

Study of airborne pollen composition and allergen spectrum of hay fever patients in South Hungary (1990–1999)

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Received and accepted 17 June 2002

Key words: allergic rhinitis, airborne pollen, hay fever, latent allergy, pollen counting, skin prick test

Abstract

On the basis of their 10-year-long aeropalynological and allergological studies, the authors examined the changes in the allergen spectrum of hay fever patients in connection with the seasonality of the symptoms and pollen count of this period of 10 years. The results of skin prick tests (SPT) and case histories of patients examined in 1990/91 and 1998/99 were compared. Pollen counting was performed with a Hirst-type pollen trap. By the end of the observed period, the ratio of severely polysensitized patients (4 or more positive skin prick tests) increased significantly according to the significantly increased amount of positive skin prick tests to trees, rye and plantain. As the seasonality of the patients' symptoms did not change during this period, this increase in skin prick test positivity means latent allergy. However, in a few years time, it may become manifest allergy causing symptoms in the early springtime. According to the results of pollen counting, the atmospheric pollen pollution of the region was markedly high during the possible sensitization period of these patients.

Abbreviations: SPT – skin prick test; SNP – specific nasal provocation

1. Introduction

Allergic respiratory disorders of a population in a geographical region are mainly determined by the presence and quantity of native plants causing allergy. Vegetation can change in consequence of many human activities and natural factors, therefore the seasonality of the symptoms and allergen spectrum of patients cannot be stable either. Therefore regularly performed atmospherical pollen counting may help physicians to identify allergens and to establish the cause of the patients' symptoms. However, knowing about the temporal changes of allergen spectrum is of great importance both in terms of treatment and specifying.

According to the randomly performed aeropalynological and allergological investigations performed before the seventies, the dominant pollen in the air

was that of grasses (Osvath et al., 1970; Simoncsics et al., 1970). Thus the hay fever patients' condition has deteriorated mainly in the early and middle summer, and on the basis of SPTs, these patients proved to be allergic to grasses.

An extremely high increase of patients allergic to ragweed was observed in the eastern part of Hungary in the late eighties (Szilasi, 1990). The sudden spread of ragweed, thus the increasing number of hay fever patients required the establishment of regular pollen counting and based on this extensive allergological examinations.

Since 1989 airborne pollen monitoring has been continuously performed in one place in South Hungary in Szeged and certain results of allergen research have already been published (Járai-Komlódi and Juhász, 1993; Juhász and Járai-Komlódi, 1996; Juhász and Juhász, 1997; Kadocsa et al., 1991, 1993, 1997).

This present paper summarizes the results of the allergological and aeropalynological research of the past ten years. We have sought connections between the changes in the allergen spectrum of patients, the seasonality of their symptoms and the pollen contents of the air during this period in South Hungary.

2. Patients and methods

2.1 Patients

Between 1990 and 1999, 1139 patients complaining of seasonal allergic rhinitis were diagnosed by means of skin prick tests (SPT). Seasonal bronchial asthma occurred in 16% of patients. This present paper considers the data of patients at the beginning and at the end of this 10-year-long period. In the years 1990/91 127 patients (59 male, 68 female, mean age 31.1 ± 10.9 years), in the years 1998/99 394 patients (181 male, 213 female, mean age: 30.6 ± 12.3 years) were examined. At the time of the examination the symptoms had been present for 6.1 ± 5.3 years in the first group and for 5.6 ± 4.4 years in the second group. By reason of these data, there was no significant difference between the two groups.

Details of case history concerning the months in which the symptoms appeared were noticed regarding the past two years. The data were recorded in the course of one single history taking.

2.2 Skin prick test (SPT)

Skin prick tests were performed using standard dilutions of allergens in 50% glycerol (Soluprick, ALK Abello). The used allergens were hazel, birch, alder, elm, willow, poplar, oak, platan, nettle, plantain, dandelion, goosfoots, rye, mugwort, grasses, ragweed. Histamine HCl (10 mg/ml) in 50% glycerol was used as a positive reference, and a negative reference (50% glycerol) was also included. The reaction to each of the allergens was regarded as a positive result if the mean wheal diameter was as large as or larger than the reaction to histamine HCl (Malling, 1993). SPTs were performed in patients with symptom free period.

2.3 Serum specific IgE

In order to prove the presence of latent tree pollen allergy, serum spec. IgE and SNP tests were performed on a group of randomly selected patients.

Serum specific IgE was measured using an immuno-chemoluminometric method (Magic Lite system, ALK) in 17 hay fever patients with latent tree pollen allergy. The allergens used were hazel, birch, alder, poplar and willow. Results ≥ 1 were regarded as positive.

2.4 Specific nasal provocation test (SNP)

Patients suffering from latent tree pollen allergy were polysensitized to tree pollens thus we performed SNP only with one tree pollen (we did not want to overload patients with more excessive examinations). SNP was performed with hazel allergen (ALK Abello) in 7 patients with latent allergy to hazel. Acoustic rhinometry was used to evaluate the results objectively. A decrease in total nasal volume $\geq 20\%$ was regarded as positive.

2.5 Pollen counting

Pollen counting was performed between January and November every year. Airborne pollen Lanzoni trap (Bologna, Italy) has been used for volumetric sampling. It was placed on the roof of a University building, approximately 20 m above street level in the centre of the city of Szeged (Hungary). The detailed description of preparation methods and scanning of slides can be found in K  pyl   and Penttinen (1981).

2.6 Statistical analysis

Statistical analysis was performed with one and two-tailed t-tests and X^2 test. Relative risk and Pearson korrelation coefficient were calculated. A p-value ≥ 0.05 was considered significant.

3. Results

In the first part of this present paper we discuss the results of aeropalynological observations based on airborne pollen concentrations. Figure 1 shows the ratios of most frequent airborne pollen grains in the biannual total pollen sums of the two periods (1990/91 and 1998/99). The most common 16 taxa are presented on this diagram, per cent of total biannual pollen counts (Figure 1).

In the second part the allergological aspects will be discussed. The most common airborne pollen types causing allergic sensitization are illustrated in Figure 2 (percentage of positive reactions among patients) (Figure 2). Comparison of the two diagrams:

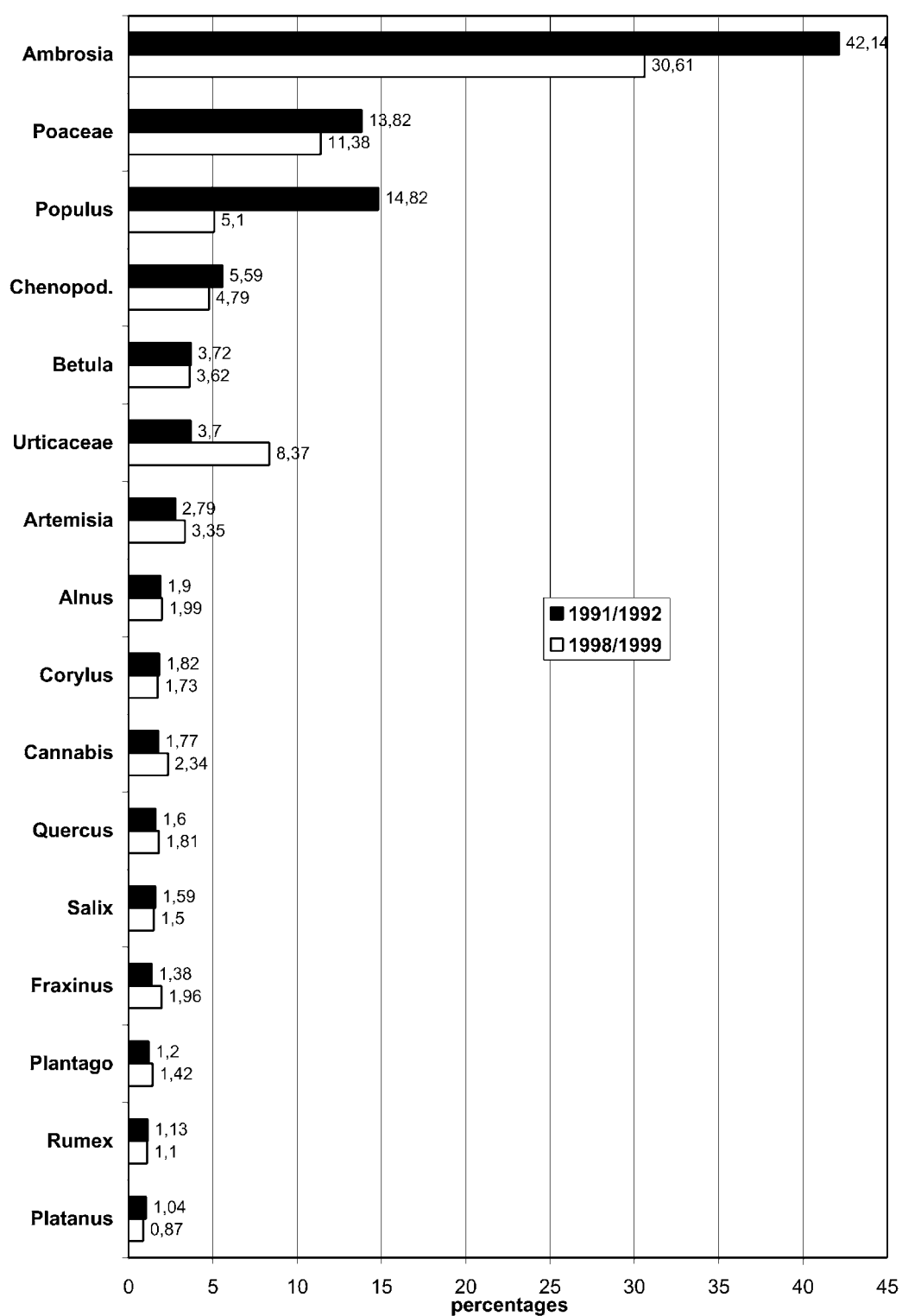


Figure 1. Ratio of most frequent airborne pollen types in the biannual total pollen concentrations (1990/1991 and 1998/1999).

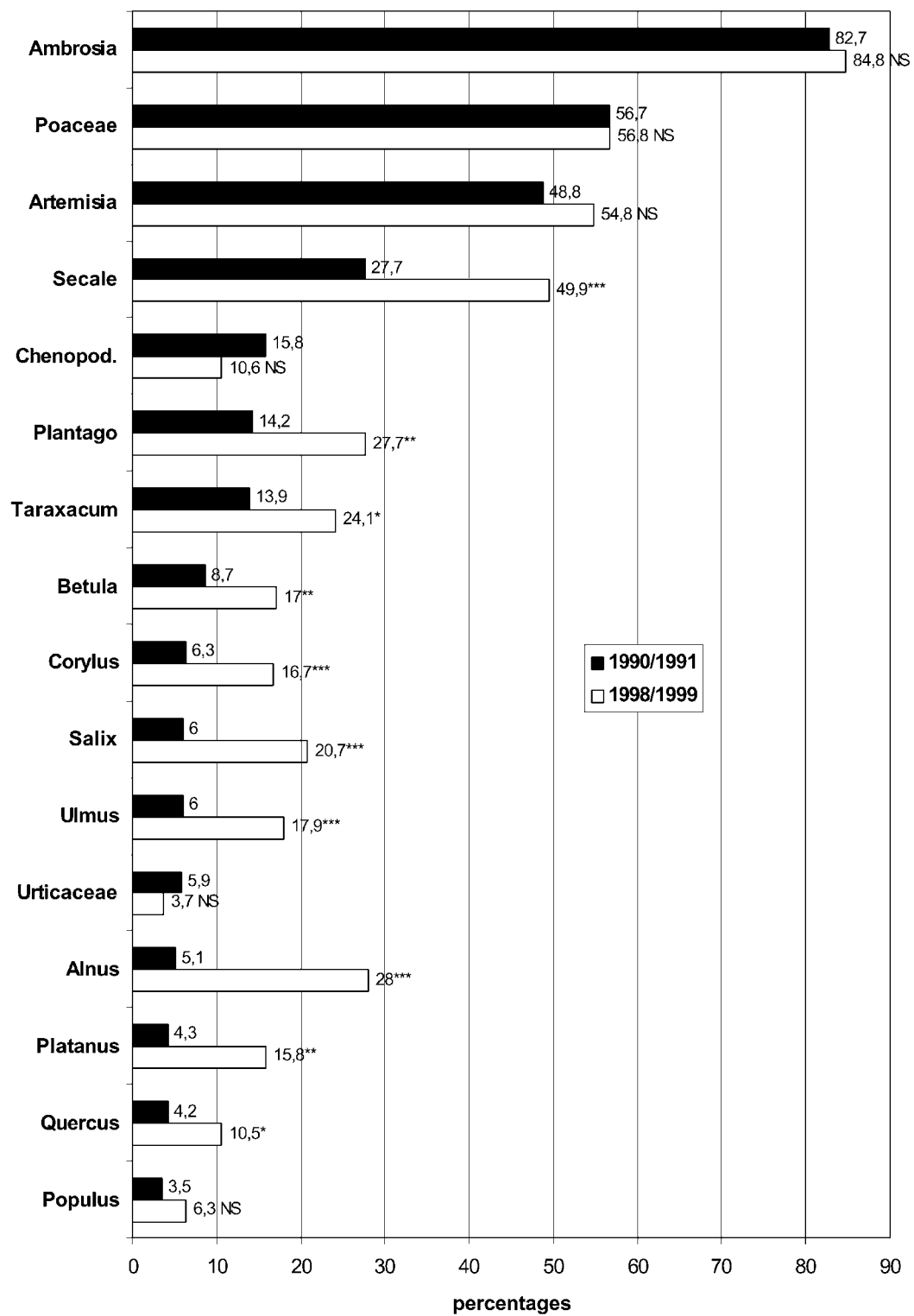


Figure 2. SPT positivity of seasonal allergic rhinitis patients examined in 1990/91 and 1998/99 (***P < 0.001, **P < 0.01, *P < 0.05, NS P = 0.05).

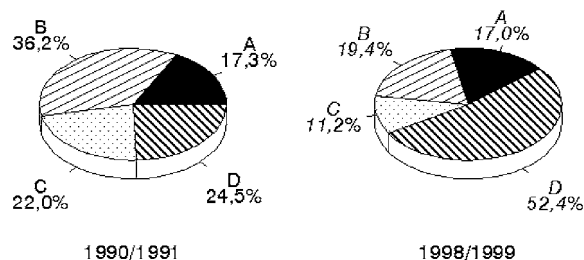


Figure 3. Change of mono- and polysensitization with SPT (in percentages) (1990/91 and 1998/99). A = monosensitization; B = SPT positive to 2 allergens; C = SPT positive to 3 allergens; D = SPT positive to 4 or more allergens.

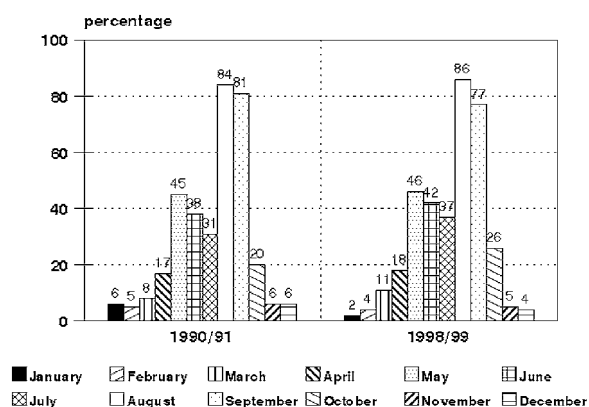


Figure 4. Seasonality of patient's symptoms (1990/91 and 1998/99).

- 1) airborne pollen of *Ambrosia* (ragweed) and Poaceae (wild grasses+rye) give the highest values on both diagrams. Not only their concentrations were extremely high during the studied periods but their allergens gave the highest frequency of positive SPT results as well;
- 2) among the different kinds of tree pollen grains, *Populus* (poplar) is the most common pollen in our region, but its role in pollinosis is very small;
- 3) some allergenic tree pollen (e.g. alder, hazel, oak, willow, platan) are present in air but in fairly low concentrations;
- 4) *Fraxinus* (ash), a representative of Oleaceae, occurs in low pollen concentration, with very little clinical importance;
- 5) Figure 2 contains the *Taraxacum* (dandelion) and *Ulmus* (elm) with medium SPT positivity. They produce small quantities of pollen thus they are not presented in Figure 1.

According to the data of Figure 2, both at the beginning and at the end of the ten-year-long period,

the vast majority of patients were allergic to ragweed, grasses and mugwort – in the order of decreasing. The ratio of these allergens did not change significantly. However, the ratios of patients allergic to hazel, rye, plantain and trees except for poplar, increased significantly (Two-tailed t-test was performed. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$ non significant (NS) $p \geq 0.05$).

The proportion of monosensitized persons was same in the two observed period, but the rate of patients who were allergic to four or more allergens doubled (Figure 3).

The vast majority of patients appeared to have symptoms in August and September during the flowering of ragweed. They were followed by the group of patients developing symptoms during the pollinative period of grasses in May and June. There was no significant difference between the data of the two observed periods. Statistical analysis was performed with one-tailed t-test ($p = 0.37$ NS) and Pearson correlation coefficient was calculated (0.99). According to the results the correlation is very high (Figure 4).

The relationships between the results of skin prick tests and specific IgE examinations performed in 17 patients with latent tree pollen allergy, are presented in Table 1.

Statistical analysis was performed with X^2 test and relative risk was calculated. If the relative risk is above 2, the correlation is acceptable. The clearest correlation occurred in the case of hazel (relative risk = 13.75 $p < 0.05$).

In the case of 7 patients with latent hazel pollen allergy, SNP examination was performed with hazel allergen. In five cases the results of SPT, serum specific IgE and SNP investigations coincided (Table 2).

According to the aeropalynological research in Southern Hungary, ragweed was the dominant pollen during the observed 10 years' period (Figure 5).

The annual amount of pollen and the rate of ragweed show a parallel pattern of fluctuation. The total pollen count was very high in the first part of the decade, thereafter it fell steeply in 1995, and it has been even lower in the recent years. The pollen production of trees is higher than the pollen production of grasses, and the changes in its relative ratio were similar to the grasses pollen ratio in this period.

Table 1. Results of SPT and serum specific IgE with five tree pollen allergens in hay fever patients with latent allergy to trees (N = 17).

Spec. IgE	Hazel SPT		Birch SPT		Alder SPT		Poplar SPT		Willow SPT	
	+	–	+	–	+	–	+	–	+	–
+	10	0	9	2	13	0	6	5	6	5
–	3	4	3	3	4	0	3	3	5	1
Relative risk	13.75		4.5		2.8		1.2		0.24	
	p < 0.05		p < 0.2		p < 2.8		p < 0.9		p < 0.3	

4. Discussion

According to our observations, the allergen spectrum of our patients in South Hungary has changed curiously in the recent ten years. The leading allergens are constantly ragweed, grasses and mugwort (Figure 2). However, the ratios of all the patients allergic to trees except for hazel and poplar have increased, and significantly increased the rate of plantain and rye allergic patients, consequently the allergen spectrum of patients is wider than in 1990/91. On the other hand, these increases in skin test positivity do not correlate with the patients' symptoms. There was no significant difference between the seasonality of complaints in the two observed groups (Figure 5). August–September and May–June are constantly the most problematic months as August–September is the flowering period of late summer weeds (Juhász and Juhász, 1997) and May–June is the flowering period of grasses (Juhász and Járai-Komlódi, 1996). In both groups (patients examined at the beginning and at the end of the ten-year-long period) only a small part of patients had hay fever during the pollinating period of trees (February, March and April), without significant difference in ratio. Thus the significant increase in tree pollen allergy in 1998/99 can be regarded as clinically latent allergy. The sensitization of patients with latent tree pollen allergy was proved by the results of specific IgE and SNP examinations. The flowering periods of rye and plantain in our country coincide with the peak flowering period of grasses, thus the clinical importance of more frequent positive skin test to plantain and rye cannot be determined merely by the observation of symptom seasonality.

According to the published data (Haggy et al., 1971), a positive pollen test of a symptom free person indicates a ten times higher risk of developing hay fever. It was described about ragweed skin tests, that a symptom-free person with a positive skin test develops

Table 2. Results of SPT, serum specific IgE and SNP with hazel in patients with latent tree pollen allergy.

Patient no.	SPT	Serum spec. IgE	SNP
1.	+++	1	+
2.	+++	2	+
3.	+++	0	–
4.	+++	0	+
5.	+++	1	+
6.	+++	3	+
7.	+++	2	+

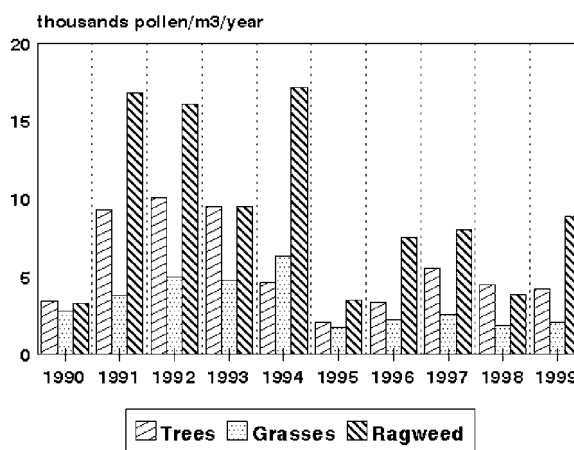


Figure 5. Annual pollen counts of the three most important pollen groups in Southern Hungary (1990–1999).

seasonal rhinitis symptoms caused by ragweed within three years' time on average (Chambers et al., 1958). According to Horak's observations (1985), children's latent allergy to inhalative allergens becomes a clinically manifest disorder within four years' time. On the basis of all these facts, it can be expected that in a few years time our patients suffering from latent pollen

allergy become hay fever patients in the early spring-time as well. This can be triggered by the extremely pollen loading which affects our patients year by year. The total pollen count was unusually high during the possible sensibilization time of our patients allergic to tree pollen. We could find only one article published on the changing allergen spectrum of patients and the airborne pollen composition changes in a foreign country (Shida T. et al., 2000). The results of investigation performed in Japan cannot be compared to our results, since complaints of patients and latent pollen allergy were not observed in that study. Nevertheless their results correlate with our findings in respect of allergen spectrum widening in the recent 30 years. They also explained this change, to a certain extent, with changes in the aeroallergen load.

5. Conclusions

Our investigations suggest that, mainly the previously polysensitized patients' allergen spectrum is becoming wider. This change in allergen spectrum clinically may be latent. In our opinion, patients' attention must be called to this danger, and they would need advice on prevention. Regularly performed atmospherical pollen counting may help physicians to determine the possible cause of allergen spectrum changing.

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