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Dog and Cat Allergens and Asthma among School Children in Los Alamos, New Mexico, USA: Altitude 7,200 feet

Key Words

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Abstract

A survey of the Middle School in Los Alamos, N.M., USA, identified 57 children with symptoms of asthma and 54 controls. Among these children, sensitization to cat and dog allergens was very strongly associated with bronchial reactivity and symptoms. In contrast, sensitization to mites, cockroach, or grass pollen allergens was not significantly associated with symptoms or bronchial reactivity. In keeping with these results, dust from houses in Los Alamos only contained high levels of cat or dog allergens.

Introduction

As judged by prevalence studies, hospital admissions, emergency room visits or mortality, there has been an absolute increase in asthma between 1960 and the present [1]. Several different explanations for this increase have been proposed, e.g. increased air pollution, possible harmful effects of adrenergic agonists, increased frequency of viral infections and increased exposure to the major indoor allergens. In all studies on children or young adults with asthma, the prevalence of sensitization to allergens has been very high [1, 2]. Thus it seems likely that allergens are either a major cause of the increase in asthma or that the relevant factors act selectively on allergic individuals. In many areas of the world, the prevalence of sensitization to dust mites among asthmatics is so high that it is possible to propose that improved conditions for dust mite growth are the cause of the asthma epidemic [1–7]. However, there must be other contributing factors, because increases in asthma prevalence have been documented in areas where mite growth is not a convincing explanation, e.g. northern Sweden, Fin-

land, and in big cities in the northern USA [8]. The question then arises whether general changes in houses could have caused a major increase in asthma. The temperature of houses has increased since 1960 and modern housing construction decreases ventilation drastically. In addition, fitted carpets represent a major reservoir for many different allergens [6, 9].

The Mountain States of the USA: Los Alamos, N.M., Middle School

A large area in the center of the USA is elevated and so dry that dust mites do not survive. Asthma is not absent in these areas, although there have been no studies documenting increases comparable to those in other areas. Los Alamos is a 'perfect' high-altitude town, with a stable population. We chose to study children aged 12–14 years (i.e. 7th and 8th grades). The study used a protocol developed in Virginia and based on that used by Peat et al. [2] in Australia. In the first phase, a questionnaire and assessment of lung func-

tion were conducted in school on the whole age group (approximately 550 children). Subsequently about 60 symptomatic children and about 60 random controls were studied in detail in a medical setting using bronchial provocation with histamine, skin tests, and assays for IgE antibody (Ab). Finally, in the third phase, about 100 houses were visited.

Sensitization and Prevalence

From the questionnaire, 18% of the children had been prescribed an asthma medicine while 13% were currently on treatment. On the other hand, using the stricter criterion of symptomatic bronchial reactivity, we estimated that about 6% of the children had asthma [10]. The prevalence of symptoms, treatment for asthma and symptomatic bronchial reactivity was the same among children born in the town as in the newcomers [10]. As judged by skin tests or IgE Ab, sensitization to cat dander and a range of pollens, particularly mountain cedar, Russian thistle and grass pollen, was common. Sensitization to dust mites or cockroach was much less common. Subsequently, serum assays were extended to dog dander (table 1) [11]. Comparing the prevalence of sensitization in children with asthma, symptomatic children, and asymptomatic controls allowed several conclusions: (a) sensitization to cat and/or dog dander was very strongly associated with asthma; (b) sensitization to mite allergen was not associated with bronchial reactivity and was actually more common among children with symptoms but no bronchial hyperreactivity; (c) cockroach sensitization was weakly associated with asthma as judged by skin tests, and (d) sensitization to pollens was common but was not associated with asthma.

Allergen Levels in Houses

Dust samples obtained from 111 houses were analyzed for group I mite allergen [Der p 1 and Der f 1], cat [Fel d 1], dog [Can f 1], and cockroach [Bla g 2] allergens [6, 9, 12] (table 2). As expected, the levels of mite and cockroach allergens were low or very low in these houses. In contrast, indoor cats and dogs were very common and the concentrations of Fel d 1 and Can f 1 were consistently high in houses with animals. A striking feature of the results was that cat and dog allergen in houses without animals were also elevated sometimes to values $>10 \mu\text{g/g}$ [11]. Again, in keeping with several previous studies, the levels of allergen in the houses did not correlate well with symptoms of asthma.

Table 1. Sensitization to cat allergen among middle school children in Los Alamos, N. M.

	Asthma (n = 21)	Symptoms (n = 36)	Controls (n = 54)	p ^a
Cat	13	10	9	<0.001
Dog	14	7	8	<0.001
Mite	1	6	2	NS
Cockroach	0	0	1	NS
Grass	6	9	22	NS
Russian thistle	10	10	12	<0.05

Sensitization was defined by detectable serum IgE Ab. NS = Not significant. Values in the table indicate the number of children with evidence of sensitization.

^a χ^2 for trend.

Table 2. Allergen levels in the houses of children in Los Alamos, N. M.

Allergen	Concentration	Symptomatic ^a (n = 50)	Controls (n = 47)
Group I mite allergen	$>10 \mu\text{g/g}$	0	0
	$>2 \mu\text{g/g}$	3	2
	$<2 \mu\text{g/g}$	47	45
Cockroach, Bla g 2	$>10 \text{ U/g}$	0	0
	$>2 \text{ U/g}$	1	1
	$<2 \text{ U/g}$	49	46
Cat, Fel d 1	$>10 \mu\text{g/g}$	29	23
	$>2, \leq 10 \mu\text{g/g}$	14	20
	$<2 \mu\text{g/g}$	7	4
Dog, Can f 1	$>10 \mu\text{g/g}$	35	32
	$>2, \leq 10 \mu\text{g/g}$	10	12
	$<2 \mu\text{g/g}$	5	3

Allergens were assayed in extracts of house dust obtained from four sites; the highest value in the house was taken as defining exposure.

^a Symptomatic children include those with bronchial hyperreactivity (n = 18) and those with symptoms of wheeze in the last year but a negative bronchial response to histamine (n = 32).

These findings demonstrate the following. Asthma is common in a community where the levels of mite and cockroach allergen are too low to give rise to sensitization or a risk for asthma. The levels of cat and dog dander in the houses in Los Alamos, i.e. $>10 \mu\text{g/g}$, are sufficient to cause sensitization and the associated risk of asthma. Children who live in a house without a cat or dog may be exposed to these allergens (a) visiting houses with animals, (b) in child care or school facilities, and (c) in their own houses.

Conclusions

These results from a mountain town in the USA extend the evidence about the importance of the indoor environment in relation to asthma. In keeping with studies from other dry areas, it is clear that sensitization to cat and/or dog dander is the dominant association with asthma. In addition, the levels of mite and cockroach allergens in this town were very low, and sensitization to these was not common and was not associated with asthma. As has been reported from New Zealand and Briançon, France, pollen sensitization was common, but was not associated with asthma [7]. The question is therefore whether the combination of changes in houses and increased time spent indoors could explain the increases in asthma. Perhaps the most convincing answer is that these changes have made a major contribution but that other factors have contributed. The major 'other factors' would appear to be: intercurrent viral infection (predominantly rhinovirus); air pollution (but notably pollution relat-

ed to western existence, i.e. car exhaust, rather than sulfur, nitrogen oxide emissions or particulates), and the harmful effects of β_2 -adrenergic agonist. What is most striking is that for each of these factors, there are published studies suggesting that the effects are restricted to allergic individuals [13–15].

Thus, the hypothesis is that the asthma epidemic worldwide has been caused by a series of interacting factors. However, the role of pollution, virus infection and the adrenergic agonists is restricted to, or at least focussed on, allergic children. Thus, the driving force for the epidemic is likely to be changes in housing conditions.

Acknowledgments

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