Published in final edited form as:

J Allergy Clin Immunol. 2014 November ; 134(5): 1189–1190. doi:10.1016/j.jaci.2014.08.035.

Comparison of Indoor Allergen Levels in Urban and Suburban Detroit

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Keywords

Cockroach; urban; dust mite; cat; dog; suburban

To The Editor

Children living in the inner city have a higher prevalence of asthma ¹ with greater asthma morbidity than the general population ². Higher levels of cockroach antigen have been reported to be associated with an increased incidence of poorly controlled asthma among urban populations ³. Additionally, exposure to indoor allergens such as dog, cat and dust mite have been linked to the onset of allergy and asthma in various reports ^{4,5,6}. These findings have raised the question of whether the differential rates of asthma and asthma morbidity that exist between urban and suburban children could be due to differences in allergen levels between urban and suburban homes. However, there are few publications that have directly compared allergen levels between urban and suburban homes in the same region.

Using data collected as part of the Wayne County Health, Environment, Allergy, and Asthma Longitudinal Study (WHEALS) birth cohort project, common indoor allergen levels that were present in an urban environment (residents of the City of Detroit) were measured and compared with suburban homes. Urban and Suburban populations were defined by zip code. Sample size was 704 for urban homes and 554 for suburban homes. During a one month postpartum home visit, dust samples were collected from the floor of the room where the cohort's infant participant usually slept. Using monoclonal antibody based assays, allergen levels for dust mite (Der f 1), German cockroach (Bla g 2), dog (Can f 1), and cat (Fel d 1) were measured. Chi-square tests were used to compare the proportions of homes that had detectable and non-detectable allergen levels. Within homes with detectable allergen levels Wilcoxon Rank Sum tests were used to compare urban vs. suburban. Logistic regression models (data not shown) were used to assess differences in allergen levels after adjustment for season of sample collection and type of flooring (carpet versus not carpet).

Detroit homes had detectable allergen from dust mite in 36% of urban vs. 39% of suburban homes, $p=0.30$ (table 2). In contrast, the proportion of urban homes with detectable cockroach allergen was greater than suburban homes (12.2% vs. 4.2%, $p<0.001$) table 2.

Suburban homes were more likely to have a dog or cat in residence (dog: 26.4% vs. 18.8%, cat: 21.0% vs. 7.2%; both $p<0.01$) and as expected, more likely to have detectable levels of both dog and cat allergen (dog: 65% vs. 55.1%; cat: 81.3% vs. 73.6%, both p -values <0.01) table 2. Furthermore, even in homes without indoor dogs, more suburban homes had detectable levels of dog allergen (54.3% vs. 45.5%, $p=0.015$). However, among homes without cats the differences in prevalence of homes with detectable cat allergen levels between suburban and urban homes abated (76.9% vs. 71.4%; $p=0.069$).

We evaluated season of sample collection, floor type and whether the pet was allowed in the child's room as possible confounders. We found that carpet was more common in suburban homes (81.9 % vs 71.9 % $p<0.00178$); and that suburban homes were more likely to allow the pet in the child's room (for dog 28.7% urban vs. 65.4% suburban, $p<0.001$, for cat 48.7% vs. 67.3%, $p=0.042$). However, none of these characteristics were found to alter the relationship between urban/suburban dwelling and allergen levels (data not shown).

We recognize having a single dust sample at the age of one from the child's bedroom might not be truly representative of the environment and if samples taken from different areas of the house would provide different information.

In summary, there was no difference in the rates of having detectable dust mite allergen between urban and suburban homes. Although more suburban homes had detectable dog and cat allergen levels, this was at least partially attributable to pet-keeping behaviors. As expected, in metropolitan Detroit, detectable cockroach allergen levels were more common in urban versus suburban homes. However, we were surprised to find, that the rate of detectable cockroach allergen was only 12.2% in urban residences which is low when compared to other inner city populations like New Orleans 44%⁷, Baltimore, Boston, New York and St Louis having detectable cockroach levels of 40 %⁸. We speculate that this may reflect the predominance of single-family dwellings in our urban sample compared to high density residential structures that are present in many large cities. However, like many inner cities, asthma morbidity and mortality is high among the urban population⁹. Based on this data, we suggest that although cockroach exposure may partially explain high urban asthma morbidity, it seems unlikely that cockroach allergen exposure is the sole or even the major contributor to the high asthma burden in Detroit children as has been suggested from other studies and cities¹⁰. Our data also emphasizes the potential importance of accounting for regional variation in key environmental allergen exposures when designing optimal intervention strategies directed toward different U.S. urban populations.

Acknowledgments

This research was supported by grants from the National Institute of Allergy and Infectious Diseases (AI051598) and the Fund for Henry Ford Hospital.

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Table 1

Baseline characteristics of Urban and Suburban homes in Metro Detroit

	Urban Homes N=524	Suburban Homes N=473	p-value
Housing Type ¹ , n (%)			
- Detached House or Trailer	349 (74.1%)	366 (80.8%)	0.020
- Apartment/Duplex/Row house	121 (25.7%)	85 (18.8%)	
- Basement	1 (0.2%)	2 (0.4%)	
Household Income < \$40,000 ² , n (%)	243 (53.4%) ¹	102 (24.2%)	<0.001
Household environment:			
Cigarette smoking, n (%)	197 (37.6%)	109 (23.0%)	<0.001
Mouse droppings, n (%)	26 (5.2%)	5 (1.1%)	<0.001
Cockroach or cockroach stains, n (%)	45 (9.0%)	7 (1.5%)	<0.001

¹ N=73 missing data;² N=121 missing data;³ N=45 missing data;⁴ N=44 missing data;

Table 2

Urban vs. Suburban differences in home allergen levels for four common indoor allergens

	Urban Homes N=524	Suburban Homes N=473	p-value
Homes with detectable ¹ allergen level, n (%)			
Dust Mite (Der f)	188 (36.0%) n=523	184 (39.2%) n=470	0.30
Cockroach	63 (12.2%) n=515	19 (4.2%) n=454	<0.001
Dog	288 (55.1%) n=523	307 (65.0%) n=472	0.001
Cat	385 (73.6%) n=523	383 (81.3%) n=471	0.004
Among homes with <i>detectable</i> allergen levels (mcg/g dust):			
Geometric mean ² (95% CI)			
Dust Mite (Der f)	0.11 (0.09 – 0.14)	0.12 (0.09 – 0.16)	0.91
Cockroach	0.04 (0.03 – 0.06)	0.03 (0.01 – 0.08)	0.23
Dog	0.13 (0.11 – 0.17)	0.28 (0.21 – 0.38)	0.002
Cat	0.18 (0.15 – 0.22)	0.63 (0.48 – 0.82)	<0.001

¹Lower level of detection for cockroach was 0.04 mcg/g, Der f 0.05 mcg/g, cat 0.016 mcg/g and dog 0.01 mcg/g. Chi-square test used to compare percent detectable between urban and suburban;

²Geometric means presented due to skewness of the data, Wilcoxon Rank Sum tests used to compare distributional differences between urban and suburban homes in detectable allergen level