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Sensitization to environmental antigens in asthmatic children from a central Italian area

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Abstract

This study was designed to evaluate the frequency of respiratory allergens in different age groups of asthmatic atopic children in the Chieti-Pescara area. We examined a pediatric population (507 children) aged between 1 to 17 years (mean 6.62 ± 2.9). All the children were submitted to a panel of skin prick tests (SPT) for 12 common aeroallergens: Grass Pollens (G.), Parietaria (P.), Olive (O.), Artemisia (A.), Ragweed (R.), *Dermatophagoides Pteronyssinus* and *Dermatophagoides Farinae* (D.P. & D.F.), Cat and Dog dander (C.D.), Feathers (F.), Alternaria (Al.), Aspergillus (As.). All the subjects gave positive result to one or more allergens. The population was subdivided in to 4 groups according to their age (Group A: 1–3 years; Group B: 4–6 years; Group C: 7–9 years; Group D: 10–17 years). In each age group, we determined the number of subjects with 1, 2, 3, 4 or 5 and more than 5 positive SPT and the prevalence of positive SPT for different allergens. We found that 74% of 507 patients showed positive reaction to *Dermatophagoides Pt*, 71% to *Dermatophagoides Fa*, 45% to Grass, 23% to Parietaria, 21% to Olive, 17% to Artemisia, 17% to Cat's or Dog's danders, 13% to Alternaria, 5.9% to Ragweed, 5.9% to Feathers, and 4% to Aspergillus. In addition we detected that 12% of children examined were monosensitized; 56% were sensitized to 2 or 3 allergens; 22% were sensitized to 4 or 5 allergens, and then 8% were polysensitized to > 5 allergens. The allergy to grass pollens and to house dust mites was the most frequent in monosensitized. In the older patients, we found an increase in number of positives SPT to several allergens, and an increase in the frequency of Gr., P. and O. allergy, while the house dust mites sensitization remained constant in all groups and represented the dominant cause of asthmatic symptoms in this population. Our data confirm the importance of age in determining a respiratory polysensitization. In conclusion, our data suggest that house dust mites (D.P. and D.F.) and grass pollens are the most common allergens in asthmatic children of the Chieti-Pescara area. © 2001 Published by Elsevier Science B.V. All rights reserved.

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1. Introduction

The prevalence and severity of asthma and allergic diseases are increasing in industrialized countries over the last few years (Blumenthal et al., 1993; Marsh et al., 1981), probably due not only to the improvement of diagnostic tools but also to a real increasing prevalence.

These diseases are believed to be resulting from an allergen-induced inflammatory process of respiratory mucosa in sensitized subjects (Naclerio, 1991; Kay, 1991), but several factors are involved in determining the pattern of respiratory symptoms following exposure to allergens (Weiner et al., 1979; Fish et al., 1980). These factors include the degree of bronchial lability, the type and intensity of allergen sensitization, the duration of sensitization and of exposure and the subject's genetically determined response to the allergic stimulus. The relative importance of the various factors remains to be established.

A large proportion of asthmatic subjects are sensitized to common indoor or outdoor allergens (Sears et al., 1989; Ronmark et al., 1998). Studies in pediatric age have focused on the importance of the indoor environment, because children spend a large part of their time indoors, and a wide variety of elements in the indoor environment, such as house dust mites, cat and dog allergens, tobacco smoke, and nitrogen dioxide, have been associated with asthma (Ronmark et al., 1998; Dekker et al., 1991; Lindfors et al., 1994; Boulet et al., 1997).

The prevalence of sensitization and clinical relevance of the indoor and outdoor allergens vary greatly with regard to country, climate, living condition and racial background (Sarpong et al., 1996; Gelber et al., 1993; Sporik et al., 1990).

There is also a relationship between atopy and age; in fact, an increased prevalence of sensitization to common allergens with age has been described (Silvestri et al., 1996; Trandafilovski et al., 1998; Erel et al., 1998).

The aim of this study was to determine the type and the number of sensitizations to airborne allergens in asthmatic children living in the Chieti-Pescara metropolitan area according to age.

2. Materials and methods

2.1. Patients

This study was performed on children observed as outpatients in the Allergological Unit of the Pediatric Clinic of the University of Chieti for atopic asthma in the period January–December 1998.

Five hundred and seven children, 336 males and 171 females (male to female ratio 1.9), with atopic asthma, aged between 1 and 17 years (mean 6.62 ± 2.9), were enrolled in this study.

The diagnosis of asthma was defined on the basis of a clinical history of repeated episodes of coughing, dyspnea and wheezing. In addition, in the children able to cooperate, baseline and after bronchodilation respiratory function tests were studied by maximal expiratory flow/volume curves (F/V). Medical history data, including allergy-related diseases (rhinitis, eczema, urticaria, conjunctivitis) and recurrent respiratory infection were also collected. The atopic sensitization was established by at least one positive skin prick test to the allergens tested, performed and evaluated according to EAACI Position Paper (Malling, 1993). The children underwent an SPT only if they had discontinued antihistamines or systemic corticosteroids for at least two weeks before the test.

2.2. Skin prick test

The skin prick tests were performed with a panel of 12 most common respiratory allergens: *Dermatophagoides Pteronyssinus* (D.P.), *Dermatophagoides Farinae* (D.F.), Grass (G.), Olive (O.), Ragweed (R.), Parietaria (P.), Artemisia (A.), Cat and Dog danders (C.D.), Feathers (F.), Alternaria (Al.), Aspergillus (As.).

Skin prick tests were performed using idroglyceric solution of allergen extracts titolated in weight/volume for Grass and Pollens (1/100 w/v), Mites and Danders (1/20 w/v), and in PNU/ml for Moulds (10 000 PNU/ml) (Bayropharm). A histamine solution (10mg/ml) was used as a positive control, and the glycerol saline solution as a negative control. The SPT

were performed using 1 mm Skin Prick Test lancets (Dome Hollister-Stier) introduced through the drop of the tested solution at a 45° angle with the skin. Interpretation was done according to current guidelines. For all subjects, the wheal response was read at 20 min and reported as an absolute value in mm (mean of the largest horizontal diameter and the largest perpendicular to it). Reactions were regarded as positive if the mean diameter was 3 mm or larger after subtracting the size of any positive reactions to the glycerol saline solution.

2.3. Statistical analysis

We have evaluated the prevalence of sensitization for the different respiratory allergens tested and the number of children monosensitized or polysensitized according to the positivity of the prick test, to one or more allergens, respectively.

According to their age the patients were subdivided into four groups: group A (1–3 years, 100 patients — 19%), group B (4–6 years, 214 patients — 42%), group C (7–9 years, 111 patients — 21%), group D (10–17 years, 82 patients — 16%).

The prevalence of sensitization for the different respiratory allergens and the number of the subjects mono- or polysensitized were calculated also in the four groups.

In each age group the number of subjects with 1, 2, 3, 4 or 5 and more than 5 skin prick tests

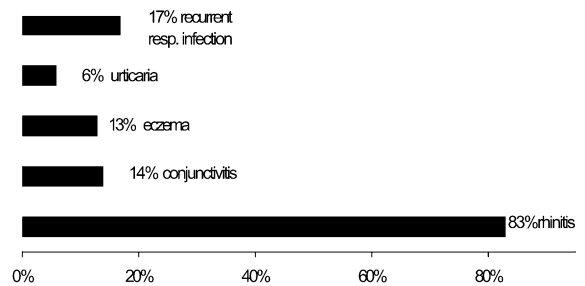


Fig. 1. The proportion of the atopic asthmatic children with recurrent respiratory infection, urticaria, eczema, conjunctivitis, rhinitis.

that were positive were determined. The percentage of sensitized subjects to different airborne allergens, in the entire population studied, and in age group, were also calculated.

Chi-square (χ^2) test was used to compare the rates between groups. *P* values ≤ 0.05 were considered statistically significant.

3. Results

Within the 507 asthmatic children, allergic rhinitis was present in 83% of the cases, conjunctivitis was present in 14%; 13% of children had history of eczema, 6% of urticaria and 17% had recurrent respiratory infection (Fig. 1).

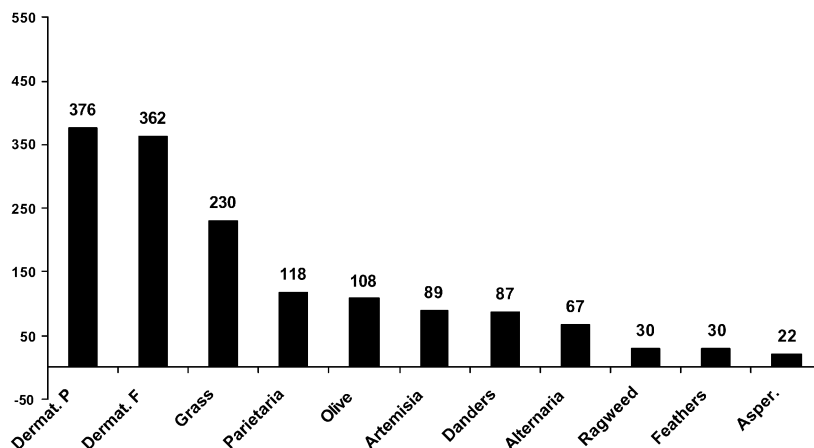


Fig. 2. Distribution of sensitization to each respiratory allergen, in the entire population studied.

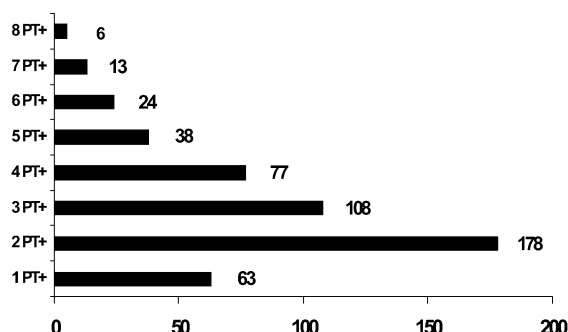


Fig. 3. Distribution of monosensitized and polysensitized subjects in the population studied, according to number of positive Skin Prick Tests.

The percentages of subjects with positive reaction to skin prick test for different allergens were: 74% (376 subjects) for *Dermatophagoides pteronyssinus*, 71% (362 subjects) for *Dermatophagoides Farinae*, 45% (230 subjects) for Grass, 23% (118 subjects) for Parietaria, 21% (108 subjects) for Olive, 17% (89 subjects) for Artemisia, 17% (87 subjects) for Danders, 13% (67 subjects) for Alternaria, 5.9% (30 subjects) for Ragweed, 5.9% (30 subjects) for Feathers, 4% (22 subjects) for Aspergillus (Fig. 2).

Among the 507 children examined, 63 (12%)

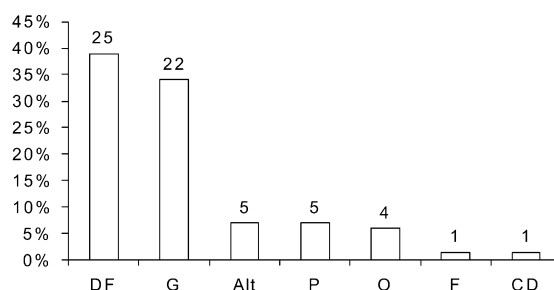


Fig. 4. Distribution of sensitization to different airborne allergens in monosensitized individuals. (D.P.) *Dermatophagoides Pteronyssinus* and (D.F.) *Dermatophagoides Farinae*; (G.) Grass; (Alt.) Alternaria; (O.) Olive; (F.) Feathers, (C.D.) Cat and dog danders.

were sensitized to only one allergen (monosensitized), 286 (56%) were sensitized to 2 or 3 allergens, 115 (22%) were sensitized to 4 or 5 allergens, 43 (8%) were polysensitized to > 5 allergens (Fig. 3).

Among the 63 monosensitized children, 25 (39%) subjects were sensitized to *Dermatophagoides Pteronissinus* and/or *Dermatophagoides Farinae*, 22 (34%) subjects to Grass, 5 (7%) subjects to Alternaria, 5 (7%) subjects to Parietaria, 4 (6%) subjects to Olive, 1 subject was

Table 1

Distribution of percentages of monosensitized and polysensitized children in each age group

Group ^a	1 SPT + (%)	2–3 SPT + (%)	4–5 SPT + (%)	> 5 SPT + (%)
A	19.00	58.15	16.32	7
B	13.76	57.33	20.18	9
C	8.18	57.27	25.45	8
D	7.31	43.90	34.14	15

^aGroup A = 1–3 years; Group B = 4–6 years; Group C = 7–9 years; Group D = 10–17 years.

Table 2

Distribution of the sensitization to each respiratory allergen^a

Group ^b	D.P. (%)	D.F. (%)	G. (%)	P. (%)	O. (%)	C.D. (%)	F. (%)	Al. (%)	As. (%)
A	75	75	27	15	16	13	7	15	6
B	75	72	43	22	20	19	7	16	6
C	73	70	58	24	24	17	5	7	2
D	75	69	60	40	32	23	7	17	6

^a(D.P.), *Dermatophagoides Pteronyssinus*; (D.F.) *Dermatophagoides Farinae*, (G.) Grass, (P.) Parietaria, (O.) Olive, (C.D.) Cat and Dog danders, (F.) Feathers, (Al.) Alternaria, (As.) Aspergillus, in each age group.

^bGroup A = 1–3 years; Group B = 4–6 years; Group C = 7–9 years; Group D = 10–17 years.

sensitized to Feathers and 1 subject to Danders (Fig. 4).

In the entire monosensitized population the allergy to house dust mites and to grass pollens was the most frequent and the frequency of sensitization to house dust mites was as frequent as sensitization to pollens.

3.1. Influence of age

The percentage of children sensitized to only one allergen tended to decrease with age of the subjects: they were 19% in group A, 13% in group B, 8% in group C, 7% in group D ($\chi^2 = 10.03$, $P = 0.02$). An opposite tendency was observed in individuals who had 4, 5 and > 5 skin prick tests positive: being respectively, 23% in group A, 29% in group B, 32% in group C, 49% in group D ($\chi^2 = 15.3$, $P = 0.002$) (Table 1).

The frequency of patients sensitized to house dust mites was similar in the four age group ($\chi^2 = 0.15$, $P = 1.0$) (Table 2).

The frequency of patients sensitized to pollens tended to increase with age (Grass: $\chi^2 = 27.6$, $P = 0.000$; Pellitory: $\chi^2 = 15.2$, $P = 0.002$; Olive: $\chi^2 = 7.4$, $P = 0.07$) (Table 2).

The sensitization to *Dermatophagoides Pt* and *Fa* was more frequent than the sensitization to grass pollens in group A ($\chi^2 = 44$, $P = 0.000$), B ($\chi^2 = 43$, $P = 0.000$) and C ($\chi^2 = 5.09$, $P = 0.02$), but not in group D ($\chi^2 = 3.3$, $P = 0.06$).

Within the monosensitized individuals, the frequency of sensitization to house dust mites was higher than the frequency of sensitization to grass pollens in group A (43% vs. 18%) and B (53% vs. 30%). In contrast, in the oldest age groups (C and D), the frequency of children monosensitized to grass pollens was higher than that of patients monosensitized to house dust mites (60% vs. 30% and 66% vs. 0 respectively).

No significant difference was observed in the prevalence of the sensitization to danders ($\chi^2 = 2.8$, $P = 0.5$), feathers, alternaria and aspergillus, among the four age groups. The sensitization to these allergens was always lower than sensitization to house dust mites or to pollens in each age group.

4. Discussion

The main findings of the present study are (a) most of the children in all groups had 2 or 3 positive prick tests; (b) in the oldest age group it was found that there was an increase of polysensitized children, and an increase of patients who were sensitized to grass, olive and parietaria allergens; (c) in monosensitized individuals the allergy to grass pollens and to house dust mites was the most frequent; (d) the house dust mites sensitization remained constant in the four age groups and it represented the main cause of asthmatic symptoms in the population studied, followed by sensitization to pollens, danders and moulds.

It is well known that although genetic factors have a great importance for developing an allergy, environmental factors also play a major role in the sensitization. The relative prevalence of various allergens have been widely reported in many studies carried out in different countries.

The maximal prevalences reported in other countries are: Grass: 71% in Turkey, Parietaria: 68% in Greece, Olive: 40% in Italy, *Dermatophagoides Pt.* and *Fa.*: 94% in Turkey, Alternaria: 38% in Hungary, Aspergillus: 56% in Russia, Cat 31% and Dog 19% in Sweden (Perzanowski et al., 1998).

In our sample population (asthmatic children from Chieti-Pescara area) the house dust mites and grass pollens are the most common sensitizing allergens, possibly reflecting regional factors. This area enjoys a humid and mild climate. The high prevalence of dust mite sensitization is consistent with other data of the literature (Sporik et al., 1990; Sarpong et al., 1997; Nelson et al., 1996). Quality and growth of dust mites appear to be directly related to humidity. In geographic areas with high relative humidities, such as the Mediterranean Sea regions, mites are found in nearly 80–100% of homes. In addition, some researchers have pointed out that there is a decrease in the number of mites with increasing altitude. Mite sensitization is the strongest association with asthma in almost all humid areas of the world. Clinical and epidemiological studies have demonstrated that sensitization and exposure to indoor allergens are risk factors for acute

asthma requiring treatment in the emergency department, and many studies have shown a close relation between allergic sensitization and asthma (Sporik et al., 1995; Von Mutius et al., 1994; Platts-Mills et al., 1995; Braback et al., 1994). Dust mite is the only indoor allergen for which it has been demonstrated that avoidance leads to beneficial results. There is good evidence that house dust allergic patients with asthma can improve if they are kept in dust-free conditions (Ehnert et al., 1992). In our study pollens (especially grass) were the other common allergen. More than house dust allergens, pollens showed a seasonal variation as their survival depends on humidity. We found that a high percentage (83%) of asthmatic patients studied had coexisting allergic rhinitis. It is common knowledge that rhinitis is closely associated with asthma, and subjects with allergic rhinitis have an increased airway responsiveness (Cockcroft et al., 1983).

The results of our study are similar to what was observed in other Mediterranean countries, but they are different from those of North and East European countries, where the danders and moulds, respectively, are the dominating allergens in children with respiratory symptoms (Ronmark et al., 1998; Perzanowski et al., 1998). In the USA, 15–40% of atopic individuals are allergic to cats or dogs.

The importance of our study is to report the distribution of different allergens in the Chieti-Pescara area. In fact, to know that the local situation can contribute to helping the physician in the diagnosis, prevention and treatment of allergic diseases.

Moreover, our data confirm the importance of age in determining a respiratory polysensitization, which is more frequent after ten years, as shown also by other authors (Trandafilovski et al., 1998). Age is also a relevant factor in increasing sensitization to pollens, in agreement with others studies (Silvestri et al., 1996; Niemeijer et al., 1992). An increased prevalence of sensitization to common allergens with age up until adulthood has been described and allergy tends to vary with the age of the subjects (Barbee et al., 1987). Our analysis demonstrates that, during childhood, indoor allergens such as house dust mites impose a

higher risk of sensitization than outdoor allergens. On the contrary, sensitization to outdoor allergens like pollens increased with age, because many years are necessary to establish this allergy.

The relationship between age of children and polysensitization can be useful for a first evaluation of the patient. Moreover, our data can be an indirect confirmation of the well-known association between the increase of asthma with the increase of age (Erel et al., 1998). In fact, asthma is strongly associated with type 1 allergy (Burrows et al., 1989) and type 1 allergy shows a different sensitization profile in different environments and in different parts of the world. For this reason, only local geographical studies are useful in order to understand the real prevalence of sensitization, which can be associated with an increased risk of asthma in those children who live in that area.

In conclusion, our study contributes to the collection of basic data for a more precise diagnosis, treatment and prevention of respiratory allergy (mainly asthma) in pediatric age.

The large number of children studied in a well defined area can contribute to clarify the local situation of the environmental causes of respiratory sensitization. Moreover, the age-dependent prevalence of polysensitization can be helpful for the better definition of the magnitude of the respiratory sensitization in this area. If further and larger studies will increase our knowledge about this problem, we can have more information about the risk factors of developing asthma in our area.

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