

The prevalence of mouse allergen in inner-city homes

Stelmach I, Jerzynska J, Stelmach W, Majak P, Chew G, Kuna P. The prevalence of mouse allergen in inner-city homes. *Pediatr Allergy Immunol* 2002; 13: 299–302. © 2002 Blackwell Munksgaard

Mouse allergen has not been studied in detail in the general population. It is common for patients from inner-city environments to report significant mouse infestation in their homes and neighborhoods. The aim of this study was to determine the prevalence of mouse allergen in the homes of inner-city children with asthma in relation to the demographic features of these children and their specific housing characteristics. Seventy-eight dust samples from 39 inner-city homes of Lodz, Poland, were analyzed for mouse allergen. Skin-prick tests (SPTs) to mouse allergen were performed in all patients. In addition, data regarding the demographics and housing of the subjects were related to the mouse allergen levels. Mouse allergen was detected in 22 of 78 dust samples (28%), and in 18 of 39 homes (46%), including 13 kitchen (33%) and nine bedroom (23%) samples. Mouse allergen levels did not correlate between different rooms in the same home. The levels detected ranged from 0.09 to 2.34 µg/g of dust. The highest levels were found in kitchens, with median levels of 0.2 µg/g, 95% confidence interval (CI): 0.12–0.85 (range: 0.1–2.34 µg/g); in bedrooms the mean levels were 0.23 µg/g, 95% CI: 0.1–0.97 (range: 0.09–1.62 µg/g). Eleven of 18 children with detectable mouse allergen in house dust, and three of 21 without detectable mouse allergen in house dust, had a positive SPT to mouse allergen. On home inspection, 18% of the homes had evidence of mice in one or two rooms and had higher levels of mouse allergen ($p < 0.01$). None of the other subject or housing variables evaluated were associated with higher mouse allergen levels. In Polish children, mouse allergen is an important factor of sensitivity and should be recognized in the diagnosis of allergic diseases as well as in allergen-reduction programmes.

Iwona Stelmach¹, Joanna Jerzynska¹, Włodzimierz Stelmach², Pawe Majak¹, Ginger Chew³ and Piotr Kuna⁴

¹M Curie Hospital, Department of Pediatrics and Allergy, Zgierz, Poland, ²Regional Health Authority, Lodz, Poland, ³Columbia School of Public Health, Environmental Microbiology Laboratory, New York, USA, ⁴Medical University, Department of Allergy and Pneumology, Lodz, Poland

Key words: mouse allergen; indoor allergens; inner-city asthma

I. Stelmach, M Curie Hospital, Department of Pediatrics and Allergy, 35 Parzeczevska Str., 95–100 Zgierz, Poland
Tel: (48 42) 716 4982
Fax: (48 42) 716 4982
E-mail: interna@wss.zgierz.pl

Accepted 7 December 2001

Morbidity from asthma is disproportionately high among inner-city children (1). Known risk factors include allergen exposure, parental smoking, diet, and exposure to infection. Currently none of these, either individually or in combination with others, can be directly implicated as the cause of the increase in asthma prevalence, but all have been shown to be associated with the onset of disease. Recently, the National Cooperative Inner-City Asthma Study (NCICAS) reported a relationship between cockroach allergen exposure and sensitivity with asthma morbidity in inner-city children with asthma (2). The same study also found that cockroach allergen exposure and atopy were important risk factors for cockroach

sensitization (3). In addition, it has been shown that exposure to ≥ 2 µg of mite allergens/g of dust should be regarded as a risk for the development of immunoglobulin E (IgE) antibody and asthma, and the higher level of 10 µg should be regarded as a risk for an acute attack of asthma (4). Similar values have been placed on cat (1 µg and 8 µg, respectively) and dog (2 µg and 10 µg, respectively) allergens (5,6).

Although mouse allergen is a well-documented cause of IgE-mediated hypersensitivity in occupational settings (7), it has not been studied in detail in other settings. It is common for patients from inner-city environments to report significant mouse infestation in their homes and neighbor-

hoods. Realizing how potent this allergen can be in occupational settings, we were interested in studying its distribution in the homes of inner-city patients with asthma. In this study, dust samples were used to determine the prevalence of mouse allergens in the homes of inner-city patients with asthma in association with the demographic features of these children and their specific housing characteristics.

Materials and methods

Seventy-eight dust samples from 39 inner-city homes of Lodz, Poland, were analyzed for mouse allergen. Dust samples were collected from homes of the patients attending our Allergy Clinic in Zgierz. The study took place in autumn 2000. All 39 children (age-range 6–18 years), had a diagnosis of asthma, and in all patients skin-prick testing (SPT) with mouse allergen (Allergopharma, Reinbek, Germany) was performed. The parents/guardians participated in a baseline evaluation, which included medical, environmental, and demographic interviews. The questions asked included: family income (low income < 1400 PLN/month/family), family history of asthma, at least one smoker in the home, type of home [old (≥ 50 years old) or new (<50 years old)], type of heat (central heating system/other), evidence of mice (droppings), evidence of trash or dirty dishes in the kitchen.

When they entered into the study, all families were asked for permission to conduct visits to their home. At the home visit, personnel inspected the home according to a standardized protocol, documenting construction, environmental conditions, and evidence of mouse infestation.

Dust samples were collected from the home with a hand-held vacuum (Cobra 2000, 1400 W; Zelmer, Poland), in a filter (Dustscreen; Heska, Freiburg, Switzerland). Samples were collected from the kitchen and bedroom(s) by using standardized methods, as previously described (8). The kitchen floor was vacuumed for 5 min. In the bedroom(s) the sample was collected from a 1-m² area near, underneath, and on the bed for 5 min. Dust samples were removed from the filter, sieved, and then stored at -30°C until they were extracted.

An aqueous extract of 100 mg of sieved dust was prepared in 2 ml of borane-buffered saline. The extracts were stored at -30°C until they were assayed for mouse allergen *Mus m 1*. A sandwich enzyme-linked immunosorbent assay (ELISA) (Indoor Biotechnologies, Cardiff, UK) with an affinity-purified monospecific anti-*Mus m 1* anti-

body was used to determine the concentration of *Mus m 1*. Allergen concentrations were reported as $\mu\text{g/g}$ of dust.

The results were analyzed using StatSoft Statistica for Windows 5.0 (StatSoft, Inc.; Tulsa, OK, USA). Data were presented as median with 95% confidence intervals (CI). Significance was determined using the Student's *t*-test for independent variables. The multiple regression test was used to assess the relationship between demographic or housing characteristics and the presence of mouse allergen. *p*-values of < 0.05 were considered to be significant.

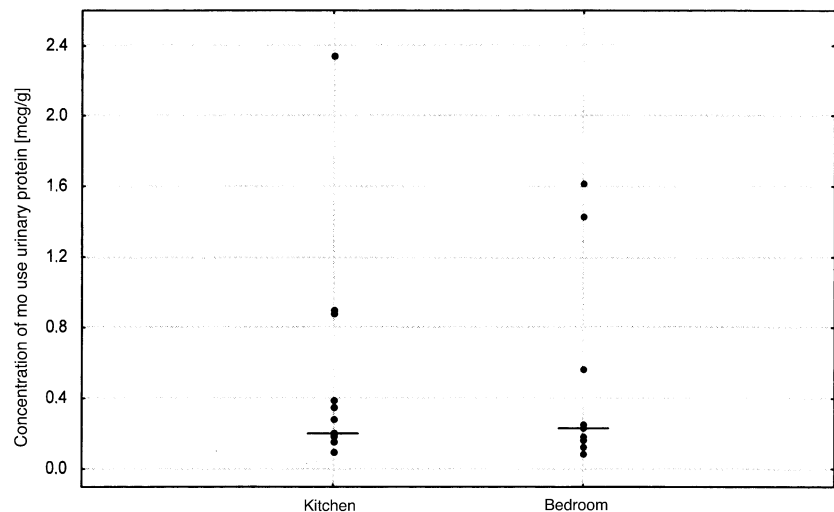
The study was approved by the Medical Ethical Committee of the Medical University, and the patients' parents or guardians gave their written consent for participation in this study.

Results

Thirty-nine patients (20 boys and 19 girls; median age 8.78 ± 2.73 years) took part in the study and completed questionnaires. Eleven of 18 children with detectable mouse allergen in house dust, and three of 21 without detectable mouse allergen in house dust, had a positive SPT to mouse allergen. Seventy-eight dust samples were collected from 39 homes. Mouse allergen was detected in 22 of 78 dust samples (28%), and in 18 of 39 homes (46%), including 13 kitchen (33%) and nine bedroom (23%) samples. Levels of allergen detected ranged from 0.09 to 2.34 $\mu\text{g/g}$ of dust. The highest levels were found in kitchens, with median levels of 0.2 $\mu\text{g/g}$, 95% CI: 0.12–0.85 (range: 0.1–2.34 $\mu\text{g/g}$); in bedrooms median levels were 0.23 $\mu\text{g/g}$, 95% CI: 0.1–0.97 (range: 0.09–1.62 $\mu\text{g/g}$). Mouse allergen levels did not correlate between different rooms in the same home. Allergen concentrations in homes where mouse allergen was detected are shown in Fig. 1.

Concentrations of the allergen were associated with several characteristics of the household, as assessed by questionnaires to determine which variables might predict higher levels of mouse allergen. Among all 39 children studied, 32 (82%) had a family history of asthma, 22 (56%) had a low family income, 26 (66%) had at least one smoker at home, and 19 (49%) homes visited had trash or dirty dishes in the kitchen. Eighteen per cent (seven of 39) of the homes had evidence of mice (mouse droppings) in the kitchen (five of 39) and/or bedroom (two of 39) on home inspection and these homes had higher overall levels of mouse allergen ($p < 0.01$). Thirty homes (76%) were old and 34 (87%) had a central heating system. We found a positive correlation between mouse allergen concentration and evidence of

Fig. 1. Allergen concentrations in homes with positive detection of mouse allergen.



mice in the kitchen ($p < 0.02$) and in the bedroom ($p < 0.01$). None of the other subject or housing variables evaluated were associated with higher mouse allergen levels.

Discussion

This is the first report to describe the prevalence and distribution of mouse allergen in inner-city home environments of asthmatic children in Poland and is one of the first world-wide. Mouse allergen was found in 46% of the homes studied, which shows that this allergen is widely distributed in inner-city homes. Data from the NCICAS population (9) showed a higher frequency of mouse allergen (95%), similar to that of cockroach allergen (85%), suggesting that mouse and cockroach allergens may be more concentrated and more clinically relevant in urban areas.

In our study, mouse allergen levels did not correlate between different rooms in the same house, suggesting that mouse allergens are not widely disseminated in homes with mouse infestation.

With regard to housing and demographic variables, we found a strong relationship between visible evidence of mouse infestation and elevated allergen levels. However, other variables, such as the type or age of the housing, and the presence of trash or dirty dishes in the home, were not associated with elevated mouse allergen levels. Similarly, no associations were detected between any personal or demographic characteristics and elevated mouse allergen levels. Further study will be required to determine the factors that promote mouse infestation and mouse allergen exposure.

In conclusion, we have found a high prevalence of mouse allergen in inner-city homes of children with asthma. In Polish children, mouse allergen is important factor of sensitivity and should be recognized in the diagnosis of allergic diseases as well as in allergen-reduction programmes. Further study is needed to assess the true clinical significance of this important and under-recognized indoor allergen.

References

1. GOTTLIEB DJ, BEISER AS, O'CONNER GT. Poverty, race, and medication use are correlates of asthma hospitalization rates: A small area analysis of Boston. *Chest* 1995; 108: 28–35.
2. ROSENSTREICH DL, EGGLESTON PA, KATTAN M, et al. The role of cockroach allergy and exposure to cockroach allergen in causing morbidity among inner-city children with asthma. *N Engl J Med* 1997; 336: 1356–63.
3. EGGLESTON PA, ROSENSTREICH DL, LYNN H, et al. Relationship of indoor allergen exposure to skin test sensitivity in inner-city children with asthma. *J Allergy Clin Immunol* 1998; 102: 563–70.
4. PLATTS-MILLS TAE, DE WECK AL. Dust mite allergens and asthma – a world-wide problem. Report of an International Workshop, Bad Kreuznach, Federal Republic of Germany, September 1987. *J Allergy Clin Immunol* 1989; 83: 416–27.
5. GELBER LE, SELTZER LH, BOUZOUKIS JK. Sensitisation and exposure to indoor allergens as risk factors for asthma among patients presenting to hospital. *Am Rev Respir Dis* 1993; 147: 57–8.
6. INGRAM JM, SPORIK R, ROSE G. Quantitative assessment of exposure to dog (*Can f 1*) and cat (*Fel d 1*) allergens: Relationship to sensitisations and asthma among children living in Los Alamos, New Mexico. *J Allergy Clin Immunol* 1995; 96: 449–56.
7. BUSH RK, WOOD RA, EGGLESTON PA. Laboratory animal allergy. *J Allergy Clin Immunol* 1998; 102: 99–112.

8. MITCHELL H, SENTURIA Y, GERGEN P, et al. Design and methods of the National Cooperative Inner-City Asthma study. *Pediatr Pulmonol* 1997; 24: 237–52.
9. PHIPATANAKUL W, EGGLESTON PA, WRIGHT EC, WOOD RA, and THE NATIONAL COOPERATIVE INNER-CITY ASTHMA STUDY. Mouse allergen. I. The prevalence of mouse allergen in inner-city homes. *J Allergy Clin Immunol* 2000; 106: 1070–4.