
Rhinitis (allergic and nonallergic) in an atopic pediatric referral population in the grasslands of inland South Africa

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Background: Allergic rhinitis is a common condition, which causes considerable morbidity. South African data are scarce.

Objective: We sought to describe allergic rhinitis in atopic children in inland South Africa.

Methods: An observational, descriptive study of rhinitis occurring in 771 new patients seen consecutively by a single observer at a referral pediatric allergy clinic (Universitas Hospital, Bloemfontein) over an 8½-year period (August 1984 to March 1993) was carried out. A detailed questionnaire was used to record clinical data. Chest and sinus x-rays, skin prick testing, and radioallergosorbent test were performed, and serum immunoglobulin E levels were determined. Response to drug treatment regimens was recorded at subsequent followup visits.

Results: Significant rhinitis was reported in 78.1% of patients, and mild intermittent rhinitis was reported in 21.4%. Male to female ratio was 1.6:1. Median age at onset of rhinitis symptoms was 6 months (range 0 months to 12 years), with 30.1% experiencing symptoms from birth. Rhinitis was chronic in 61.3%, although 53.5% reported seasonal variation. More children with rhinitis were born in midsummer than during other seasons, although this did not reach statistical significance ($P = 0.46$). Breast-feeding had no protective effect, and parental smoking and household pets were not found to be risk factors. Family history was positive for allergic rhinitis in 88% of patients. Exposure to dust, weather changes, strong odors, pets, pollens, and tobacco smoke were the most common trigger factors. Sinus x-ray findings associated poorly with clinical findings. The most common allergens identified were grass pollen, tree pollen, and cat. Oral antihistamines provided good symptomatic relief in 62.9% of patients who used them. Intranasal corticosteroids provided good relief in 78.0% of those who used them, and ketotifen provided relief in 54.4% of those who used it.

Conclusions: Rhinitis is a common manifestation of allergy in the population studied. Onset occurs early in childhood. A family history of allergy is a risk factor for the development of the condition, and grass pollen is the most common allergen involved. Special investigations are of limited value. Appropriate treatment is very effective.

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INTRODUCTION

Rhinitis is characterized by chronic or recurrent sneezing or by runny or blocked nose.^{1,2} Rhinitis occurs in nearly 100% of the population as the common cold.^{3–5} Allergic rhinitis, implying the presence of an underlying immunoglobulin (Ig)E-mediated hypersensitivity response to environmental allergens, often includes itching among the symptoms.^{6,7} Estimates of the prevalence of allergic rhinitis vary considerably according to the diagnostic criteria applied, the methods of investigation used, and the population studied.² The recent worldwide questionnaire survey of atopic disorders in children aged 13 to 14 years⁸ showed that the 12-month prevalence of rhinoconjunctivitis ranged from 3.4% (Akola, India) to 66.6% (Asuncion, Paraguay). The South African center in Cape Town recorded a prevalence of 30.3%.⁹ A study in Tucson, Arizona, has reported that allergic rhinitis occurs

in 42% of children 6 years of age.¹⁰ In France, the prevalence of hayfever symptoms in adults has been shown to range from 14.1 to 31.5% depending on geographic location.¹¹ Other recent studies in Europe have found the prevalence of allergic rhinitis for both adults and children to be between 20 and 25%.^{2,12,13} Although Southern African epidemiologic data are scarce, clinical experience has suggested that the overall prevalence of allergic rhinitis in children in this country is at least 20%.¹⁴

The significance of allergic rhinitis is not only its high prevalence but also its effect on quality of life. It commonly causes sleep disturbances, fatigue, listlessness, irritability, and poor concentration, leading to developmental delay, impaired learning ability, and poor school performance in children.^{15–18} Socially unacceptable behavior such as sniffing, sneezing, noisy breathing, and coughing may lead to isolation and rejection at school and at home. Further morbidity results from associated conditions such as sinusitis, adenoid and tonsillar hypertrophy, and otitis media.^{6,18}

Despite these sequelae, allergic rhinitis remains misdiagnosed and undertreated, particularly in children, where nasal symptoms frequently are attributed to recurrent viral infections.^{18,19} When the correct diagnosis is made, the potentially

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high cost of drug treatment of chronic allergic rhinitis becomes a significant factor.²⁰ This study was undertaken to highlight the extent and importance of allergic rhinitis in atopic children in inland South Africa and to examine ways to enhance its accurate diagnosis and successful management.

SUBJECTS AND METHODS

The study included 771 new patients who were seen by MJM at the pediatric allergy clinic of the Universitas Hospital between August 1984 and March 1993.

Patients' demographic and clinical data were recorded on a standard questionnaire. All symptoms were noted. Patients were asked about trigger factors such as upper airway infection (fever with pharyngitis, sinusitis, tonsillitis, or otitis media), weather changes, allergens (dust, pets, pollens, foods), and irritants (tobacco smoke, strong odors, food additives). The presence or absence of a family history of allergic rhinitis in first- and second-degree relatives was also noted.

Relevant environmental details were recorded, including the effect of a coastal climate on allergic symptoms. Information on the presence of pets and tobacco smoke in the home was sought. Previous drug therapy for allergic rhinitis was noted. The length of time the patient had been breast-fed was recorded.

The severity of the patient's rhinitis was graded as follows: grade 0, no symptoms; grade 1, mild intermittent symptoms without discomfort; grade 2, moderate intermittent or persistent symptoms with some impairment of daily activities; grade 3, severe persistent symptoms with ongoing severe impairment of daily activities or sleep impairment.¹⁵

Height and weight were measured, and each child was examined for the presence of rhinitis, conjunctivitis, otitis media, and asthma.

Skin-prick testing (SPT) with 0.5% phenol saline (negative control), 1% histamine (positive control), and 20 common allergens was performed on patients 6 years and older (N = 275). The following allergenic extracts (Bencard, Glaxo-SmithKline, Uxbridge, UK) were used: pollens of Bermuda grass, maize, mixed South African grasses, weeds and trees; dog hair; cat hair; feathers; *Dermatophagoides pteronyssinus* (house dust mite); *Aspergillus* and *Penicillium* fungi; wool; synthetic fiber; dietary wheat, milk, egg, fish, orange, tomato, and chocolate. Reactions were measured at 20 minutes. Any wheal greater than that of the negative control was taken as a positive reaction.²¹

Sinus x-rays were taken in 632 children. Serum IgE levels were recorded in 743 patients, and the radioallergosorbent test (RAST) results were recorded for 761 patients. Specific allergens used were Bermuda grass pollen, Cocksfoot grass pollen, mixed tree and mixed weed pollens, cat, dog, *Dermatophagoides pteronyssinus*, *Aspergillus* and *Penicillium* fungi, and dietary wheat, milk and fish. Where indicated from the history, additional allergens were used, including bee venom, horse, egg, cheese, peanut, soya, tomato, orange, banana, rice, pork, and potato.

Management included counseling on the importance of allergen avoidance. Medication consisted of one or more of the following: oral antihistamines (used continuously or as needed), oral decongestants (used for short periods of time up to 5 days for symptomatic relief only), oral ketotifen (given continuously for prophylaxis), and intranasal disodium cromoglycate (DSCG) and corticosteroid sprays (used continuously for prophylaxis). At the time of the study, allergen-specific immunotherapy was still regarded as controversial.²² Because the clinic is small, it was difficult to find suitable patients. Criteria were patient age at least 5 years, severe nasal disease but not asthma, and monosensitive to either grass pollen or house dust mite.²³ Further, more than half (54.9%) of the patients lived out of town. Developing the necessary expertise for this form of treatment would have been difficult. For these reasons, it was decided not to offer immunotherapy.

Whether patients returned for followup visits was noted as was the patient's response to the various drug treatments.

Results were summarized by frequencies and percentages or medians and ranges as appropriate. To evaluate the significance of associations, 95% confidence intervals (CI) for risk differences were calculated.

RESULTS

Rhinitis often was not a symptom for which patients sought medical attention. Often it was an additional complaint or incidental finding in a patient with asthma, eczema, urticaria, angioedema, or food or insect allergy. Only 4 patients (0.5%) had never experienced nasal disease. The grades of severity of rhinitis experienced by the remaining 767 patients are shown in Table 1. A significant degree of rhinitis (grades 2 and 3) occurred in 602 patients (78.1%). The male to female ratio of patients with rhinitis was 1.6:1. The range of severity was similar for both sexes.

The median age at presentation was 60 months, with a range of 3 months to 15 years. The median age at onset of rhinitis symptoms (recorded in 761 patients) was 6 months, with a range of 0 months to 12 years. There were 229 patients (30.1%) who reported having experienced rhinitis symptoms from birth. More than half (474 patients, 62.3%) had onset of rhinitis by age 1 year. An earlier age at onset was associated with a more severe degree of rhinitis (Fig 1).

The most common symptom of rhinitis was nasal obstruction (84.6%), followed by rhinorrhea (82.1%), itching (74.8%), and sneezing (72.3%).

Table 1. Grade of Severity of Allergic Rhinitis in 771 Patients (%) by Sex

Grade	Total 100%	Male 61.2%	Female 38.8%
0-No Rhinitis	0.5	0.9	0
1-Mild	21.4	20.3	23.1
2-Moderate	74.1	73.5	74.9
3-Severe	4.0	5.3	2.0

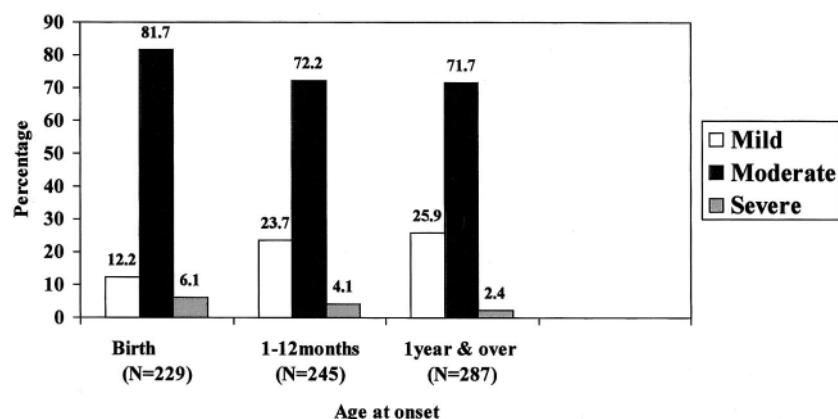


Figure 1. Degree of severity of rhinitis related to age at onset in 761 patients.

Rhinitis was chronic in 470 patients (61.3%) and intermittent in 297 (38.7%). Seasonal variation in symptoms was reported in 407 patients (53.1%) from both groups. The most common season for worsening of symptoms was winter (99 patients), followed by worsening at the changes of the seasons, meaning spring and autumn (58 patients).

Specific trigger factors for allergic rhinitis other than viral upper respiratory tract infection are shown in Figure 2. Dust, strong odors, weather changes, pollens, tobacco smoke, and household pets were the most common trigger factors. Of 465 patients who had spent time in a coastal climate, 275 (59.1%) experienced improvement in their symptoms, 87 (18.7%) worsened, and 103 (22.2%) remained unchanged.

The most common birth month of patients was December (76 patients, 9.9%) and the least common was October (52 patients, 6.8%). The mean number of patients born per month, during early to midsummer (November to January) was 70 compared with 61 per month during midwinter (May to July). In contrast, total numbers of births registered²⁴

showed a peak in March, April, and May of those years and were at their lowest from November to January (Fig 3).

A total of 473 patients of 744 (63.6%) had been breast-fed for 1 month or longer. A slightly greater proportion of patients with severe rhinitis were breast-fed compared with those with mild and moderate symptoms (Table 2). Household exposure to dogs and cats (data not shown) had no association with either the age of onset of allergic rhinitis or the degree of disease severity. Family smoking was present in 220 of 471 patients (46.7%). The number of patients with onset of rhinitis within 12 months of birth was similar for both the smoking (70.9%) and the nonsmoking (65.2%) groups. The severity of rhinitis was also similar, with severe rhinitis occurring in 3.6% of the smoking group and 5.6% of the nonsmoking group.

Family history was recorded for 759 patients. Allergic rhinitis was present in first-degree relatives of 668 children (88.0%). In 171 (22.5%) children, both parents had allergic rhinitis; in 256 (33.7%), only the mother was affected; in 165

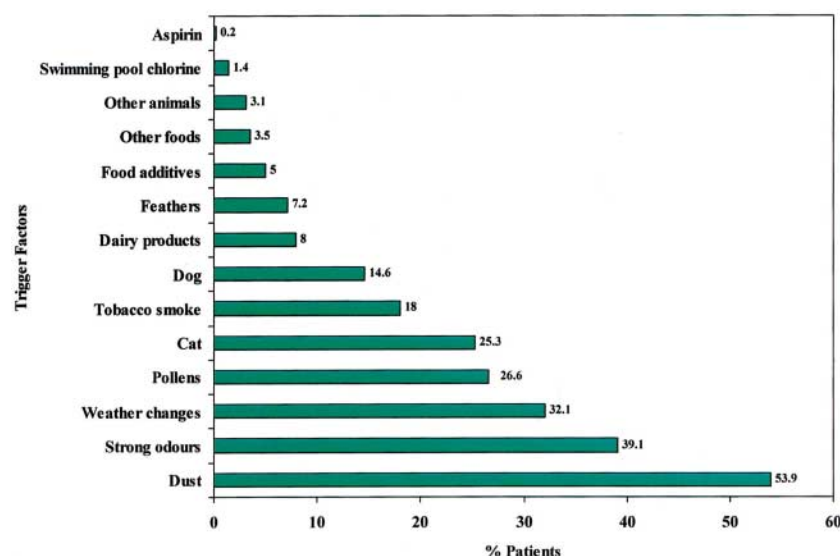


Figure 2. Trigger factors for allergic rhinitis in 767 patients.

Birth month of 767 patients with allergic rhinitis

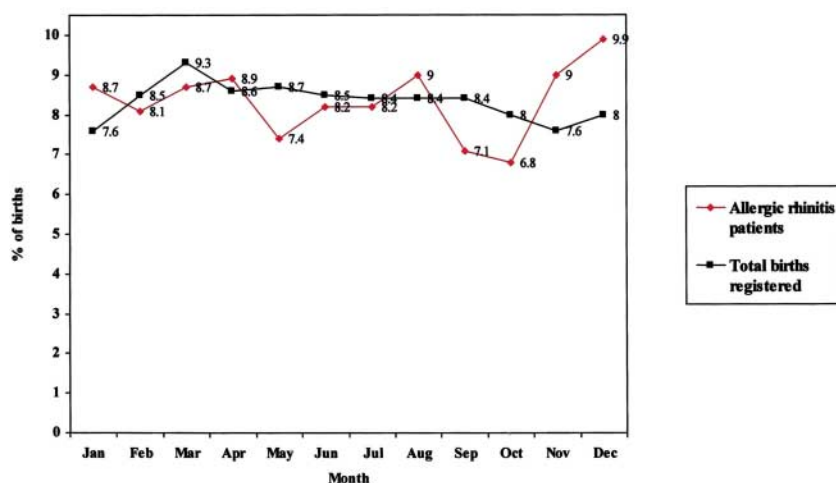


Figure 3. Birth month of 767 patients with allergic rhinitis.

Table 2. Breast-feeding in 744 Patients with Varying Degrees of Severity of Allergic Rhinitis (%)

Grade	Breast-fed		
	Ever	3 Months	6 Months
Mild (n = 158)	63.3	36.7	20.9
Moderate (n = 556)	63.5	36.9	19.4
Severe (n = 30)	66.7	50.0	30.0

(21.7%), only the father had allergic rhinitis; and in 76 children (10.0%), the siblings were affected but neither parent.

Figure 4 shows the prevalence of other atopic and nonatopic, rhinitis-related conditions reported by patients. Three-fifths (60.5%) of the patients had experienced asthma (cough, wheeze or dyspnea relieved by a bronchodilator), and an

additional 36.1% had experienced similar mild or intermittent chest symptoms during upper respiratory tract infection. More than half (51.6%) of the children had allergic conjunctivitis and a third (33.1%) of the children had eczema. The most common nonatopic conditions associated with allergic rhinitis were otitis media (59.2%), snoring (42.1%), and headache (37.8%).

All but 20 patients (2.6%) had received previous treatment for allergic rhinitis. Monotherapy with oral antihistamines was given to 159 patients (20.7%). In total, 678 patients (88.4%) had used oral antihistamines, 362 (47.2%) intranasal corticosteroids, 249 (32.5%) ketotifen, 109 (14.2%) pseudoephedrine, and 30 (4.7%) intranasal DSCG.

Figure 5 shows the clinical findings in 767 patients during the initial visit to the clinic. The most common findings were

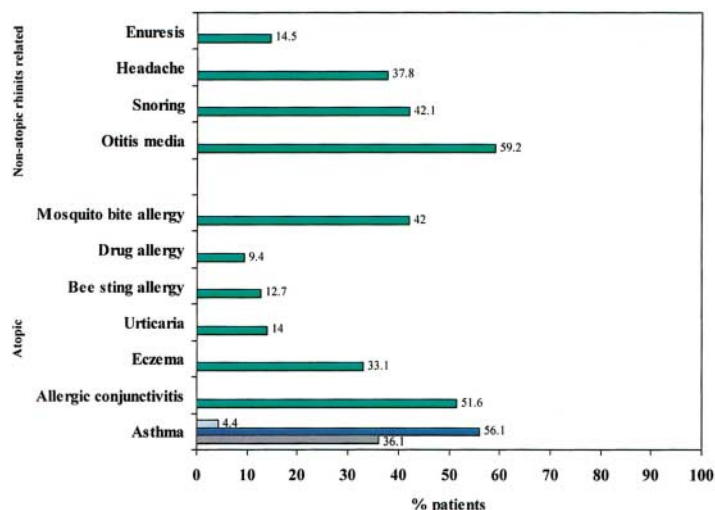


Figure 4. Other conditions suffered by 767 patients with allergic rhinitis.

Clinical findings in 767 patients with varying severities of allergic rhinitis.

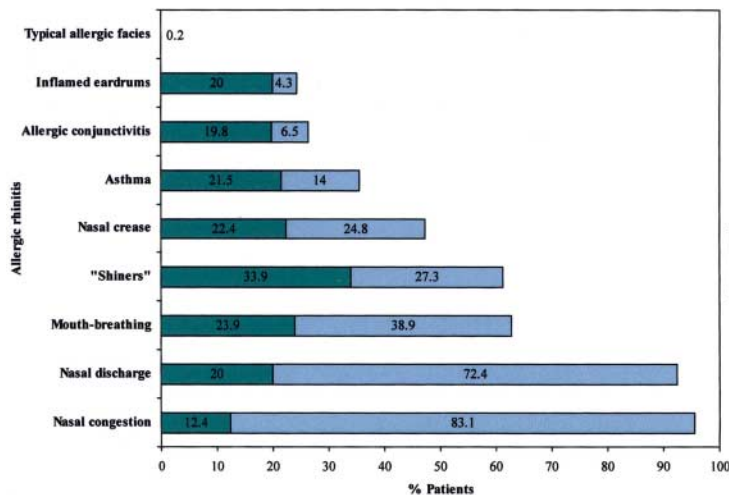


Figure 5. Clinical findings in 767 patients with varying severity of allergic rhinitis.

nasal congestion and nasal discharge. The typical allergic facies was rare.

Routine sinus x-rays were performed on 584 patients. A further 48 patients under the age of 2 years underwent only lateral neck x-ray. Sinus disease (mucosal thickening and/or consolidation) was present in 280 patients (48.0%), and enlargement of the adenoids was seen in 177 patients (28.0%). There was no significant association between radiologic enlargement of the adenoids and the presence of mouth breathing, a history of snoring, or a history of otitis media (Table 3). Neither maxillary sinus mucosal thickening, present in 185 patients (31.7%), nor consolidation of the maxillary and/or ethmoid sinuses, present in 146 (25.0%), showed any statistically significant associations with clinical features (Table 4).

Total serum IgE levels were raised in 329 of 743 patients tested (44.3%). The occurrence of a raised IgE level increased with increasing severity of allergic rhinitis (Table 5). A positive RAST was obtained in 444 of 761 patients tested (58.3%). Total serum IgE was normal in 168 (38.9%) of RAST-positive patients. Conversely total serum IgE was raised in 78 (23.7%) patients with negative RAST.

Table 3. Association between X-Ray and Commonly Regarded Clinical Features of Enlarged Adenoids (%)

X-rays	Clinical Features		
	Mouth-breathing	Snoring	History of otitis media
Adenoids enlarged (n = 177)	66.7	52.0	58.2
Adenoids normal (n = 455)	63.8	49.7	58.2

Table 4. Association Between Clinical Features and Sinus X-Ray Findings

Clinical Feature	X-Ray Findings	
	Mucosal Thickening (n = 185)	Consolidation (n = 146)
Headache (n = 278)	99 (35.6%)	74 (26.6%)
No headache (n = 306)	87 (28.4%)	72 (23.5%)
Allergic shiners (n = 379)	131 (34.6%)	103 (27.2%)
No shiners (n = 202)	54 (26.7%)	43 (21.3%)
Nasal discharge (n = 540)	171 (31.7%)	134 (24.8%)
No nasal discharge (n = 41)	13 (31.7%)	11 (26.8%)
Signs of asthma (n = 230)	79 (34.4%)	63 (27.4%)
No signs of asthma (n = 351)	106 (30.2%)	83 (23.7%)

The results of the standard RAST panel used are shown in Figure 6. Additional allergens were used where the history was suggestive. Thus 48 patients were found to be positive to bee venom, 8 to horse hair, 27 to egg, 12 to tomato, 10 each to peanut and citrus, 2 each to cheese and pork, and 1 each to banana, strawberry, rice, sesame, maize, buckwheat and potato.

Of the 275 patients who were skin tested, a total of 213 (78.0%) showed a positive SPT to one or more allergens (Fig

Table 5. Relationship between Severity of Allergic Rhinitis and Serum IgE Level (%)

Severity	IgE raised
Mild (n = 162)	40.1
Moderate (n = 550)	44.5
Severe (n = 31)	58.1

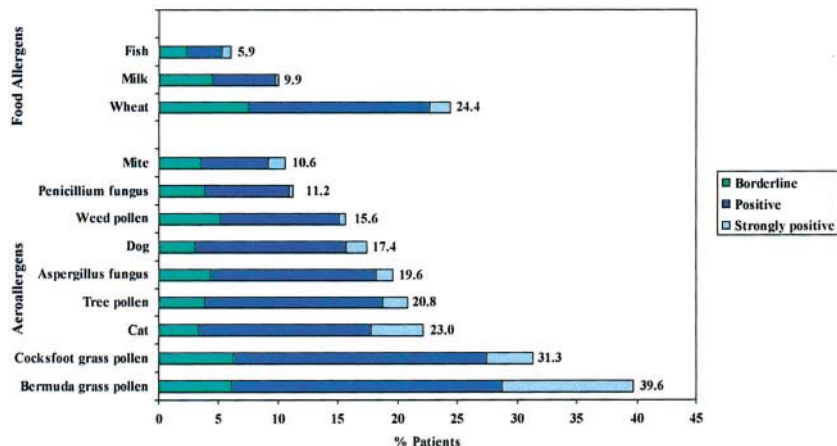


Figure 6. Results of standard radioallergosorbent test panel in 761 patients.

7). A higher positive rate was found with SPT than with RAST for all allergens tested. Agreement between SPT and RAST ranged from 61.7% (*Aspergillus*) to 73.4% (fish; Table 6).

Patients complaining of the four most common allergenic trigger factors (dust, grass, cat, dog) showed between 40 and 60% SPT positivity and between 30 and 45% RAST positivity (results not shown). The associations were strongest for cat and grass pollen. Patients not complaining of these specific trigger factors showed 30 to 45% SPT and 12 to 13% RAST positivity.

Most patients (741, 96.6%) received oral antihistamines, 450 (58.7%) were placed on long-term continuous treatment with topical intranasal corticosteroids, 259 (33.8%) received oral ketotifen, and 36 (0.5%) were treated with intranasal DSCG. Oral decongestants were given to 115 patients (15.0%).

Nearly one-quarter of patients (189, 24.6%) failed to return for followup. Of those who returned, only 20 patients (3.5%) had no improvement. The response to the various drug treatment modalities of those who did return after a treatment period of at least 6 weeks is shown in Table 7.

DISCUSSION

The findings confirm that allergic rhinitis is a very common manifestation of pediatric allergy in South Africa's dry inland plateau region.^{21,25} The male preponderance is in agreement with the generally accepted view that more boys than girls have atopy, although these differences are thought to lessen later in life.^{26–28} Recent studies in Korea,²⁹ the United Kingdom,³⁰ and Hong Kong,³¹ however, have shown a female preponderance of allergic rhinitis in the general population and in adolescents.

Most striking in the population we studied is the early age at onset of symptoms of allergic rhinitis. The median age for onset of symptoms was 6 months, with 30.1% of patients symptomatic from birth. This conflicts with a widely held belief that allergic rhinitis is a disease of older children and young adults,^{2,6,12,14,29} but it is in agreement with another view that rhinitis is an early indicator of an atopic predisposition,^{10,32} and indeed, often is the very earliest sign of allergy.^{33–35}

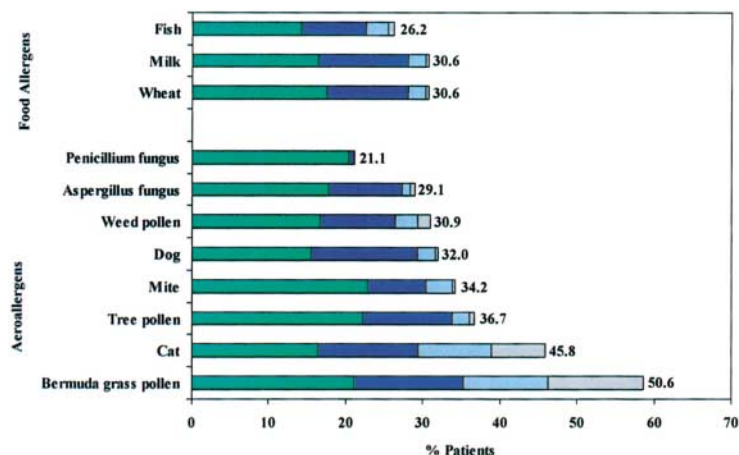


Figure 7. Results of skin prick testing in 275 patients aged 6 years and older.

Table 6. Agreement between RAST and SPT Results (%)

Allergen	RAST+ SPT+	RAST– SPT–	RAST+ SPT–	RAST– SPT+	Overall Agreement
Bermuda grass (n = 274)	40.9	27.0	13.9	18.2	67.9
Cat (n = 274)	18.6	47.8	6.9	26.7	66.4
Wheat (n = 275)	12.0	54.9	16.4	16.7	66.9
Dog (n = 273)	11.3	59.7	8.1	20.9	71.0
Tree pollen (n = 273)	11.0	51.6	12.1	25.3	62.6
Mite (n = 275)	9.4	59.3	6.9	24.4	68.7
<i>Aspergillus</i> fungus (n = 274)	6.2	55.5	16.0	22.3	61.7
Weed pollen (n = 272)	5.9	59.9	9.2	25.0	65.8
Milk (n = 274)	3.7	65.3	5.1	25.9	69.0
Fish (n = 274)	2.2	71.2	2.9	23.7	73.4
<i>Penicillium</i> fungus (n = 273)	2.2	70.3	9.2	18.3	72.5

RAST, radioallergosorbent test; SPT, skin prick test; +, positive; –, negative.

An early age at onset has been shown to correlate with a more severe, persistent form of atopic disease.^{10,33,34} Our finding that symptoms were chronic in 61.3% of patients is in keeping with this. Both SPT and RAST suggest that the most common responsible allergen was grass pollen (59.0 and 40.3% positivity rates, respectively). The region's warm, dry climate supports the existence of natural grasslands and cultivated cereals, which pollinate sequentially from early spring (August) to the beginning of winter (June), providing a virtually continuous aeroallergen load.^{21,36,37} Grass pollen similarly has been implicated as the major cause of hayfever in other countries such as Australia,³⁸ the United Kingdom,³⁹ and Sweden.⁴⁰

The role of other environmental risk factors is less clear. There was some suggestion that birth in early to midsummer was a risk factor. Other studies have drawn contradictory conclusions in this regard, although birth during or shortly before the pollen season frequently has been thought to be a possible risk factor.^{41–43}

Also controversial is the question of whether breast-feeding protects against atopy.⁴⁴ In this study, as in many other studies,^{45,46} it was not found to have a protective effect, indeed possibly the reverse. Unfortunately, the ages at which cow's milk supplements or mixed feeds were introduced into our patients' diets were not recorded, so the effects of exclu-

sive breast-feeding, recently thought to be the more relevant factor, can not be evaluated.^{35,47,48}

The finding that furred pets and passive smoking in the home were not risk factors for either earlier age at onset of disease or for more severe allergic rhinitis is in agreement with the recent weight of opinion,^{12,49,50} although here too controversy remains.¹⁰ Undisputed, however, is the importance of an atopic family history as a risk factor for the development of atopy in childhood, with reported incidences of between 58.5 and 86.3%.^{12,18,27} This risk recently has been shown by Harris et al⁵¹ to be primarily genetic in origin, rather than the result of environmental influences.

Chronic allergic rhinitis is well known to be associated with significant complications, the majority of which are related to nasal obstruction.^{17–19} Otitis media has been reported to occur in 35 to 47% of those with childhood allergic rhinitis.^{18,52} Our figure of 59.2% probably reflects parental overreporting.

Snoring was reported by Green and Luyt¹⁸ to be present in 54.4% of their patients, which is higher than in our study. Snoring is significant because children with obstructed breathing during sleep often have apneic, hypopneic, and hyperpneic episodes, as well as so-called micro-arousals, all of which can cause excessive daytime sleepiness, leading to significant educational and intellectual impairment.^{53–55}

Abnormal findings on sinus x-rays in 48% of patients is in keeping with the figure of 53% reported by Rachelefsky et al.⁵⁶ When coronal computed tomographic (CT) scanning is used, the incidence of sinus abnormalities has been shown to increase to 63%.⁵⁷ However, the significance of these abnormal findings, particularly mild mucosal thickening, remains uncertain.^{57,58} The absence of any statistically significant association between clinical symptoms and radiographic imaging in our patients confirms this view and supports the current, generally accepted recommendation that sinus imaging should be limited to patients who do not respond to therapy, or in whom acute infective sinusitis is suspected.^{6,7,14}

The results of allergy testing suggest that, in our hands, SPT was more useful than RAST for confirming the presence

Table 7. Response to Various Drug Treatments in 578 Patients (%)

Drug	Response		
	None	Unsatisfactory	Satisfactory
Oral antihistamines (n = 567)	3.4	33.7	62.9
Topical corticosteroids (n = 377)	10.9	11.1	78.0
Ketotifen (n = 202)	12.4	32.2	54.4
Pseudoephedrine (n = 66)	6.1	43.9	50.0
Disodium cromoglycate (n = 30)	16.7	53.3	30.0

of atopy. This is in keeping with the conclusion of many other authors.^{1,6,7,59} The poor RAST results may reflect the technical inadequacies of the original Phadebas RAST that was used.¹⁴ Agreement between SPT and RAST was also disappointing and calls into question the reliability of both tests, particularly when the result is only borderline or mildly positive.⁶⁰ Nonetheless, the allergen trends were similar, reflecting the importance of grass and tree pollens in the area and the propensity for families to keep furred animals as pets.

The relatively low rate of skin reactivity to house dust mite, also found previously at this center,²¹ is thought to reflect the region's extremely low humidity. In contrast, in the South African coastal city of Cape Town, it has been shown that skin reactivity to house dust mite is twice as common as to grass pollens.⁶¹ Similar differences between coastal and inland communities have been described in Australia.³⁸ Other centers situated on the inland Southern African plateau, where winter temperatures are less severe and the humidity is higher than in Bloemfontein, have shown correspondingly higher house dust mite SPT positivity rates. In Johannesburg, South Africa, positivity for both grass pollen and house dust mite was 40%,²⁵ and in Harare, Zimbabwe, positivity rates of 40% were found for grass pollen and 60% for house dust mite.⁶²

Our total serum IgE test results also are in keeping with reported findings that this test has poor general predictive value for atopy,^{6,7,63} although our results do confirm that raised IgE is a common feature of more severe atopic disease.³³

Most of our patients received appropriate pharmacotherapy before their attendance at the clinic. Treatment failure may have been the result of poor understanding of the nature and usage of the prescribed drugs, or it may have been the result of continued exposure to environmental allergens. In our hands, management by means of allergen avoidance advice and appropriate pharmacotherapy was helpful to more than 80% of patients.

Our results confirm that intranasal corticosteroids are the most effective drug treatment for allergic rhinitis.^{64–67} Of greater interest, however, is the finding that oral ketotifen was highly effective in 54% and partially effective in 32% of the patients who received it. Ketotifen, a second-generation H₁-receptor antagonist,⁶⁸ was used as a prophylactic anti-inflammatory agent in our youngest patients (<2 years) because of its preferred safety profile and ease of administration.^{69–72} Ketotifen has been shown to be useful in the treatment of allergy, with a degree of efficacy in allergic rhinitis similar to that of intranasal DSCG.^{72–75} Our findings suggest that ketotifen may be more effective than DSCG, although the small number of patients using DSCG makes statistical comparison difficult. Although sedating oral antihistamines are known to impair learning ability in children,⁷⁶ ketotifen studies have shown either no demonstrable side effects or only mild transient fatigue.^{68,72–74} An added benefit of the use of ketotifen would be the possible prevention of the onset of asthma in preasthmatic patients.⁷⁷

Although the cost of preventing perennial allergic rhinitis with both intranasal corticosteroids and ketotifen is considerable,²⁰ the cost of physician visits and parental productivity losses has been shown to be at least four times greater.⁷⁸ We conclude that accurate diagnosis and effective treatment of all but very mild and intermittent forms of allergic rhinitis in children is worthwhile.

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