

# Inner-City Environments and Mitigation of Cockroach Allergen

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Exposure and sensitization to indoor allergens are important risk factors for asthma. While the role of indoor allergen exposure in the development of allergic sensitization and the onset of asthma remains a subject of controversy, there is strong evidence that indoor allergens play a key role in exacerbation of existing asthma, particularly in sensitized individuals.<sup>1</sup> In this supplement to the *American Journal of Preventive Medicine*, Crocker and coworkers<sup>2</sup> advocate for a multi-trigger, multicomponent, home-based environmental intervention for the reduction of morbidity in asthmatic children and adolescents. This is appropriate guidance when dealing with the general population; however, inner-city asthmatic children, especially those who are sensitive and exposed to cockroach allergen, may experience greater benefit from a highly effective, single-component intervention that specifically targets cockroach allergen.

Asthma morbidity is a significant public health concern, especially in inner-city populations. The National Cooperative Inner-City Asthma Study (NCICAS) demonstrated that asthma morbidity was strongly associated with the presence of a positive skin test and high allergen exposure.<sup>1</sup> In particular, sensitization and exposure to cockroach allergen was shown to be one of the major risk factors for severe asthma.<sup>1,3</sup>

Asthma morbidity was highest in children with **both** a positive skin-test response to cockroach and a high exposure (defined as >8 units of cockroach allergen per gram of dust [U/g]) in the bedroom.<sup>3</sup> Detectable levels of cockroach allergen were found in 85% of the bedrooms tested, and 50% of the bedrooms had levels >2 U/g, the proposed threshold for allergic sensitization.<sup>3,4</sup> Correspondingly, a study of children in Boston showed that cockroach allergen exposure in the family room was a predictor of two or more episodes of wheeze in the first year of life.<sup>5</sup> The risk of asthma from exposure to cockroach allergen is not limited to children. Indeed, a recent study showed that sensitization to cockroach allergen was

the most common sensitization (approaching 50%) and was associated with a greater degree of airflow obstruction and hyperinflation among elderly asthmatics in New York City.<sup>6</sup>

In the Inner City Asthma Study (ICAS), the percentage of asthmatic children with a positive skin prick test to cockroach allergen ranged from 59% to 81%, depending on study site.<sup>7</sup> ICAS investigators found that reductions in levels of cockroach and dust-mite allergens on the bedroom floor were significantly correlated with reduced asthma morbidity, with the correlation between asthma morbidity and cockroach allergen exposure being particularly strong.<sup>7</sup> Of note, cockroach allergen levels were reduced 53% from baseline in the bedroom floor during the first year of ICAS after implementation of a cockroach intervention by a professional pest-control company.<sup>8</sup> The actual reduction in cockroach infestation was not measured.

In 2007, Sever and co-workers<sup>9</sup> reported an 82% reduction in cockroach allergen levels in the bedroom floor and a >90% reduction in the number of trapped cockroaches following a 12-month intervention conducted by entomologists from North Carolina State University (NCSU) in inner-city homes. Prior to this study, sustained reductions in cockroach allergen levels had proven difficult to demonstrate.<sup>10–12</sup> A second treatment group in this study involving extermination performed by professional pest-control companies achieved some reductions in the number of trapped cockroaches and cockroach allergen levels; however, these reductions were not significantly different from those in the control group.

The major difference in the methods used between the two treatment groups was that cockroach monitoring was used to guide bait placement in the homes treated by NCSU. In addition, the types of pesticides used and the schedule and intensity of treatment varied between the two treatment groups. NCSU monitored cockroach populations throughout the study, and homes were retreated if any cockroaches were trapped at interim follow-up visits. NCSU also used layout maps of each home to identify problem areas and to target insecticide bait placement throughout the 12 months of follow-up. They utilized highly effective, reduced-toxicity gel baits for every treatment and did not use spray or dust formulations. The methods employed by NCSU differed from tradi-

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tional integrated pest management (IPM) in that they did not include cleaning, resident education, or sealing of cracks and crevices to prevent re-infestation. Importantly, the reduction in cockroach numbers achieved by guided insecticide baiting, the method used by NCSU, has been shown to be similar to that of an IPM program that included extensive cleaning, resident education, and baiting.<sup>13</sup>

We are unaware of any published intervention studies that examine the effects of a single-component, highly effective cockroach-reduction strategy on asthma morbidity in inner-city children. Although children who are sensitized to cockroach allergen may also be sensitized and exposed to other allergens, it is worth investigating whether or not targeting of a single, primary allergen exposure could provide clinical benefit. The National Institute of Environmental Health Sciences is planning to begin a single-component intervention study in inner-city children with moderate to severe asthma. This study, called the Childhood Asthma Reduction Study (CARES), will enroll over 400 children who are both sensitized and exposed to cockroach allergen and will investigate the effectiveness of the NCSU intervention in reducing asthma morbidity in this population. A single-component intervention like the one that will be implemented in CARES is highly desirable because of its lower cost compared to a multicomponent intervention. The methods utilized by NCSU do not involve participant education and do not require that individuals actively participate in the intervention in order for it to be successful. Because of the high cost and complexity of multicomponent interventions, a single-component environmental intervention that targets cockroach allergen could provide significant cost savings in a public health program if such an intervention could be shown to reduce asthma morbidity.

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