

Skin tests and atopic allergy in children

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Summary

The onset of asthma has been found to follow a similar pattern in boys and girls. Eczema is associated with early onset of asthma, with frequent positive skin reactions and with a history of food allergy. Wealing reactions to inhalant allergens are commoner in later childhood and are more often large, exceeding 5 mm in diameter, in children over 5 than in those under 5. Skin reactions to foods are also more common in older children but large reactions to foods show less tendency to be commoner over the age of 5. Children born in tropical countries had less atopic disease than children of similar race born in England or than English children. Although asthmatic children, wherever they were born, frequently gave positive skin reactions to mite extracts it is possible that the total 'allergic bombardment' to which children are exposed in England is greater than it is in tropical countries and that this may explain the difference in prevalence of atopic disease which is not explainable on genetic grounds.

Introduction

The prick test has been validated by clinical experience and scientific enquiry as a valuable method of investigation (Squire, 1949). Like other investigations in clinical medicine, it is subject to inaccuracy if incorrectly performed and its results must be interpreted against the background of the clinical examination and history. Stenius and her colleagues (1971) have shown that there is a highly significant statistical correlation between weal size on prick testing in persons sensitive to the *Dermatophagoides* mites or to grass pollen and the clinical history, nasal provocation tests and measurements of specific IgE in serum. In a second paper Stenius and her colleagues (1972) failed to find a correlation between total IgE levels and the age of the patient, age of onset of symptoms, duration, frequency, or severity of symptoms. A highly significant correlation was, however, found between total IgE and the number of positive skin test reactions and sizes of these reactions. It is presumed that the patients referred to by Stenius and her colleagues in both papers were adults. Further examination of some of their conclusions in children seemed desirable, since clinical experience has suggested that

there may be correlations between skin test results and clinical findings other than those found by Stenius and her colleagues. The skin in children is responsive on prick testing; the results are remarkably repeatable if the technique is correct and the correlation with the clinical history is good. The relationships between the size of wealing reactions on prick testing and clinical history of allergic disease in children have already been reported (Smith, Harding & Cumming, 1969). It has been shown that, for grass pollen, common foods and *Dermatophagoides* mites, the larger the wealing reaction the greater is the chance that the reaction indicates a clinical sensitivity. Thus asthmatic children with wealing reactions to these allergens with weals of 5 mm or more in diameter can be expected to have a clinical history consistent with allergy to the allergen in at least 75% of cases.

It was decided to examine positive prick test reactions in atopic children as indication of specific IgE and to consider the findings in relation to the onset of clinical disease.

Methods

During 1969, 1970 and 1971 over 700 new patients were seen at a special clinic in Birmingham for school children between 5 and 18 years of age suffering from asthma and atopic disease. In most cases a detailed clinical history was obtained and investigation was carried out to a uniform pattern. At a paediatric clinic over 400 similar children under 5 years of age were examined under similar conditions. Thus information was collected relating to about 1100 atopic children of all ages up to 18. As would be expected from the epidemiological studies in Birmingham (Smith, 1961; Smith *et al.*, 1971) and elsewhere, there were twice as many boys as girls seen.

Prick tests were carried out using the same methods, operators and extracts. These extracts are listed in Table 1 and were obtained from the Bencard Allergy Unit except for the extracts of *Dermatophagoides pteronyssinus* and *Glycyphagus domesticus* which are prepared in Dudley Road Hospital. Measurements of the diameter of the wealing reactions were made in 440 children under 5 and in an unselected group of 100 of the children over 5.

Table 1

Control	Chocolate
House dust	Peas
Feathers	Beans
Horse hair	Tomato
Kapok	<i>Dermatophagoides pteronyssinus</i>
Cat fur	<i>Dermatophagoides farinae</i>
Dog fur	<i>Glycyphagus domesticus</i>
Grass pollen	<i>Cladosporium</i>
Shrub pollen	<i>Alternaria</i>
Tree pollen	<i>Aspergillus fumigatus</i>
Egg	<i>Penicillium</i>
Milk	Dry rot
Fish	<i>Sporobolomyces</i>
Wheat	<i>Ustilago</i>
Oats	<i>Botrytis</i>

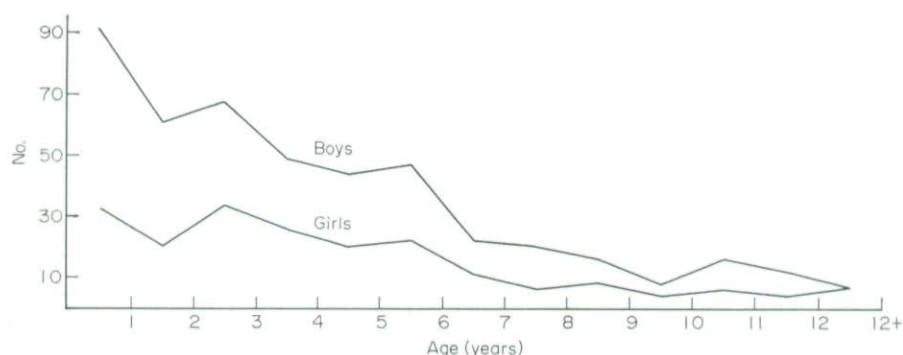


Fig. 1. Age of onset of asthma.

Results

In children over 5 the pattern of onset of asthma is shown in Fig. 1. Proportionally the onset is similar in boys and girls. The occurrence of atopic eczema was found to be associated with a significantly earlier age of onset of asthma (Table 2). There was an association between eczema and a history of food allergy but no association between eczema and a history of hay fever.

Positive prick reactions to three or more allergen groups were associated with a significantly earlier onset of asthma ($P < 0.01$) as shown in Table 3.

In children under 5 and over 5 the percentage of positive prick reactions to the main allergen groups is shown in Fig. 2. In the case of each allergen group a higher percentage of the children over 5 gave positive reactions and a lower percentage failed to give any positive reactions. It may be noted that using the extracts at present available and generally considered of importance only 5% of the asthmatic children over 5 years of age in this series failed to give any positive reactions. The percentage of asthmatic children with positive reactions to one or more allergen groups increased with increasing age (Table 4). Large wealing reactions of 5 mm or more in diameter

Table 2. Number of positive skin reactions

Age of onset (years)	No. of positive skin reactions							Total
	0	1	2	3	4	5	6	
-1	19	28	20	27	11	9	9	123
-2	7	14	20	13	11	5	11	81
-3	6	22	27	17	12	8	10	102
-4	5	20	19	14	4	5	8	75
-5	6	8	21	14	4	5	6	64
-6	6	20	26	6	4	6	2	70
-7	2	10	10	8	1	1	1	33
-8	3	7	9	3	3	1	0	26
-9	2	5	5	5	2	4	1	24
-10	2	3	3	1	2	1	0	12
Over 10	2	16	16	6	4	4	3	30
Total	60	153	176	114	58	50	51	662

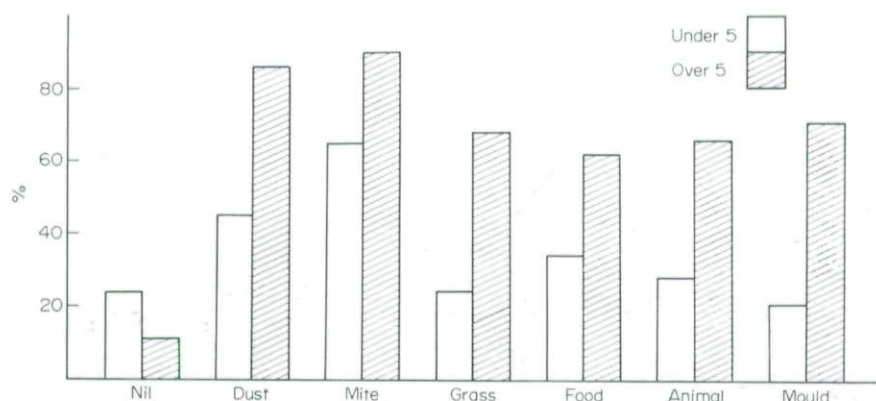


Fig. 2. Percentage of patients with positive reactions.

were commonest to mite extracts (Fig. 3) and were fairly frequent under 5. Such reactions were almost as common to pollen extracts but not nearly so common under 5. Large reactions to foods occurred in children under 5 and over 5 but large reactions to animal danders and moulds were almost absent in children under 5.

In the children over 5 information was available about race and place of birth. Negro children, born in England, had atopic eczema as frequently as European children born in England (Table 5). It has previously been reported that Negro children born in England have at least as high a prevalence of asthma as European children born in England but a very much higher prevalence of asthma than Negro children born in the West Indies (Smith *et al.*, 1971). Atopic disease in immigrant children arriving in Birmingham from tropical countries appears to be uncommon, as shown by

Table 3. Eczema and age at onset of asthma

Age at onset	Eczema	No eczema	Total
0-1	36 (21%)	87 (18%)	123
2-4	105 (60%)	219 (45.5%)	324
5-9	27 (15.5%)	130 (27%)	157
10+	6 (3.5%)	46 (9.5%)	52
Total	174 (100%)	482 (100%)	656

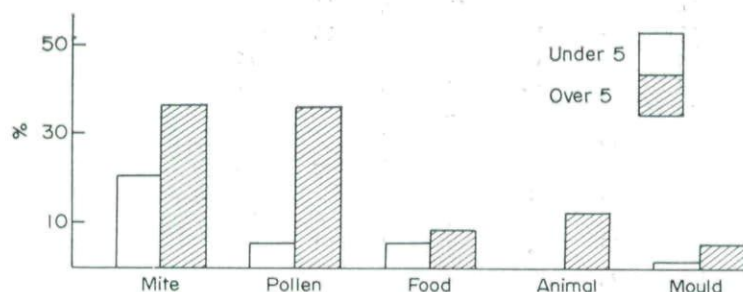


Fig. 3. Percentage of patients with weals of 5 mm or more.

the results of screening children at a special clinic before entry to school in Birmingham (Table 6).

Positive skin tests to mite extracts are common in asthmatic children of all racial groups wherever they are born. Although the number of asthmatic children in this series who were born abroad is small nearly all had positive skin reactions to mite extracts (Table 7).

Table 4. Percentage of patients with positive reactions to allergen groups

Age (years)	No. of positive reactions to allergen groups						
	0	1	2	3	4	5	6
-1	41	25	23	0	5	2.5	2.5
-2	40	9	22	22	3.5	2	0
-3	26	10	27	14	17	4	1
-4	17	14	23	18	16	7	7
-5	11	11	24	18	14	13	10
<5	24	13	24	16	12	6	5
>5	6	2	6	8	26	15	37

Table 5. Eczema in children with asthma who were born in U.K.

Race	Eczema		Total
	Yes	No	
European	141 (148.08)	362 (354.91)	503
Negro	38 (30.91)	67 (74.09)	105
Total	179	429	608

Figures in parentheses are expected numbers. $\chi^2 = 2.78$ N.S. There is no statistically significant difference in the incidence of eczema between European and negro children born in the U.K.

Table 6. Atopic disease in immigrant school children

	Asian		Negro			Total
	Born in Asia	Born in Africa	Born in West Indies	Born in Africa	Others	
Asthma	1	0	1	0	0	2
Eczema	1	0	0	0	0	1
Hay fever	0	0	0	0	0	0
None	646	175	181	17	19	1037
Total	648	175	181	17	19	1040

Table 7. Racial groups and positive mite skin reactions

	European		Asian		Negro		Other		Total
	U.K.*	U.K. Abroad	U.K. Abroad	U.K. Abroad	U.K. Abroad	U.K. Abroad	U.K. Abroad	U.K. Abroad	
Positive to mites	384	22	17	89	6	27	5	550	
Negative to mites	94	3	1	10	0	4	0	112	
Total	478	25	18	99	6	31	5	662	
	478	43		105		36			

* Place of birth.

Discussion

The results suggested that positive prick test reactions are acquired by atopic subjects progressively in childhood (Fig. 2). Thus, children who react to one group of allergens are likely to acquire reactions to other groups, at least up to the age of 5. The size of reactions to most groups tends to increase with age (Fig. 3), but foods may be an exception to this. Those who develop asthma in early life seem to acquire positive reactions to more groups of allergens than those who acquire positive reactions later in childhood. There is evidence of a sequence in which positive reactions are commonly acquired. Reactions to common foods are often acquired early in life, whereas reactions to pollen, animal danders and moulds are acquired relatively late. Reactions to mites are acquired relatively early and increase in size and frequency, whereas this may not be so in the case of foods. It might be concluded that the alimentary tract is an important route of sensitization in very early life, but that the respiratory tract is the main route and becomes increasingly important with age.

It is not clear whether acquiring sensitivity to one group of allergens predisposes to sensitivity to others, but the intensity of the 'allergen bombardment' on genetically predisposed children may contribute to the occurrence of sensitization and clinical disease. This is suggested by the finding that atopic disease is much more frequent in immigrant racial groups born in England than in children of the same racial group born in poor tropical countries in which important airborne allergens such as grass pollen are probably scarce and where breast-feeding may yet be more common than in England (Grantham-McGregor & Black, 1970).

Positive skin reactions to mites are common in patients with atopic disease who have been born in tropical countries and have frequently been the only reactions obtained. Buchanan & Jones (1972) report that positive skin reactions to mite extract are frequent in asthmatic patients in Zambia, while R. S. Bruce Pearson (personal communication, 1972) found the same thing in Barbados. Mites were plentiful in dust samples from houses in Zambia and in Barbados, particularly during the rainy season. It is, however, possible that children in these countries live a more open-air life than children in temperate climates, which may reduce their exposure to house dust and to mites.

It appears that atopic disease and positive skin reactions build up during early childhood, possibly using up most of the genetically-prone population in 5 or 6 years, and then some years later, in adolescence, atopic disease declines with clinical recovery in many cases (Smith *et al.*, 1971; Williams & McNicol, 1969; Dawson *et al.*, 1969).

In my experience children with large and multiple skin reactions to common allergens have less tendency to recover in adolescence. However, the most obvious factor related to the prognosis of asthma in childhood is the clinical severity of the condition, which is not closely related to the size and number of skin reactions or to IgE levels (Kumar *et al.*, 1971).

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