

Cockroach extermination does not rapidly reduce allergen in settled dust

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Because little is known about the control of cockroach allergen, we studied the effect of eradication of cockroaches on cockroach allergen in vacuumed dust from single-family homes.

METHODS

Cockroach-infested homes were recruited by use of posters placed at a local public health clinic. The Duke University Institutional Review Board for Clinical Investigation approved the protocol. We visited all responding single-family homes and duplexes where occupants reported seeing cockroaches daily.

On the first and subsequent visits we placed 4 × 4 cm sticky traps (Mr. Sticky, Van Waters and Rogers, Greensboro, NC) in the kitchen, bathrooms, and any other rooms where occupants reported seeing cockroaches. Traps were placed at intervals of 0.3 to 1.0 m at the junction of floors and kitchen cabinets, inside cabinets housing the sink, at the junction of countertops and walls, and around garbage cans, refrigerators, and any other appliances. Between 10 and 18 traps were placed in kitchens and 2 to 4 in bathrooms, depending on the size and layout. Traps were collected after 1 night; the cockroaches were counted and logged by trap location. The locations of the traps and baits were plotted on diagrams of the rooms. Homes with 10 or more trapped cockroaches continued in the study and were visited again at 2, 4, and 6 months.

At each visit vacuumed samples of dust were collected from approximately 1-m² areas vacuumed for 2 minutes. Separate samples were obtained from the floors of the kitchen, bathroom, and some bedrooms. All samples were obtained with the same Hoover Sprint vacuum cleaner with an unwoven filter inserted in the wand just proximal to the vacuum tool. Dust samples were processed for analysis within 24 hours.

Homes were assigned to active intervention (n = 5) or to placebo (n = 3) in a single-blind fashion, in an attempt to obtain a similar distribution of homes with high- and low-trap numbers in both groups. We placed 2% hydramethylnon bait trays (Combat Superbait, Clorox Company, Pleasanton, Calif) in actively treated houses and identical-appearing placebo bait stations in placebo-treated houses. Occupants of homes were not asked to do any cleaning. The cockroach population density, inferred from the trapping results,

guided placement of bait stations. Homes were treated with 10 to 15 baits in the kitchen, 2 to 4 in the bathroom, and, if trapping confirmed the presence of cockroaches elsewhere, 2 to 4 baits in other rooms (dining areas, living room, and hallways). Baits were placed to optimize their effect (ie, horizontally next to walls to conform to typical cockroach foraging activity) and secured in place with double-sided tape. Baits were replaced at the 4-month visit.

Vacuumed dust was extracted and the allergens were measured by ELISA and reagents previously described.¹ Anticockroach antibodies and reference standard were the gift of T. A. E. Platts-Mills. The concentration of allergen in the extract (units per milliliter) was converted to units of allergen per gram of dust.

RESULTS

Of 20 responding homes, 8 had 10 or more cockroaches trapped and agreed to continue in the study. One home in the placebo arm refused further participation at 2 months because there was no evident change in the cockroach population of the house; all other homes completed the study. More than 90% of baits remained in place at follow-up visits. The placebo and active groups were comparable at entry for number of cockroaches trapped and in the cockroach allergen in vacuumed dust (Table I). The insects trapped were *Blattella germanica* (German cockroach) except for ~2% *Periplaneta americana* (American cockroach).

At 2 months, 4 of 5 homes treated with active bait stations showed a greater than 95% reduction in cockroaches trapped. This reduction continued through the 6-month follow-up. The home with a less-impressive reduction in trapped cockroaches had a comparable decrease in cockroaches trapped after a rain leak from hurricane damage was repaired. The reduction in trapped roaches in active compared with placebo homes was statistically significant at 2, 4, and 6 months ($P < .05$, Wilcoxon rank-sum test).

Sufficient dust for analysis was obtained from all the kitchens. A minimal effect on cockroach allergen concentration in the kitchen dust was found (Table I). At 2 and 4 months no significant difference was seen between active and placebo homes for either Bla g 1 or Bla g 2 content in the dust. At 6 months, in the actively treated homes, there was a statistically significant decrease in Bla g 1 ($P = .048$, Wilcoxon rank-sum test) but not Bla g 2.

DISCUSSION

Our results for control of cockroach infestation replicate previous reports in the entomologic literature.^{2,3} The number of living roaches is greatly decreased after the hydramethylnon treatment, probably in parallel to the decrease in trapped insects.

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TABLE I. Cockroaches trapped and cockroach allergen in study homes

Group			Baseline	2 mo	4 mo	6 mo
Placebo homes						
Bla g 1	Geometric mean (range)		127 (28.7-2107)	184 (95.3-355)	351 (122-1007)	220 (127-382)*
Bla g 2	Geometric mean (range)		32.8 (12.6-201)	54.5 (11.6-256)	114 (39.1-331)	69.3 (24-200)
	Median cockroaches per trap (range)		2.1 (0.91-8.5)	4.3 (0.92-7.6)*	5.7 (0.77-10.6)*	1.8 (1.15-2.36)*
Hydramethylnon-treated homes						
Bla g 1	Geometric mean (range)		167 (88-248)	212 (120-533)	124 (111-157)	90 (52-120)*
Bla g 2	Geometric mean (range)		31.9 (10.3-110)	63.7 (37.8-114)	39.4 (27.2-95.7)	30.4 (8.9-140)
	Median cockroaches per trap (range)		3.7 (0.71-9.5)	0.05 (0-0.17)*	0 (0-0.43)*	0 (0-0.07)*

Bla g 1 and Bla g 2 in units per gram of sieved kitchen dust.

*P < .05 for hydramethylnon-treated versus placebo-treated homes.

Despite the reduction in cockroaches present, there was not a correspondingly impressive decrease in allergen in the dust. The statistical effect on Bla g 1 at 6 months is trivial because it resulted from the presence of minimally higher Bla g 1 in the 2 remaining placebo homes than in the hydramethylnon homes. More important, the allergen content at 6 months does not approach levels suggested to be sufficient for sensitization (about 4 units/g for bedroom Bla g 1).⁴ Studies of dust mite allergen suggest that a reduction of allergen in bedroom dust by 90% may be sufficient to allow improvement of asthma.⁵ The decrease of cockroach allergen levels at 6 months does not approach either of these possible standards of clinical significance.

There is little other published information on the control of cockroach allergen in households. The National Cooperative Inner City Asthma Study⁶ included cockroach control efforts as part of a larger design. In that study no change was seen in the number of dwellings with obvious infestation (visible living cockroaches) despite professional application of the very effective insecticide abamectin; the allergen content of vacuumed dust also did not fall.⁶ Most homes in the study were apartments. Because entire buildings could not be treated, reinfestation would be almost certain as a source of continued allergen contamination.

In summary, we have demonstrated that an impressive decrease in cockroach infestation in single-family homes may be obtained with hydramethylnon bait stations if sufficient baits are properly located and remain in place. However, during the initial 6 months of treat-

ment there is no clinically significant fall in allergen levels if no special cleaning efforts are made. The extent of cleaning required to effect an immediate drop in allergen is not known. As a practical model for the study of cockroach allergen, single-family homes avoid the problems inherent in studies of multifamily buildings. If methods of cockroach eradication and allergen abatement that reduce allergic symptoms can be demonstrated in single-family homes, an argument could be advanced for treating entire apartment blocks as a public health measure.

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