

COCKROACH ALLERGY IN DURBAN

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A TRIBUTE TO PAUL POTTER

I was a senior registrar at the Division of Allergy of the Red Cross War memorial Children's Hospital in Cape Town in 1990. We were very keen on using monoclonal antibody techniques to measure indoor allergen levels. This was the first study using this technology in South Africa. We were involved in a study on control of house-dust mites (HDM) using acaricides and other HDM-reduction methods. My supervisors were Prof Eugene Weinberg and Prof Paul Potter.

There were many papers published around that time on cockroach allergy and inner-city asthma. Cockroaches thrive in hot humid environments such as Durban. Prof Potter told a story about when he was an intern at Addington Hospital in Durban. He made tea every morning at the doctor's residence in the hospital using an old kettle. He filled water through the spout and continued with this practice for a long time until, one day to his horror he discovered a large number of dead cockroaches lying at the bottom of the kettle.

When I returned to Durban we decided to study the prevalence of cockroach allergy in Durban. We embarked on this study using monoclonal antibody technology to quantitate and characterise indoor cockroach allergen levels in patients who were allergic to cockroaches.

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INTRODUCTION

Cockroaches have become increasingly recognised as important components of HDM allergens causing allergic sensitisation. Cockroach allergy was reported to cause allergic reactions by Bernton and Brown in 1964 in a study that demonstrated that 40% of their asthmatic patients reacted on skin-prick testing (SPT) to cockroach extract.¹ Many subsequent studies have identified the cockroach as an important indoor allergen, responsible for causing asthma in urban inner-city dwellers.^{2,3,4}

In a study by Kang in Chicago, the United States, on a group of 592 asthmatics, it was demonstrated that more than 60% were allergic to cockroaches. Bronchial-provocation testing in patients with cockroach allergen demonstrated reactivity in 87% of patients. When compared with asthmatics in general, they found that cockroach-sensitive asthmatics had a more severe type of asthma, required higher corticosteroid usage and that more than 90% of these patients had multiple hospital



admissions for acute asthmatic attacks.² Kang et al have demonstrated the aetiological role of cockroaches in asthma in many other studies.^{2,3} Pollart and Gelber, in two separate studies in Charlottesville, Virginia, Atlanta, studied the epidemiological trends in these patients. They showed that both sensitisation and exposure to cockroaches are major risk factors for hospital admission with asthma, especially in patients living in poor social circumstances.^{4,5}

Cockroaches have also been reported to cause asthma in other parts of the world, for example Central America, Asia and South Africa.^{6,8,9} In a study performed in Durban in the 1970s Fraser demonstrated that 30% of asthmatics

presenting at Addington Hospital reacted to cockroach allergen on SPT.⁶

COCKROACH ALLERGENS

There are many different species of cockroach but only three have been implicated in the pathogenesis of asthma. These are the American (*Periplaneta Americana*), German (*Blatella germanica*) and Oriental (*Blatella orientalis*) cockroaches. The important cockroach allergens have been identified using immunochemical techniques. They are designated as Bla g I, Bla g II and Per a I.¹⁰ Bla g I is a *B germanica* allergen and 30–40% of cockroach-allergic patients have serum IgE to Bla g I. Bla g II is a specific *Blatella* allergen and 60–80% of cockroach-allergic patients have specific IgE to Bla g II. Per a I cross-reacts with Bla g I. Its quantification using monoclonal antibodies may indicate total allergen load in our area since it is a common allergen shared by important cockroaches associated with asthma.^{11,12}

AIMS OF THE STUDY

Durban is a coastal city with a warm humid climate conducive to mite and cockroach infestation. It is well known that Durban has a heavy cockroach infestation. The only published data to date on cockroach allergy in Durban was a study conducted by Fraser in 1979. We therefore studied the prevalence of cockroach allergy and environmental contamination in a prospective trial in Durban. Our aims were to:

- assess the level of cockroach sensitisation in Durban asthmatics;
- determine the presence of cockroach allergen in the homes of cockroach-sensitive asthmatics using immunochemical methods;
- assess which assay is most suitable for local environmental surveys.

METHODS

SPTs were performed on 70 asthmatic children selected randomly from our practice. The skin-test extract used was the Dome Hollister Stier extract. The mixed cockroach extract consisted of extracts from *B germanica*, *B orientalis* and *P Americana*. SPTs were performed in a standardised manner with the following extracts: mite, grass, pollen, zea mays, cat, dog, Bermuda grass pollen, moulds, tree pollen, weed pollen and mixed cockroach extract. A wheal diameter of greater than 5 mm was regarded as positive.

Dust was collected from the homes of mite- and cockroach-sensitive asthmatics using a vacuum cleaner over a 1 m² area in the patient's bedroom. The dust was collected from the bedroom floors of 22 patients' homes and dust samples were sent to the Allergology Unit, University of Cape Town Medical School for immunochemical assays. The allergens Bla g I, II and Per A I were measured using monoclonal antibodies. The assays were performed using the method described by Schou et al¹² and the Bla g I antibodies were

purchased from Dr Martin Chapman (United States).

RESULTS

The SPTs were positive to the mixed cockroach allergen extract in 29 of the patients tested (see Table I). This constituted 41% of patients. Skin-test reactivity to HDM was demonstrated in 95% of patients. Cockroach sensitivity is therefore the second most common reactive allergen in SPTs in the Durban area.

TABLE I: SPT ON ATOPIC ASTHMATIC CHILDREN IN DURBAN

Allergen	% Positive
HDM	95%
Cockroach	41%
Cat	22%
Bermuda grass	14%
Dog	7%
Moulds	4%

ALLERGEN ASSAY

Bla g I levels were undetectable in six (27%) homes and found to be moderately high in 15 (68%) homes. It was very high in one home. Bla g II levels were undetectable in the majority of homes studied, that is 18 (81%) and detectable in only four (18%) homes (see Table II). Per a I levels were detectable in all the homes studied (see Figure 1). There were six homes in which Bla g I levels were undetectable but had measurable levels of Per a I, whereas 16 homes had detectable levels of Per a I and Bla g I. Per a I levels (ng/mL) in Figure 1 are shown in ng/mL and can be converted to µg/g dust by multiplying by a factor of 0.38.

TABLE II: COCKROACH ALLERGEN LEVELS (N = 22)

Levels	Number	%
Bla I <0.02 (undetectable)	6	27.3
0.02–5	15	68.2
>5	1	4.5
Bla II <0.02	18	81.8
0.02–5	4	18.2
>5	0	—

Bla g I and Gla g II levels are expressed in µg/gram dust

DISCUSSION

Our study has shown that cockroach allergy is the second most common allergy in asthmatic children following HDM allergy in Durban.

There are significant levels of Per a I allergen in the homes of our cockroach-sensitive asthmatic patients. Our data shows that Per a I is detectable in all the homes that we studied. The low and undetectable levels of Bla g I suggests that *B germanica* is a less important allergen of indoor house dust. The very high levels of Per a I in some

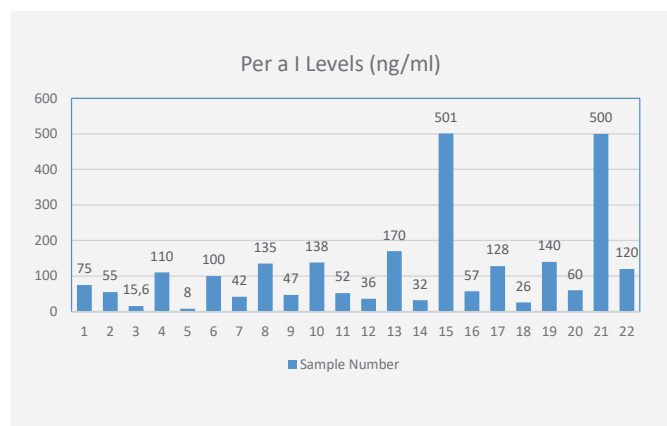


Figure 1: Per a I (ng/mL) can be converted to $\mu\text{g/g}$ dust if multiplied by 0.38

homes suggests that other species of cockroaches such as *B. orientalis* or other species may also be contributing to the total allergen load. Measuring Per a I level is a useful measurement since it quantifies the total allergen load and is not a species-specific allergen.

Considering the studies of Kang et al² and our studies, it is apparent that exposure to cockroach allergens contributes to the pathogenesis of asthma in our patients. The observation that cockroach-sensitive asthmatics are usually steroid-dependant and experience severe symptoms must be kept in mind when treating cockroach-sensitive asthmatics.² These patients often require frequent hospitalisation for acute asthma. Therefore prophylactic asthma therapy and environmental control need to be aggressively instituted in these patients.

Our study also has other important therapeutic implications. When considering immunotherapy for patients with mite-sensitive allergic rhinitis (AR) it is important that cockroach allergy be excluded in the Durban area. Immunotherapy may fail if measures are not introduced to reduce exposure to cockroach allergen.

In practice therefore, it may not be appropriate to desensitise against HDM for nasal allergy if the patient has a concomitant cockroach allergy. Avoidance measures that are used for HDM reduction also help with reducing cockroach exposure. However, the use of fumigation techniques and insect killer sprays must be combined with HDM avoidance protocols in patients with cockroach allergy.

One major drawback of our study was that we measured cockroach-allergen levels in the patients' bedrooms. Levels have been found to be highest in kitchens in other studies. This needs to be taken into account in future studies.

Our results also differ from the work of Pollart et al⁴ in that cockroach infestation and sensitivity in their study affected mainly poor communities. In our study, cockroach allergy was shown to affect homes across the spectrum.

We therefore suggest that doctors practising in areas with a heavy cockroach infestation look carefully for cockroach allergy in their asthmatic patients since this has important therapeutic implications. We also suggest that skin-test kits in the Durban area should have the cockroach mix extract as part of the standard kit. If patients are unsuitable for skin testing, RAST (Pharmacia) can be performed as is available from commercial laboratories.

In conclusion, cockroach allergy is a problem in the Durban area and more detailed studies need to be performed to quantify the extent and significance of the problem.

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