

Asthma in the Third World: can environmental intervention improve childhood asthma in US inner cities?

With 20% of children living in poverty, many parts of the United States are a reflection of the Third World. Poor children are at higher risk of developing an array of chronic diseases, including cardiovascular disease, diabetes mellitus, and asthma. The increase in asthma mortality and morbidity has been most marked among uninsured children living in households earning less than \$15,000 per year and in substandard, damp houses or apartments. In urban areas, these predominantly African American or Hispanic children are treated for asthma in hospital emergency departments (EDs). Previous epidemiologic studies¹⁻³ clearly show that sensitization to indoor allergens is a major risk factor for admission to the ED with asthma. One study,³ in Wilmington, DE, distinctly characterized the demographics: most patients admitted to the suburban hospital ED were white, insured, and allergic to cats, whereas patients admitted to the urban hospital ED were African American (or Hispanic), uninsured, and allergic to cockroaches. These differences in IgE responsiveness simply reflect the differences in environmental allergen exposure among these populations. Sensitization to cockroach allergens occurs in atopic individuals living in rural, suburban, or urban housing that harbors cockroaches, and asthma is the most common disease associated with living in cockroach-infested housing.

The landmark National Cooperative Inner-City Asthma Study (NCICAS) showed that sensitization and exposure to cockroach allergens is strongly associated with increased asthma morbidity among school-aged children with asthma, as evaluated by medication use, symptom scores, hospitalizations, and days missed from school.⁴ More than 475 children aged 4 to 9 years from 8 US cities were enrolled in the NCICAS. Subsequently, sensitization to mouse allergen was shown to occur in 20% of the NCICAS population and was associated with high levels of exposure to mouse allergen found in the kitchen (all of the homes in Baltimore contained detectable *Mus m 1* allergen).^{5,6} Together, these studies point to a combination of risk factors for asthma that is a major public health concern: poverty, race and ethnicity, damp housing, and long-term exposure to indoor allergens and other pollutants. What is to be done about cockroach, mouse, and other environmental exposures in urban homes? Can

environmental intervention improve the asthma symptoms of inner-city children?

Two recent studies^{7,8} have confirmed that cockroach allergens can be successfully remediated using a combination of insecticide baits and intensive or professional cleaning. Last year, the Inner-City Asthma Study (ICAS) Group reported the results of a study⁹ in which 937 children with asthma from 7 US cities were enrolled in a randomized controlled trial of environmental intervention. The intervention included extensive caretaker training and education on environmental control procedures, interventions that were tailored to the child's sensitization, and multiple control methods for specific allergens (mattress covers, high-efficiency particulate air cleaners, and professional pest control). The intervention group had significant reductions in mite and cockroach allergen levels and showed consistent reductions in asthma symptoms throughout the 1-year study.⁹ Remarkably, the authors considered the clinical improvements to be comparable to those seen in placebo-controlled studies of inhaled corticosteroids.

An article by Eggleston and colleagues¹⁰ from The Johns Hopkins University in this issue of the *Annals* reports the results of a similar intervention study involving 100 asthmatic children (aged 6–12 years) recruited from a school-based asthma education program in Baltimore public schools. The study population was almost exclusively African American, with more than 75% having incomes of less than \$20,000 per year and 24% of their homes having leaky roofs. Cockroach and mouse were the predominant sources of allergens in the homes; mite and cat allergen levels were generally low (median, <0.5 $\mu\text{g/g}$). The interventions involved the use of mattress covers, pillow encasings, high-efficiency particulate air cleaners, professional extermination advice, and bait treatments for cockroach (0.01% fipronil) or mouse (0.005% bromdialone). Outcomes included home evaluations for allergen content, air particulates, ozone, and nitric oxide and evaluation of health effects (asthma symptoms, hospitalizations, quality-of-life scores, and lung function tests). During the 12-month study, the interventions provided significant reductions in levels of particulate matter 10 μm or smaller and 2.5 μm or smaller and reductions in cockroach, but not mouse, allergen levels. There was a significant decrease in daytime symptoms in the intervention group during the first

9 months of the study ($P = .04$). However, other symptomatic outcomes were not significant between the intervention and control groups. The authors describe the clinical outcomes as “modest” but nonetheless worthwhile as part of a long-term treatment plan for this population. Why were the clinical outcomes of this study less dramatic than those reported by the ICAS Group? The Baltimore study population comprised mainly mildly asthmatic patients, half of whom were asymptomatic on study enrollment. Only 40% of the population was allergic to cockroach, and sensitization and exposure to mite and cat allergens were low. Although mouse allergen exposure was common, only 10% of the study participants were sensitized to mouse. In contrast, 30% to 70% of the participants in the ICAS were sensitized to mite, cockroach mold, animal, or rodent allergens, and this group had significant asthma symptoms on enrollment.⁹

An earlier study¹¹ of environmental intervention to treat asthma in mite-allergic African American children living in Atlanta, GA, showed a decrease in acute hospital visits for asthma in the treatment group but no significant change in allergen concentrations. This finding was attributed to a placebo effect and highlights the difficulty of designing studies in which the control group remains uninformed of the active intervention procedures. All the environmental intervention studies have involved repeated home visits and follow-up during the study, especially in the treatment groups. As a result, most children completed the study (87% in the ICAS and 91% in Baltimore), and there was a commendable degree of compliance with the interventions. These studies show that despite the difficulties, it is possible to perform well-controlled environmental studies in US inner cities and that these interventions benefit children with asthma. Successful intervention requires persistent follow-up, clear reductions in allergen levels, and multiple allergen control procedures. Single interventions, such as the use of mattress covers for dust mites, are unlikely to be effective.¹² The costs of remediation are \$500 to \$1,000 per year, and these costs, according to the ICAS, should be weighed against the positive societal benefits and quality-of-life improvements for these underserved populations.⁹ But even successful environmental intervention takes us only so far. The underlying public health problems are poverty and dilapidated housing, which we should all seek to resolve. Welcome to the Third World.

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