma (78.85%), sinusitis (57.69%), conjunctivitis (40.38%), and nasal polyposis (36.54%). Nasal symptoms of AR are more intense in the spring (51.92%) and in autumn (28.85%). Only 26.92% of the participants mentioned that the symptoms persisted throughout the year. This is likely due to the presence of different allergens according to season, as a result of the differences in climate among geographical regions.

Subjects with an increase in allergic inflammation and ICAM-1 expression are more susceptible to upper respiratory tract infections because ICAM-1 is the receptor for rhinoviruses [21]. Rhinovirus infection is an important viral precipitant for asthma exacerbations. Thus, allergic inflammation in the nose could facilitate rhinovirus infection in allergic individuals, with consequent asthma exacerbation.

Comorbidities are common in children with AR. The chronic effects of the inflammatory process affect other related systems or organs, such as the lungs, ears, growth, and others. AR can easily induce medical complications, learning problems and sleep-related complaints, such as chronic and acute sinusitis, acute otitis media, serous otitis media, aggravation of adenoid hypertrophy [22], and underlying asthma [23]. Comorbidities of AR are also reported as asthma, chronic middle ear effusion with hearing loss, sinusitis, lymphoid hypertrophy and obstructive sleep apnea, sleep disorders, and consequent behavioural and educational effects [20].

Several possible relationships between AR and asthma exist: (1) AR may confound the diagnosis of asthma, (2) AR may be statistically associated with asthma, (3) AR may exacerbate coexisting asthma, and (4) AR may have a causal role in the pathogenesis of asthma [20].

The relationship between AR and asthma is complicated by the fact that they share common symptomatology. AR and sinusitis have long been known to cause postnasal drip with resultant cough, particularly at night. In the past 2 decades, there has been increasing awareness of the importance of nocturnal cough in poorly controlled asthma. Hannaway and Hopper [24] described 32 children with cough-variant asthma. These children had chronic cough, had never been heard to wheeze, and improved after bronchodilator treatment.

In our survey, the main symptoms were nasal blockage (94.23%) and rhinorrhea (90.38%). The other symptoms were hypo-anosmia, asthma and conjunctivitis, snoring, sleep problems, and chronic cough. AR patients consulted an otorhinolaryngologist (69.23%) initially, followed by an allergologist (38.46%). Nonspecific nasal hyperreactivity is an important feature of allergic and nonallergic rhinitis [18, 25] and can be defined as an increased nasal response to a normal stimulus resulting in sneezing, nasal congestion and secretion, either one of these symptoms or in various combinations.

Aeroallergens are frequently implicated in AR and asthma [26]. They are usually classified as indoor (principally mites, pets, insects, outdoor (pollens and molds), or occupational agents. Classically, outdoor allergens appear to constitute a greater risk for seasonal rhinitis than indoor allergens [27], and indoor allergens pose a greater risk for asthma and perennial rhinitis [18, 28]. House dust mites comprise a large portion of house dust allergens and belong to the family Pyroglyphidae, subclass Acari, class Arachnida, phylum Arthropoda [29, 30].

Our survey results showed that the most common aero-allergens are pollen and mites (67.31%), animal dander and pollutants (23.08%), and fungal allergens (21.15%). The prick test was performed by 46.15% of the participants. Mold spores are an allergen source whose importance is significantly related to an increase in the hospitalisation of asthmatics [31-33]. Widespread in the air and resulting from putrefying organic matter, fungi and molds are present everywhere, with the exception of at low temperatures or in the presence of snow, where their growth is hindered. Their development is particularly increased under hot and humid conditions, explaining their seasonal peaks and abundance in certain hot and humid areas. Mold spores are small in size and penetrate deeply into the respiratory tract. They can provoke rhinitis as well as asthma [18].

The tested pollens were mainly grass mix (32.69%), *A. vulgaris*, *P. officinalis* and *A. eliator* (15.38%), *B. verucosa* or betulaceae mix and *P. occidentalis* (13.46%). The tested mites were *D.*

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pteronyssimus and *D. farina*. The animal allergens were cat (*F. domesticus*) and dog (*C. familiaris*) allergens; the fungal allergens were *A. alternate* and *C. album*; and the insect was the cockroach (Blatella sp.) in the prick test. The skin test was considered positive when the wheal size was >3 mm after 15 minutes (36.54%) or regardless of the diameter, on comparison with the positive control (19.23%).

In the literature, cats and dogs produce major allergens in asthma, rhinitis or rhinoconjunctivitis, cough but more rarely in urticaria and angioedema. The principal sources of cat allergen are the sebaceous glands, saliva and perianal glands; the main reservoir is fur. The major cat allergen (Fel d 1) is transported in the air and can remain airborne for long periods [34]. The number and variety of domestic animals have considerably increased over the past 30 years, particularly in urban environments of western countries. It is estimated that, in many European countries, as many as 1 in 4 residences possess a cat. Dogs are found in even greater numbers. Their danders and secretions carry or contain powerful allergens capable of causing allergic reactions [35].

Allergy is generally caused by a sustained overproduction of IgE in response to common environmental antigens such as indoor and outdoor allergens, foods and other allergens [36]. IgE itself constitutes a minute fraction of the total antibody in human serum (50–300 ng/mL IgE vs. 10 mg/mL IgG). However, the biological activities of IgE are powerfully enhanced by the activities of the specific cell-surface receptors to which it binds, which may be of the high- or low-affinity phenotype. IgE production results from complex interactions among B cells, T cells, mast cells and basophils, involving the presence of the cytokines interleukin (IL)-4, IL-13, and IL-18, as well as a physical interaction between T cells and B cells by several surface and adhesion molecules [37]. In our study, after the skin prick test, measurement of the total serum and specific IgE were prescribed by 44.23% of the participants.

In our survey, other diagnostic tests included CT, rhinomanometry, nasal cytology (30.77%) and the nasal provocation test in AR patients. The olfactory test and nasal mucociliary clearance were not frequently used for this purpose. The nasal provocation test was performed by 26.92% of the participants and is suggested in the conditions of "mismatch clinical history and allergy outcomes" (25.0%) and "occupational rhinitis" (15.38%). Nasal cytology is considered to be useful for the "differential diagnosis between allergic and nonallergic or infective rhinitis" and is performed by 30.77% of the participants.

The most common diagnostic tests for AR are the percutaneous skin test and allergen-specific IgE antibody test. Less common diagnostic tools include nasal provocation testing, nasal cytology (e.g., blown secretions, scraping, lavage, and biopsy), nasolaryngoscopy, and intradermal skin testing. The World Health Organization report [3] offers limited recommendations on when these tests should be used, but notes that they generally are used by subspecialists or in research and do not play a role in the routine evaluation of rhinitis.

The determination of specific IgE, preferably by skin testing, is indicated to provide evidence of an allergic basis for the patient's symptoms, to confirm or exclude suspected causes of the patient's symptoms, or to assess the sensitivity to a specific allergen for avoidance measures and/or allergen immunotherapy [38]. Skin tests are preferred for the diagnosis of IgE-mediated sensitivity. The number of skin tests and allergens selected for skin testing should be determined based on the patient's age, history, environment, and living situation, such as area of the country, occupation, and activities [38].

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Allergen-specific IgE antibody testing (radioallergosorbent testing, RAST) is particularly useful in primary care if percutaneous testing is not practical (e.g., problems with reagent storage, expertise, frequency of use, and staff training) or if a patient is taking a medication that interferes with skin testing (e.g., tricyclic antidepressants or antihistamines) [39]. RAST is highly specific but generally less sensitive than skin testing [40, 41]. RAST is useful for identifying common allergens (e.g., pet dander, dust mites, pollen, and common molds), but it is less useful for identifying food, venom, or drug allergies.

Our survey results showed that allergen-specific immunotherapy is prescribed for both perennial and seasonal allergens (32.69%) by a large proportion of specialists (primarily those from Europe and Asia) via the sublingual-swallow (46.15%) and subcutaneous (32.69%) routes. In the literature, allergen-specific immunotherapy is the practice of administering gradually increasing quantities of an allergen extract to an allergic subject to ameliorate the symptoms associated with subsequent exposure to the causative allergen. However, some registered sublingual immunotherapy products do not require up-dosing. Allergen immunotherapy was introduced in 1911 by Noon and Freeman to treat pollinosis or allergic rhinitis [42]. There is sound evidence that immunotherapy using inhalant allergens is clinically effective in the treatment of allergic rhinitis and asthma [43]. It induces clinical and immunologic tolerance, has long-term efficacy, and may prevent the progression of allergic disease. Allergen-specific immunotherapy also improves the quality of life of allergic patients [44]. Subcutaneous immunotherapy raises contrasting efficacy and safety issues, as does immunotherapy dosing. Low-dose specific immunotherapy is ineffective [44, 45], and high doses of allergen vaccines may induce a high and unacceptable rate of systemic reactions [45].

Our survey results showed that, for the AR patients, the most prescribed drugs were intranasal corticosteroids (86.54%), oral H_1-antihistamines (82.69%), antileukotrienes (40.38%), and intranasal corticosteroids and intranasal antihistamines (34.62%). Nasal douches with isotonic solution (28.85%) and nasal douches with hypertonic solution (21.15%) were also prescribed. In the literature, topical antihistamine nasal sprays [46, 47], intranasal steroids [48] and oral decongestants are the mainstays of therapy. Topical antihistamines—e.g., azelastine hydrochloride or olopatadine hydrochloride—have been shown to decrease postnasal drip and congestion [47]. When used in combination, a topical antihistamine and a nasal steroid provide greater symptomatic relief than monotherapy [49, 50]. Oral decongestants, such as pseudoephedrine, help with symptoms of congestion if the side effects are tolerated. It is important to take a thorough history regarding hypertension, arrhythmia, insomnia, prostate hypertrophy, or glaucoma to prevent serious side effects associated with pseudoephedrine.

When comparing the available intranasal corticosteroids, the overall clinical response does not appear to vary significantly between products irrespective of the differences in topical potency, lipid solubility, and binding affinity [38]. There is evidence that topical saline is beneficial in the treatment of the symptoms of chronic rhinorrhea and rhinosinusitis when used as a sole modality or for adjunctive treatment [38].

These results indicate that AR is both a common and growing global concern. The perceived prevalence of AR seems to reflect data collected in epidemiological studies, and it is steadily increasing worldwide. The pollen concentration in the atmosphere depends on the vegetation and climate of a given geographic zone, and there are important regional differences. Recently, the attention has been focused on pollen peaks and migration. New

disciplines have been born, such as aerobiology and bioclimatology, which are dedicated specifically to the study of the interaction among environmental factors.

The diagnosis of allergy is based on the correlation between the clinical history and diagnostic tests for allergy, but the most recent clinical practice guidelines on AR [2] suggest performance of skin or blood tests in the case of patients with a clinical diagnosis of AR who do not respond to empiric treatment, when the diagnosis is uncertain, or when knowledge of the specific causative allergen is needed to target therapy.

In conclusion, allergic disease is increasing in prevalence globally because of genetic predisposition, epigenetic events, and environmental exposure; this complexity underlies why epidemiologic results often show marked variability among different populations and locations. Additionally, it is possible that the discordance between self-reported allergies and positive allergy testing was not fully appreciated in the past.

Our results confirm that a network of experts can improve our knowledge of the epidemiology of AR, and could assist practitioners and otolaryngologists in standardising the diagnosis and uniform treatment of AR together with guidelines.

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