

EDITORIAL

Clinical & Experimental Allergy

Further confirmation of the relevance of cockroach and dust mite sensitization to inner-city asthma morbidity

This editorial discusses the findings of the paper by Wang et al. [5] pp. 1381–9.

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Inner-city populations bare a disproportionate burden of asthma morbidity in the United States [1]. In these communities, allergens from cockroaches, mice and sometimes dust mites are common sensitizers, sensitization to these pests is strongly associated with asthma symptoms, and exposure to these allergens in the home is associated with asthma exacerbations [2–4]. In the current issue, Wang et al. have further demonstrated in a population of asthmatic children living in several inner-city communities in the United States that having specific IgE antibodies to cockroaches and dust mites was associated with an increased risk for asthma hospitalizations and corticosteroid use [5]. They found a linear association between these health outcomes and both the presence and titre of allergen specific IgE with no obvious cut-off value, further reinforcing the importance of cockroach and dust mite specific IgE antibodies to inner-city asthma.

While the differences in asthma prevalence among inner-city communities and their suburban and rural US counterparts are striking, equally remarkable is the difference in asthma prevalence among the urban inner-city and higher socio-economic status communities in the same cities. For example, a report by the New York City (NYC) Department of Health and Mental Hygiene (DOHMH) found that close to one in five children living in East Harlem had a report of asthma at the age 4–5 years (1). This prevalence was higher than that of the overall United States. Even more striking, it was also three times higher than the prevalence in the neighbourhood that borders it, the Upper East Side. Clearly, differences in

socio-economic determinants and access to health care can explain part of the differences in disease management and consequently, hospitalization rates. However, the explanation for the difference in prevalence of asthma, given the current theories for the cause of the increase in asthma, must be more complex than access to health care alone and more likely points to environmental exposures as causative. In addition, a substantial component of the outdoor air pollution in dense urban environments, like NYC, comes from sources outside of the city (i.e. carried by weather patterns) and therefore is also unlikely to be the sole cause for the large difference in asthma risk among children living just city blocks apart. However, the distribution of local combustion byproduct sources like major roadways, truck routes and bus depots are not evenly distributed in urban settings. Other hypothesized and observed differences include those in physical activity, race, socio-cultural and socio-economic factors and even the density of street trees [6–8]. The ‘hygiene hypothesis’ is unlikely to explain the asthma epidemic in NYC inner-city communities, but neighbourhood differences in endotoxin exposure have been observed [9] and endotoxin has been shown to be relevant to early respiratory symptoms and allergic outcomes in several urban cohorts [9–11].

Given the strong association between cockroach and dust mite sensitization and asthma exacerbations in inner-city communities [2], exposure to these allergens offers one potential explanation for the differences in asthma prevalence within urban settings. Sensitization to mouse allergen has also been shown to be common [3]. In our studies in low-income urban populations in NYC, we have demonstrated high levels of both cockroach and mouse allergens in the homes of children living in high asthma prevalence neighbourhoods [4]. However, we observed geographical variability in mouse allergen by neighbourhood suggesting that asthma triggers may vary by neighbourhood. In these same children, we have

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demonstrated the importance of sensitization to cockroach and mouse allergens, which were associated with respiratory symptoms in children as young as 2–3 years old [12]. Children with higher cockroach allergens in their bed dust had a greater risk for being sensitized to cockroach [13]. The NYC DOHMH observed differences in reported domestic sightings of cockroaches and mice that varied by income and race/ethnicity and correlated with asthma prevalence [14]. Preliminary findings from an ongoing study at Columbia University indicate significantly higher cockroach and mouse allergens in the bed dust of children living in neighbourhoods with high asthma prevalence as compared with those where asthma prevalence is low.

As Wang et al. discussed, exposure to allergens outside of the home is also likely to be important. Schools are an important location for exposure to cat allergens [15] and the relevance of allergen exposure in the schools was elegantly demonstrated by Almqvist et al. in Sweden, who found that upon returning to classrooms after summer vacation, cat allergic children had a reduction in lung function if the classrooms had moderate levels of cat allergen [16]. While cat allergen appears to be relevant to inner-city asthma [17], schools may also be an important site for cockroach and mouse allergen exposure. Both cockroach and mouse allergens have been found to be common in inner-city schools [18, 19]. Exposure to these allergens outside of the home in schools and in other homes (e.g. grandma's home) may confound studies testing the relevance of domestic allergen exposure and interfere with the efficacy of allergen intervention trials.

One aspect of the findings by Wang et al. that was difficult to understand was the observation of associations between sensitization and acute visits for asthma and medication use, but not between sensitization and frequency of wheeze or missed school days. One possible reason is that wheeze was reported only for 2 weeks, while corticosteroid use and hospitalizations were reported for 3 months and 1 year, respectively. Also, hospitalizations for asthma are the consequence not only of asthma symptoms, but also of access and proper use of medical resources.

An important consideration when using hospitalization and medication use as outcomes in the inner-city is the decrease in rates for asthma hospitalizations in the past decade. In NYC, possibly due to public health and physician awareness campaigns by groups like the department of health, asthma hospitalization rates in low-income neighbourhoods actually dropped by 45% between 1997 and 2005. This decline was greater than that observed in the wealthier neighbourhoods of the city [20]. While that might be expected, since the poorer neighbourhoods had a higher initial hospitalization rate, it is in striking contrast to other diseases like diabetes and cancer deaths which have, over the same decade, increased while decreasing in high income communities. Therefore, from a public health

perspective the decrease in hospitalizations for asthma is encouraging. But it is important to point out that hospitalizations rates and asthma prevalence while related, are not the same. There has not been a report of a decrease in asthma prevalence in NYC over the past decade. Future research in these communities should focus on disentangling the factors that cause the development of asthma from those that contribute to exacerbations and lead to poor asthma control. It is also important to highlight that the data from Wang et al. was collected during the mid-1990s and the rates of hospitalizations in this community, at least in NYC, have dramatically decreased since then, which could affect the generalizability of their findings to asthmatics in inner-city communities today.

However, these findings from the Inner-city Asthma Study do suggest that measuring the levels of specific IgE to dust mite and cockroach could help identify children who are more likely to end up being hospitalized for asthma. Targeting these children with appropriate therapy could lead to a reduction in acute visits for asthma.

The clinical relevance of pest allergen exposure appears to be clear, but what should be done? The literature on domestic allergen interventions, while extensive, is mixed in its conclusions with some studies showing an effect and other showing little or no effect of intervention over placebo [21, 22]. There has been a recommendation for patient-specific, allergen-targeted, multifaceted interventions and this method was shown to be effecting in an inner-city community [23]. Again, it is important to highlight that inhalant allergen exposure occurs outside of the home in schools and other homes, which should be considered when designing and evaluating the efficacy of allergen avoidance. However, for patients with high levels of cockroach-, mouse- or dust-mite specific IgE the addition of allergen avoidance measures to appropriate clinical monitoring and pharmacotherapy seems reasonable.

Future research to understand reasons for such high asthma prevalence in the inner-city communities of the United States could benefit from several directions. First, the study by Wang et al. and others demonstrates the utility of measuring allergen specific IgE, levels of which are more directly comparable between studies than skin test weal size. Second, studies which utilize the communities adjacent to inner-city communities as control populations could lead to a better understanding of the great difference in asthma risk among children living just city blocks apart. In NYC, we are currently enrolling children in a study that is measuring domestic exposures, including allergens, in homes in both high and low asthma neighbourhoods, and this research builds on neighbourhood level studies like those being conducted in Chicago [7]. Third, cross-sectional studies can show important associations, but to demonstrate causality, exposures need to be measured before development of a disease, calling for more longitudinal studies of asthma

development. Given the timing of immune development, birth cohort studies are probably required. Fourth, an obvious long-term objective is to study primary prevention. To date, cockroach or mouse allergen avoidance as primary prevention has not been extensively tested. Results for dust mite avoidance seem to indicate that primary prevention will need to include more than just allergen avoidance and that the additional 'intervention' items are yet to be determined. Demonstration of effective avoidance strategies could lead to meaningful public health recommendations. In recent years, cities like NYC have shown a willingness to implement city wide interventions including asthma education, eliminating smoking in restaurants, reduction of idling vehicles and a cleaner public transportation bus fleet.

In summary, the cause of the high asthma prevalence among inner-city populations in the United States is not yet known. But, allergic sensitization and exposure to allergens from cockroaches, mice and dust mites appear to play an important role in asthma in this community. Findings by Wang *et al.* further strengthen the association between allergen specific IgE and the consequences of asthma morbidity.

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