

Short communication

Cockroach allergen in house dust

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Allergy 1997; 52: 460–464. © Munksgaard 1997.

The cockroach allergen (Bla g 1) content was determined in the floor dust of 46 homes with recent cockroach extermination in Amsterdam, The Netherlands. IgE antibodies to *Blattella germanica*, house-dust mite, cat dander, dog dander, and a mixture of molds were determined in venous blood samples of 46 children (4–12 years) and one of their biologic parents (24–54 years). Specific IgE to cockroach was also determined in a sample of the general population studied in a previous case-control study, one group ($n=20$) with and three groups ($n=76$) without history of cockroach infestation of the home. Cockroach allergen was detected in floor dust from 44% of the homes, with levels up to 3899 ng Bla g 1/g. Seven of the 46 adults and only one of the 46 children studied had positive RAST to cockroach. Geometric mean cockroach allergen concentrations in living room and master bedroom of sensitized adults were similar to those of nonsensitized adults. In the groups of children without a history of cockroach infestation of the home, positive RAST against cockroach was observed in 16% of the children with respiratory symptoms, in 4% of the children without respiratory symptoms, and in 48% of the children with two or more positive RAST to other allergens. Of the 18 children with positive RAST against cockroach, only one had a history of cockroach infestation of the home and 16 (89%) had also positive RAST against house-dust mite.

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Key words: cockroach allergen; cockroach infestation; house dust; specific IgE.

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Accepted for publication 29 November 1996

Cockroach infestations are fairly common in Amsterdam (The Netherlands), *Blattella germanica* being the dominant species. Yearly, the Pest Control Service of the Municipal Health Service performs cockroach exterminations in roughly one of every 40 homes (1). In a number of small transversal studies published since 1966, the etiologic role of cockroach antigen in respiratory disease has been studied. Mostly, antibody levels against *B. germanica* and *Periplaneta americana* were studied in small selected groups of (asthma) patients. In urban atopic populations, elevated specific IgE to cockroach has been reported with prevalences up to 50% (2–17). In Singapore, cockroach infestation of the home was associated with an elevated prevalence of allergic rhinitis (18). Neither the occurrence of specific IgE to cockroach allergens nor the presence of cockroach allergens in house dust had been studied in Dutch populations. The purpose of this pilot study was to analyze the presence of cockroach allergens in the floor

dust of homes with recent cockroach infestation, and to obtain preliminary information on the prevalence of specific IgE to cockroach allergens in children in The Netherlands.

Material and methods

Study populations

Inhabitants of homes with recent cockroach extermination. The pilot study was conducted in 46 homes with recent cockroach extermination. Addresses of homes with recent cockroach extermination were obtained from the Pest Control Service of Amsterdam. Only homes where at least one child aged 4–12 years lived were included in the study. Parents who agreed to participate signed an informed consent form. During the home visit by a trained nurse, a detailed questionnaire about the inhabitants, presence of pets, and home characteristics was administered to the parents.

Sample of general population. In sera of a number of children aged 6–12 years who had participated in a previous case-control study on respiratory symptoms and home dampness (19), antibodies against *B. germanica* were also determined. In this case-control study, questions were asked about cockroach infestation in the house during the life of the child. The subjects were children with one or more of the following reported symptoms and/or diagnosis: chronic wheeze in the past 12 months, cough on most days or nights for 3 consecutive months in autumn/winter season, attacks of shortness of breath with wheezing in the past 12 months, and/or doctor-diagnosed asthma. The sera of the following groups of children were selected:

- 1) 20 children with history of cockroach in the home
- 2) 26 children sensitized to two or more allergens, without history of cockroach infestation
- 3) 25 children with respiratory symptoms (cases), without history of cockroach infestation
- 4) 25 children without respiratory symptoms and without history of cockroach infestation.

Antibody determinations

Venous blood samples were taken from 46 children and one of their biologic parents (24–54 years), usually the mother. After centrifugation, the sera were stored at -20°C . IgE antibodies against *B. germanica* (whole-body extract), house-dust mite (whole *Dermatophagoides pteronyssinus*), cat dander, dog dander, and a mixture of molds were determined with Pharmacia CAP System (RAST FEIA), Pharmacia Nederland bv, Diagnostics, Woerden, The Netherlands (20). RAST results were considered positive at 0.385 kU/l, which was 10% higher than the transition point from class zero to class one.

Specific IgE against cockroach was also determined in the 96 children from the case-control study on respiratory symptoms and home dampness.

Dust sampling and assay for cockroach allergens

In the 46 homes, dust samples were taken from the floors of the living room, the master bedroom, and the child's bedroom, by vacuum-cleaning an area of 2 m² for 4 min in each room. Dust was collected on cellulose filters with a special nozzle marketed by ALK, Hørsholm, Denmark. Between each sampling, the sampling nozzle was cleaned thoroughly with 70% ethanol. The dust samples were extracted by agitation in 0.125 M NH_4HCO_3 , 0.1% NaN_3 , at a ratio of 1 : 10 (w/v) for 2 h at room temperature. The suspension was centrifuged for 15 min at

1000 g and stored at -20°C until analysis. Determination of the amount of cockroach allergen was carried out by ALK, Hørsholm, Denmark, with ELISA, as described earlier (21). This assay uses antibodies reacting with determinants shared by the allergens of *P. americana* (Per a 1) and *B. germanica* (Bla g 1) and does not distinguish between the allergens. In Amsterdam, *P. americana* is rare and was not observed in the homes studied. The results can be expressed in concentration of major allergen per gram of dust, and the limit of detection of the method is 1 ng Per a 1/g dust or, in this case, 1 ng Bla g 1/g dust.

Statistical analysis

Statistical analysis was performed with SPSS-PC version 5.01. The distributions of allergens were skewed and became by approximation normally distributed after ln-transformation. The descriptive results were mainly obtained by frequency tables and 2 by 2 tables.

Results

Cockroach allergens were detected in dust from 20 homes (44%): 12 living rooms (26%), 15 master bedrooms (33%), and seven children's bedrooms (15%). Table 1 presents the concentrations of cockroach allergens in house dust by type of room and by type of floor covering.

Higher concentrations of cockroach allergens were observed in rooms with textile floor covering. On smooth floor coverings, only once (child's bedroom) were cockroach allergens found above the detection level. Fig. 1 shows the concentrations

Table 1. Cockroach allergen in house dust (ng Bla g 1/g) by room and by type of floor covering

	n	GM	Range	% < detection limit
Living room				
All	46	3.3	<d.l.–1923	74
Smooth	10	–	–	100
Smooth plus rug	14	3.4	<d.l.–93	71
Textile	21	6.0	<d.l.–1923	62
Child's bedroom				
All	46	2.0	<d.l.–316	85
Smooth	17	1.3	<d.l.–88	94
Smooth plus rug	4	8.6	<d.l.–84	50
Textile	25	2.5	<d.l.–316	84
Master bedroom				
All	46	5.6	<d.l.–3899	67
Smooth	12	–	–	100
Smooth plus rug	1	–	–	100
Textile	33	11.0	<d.l.–3899	55

GM: geometric mean; d.l.: detection limit.

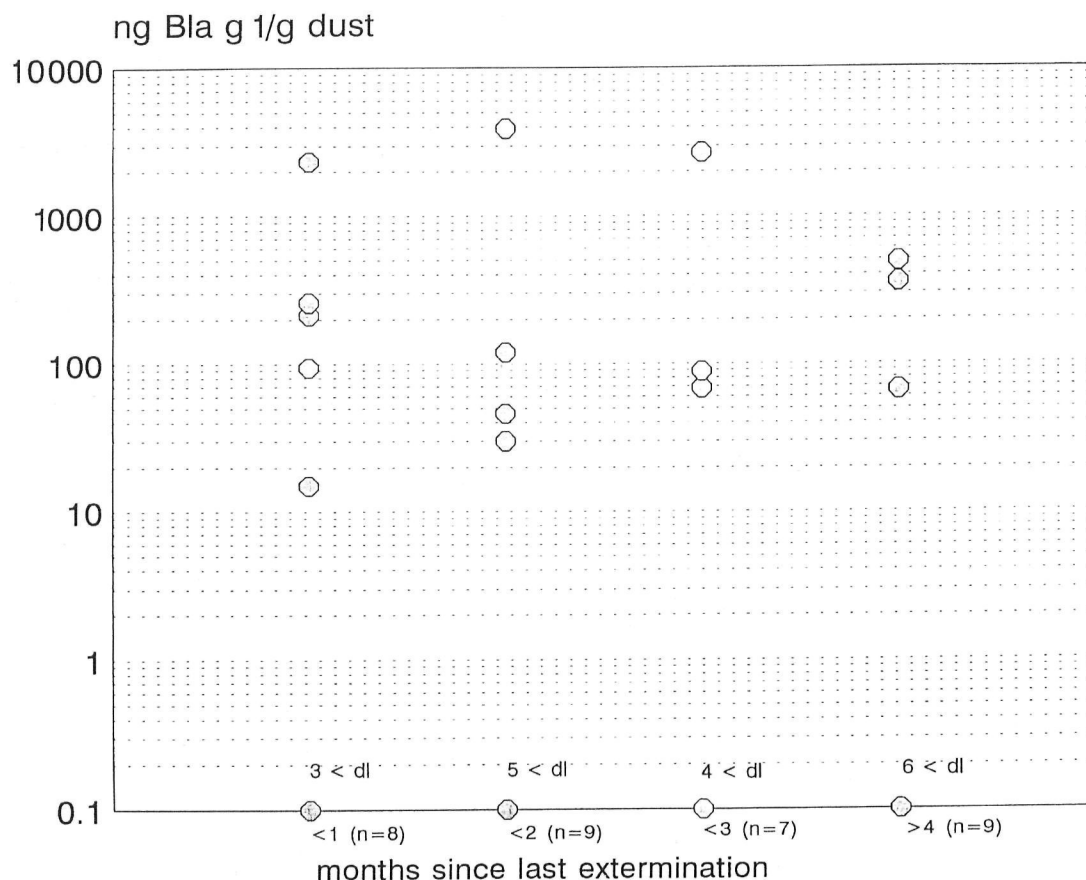


Fig. 1. Cockroach allergen (ng Bla g 1/g dust) in master bedrooms with textile floor covering by month since last cockroach extermination.

of cockroach allergens in the master bedrooms with textile floor covering by months passed since the last cockroach extermination. In the living rooms and the children's bedrooms, the proportion of samples below the detection limit increased similarly.

Seven adults (15%) and only one child (2%) of the study group living in homes with recent cockroach extermination had positive RAST against cockroach. The geometric mean cockroach allergen concentrations in living room and master bedroom of the sensitized adults were 2.0 ng Bla g 1/g dust (range < detection limit [d.l.]–123) and 5.6 ng Bla g 1/g dust (range < d.l.–3899), respectively. The geometric mean cockroach concentrations in the homes of nonsensitized adults were similar, in the living room 3.6 ng Bla g 1/g (range < d.l.–1923) and in the bedroom 5.6 ng Bla g 1/g (range < d.l.–2693). The home of the only child with a positive RAST against cockroach showed cockroach allergens in floor dust from the living room (58 ng/g) and from the child's bedroom (95 ng/g).

The children from the case-control study on respiratory symptoms and home dampness showed

the following results. Of the 20 children with history of cockroach infestation in their home during their lifetime, only one child (5%) had positive RAST to cockroach. Of the children with and without respiratory symptoms, without history of cockroach infestation, four (16%) and one (4%) had positive RAST to cockroach. Of the 26 children with two or more positive RAST and without history of cockroach infestation, 11 (42%) also had positive RAST to cockroach allergens.

The prevalence of positive RAST to house-dust mite among children living in homes with a recent cockroach extermination was 12%. Five of the seven adults with positive RAST to cockroach also had positive RAST to house-dust mite. Two children living in homes with recent cockroach infestation showed positive RAST to dog dander, and one child had positive RAST to cat dander. The single child in this group with positive RAST to cockroach had negative RAST to house-dust mite.

Among the children from the case-control study, 20% of the group without respiratory symptoms had positive RAST to house-dust mite, and in the group with respiratory symptoms, this prevalence

was 44%. The children without respiratory symptoms ($n=25$) and the children with respiratory symptoms ($n=25$) did not have positive RAST to cat and dog dander. Among the 26 children with two or more positive RAST, 96% had positive RAST to house-dust mite. Furthermore, 50% had positive RAST to mold mix, 69% to cat dander, 50% to dog dander, 23% to guinea pig/*Cavia*, and 12% to rat/mouse. Among the 18 children with positive RAST to cockroach, 16 (89%) also had positive RAST to house-dust mite.

Discussion

In this pilot study in Amsterdam, cockroach allergens were detected in dust from 44% of the 46 homes with a recent cockroach extermination, with cockroach allergens levels up to 3899 ng Bla g 1/g dust. Seven of the 46 adults and only one of the 46 children studied were sensitized to cockroach allergen. We found three studies that reported measurements of cockroach allergens in house dust. In two studies, Bla g 2 levels were determined, and in one study the Per a 1/Bla g 1 content was analyzed. Call et al. (22) studied the Bla g 2 levels in house dust in the homes of 35 children with asthma and 20 controls in Atlanta, Georgia, USA. In both groups, the allergen levels ranged up to approximately 1000 units/g in the kitchen. The percentage of homes with high levels of cockroach allergen was reported to be very similar for both patients and controls. Our study found similar levels of cockroach allergen in the homes of adults sensitized and adults not sensitized to cockroach. Sarpong et al. (23) measured median Bla g 2 levels of 3.3 to 10.6 units/g in various sites in 19 bedrooms in a campus dormitory in Baltimore, MD, USA, with the highest level of 388 U/g in a bedroom floor sample. They reported stable Bla g 2 levels during the first 3 months after extermination and weekly vacuum-cleaning, with slowly rising levels thereafter. In our study, the levels of Bla g 1, stratified by month after extermination, did not differ in the homes sampled in the 4 months after extermination. Munir et al. (24) reported that in dust from various rooms of 123 homes of asthmatic children in Sweden, cockroach allergens were detected in only one home (40 ng Per a 1/g dust). In homes with a recent cockroach extermination in Amsterdam, clearly higher levels of Per a 1/Bla g 1 were present in house dust. Probably, the proportion (44%) of homes with detectable levels of cockroach allergen as well as the maximum allergen levels in house dust would have been higher if the kitchen had been included in the sampling program. Schou et al. reported Per a 1 levels ranging from 10 to 10 000 ng/g in house dust from most of the 73

homes in the Tampa area in southern Florida, USA (21).

In the study by Call et al. (22), nine asthma patients and one control had elevated specific IgE to cockroach, while 25% of the children with asthma had specific antibodies to both dust mite and cockroach. In the present study, four (16%) of the children with respiratory symptoms from the case-control study and one (4%) of the group without respiratory symptoms had elevated specific IgE to cockroach. Three (12%) of the children with respiratory symptoms had positive RAST to both house-dust mite and cockroach. In the group of 26 children from the case-control study with two or more positive RAST, almost all with respiratory symptoms, 48% had positive RAST to both house-dust mite and cockroach. However, for none of these children was a history of cockroach infestation reported. This agrees with an earlier report by Baldo & Panzani (25) that 63% of the sera of subjects diagnosed as having inhalant allergies to insects, including *B. germanica*, also contained IgE antibodies to house-dust mite. Recently, Witteman et al. (26) identified a cross-reactive allergen, presumably tropomyosin, in Crustacea, house-dust mite, and cockroach. In the general population, prevalences of house-dust mite sensitization range from 5 to 30% (27). We found sustained elevated levels of cockroach allergen in roughly half of the homes with recent cockroach extermination. As the proportion of cockroach-infested houses can be high, particularly in the lower income city districts, cockroach allergens might contribute significantly to the prevalence of respiratory symptoms.

Acknowledgment

We thank Gitte Nordskov Hansen for technical assistance.

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