

Position paper*

Epidemiologic identification of allergic rhinitis

Charpin D, Sibbald B, Weeke E, Wüthrich B. Epidemiologic identification of allergic rhinitis.

Allergy 1996; 51: 293–298. © Munksgaard 1996.

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Key words: allergens; epidemiology; hay fever; questionnaire; rhinitis

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Accepted for publication 4 March 1996

Although rhinitis is common, surprisingly little is known about its epidemiology. Most research has focused on seasonal allergic rhinitis, in particular, hay fever – probably because this is the most conspicuous and easily investigated form of rhinitis. Almost nothing is known about the epidemiology of perennial and nonallergic rhinitis. The estimated prevalence of hay fever among children in different countries has been reported to vary between 0.5% and 28% (1, 2), but much of this variation may be due to differences in diagnostic criteria and the age groups studied. Hay fever prevalence appears to have increased in recent decades (3, 4). However, it remains unclear whether these changes reflect a true increase in the prevalence of disease or changes in doctors' diagnostic preferences or patients' consulting behavior.

One important obstacle to a better understanding of the epidemiology of rhinitis is the absence of a standardized and well-validated method for identifying the condition. The difficulty lies in distinguishing rhinitic from normal subjects, since the characteristic symptoms of rhinitis may occur occa-

sionally in anyone. Clinical definitions focus on the identification of patients whose symptoms are severe enough to warrant medical attention. In contrast, epidemiologic definitions focus on the nature and distribution of symptoms in the population irrespective of whether they are brought to the attention of doctors. Even within epidemiologic studies, there has been a lack of standardization, and this prevents meaningful comparisons between populations and over time. Such comparisons are potentially of great importance since factors affecting the distribution of rhinitis may vary more between populations than within populations. Therefore, research which focuses on why some individuals have rhinitis while others do not may therefore fail to identify important risk factors which become obvious when populations with differing prevalences are compared.

Patients are generally classified, according to the suspected cause of their condition, into allergic and nonallergic types. Rhinitis is labeled "allergic" when a causative allergen can be identified. Otherwise, it is labeled "nonallergic". This approach to classification is problematic in that it is impossible to be certain that a nonallergic subject would not prove reactive to some allergen yet to be examined. Moreover, it is not always possible to investigate

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patients' allergic status. The best available methods for detecting allergy among those with rhinitis are allergy skin testing or serum IgE determination. Questionnaire identification of "allergic" rhinitis can only approximate these methods.

Epidemiologic definition

Research into the epidemiology of rhinitis would benefit from a standardized instrument for identifying the condition. Clearly, such an instrument needs to be feasible, reliable, and valid. This means it must be easily administered to large populations and among people varying in age, language, culture, and literacy. It must give the same result on repeat application in the same individual. In particular, where the object is to establish the 1-year period prevalence of allergic rhinitis, the instrument must give the same result when administered during and outside the pollen season. Most importantly, the instrument must have both high sensitivity and specificity in identifying the condition and both high positive and negative predictive values when applied to a population (Table 1).

Here we review the main questionnaires which have been used to identify allergic rhinitis. The evidence supporting their validity, reliability, and feasibility is presented, together with recommendations on their suitability for epidemiologic research.

Review of existing respiratory questionnaires

Standardized questionnaires in the field of respiratory medicine were first designed to ascertain the prevalence (and severity) of chronic bronchitis. The first one was published by the British Medical Research

Council (BMRC)'s Committee on Research into Chronic Bronchitis (5). One section of this questionnaire was entitled "nasal catarrh" and included one question on "usual stuffy nose or catarrh at the back of the nose in the summer". The European Steel and Coal Community published its first questionnaire, derived from the BMRC questionnaire, in 1962 (6). It included the following question: "Have you ever had a runny nose in spring?" The 1967 version (7) included for the first time the diagnostic question: "Have you ever had hay fever?" The 1976 version of the BMRC questionnaire (8) had no more questions on nasal symptoms but included "hay fever" in a list of possible "past illnesses".

The American Thoracic Society (ATS) questionnaire (9), published in 1978, included for the first time a question about triggering factors: "Has a doctor ever said that this child had an allergic reaction to pollen or dust?" The ATS questionnaire for adults had a diagnostic question in the "past illnesses" section: "Have you ever had hay fever?"; if yes: "Was it confirmed by a doctor? At what age did it start?" The European Community Health Survey Questionnaire published in 1984 (10) included both a diagnostic question, "Do you have any nasal allergies including hay fever?", and questions about induction of rhinitis and/or conjunctivitis after exposure to animals, dust, and feathers on one hand, and "trees, grass, plants, flowers, and pollen" on the other hand.

Finally, a community survey of rhinitis in south London used a postal screening questionnaire to identify subjects with rhinitis. Subjects were asked whether they were troubled by sneezing, running, and/or nasal blockage "when they did not have a cold or the flu". Subjects were then asked to state whether symptoms occurred only in certain months of the year or all year round, and to rate the overall severity of their condition. A stratified random sample of subjects was then interviewed in depth and administered allergy skin tests (11). From this study was derived a new screening questionnaire for use within the International Survey of Asthma and Allergies in Childhood (ISAAC) (12). This six-question instrument asks whether subjects have "had a problem with sneezing or a runny or blocked nose" when they "did not have a cold or the flu". Subjects are also asked whether this problem was "accompanied by itchy watery eyes", in which months of the year the problem occurred, and how much it interfered with daily activities. A final question asks whether the subject has "ever had hay fever".

Validity studies on existing questionnaires

Identifying rhinitis

Reliance on doctors' diagnoses will rarely result in the incorrect labeling of subjects as rhinitic, but

Table 1 Parameters used to evaluate test (in present case, question or set of questions)

		Underlying disease	
		+	-
Question	+	a	b
	-	c	d
Total		a + c	b + d

$$\text{Sensitivity} = \frac{a}{a + c}$$

$$\text{Specificity} = \frac{d}{b + d}$$

$$\text{Positive predictive value} = \frac{a}{a + b}$$

$$\text{Negative predictive value} = \frac{d}{b + d}$$

underdiagnosis is common (13). Physician attention is understandably focused on the identification of people able to benefit from treatment. Patients with mild disease and those with an atypical clinical presentation will often go undetected. Therefore, the diagnostic questions, "Have you ever had hay fever?" and "Has a doctor ever told you that you had hay fever?", have good specificity but low sensitivity. For example, in the south London study described above, the hay fever label had a specificity of 94% and a sensitivity of only 33% in identifying subjects subsequently found to have rhinitis at interview (Sibbald, personal communication). As diagnostic preferences may vary between countries and over time, the value of these questions as indicators of rhinitis may be further undermined. Besides, because it includes medical terminology, hay fever prevalence rates obtained by questioning children provide lower figures than those obtained from their parents (Charpin, unpublished findings).

Therefore, questions addressing the principal symptoms of rhinitis – sneezing, runny nose, and blocked nose – are preferable. The south London study described above showed a high level of agreement in subjects' reporting of trouble with sneezing, runny nose, or blocked nose between postal survey questionnaires and in-depth interviews. Assuming the interview to be the gold standard, the postal questionnaire had a sensitivity of 96% and a specificity of 91% in identifying subjects with rhinitis (11).

The ISAAC questionnaire (14), which uses symptoms to identify rhinitis, is the only questionnaire in widespread use to have undergone in-depth evaluation. The questionnaire was derived from community surveys of adults, but has proved applicable to schoolchildren. The self-questionnaire is short and easily administered, and its translation into other languages has been governed by high standards of quality control. Experience shows that responses may vary with the season of the year in which the questions are administered, being higher during than outside the pollen season (Langridge, unpublished findings). It has also been shown that lower prevalence rates are obtained when the questionnaire is administered to parents as opposed to children themselves (Langridge, unpublished findings).

Distinguishing between allergic and nonallergic rhinitis

Five types of questions have been used and evaluated. The gold standard used for the definition of allergy is positivity of skin tests to common inhaled allergens or presence of serum-specific IgE against these allergens.

Diagnosis of hay fever. In the general population, the question, "Have you ever had hay fever?", has both a low sensitivity (false negative) and a rather low specificity (false positive). For example, in a population of 2067 adults aged 18–65 years visiting a health center for a checkup (15), the sensitivity of the question versus a positive Phadiatop® test was equal to 36%, its specificity to 86%, and its positive predictive value to 37%. This last figure means that slightly over one-third of subjects acknowledging present or past hay fever had a positive Phadiatop® test. In like manner, in a population-based survey using positive skin tests as a criterion for atopy (16), the positive predictive value of the question was only 43%. In the latter survey, the efficiency of this question was not enhanced by adding the question, "Did these symptoms occur each spring?". In the southwest London study (11), among subjects known to have rhinitis, the positive predictive value of the label "hay fever" for detecting atopy (defined by positive skin tests to common aeroallergens) was equal to 71% (Table 2). The higher positive predictive value found in this latter survey was probably due to the fact that the questionnaire was administered to a selected group of patients in which the prevalence of atopy was much higher than in the general population. Indeed, predictive positive (and negative) values of a test (or a question) are highly dependent upon the prevalence of the symptom in the target population. The SAPALDIA study (17), which is a large Swiss community survey in adults, demonstrated high sensitivities equal to 67% and 69%, respectively, for questions on hay fever and current hay fever. However, the specificity and positive predictive value of these questions were not reported. In this latter survey, the computer-assisted interview was administered by technicians. This difference in methods of gathering information, as well as differences in patients' use of the hay fever label in various countries, might account for this discrepancy. Prevalence rates for the questions, "hay fever ever" and "seasonal rhinitis and conjunctivitis symptoms ever", were very similar, but only 80% of the subjects of each category belong to the other as well.

Questions on nasal or eye symptoms. A Swedish study (18) compared questionnaire responses of patients with allergic rhinitis to those of patients with perennial nonallergic rhinitis or vasomotor rhinitis (VMR). Nasal blockage was the predominant symptom in the VMR group, whereas the allergic rhinitis patients mainly suffered from eye irritation, sneezing, and, to some extent, rhinorrhea. Similar findings were obtained in the southwest London "community survey of rhinitis" (11). In

Table 2 Sensitivity and specificity of clinical characteristics in predicting atopy among subjects with rhinitis (re-analysis of data presented by Sibbald & Rink (13))

Clinical characteristics	Estimated prevalence	Sensitivity	Specificity	Positive predictive value
<i>Symptoms</i>				
Itchy watery eyes	0.73	0.80	0.40	0.78
Diurnal variation in symptoms	0.65	0.66	0.38	0.70
Seasonal exacerbation	0.56	0.65	0.59	0.67
<i>Provoking factors</i>				
Dust	0.72	0.76	0.37	0.77
Pollen	0.49	0.63	0.75	0.71
<i>Ever labeled</i>				
Hay fever	0.34	0.48	0.90	0.71

this study, itchy, watery eyes had a sensitivity of 80%, a specificity of only 40%, and a positive predictive value of 78% in detecting atopy as shown by positive skin tests (Table 2). Recently, the combination of several nasal or eye symptoms has been evaluated (19). As expected, a positive answer to several questions implied a high probability of atopy (high specificity), but failing to answer all questions positively did not imply the absence of atopy (low sensitivity). In this study, the overall efficiency of the various questions on nasal (plus eye) symptoms to predict atopy varied between 53 and 56%.

Questions on triggering factors. Eriksson (20) found that symptoms caused by exposure to dust and pollen (and, to a lesser extent, to animals and food) characterized allergic rhinitis, whereas symptoms occurring after colds and other infections or change in air temperature were more characteristic of non-allergic rhinitis. In a Swedish study (18), triggering factors such as sinusitis and infections characterized vasomotor rhinitis. However, about 60% of subjects with allergic rhinitis or vasomotor rhinitis reported symptoms when exposed to nonspecific irritants such as cigarette smoke and perfumes. The Glostrup Allergy Study in Denmark (21) evaluated the probability of different ENT and respiratory symptoms, given the results of skin tests to common allergens. It showed that the probability of nasal or eye symptoms on exposure to animals or dust did not increase, or increased only weakly, with increasing skin reactivity, whereas it increased on exposure to plants or during the summer. It is, however, more relevant to ask what the probability is that a subject will be atopic, given certain symptoms. In the health center study (19), subjects who acknowledged exposure to dust, pollens, or animals as triggering factors for rhinitis were atopic in 77%, 78%, and 85% of cases, respectively. In contrast, the prevalences of atopy in rhinitis patients who denied such trigger factors were only 46%, 45%, and 38%, respectively. Subjects who reported that dust and either animals

or pollens triggered nasal symptoms were atopic in 88% of cases. Thus, the positive predictive value of these triggering factors was very high. However, their negative predictive value and their overall efficiency was low, ranging from 44% to 59% according to the trigger factor.

Seasonal and diurnal variation in symptoms. The south London community survey of rhinitis (11) found that the prevalence of atopy as shown by skin testing was highest in those with seasonal symptoms alone (78%), intermediate in those who had perennial symptoms with seasonal exacerbation (71%), and lowest in those with perennial symptoms alone (49%). Seasonal exacerbation was found to have a positive predictive value of 67% with only moderate sensitivity (65%) or specificity (59%) in detecting atopy among those with rhinitis (Table 2). An additional problem is the difficulty of establishing the seasonal or perennial nature of the condition. In the south London community survey (11), a comparison of subjects' postal survey responses with those given at interview showed only modest levels of agreement in the seasonal distribution of symptoms. The positive predictive value of the postal questionnaire in identifying subjects who were found to have seasonal problems alone at interview was only 16% (Sibbald, personal communication). In view of these findings, the ISAAC questionnaire does not ask whether symptoms "occur only in certain seasons of the year" or "all the year round". Subjects are instead asked to indicate in which months of the year they have symptoms. The validity and reliability of this approach has been evaluated in a community survey of 21 437 children in New Zealand, which concluded that the question was probably invalid (Innes Asher, personal communication). Thus, there is, as yet, no proven method for ascertaining the seasonality of symptoms by questionnaire. The Swiss community survey (SAPALDIA) found that the combination of seasonal nasal symptoms with itchy or watering

eyes had a sensitivity of 76% in detecting atopy as shown by a positive Phadiatop or skin prick test. However, the specificity and positive predictive value of these questions were not reported.

At least two studies have found an association between diurnal variation in symptoms and allergic rhinitis. However, in the south London community survey (11), diurnal variation had only moderate sensitivity (66%) and poor specificity (38%) in detecting skin test positivity among those with rhinitis (Table 2).

Identifying specific sensitization

Can we trust the patients' own statements about their allergies? Murray et al. (22) used a standardized questionnaire in 530 children referred for asthma to determine which clinical features were associated with house-dust allergy as shown by a positive skin prick test. The triggering of symptoms by domestic activities which stir up house dust and improvement of symptoms outdoors were associated with mite allergy, whereas seasonal variation and occurrence of symptoms at night or on waking were not. In a recent study on parents of 1160 children, the same group reported that a detailed history of triggering factors is useful for excluding specific sensitizations, but lacks sensitivity. In another study, Eriksson et al. (24) interviewed a large group of patients with spring-time hay fever. They found that patients who reported an adverse reaction, particularly oral itching after handling or eating nuts, fruits, or roots were likely to have birch pollen allergy. In the Swedish study (18), patients had to state whether or not their symptoms were triggered by various allergens. Hypersensitivity to grass, deciduous trees, cats, and mugwort was reported significantly more often by allergic than nonallergic rhinitis patients. However, sensitivity to dust mite was mentioned by 54% of allergic and 38% of nonallergic patients, a difference not statistically significant. Clinical sensitivity to molds was not different in the two groups. Positive and negative predictive values were equal to 0.58 and 0.83, 0.58 and 0.83, and 0.49 and 0.90 for pollen, cat, and dust exposure, respectively (Table 3). If doubtful skin tests are considered positive, positive predictive value goes up and negative predictive value goes down. From Eriksson's data (20) gathered in a group of 397 adult patients with asthma and/or allergic rhinitis, it is possible to compute both the positive and negative predictive values of the main triggering factors. From those results, it appears that identification of specific sensitization from clinical history is more reliable if doubtful clinical histories are considered negative. In a health care center (19), exacerbation of rhinitis on exposure to

Table 3. Positive (PPV) and negative (NPV) predictive value of questions on triggering factors to predict specific sensitizations

	Pollens		Dust		Cat	
	PPV	NPV	PPV	NPV	PPV	NPV
Lindberg & Malm* (18)	0.58 0.78	0.83 0.61	0.30 0.42	0.97 0.80	0.49 0.90	0.90 0.71
Eriksson** (20)	0.78 0.55	0.81 0.81	0.83 0.63	0.85 0.88	0.77 0.68	0.78 0.77
Charpin et al. (16)	0.63	0.79	0.68	0.80	0.76	0.76
Murray & Milner (23)	0.54	0.72	0.38	0.74	0.55	0.85

* On line 1, doubtful skin tests are considered negative; on line 2, they are considered positive.

** On line 1, doubtful clinical histories are considered negative; on line 2, they are considered positive.

pollen, dust, and cat had positive predictive values of 63%, 68%, and 76%, respectively, for predicting sensitization to each of these allergens. The negative predictive values were higher, 79%, 80%, and 77%, respectively. In the general population, these questions have a high negative predictive value, but a low positive predictive value for identifying specific sensitizations. In studies reported in Table 3, noteworthy positive and negative predictive values were quite similar for the three trigger factors listed.

Conclusions

At present, the best evaluated questionnaire for detecting rhinitis among members of the general population is that used by ISAAC. This asks whether subjects have had "a problem with sneezing or a runny or blocked nose when they 'did not have a cold or the flu'". Its positive predictive value is high in detecting subjects found to have rhinitis on in-depth interviewing. In order to detect allergy among those with rhinitis, questions on concomitant eye symptoms ("Was this nose problem accompanied by itchy-watery eyes?") and pollen, dust, and cat exposure as trigger factors ("Which of the following make your nose symptoms worse?"), should be included. A number of studies show that each of these characteristics has a moderately high positive predictive value in identifying subjects with skin test positivity to common aeroallergens. Lastly, it should be kept in mind that parameters such as positive and negative predictive values depend not only on the questionnaire used but also on the prevalence of the disease in the target population.

Acknowledgment

We thank the Kabi-Pharmacia Company (Uppsala, Sweden), which provided financial support for this work.

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