

Trend of herbaceous pollen diffusion and allergic sensitisation in Genoa, Italy

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Abstract

In order to investigate the relationship between allergenic load and allergic sensitisation prevalence on a long period, we analysed the annual data of herbaceous pollen airborne diffusion in Genoa (NW-Italy) for 17 years (1981–1997), with particular regard to the most important allergenic species: Poaceae, *Parietaria*, *Artemisia*, *Ambrosia*. We evaluated the relative trend and compared it with the prevalence data of patients sensitisation to these pollens in the same period. The analysis of annual pollen amount revealed a significant rising trend ($r = 0.73$, $p < 0.05$) of *Parietaria* pollen (average 14.324 grains/m³/year), whereas Poaceae (2048/year) and *Artemisia* (170/year) pollen count did not show any significant change. *Ambrosia* (average 70/year) has been rising since 1989 ($r = 0.87$, $p < 0.05$) and reached the maximum pollen count in the last three years.

The prevalence of pollen sensitisation resulted to be very high (about 75%) in our atopic patients with respiratory symptoms and did not change significantly in the years: *Parietaria* pollen allergy was present in about 70% of patients with at least one SPT positive to pollens (and 55% of atopic subjects), and this frequency, much higher than the one found in North Italy, showed low year-to-year variability. Among pollinotics patients, Poaceae cutaneous sensitisation was found at a quite stable rate in the above mentioned period (about 51%), as well as that to *Artemisia* pollen (8%). *Ambrosia* skin prick test positivity is very rare (about 0.5%), without any evident increase.

The present study shows that, for some of the herbaceous species, we cannot demonstrate a straightforward relationship between the trend of airborne pollen and the frequency of sensitisation in exposed people. However, in the case of *Parietaria*, the high level of pollen amount in the air is clearly related with the high rate of cutaneous positivity in patients, but it seems to suggest a “plateau” that is not modified by any further increase in airborne pollen (perhaps for genetic limiting factors). On the other hand, *Ambrosia* pollen count, even if increasing in Genoa’s atmosphere, could still be too low, and it would take some more time to cause allergic sensitisation in exposed people.

This kind of study, pointing out the influence of airborne allergen exposure on hypersensitivity mechanisms, should be extended in time and world-wide to obtain general conclusions.

Introduction

There is some evidence that allergen load should be considered as an important one, among the environmental factors related to the increasing prevalence of allergic diseases and asthma world-wide (Woolcock et

al., 1995). Nevertheless, there are hardly any studies of allergen levels in the literature that have documented changes in load: in particular, there are few measurements of indoor allergens, but it is generally agreed that house-dust mites have increased in number (Green et al., 1993; Wickman et al., 1991).

Aerobiological data on a long period represent an essential tool for assessing exposure to pollen allergens, for measuring variations in yearly pollen production, and for observing changes of the allergen content of the air (Jäger, 1989; Rogers, 1997; Larese et al., 1998).

Airborne pollen monitoring has been carried out by the same methodology since 1981 in Genoa (N-W Italy), allowing us to study a large amount of data. In a previous study, we compared our pollen trends with data coming from another monitoring station in the region (Arobba et al., 1992). In a different report (Voltolini et al., 1994), we evaluated the variation in airborne concentration of tree pollen over a long period of time (1981–1994) and the correlation with the prevalence of patients with respiratory allergy due to some of these trees (Troise et al., 1992). The present study analyses the pollen count of herbaceous plants, obtained from the air of Genoa in the period 1981–1997 and the relative trends, limiting the analysis to the four taxa of great world-wide allergenic interest: *Parietaria*, Poaceae, *Artemisia*, *Ambrosia* (D'amato et al., 1998). Then, in order to investigate the existence of a correlation, we compared yearly pollen data with the frequency of patients with respiratory symptoms, showing allergic sensitisation to these pollens in the same period.

Methods

Pollen has been collected all year long since 1981, by volumetric 7-day Hirst-type samplers (Burkard and Lanzoni) placed 20 m above ground level, on the rooftop of our Hospital building. Data were interpreted according to the same methodology (standard method of the Italian Association for Aerobiology) and by the same researcher (Negrini AC et al., 1987).

During the year, for each taxon, 52 average weekly pollen concentration values (P/m³ of air) were registered: the sum of these 52 values gives an estimate of the annual amount of each pollen type expressed as pollen index. To calculate trends, a linear regression and correlation analysis has been performed: the annual cumulative pollen count of 17 years (1981–1997) of records for each plant was correlated with the increase of time. Then, the mean of the annual cumulative count of each pollen in two periods, 1981–1989 and 1990–1997, was compared by Student's t-test. Differences are considered significant when $p < 0.05$.

Table 1. Annual cumulative pollen count. Gross character numbers indicate the maximum values per pollen.

Year	<i>Parietaria</i>	Poaceae	<i>Ambrosia</i>	<i>Artemisia</i>
1981	6692	857	15	225
1982	10430	2400	18	114
1983	14433	2533	25	253
1984	15443	1812	28	90
1985	7855	2534	22	171
1986	6902	1457	20	134
1987	4736	693	37	172
1988	12587	2403	26	149
1989	16237	1947	53	211
1990	14326	1223	80	122
1991	12959	2380	141	111
1992	18018	2514	69	131
1993	18068	2337	76	184
1994	21591	2814	80	111
1995	25848	2710	175	211
1996	21052	2265	163	156
1997	16335	1929	156	337
Total	243512	34808	1184	2882
Average	14324	2047	70	170
r	0.73	0.35	0.87	0.18
p	<0.05	n.s.	<0.05	n.s.

Finally, data of yearly prevalence of patients with skin prick test (SPT) positive towards herbaceous pollens, coming from the analysis of about 6800 outpatients skin-tested in our Allergy Unit in the years 1983–1990 and 1995–1996, were compared with data of yearly pollen amount.

Results

Among the herbaceous plants studied, *Parietaria* produces the greatest amount of airborne pollen (average of 14324 P/year), followed by Poaceae (average 2048 P/year), *Artemisia* (170 P/year) and *Ambrosia* (70 P/year).

Table 1 shows the annual cumulative pollen count for each of the herbal plants: the peak values in annual incidence are not synchronous but all located in the last few years. *Parietaria* ($r = 0.73$) and *Ambrosia* ($r = 0.87$) are the only taxa showing a significant correlation index, with an increasing trend.

The comparison (Table 2) of the average annual cumulative count for each pollen in the two periods (1981–1989 and 1990–1997) clearly shows a significant difference for *Parietaria* (10591 vs 18525 P/m³,

Table 2. Cumulative pollen count in two periods expressed as annual index (Σ of average weekly pollen concentration).

	<i>Parietaria</i>	Poaceae	<i>Artemisia</i>	<i>Ambrosia</i>
First period 1981–1989 (9 year time)				
Total	95315	16636	1519	244
Average	10591	1848	169	27
Second period 1990–1997 (8 year time)				
Total	148197	18172	1363	940
Average	18525	2272	170	118
	$p < 0.002$	$p = \text{n.s.}$	$p = \text{n.s.}$	$p > 0.001$

Table 3. prevalence of SPT positive to each pollen in % of pollinotics patients.

Years	<i>Parietaria</i>	Poaceae	<i>Artemisia</i>
1983	77	46	9
1984	80.6	46.8	8.2
1985	70.3	46.6	3.0
1986	68.3	49	3.5
1987	67.9	55.6	7.4
1988	63.7	52	4.8
1989	67.9	55.6	8.2
1990	71.1	55	9.1
1995	63.5	55.3	14
1996	75.7	47.7	11.7
Average	70.6	50.1	8

$p < 0.002$) and *Ambrosia* (27 vs 118 P/m^3 , $p < 0.001$), confirming a significant increasing trend. On the contrary, the average value of annual total pollen count of Poaceae (1848 vs 2272 P/m^3) and *Artemisia* (169 vs 170 P/m^3) does not show any significant variation in the two periods considered.

The analysis of our available data (Table 3) regarding about 6800 patients living in the city of Genoa and surrounding areas, suffering from rhinoconjunctivitis and/or asthma, shows that the rate of subjects with positive SPT is 69%. Among them, the prevalence of pollen sensitisation is very high (about 75%), without any significant change over the years. The mean prevalence of SPT positive to the herbs in pollinotic patients in decreasing order is: *Parietaria* (70%), Poaceae (51%), *Artemisia* (8%). *Ambrosia* gave only rare positive SPT, usually in patients coming from different regions of Italy.

Figure 1 shows the curve of annual cumulative pollen counts of *Parietaria*, with the resulting signifi-

cant increasing trend ($+5.87 - r = 0.73 - p < 0.05$); the peak value is clearly evident in 1995 (25.848 P/year). Bars indicate the percentage of positive SPT on the total of pollinotic patients: no significant variation occurs in this prevalence, which shows a high level since the first year of study with some low fluctuation year to year (70% of pollinotics patients, 55% of SPT positive patients).

Figure 2 shows the same analysis for Poaceae pollens, having a much lower concentration than *Parietaria*, with a variability to some extent from year to year, without a significant trend. The rate of patient sensitisation to these pollens results at a quite stable level, involving about 51% of pollinotic and 40% of atopic subjects.

Artemisia pollen annual values show a quite steady trend (Figure 3): the prevalence of sensitized patients, usually less than 10%, appears slightly increasing in the years, reaching a maximum of 14% of pollinosis cases in 1995.

In the Figure 4 the yearly pollen sums of *Ambrosia* show a clear, slow, but significant increasing trend ($+13.8 - r = 0.87 - p < 0.05$), while the concentration is very low (maximum 175 P/m^3 in 1995). In this case, the prevalence of sensitized patients is not shown, for their small number.

Discussion

Atmospheric pollen concentration is well known to be highly variable in time, either on hourly, seasonally or yearly scale: for this reason, it is necessary to obtain several years of data in order to calculate an average pollen presence and to assess any change in trends.

Airborne pollen sampling in Genoa has been carried out in the same location (the roof-top of the Hospital) all year long since 1981, using a 7-day volumetric pollen trap, by the same operator and according to the same method, for the entire 17 years period. So, our data appear to be particularly homogeneous and useful for this kind of analysis.

Our previous study (Voltolini et al., 1994a) about trend in airborne concentration of tree pollens, confirmed the existence of large variations in yearly pollen production and diffusion; in some cases (*Ostrya carpinifolia*), we observed the so-called “mast cycling”, highly sensitizing years for atopic subjects (Voltolini et al., 1994b).

Herbaceous taxa generally show lower yearly fluctuations in pollen production, without intrinsic genetic

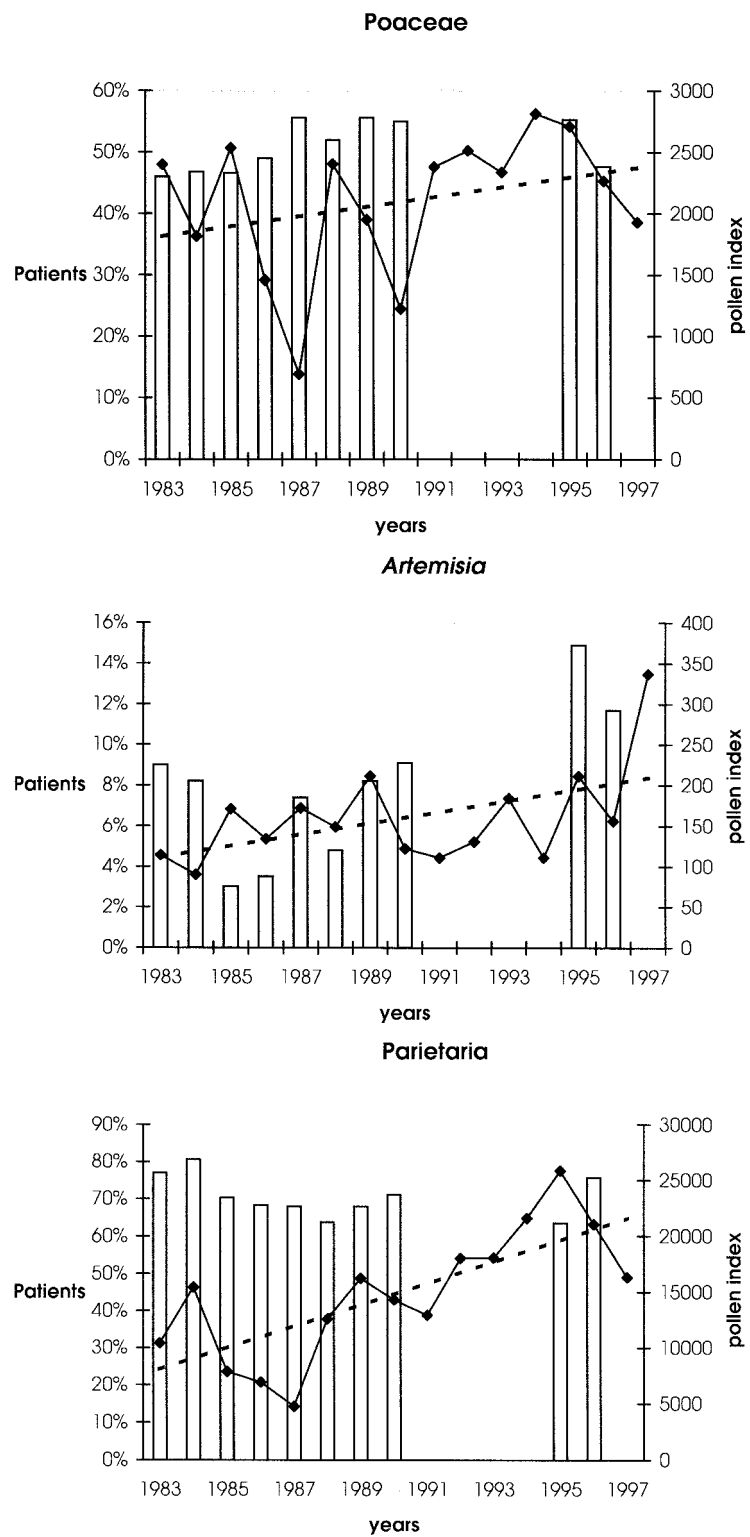


Figure 1-3. Trend of annual cumulative pollen count and percentage of sensitisation in pollinotics patients. Years 1983-1997.

cycles, so that average yearly pollen sums appear to be a reflection of relative plant abundance in the surrounding vegetation. Our study shows a significant pollen increasing trend of weeds as *Parietaria* and *Ambrosia*, typically widespread in urban disturbed habitat. In contrast, the airborne concentration of species as Poaceae and *Artemisia* seems to undergo a much lower variability in the years. The peak values in annual incidence for each taxon are not synchronous, suggesting specie-specific responses to meteorological conditions; however, they are all located in the last few years, indicating a possible general increasing in airborne pollen diffusion.

The analysis of the relationship between pollen load exposition and frequency of patient sensitisation suggests a clear influence, not a direct relationship. In fact, in the case of *Parietaria*, the high level of presence in the air of our area (more than 25% of the total annual pollen count) is associated with the highest prevalence of allergic patients (70% of the pollinotics patients), but this rate appears to be slightly influenced by any further increase in pollen load, that could influence the severity and the length of symptoms. On the other hand, *Ambrosia* yearly pollen sum, even if increasing, is very low and it is not probably able to cause allergic sensitisation in people exposed for a few years. The existence of genetic factors, influencing the differences in sensitisation in various countries (Bonini et al., 1994; Ruffilli and Bonini, 1997), could partially explain these findings. These hypotheses need to be confirmed by genetic, epidemiological and aerobiological studies on a large scale and on a long period.

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