
Cockroach allergy appears early in life in inner-city children with recurrent wheezing

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Background: Cockroach allergy and exposure to high levels of this allergen are important in the increasing asthma-related health problems among young inner-city children. However, there are very little data regarding the prevalence of cockroach allergy in infants and young children with asthma.

Objective: This retrospective study was designed to test the hypothesis that cockroach allergy appears early in life in young children with recurrent wheezing.

Methods: We reviewed the medical records of all 196 children (ages 5 months to 16 years) evaluated between January 1995 and September 1997 at the Cook County Hospital Pediatric Allergy Clinic for recurrent wheezing. The patients were assigned into two age groups, less than 4 years old and 4 to 16 years old. The percentages of IgE skin tests positive for common aeroallergens were compared within and between the two age groups. All children in the younger age group were tested for cockroach and dust mites, cat, and dog when indicated by positive environmental history. All children in the older age group were tested for indoor and outdoor allergens.

Results: Sixty-three children were younger than 4 years of age, and of these, 15 (23.8%) had cockroach allergen sensitivity, compared with only eight patients (12.7%) who were skin test positive to dust mite allergen ($P = .01$). The youngest patient with a positive reaction to cockroach allergen was 6 months old. Patients with a single allergen skin reactivity were considered as monosensitized. Nine children younger than 4 years of age (14.3%) were monosensitized only to cockroach allergen in contrast to three children (4.8%) who were monosensitized to house-dust mites ($P < .05$).

Conclusions: Our data suggest that cockroach allergen sensitivity starts early in life and may be the only sensitizing allergen in many young inner-city children.

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INTRODUCTION

An estimated 4 million American children suffer from asthma.¹ Since the late 1970s, asthma prevalence, morbidity, and mortality have been dramatically increasing despite advances in medical technology and the development of new pharmacologic agents for the treatment of asthma.^{2–4} Residents living in poor inner-city areas are disproportionately at high risk for asthma morbidity and mortality.^{5,6} One

of the reasons for this might be due to chronic exposure to indoor allergens, and high indoor allergen exposure is a significant risk factor for asthma. The major indoor allergens in the inner-city causing asthma are house-dust mites and cockroach allergen.^{7,8} Although it is now clear that cockroach allergen is a significant contributor to asthma,^{9,10} the data on the prevalence of cockroach allergy in young inner-city children are limited. Most of the recent studies have examined the prevalence of cockroach allergy in children 4 years and older.^{11,12}

Children less than 4 years old have the highest hospitalization rates for asthma.¹ However, very few studies have examined the prevalence of cock-

roach allergy in children less than 4 years old. Therefore, this retrospective study was designed to determine the prevalence of cockroach allergy in young children and to test the hypothesis that cockroach allergy appears early in life in children with recurrent wheezing.

METHODS

Study Design

A retrospective chart review was used to investigate whether there are differences in the prevalence of cockroach allergy between younger and older children who were seen in the Cook County Children's Hospital Allergy and Immunology Clinic. We grouped the data into two age groups, children younger than 4 years and 4 years and older.

Subjects

Cook County Children's Hospital in Chicago provides service mainly to patients with no private medical insurance. One hundred ninety-six children were referred to the Cook County Children's Hospital Allergy and Immunology Clinic by their primary care physicians from January 1995 through September 1997 for evaluation of recurrent wheezing. Recurrent wheezing was defined as two or more episodes of wheezing during the child's life. All 196 children were included in the study. The patients' ages ranged between 5.7 months and 16 years. The study population consisted of 69.9% African-Americans, 26.5% Hispanics, 1% Caucasians and 2.5% other ethnic groups (Asians, Indians, or patients with mixed ethnic background). Sixty-three of the study patients were younger than 4 years of age.

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Table 1. Subject Characteristics

	Total	<4 yrs	>4 yrs
# of patients	196	63	133
Age (years)			
Mean $\pm$ SEM	6.6 $\pm$ 4.2	2.1 $\pm$ 1.0	8.7 $\pm$ 3.4
Range	5.7 mo–16 yr		
Gender			
Male	126 (64.2%)	37 (58.7%)	89 (66.9%)
Female	70 (35.7%)	26 (41.3%)	44 (33.1%)
Race/Ethnicity			
African American	137 (69.9%)	45 (71.4%)	92 (69.2%)
Hispanic	52 (26.5%)	13 (20.6%)	39 (29.3%)
Caucasian	2 (1%)	2 (3.2%)	0
Other	5 (2.5%)	3 (4.8%)	2 (1.5%)

Measurements

As part of the routine evaluation, all patients were skin tested with extracts of house-dust mites *Dermatophagoides pteronyssinus* and *Dermatophagoides farinae*, and cockroach extracts using the Pepys skin prick test method.¹³ Patients 4 years or older were also tested with other common aeroallergens including cat hair and pelt, dog dander, molds, grass mix, tree mix, and ragweed mix extracts (Bayer Corp., Spokane, WA). Patients less than 4 years old were tested with cat and/or dog antigens only when indicated by their environmental histories. A negative control (normal saline) and a positive control (histamine) were included. The test for a specific allergen was considered positive if the diameter of the wheal was at least 3 mm larger than the negative control.

As part of the environmental history, the parents were asked to fill out a questionnaire which sought to document the presence of cockroaches in their homes. They were also questioned about pet ownership.

Statistical Analysis

Data were analyzed using the Statview software program (Abacus Concepts, Inc.), on a Macintosh computer. Bivariate tests of significance were analyzed by the χ^2 method. A *P* value of $< .05$ was considered statistically significant.

RESULTS

There were 196 children who were referred and evaluated for recurrent wheezing. All of them had complete

records for age, sex, ethnicity, environmental history, and skin test results, and they were all included in the study. Table 1 shows the patients' characteristics. Among the 196 study subjects, 63 were younger than 4 years of age, 133 were 4 years or older. Ninety-six percent of the patients were from racial and ethnic minority groups, which is consistent with the ethnic distribution for the area that the clinic serves. The mean age of the patients was 6.6 ± 4.2 years. There were more males than females (126 and 70, respectively).

Table 2 describes the distribution of indoor allergen sensitivity among children younger than 4 years of age. Fifteen of the 63 (23.8%) children in the younger age group had a positive reaction to cockroach allergen. The youngest child with a positive skin test to cockroach was 6 months old. Eight patients (12.7%) in this age group showed positive skin test reactions to house-dust mite. In this younger age group, 36 patients were tested for cat sensitivity, 35 patients were tested for dog sensitivity, and 33 patients were tested for mold sensitivity, in addition to dust mites and cockroach. Among these patients, cat sensitivity was 11%

(4/36), dog sensitivity was 11% (4/35), and mold sensitivity was 9% (3/33).

As was expected, more children over the age of 4 had positive skin tests to aeroallergens in comparison to the younger age group (89% vs 43%, respectively). Of the 133 children who were 4 years or older, 95 (71.4%) were sensitive to cockroach and 87 (65.4%) were sensitive to house-dust mite.

For both age groups, single-allergen sensitization, or monosensitization, to cockroach was more prevalent than monosensitization to the other aeroallergens, and was three times higher in the younger than the older age group ($P = .02$). Figure 1 shows that, when compared with all the other allergens combined, cockroach monosensitization was seven times more common in the younger age group ($P < .005$) and was three times more common in the older age group ($P = .02$). Twenty-eight patients in the younger age group were skin tested for cat, dog, and molds, as well as for cockroach and house-dust mites. Of these, six (21.4%) were monosensitized to cockroach, two (7.1%) to dust mite, one (3.6%) to cat, and none to dog or molds. In the older age group, 10 children had monosensitization to cockroach (7.5%), five children to house-dust mites (3.7%), and seven children (5.2%) to mold. None of these children were monosensitized to pollens, cat, or dog.

Among the children younger than 4 years of age, χ^2 analysis revealed that patients reporting visual evidence of cockroaches in their homes were more likely ($P = .01$) to have positive skin tests (36.7%) to cockroach allergen than patients who denied seeing cockroaches (10% skin test positive). For the older patients, the result was 80.6% skin test positive for those patients

Table 2. Results of Aeroallergen Skin Test Sensitivity among Children Younger than 4 Years of Age

	Dust mite (*n = 63)	Cockroach (*n = 63)	Cat (*n = 36)	Dog (*n = 35)	Mold mix (*n = 33)
SKT Positive	8 (12.7%)	15 (23.8%)	4 (11%)	4 (11%)	3 (9%)

* n is the number of children who were skin tested for that particular aeroallergen.

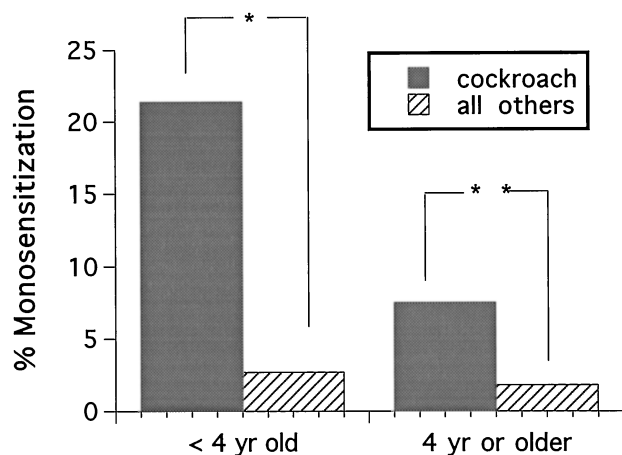


Figure 1. Comparison of monosensitization to cockroach with other allergens. For the younger age group, all others represent dust mites, cat, dog, and molds. The percentage for cockroach monosensitization in this age group is calculated from 9/28, and for all others the percentage is calculated from 3/112. In children older than 4 years, all others represent grass, tree, ragweed, and weed mix in addition to dust mites, cat, dog, and molds. In this group, the percentage for cockroach represents 10/133, and for all others, 12/665. *, $P < .005$, **, $P = .02$, χ^2 analysis.

who reported seeing cockroaches and 63.8% for the patients who denied seeing cockroaches in their homes ($P = .04$).

DISCUSSION

Since the original description of cockroach sensitivity in 1967 by Bernton and Brown,¹⁴ several reports have suggested an association between sensitivity to cockroach allergens and asthma prevalence.^{8-10,12} Although much of the current literature to date has focused on older children and young adults, only a few studies have examined the prevalence of cockroach sensitivity in infants and young children.^{12,15} In a recent study, Wilson et al¹⁵ reported that in 196 children with infantile asthma, 45% had at least one positive skin test to a common indoor allergen, and 26% of those were to cockroach, making this the most sensitizing agent. Their study suggests that cockroach allergen sensitization is not only a problem of the inner-cities but can be a significant sensitizing factor in rural settings as well.

In this study of infants and young children with asthma, we found that twice as many young children were sensitized to cockroach than to dust mites, whereas the prevalence of sensitization

to the two allergens was comparable in older children. Our study suggests that cockroach is not only the most common sensitizing allergen, but also possibly the first one to appear, as monosensitization to this allergen occurred with the highest prevalence in both of our study groups. For practical purposes, our data might be relevant, as allergen avoidance may be particularly effective especially in monosensitized patients.¹⁶ Des Roches et al¹⁷ take this conclusion one step further and suggest that specific immunotherapy started when children have monosensitization, may alter the course of allergy in preventing the development of new sensitizations. Longitudinal data will help to better understand the natural history of monosensitization in these young children.

The National Cooperative Inner-City Asthma Study (NCICAS) group reported that cockroach is the predominant allergen in inner-city homes.¹² Cockroach skin test sensitization develops in susceptible individuals even with a concentration below the level of detection, and maximizes when levels are above 4 U/g.¹⁴ Rosenstreich et al¹² found that asthma symptoms occur with increased frequency when sensitized individuals are exposed to 8 U/g or more of the cockroach allergen.

There is also evidence that the development of allergic disorders may be related to early exposure of allergens.^{18,19} In our study, the patients with cockroach sensitivity were more likely to have visual evidence of cockroach in their environment. Previous studies suggest that avoidance of potent allergens in early life increases the threshold for sensitization in the infants who are at high risk for allergic disorders.²⁰ Also, reduced exposure of infants to common allergens may prevent, or at least delay, the sensitization.¹⁶ Even after the sensitization has been established, allergen avoidance is still effective in reducing the symptoms.²¹ However, the removal of cockroach allergen from the home environment is not an easy task. The NCICAS group attempted to decrease cockroach allergen levels in the homes of the inner-city children with asthma who had positive skin test reaction to cockroach allergen, however the success was only temporary.²²

In this study we specifically searched for indoor allergen sensitization in very young inner-city children with recurrent wheezing. There are a number of potential limitations of our study. It was a heterogeneous group consisting of children referred for recurrent wheezing with or without a diagnosis of asthma. Possibly in some children in our study wheezing was a temporary phenomenon. However, previous studies suggested that among wheezing patients under 2 years of age who had documented viral infections, sensitivity to inhalant allergens was uncommon.²³ Our results support the findings of a previous study that inhalant allergy, especially cockroach allergy, is a significant contributing factor to infantile asthma.¹⁵

Our study is based on patients from one clinic which serves mainly low-income inner-city patients. Whether these results can be generalized needs to be clarified. However, it is of interest that Wilson et al¹⁵ reported similar results on a mainly Caucasian patient population. In their study, 45% of the children with cockroach sensitivity were from higher socioeconomic classes.

In summary, our data suggest that sensitization to cockroach allergens develops early in life, as early as 6 months of age in one child, and may be more prevalent in very young children than previously appreciated. Therefore, strategies to reduce the exposure of children to cockroach allergen should start in infancy and should be a vital part of asthma management.

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