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2017

Link to publication

Citation for published version (APA):

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Utility of measuring allergen content in house dust samples in a cross-sectional study of respiratory health and atopy in a cohort of immigrant families in poor-quality housing in Malmö, Sweden

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Abstract
Background. Exposure to allergens plays a role in the development of atopic sensitization and influences allergic phenotype. House dust mites (HDM) are a common source of allergens in many parts of the world. The relationship between indoor environment factors such as temperature, moisture/humidity, and ventilation and HDM allergen load is complex.

Methods. Part of a larger study into the health in its social context of an immigrant population living in poor-quality housing in Malmö, Sweden. Families with small children were identified from health care records (child treated in primary care with respiratory illness), and school records (matched for age range). Families were visited in their home by health care professionals fluent in the language. For 6 months, allergen content was measured using sandwich ELISA.

Results. 130 families participated, with usable data for 359 children under the age of 12, 61 older children and 230 parents. The overall exposure to potentially harmful factors was relatively high, the burden of atopy and respiratory diseases was significant. Dust samples were collected in all 130 apartments. Correlations between apartment characteristics, allergen content and health outcomes in this vulnerable population are explored and discussed against the framework of a model explicitly accounting for social determinants of health.

Conclusions. The utility of allergen content measurements in the context of this study was rather limited, as it did not add vital information that could further elucidate pathways and connections between environmental exposures and health outcomes.

BACKGROUND

In 2008, the public in Sweden became aware of the extremely poor housing conditions in certain areas of Malmö, a predominantly immigrant neighborhood in Malmö (county of Skane, southern Sweden). Uptake had been severely neglected by the proprietors for many years. Apartments in the affected neighborhood, Hanstorp, were overcrowded, damp, affected by mould, and invaded by cockroaches and other vermin. The main property owner, after massive media attention and subsequent court trial, received an injunction from local authorities to perform extensive renovations to 990 housing units. This provided a unique opportunity to examine whether the health of children living in this neighborhood had been affected by poor indoor environment.

Background information from previous care centre examinations indicated unusually large numbers of children with asthma. The study approach also considered the social determinants of public health.

MATERIALS AND METHODS

Because the main study design was a prospective intervention study looking at the effect of the renovating intervention, respiratory health and indoor pollutants were assessed at three time points: at baseline; during renovation; and after renovation.

Baseline study
A total of 359 children were recruited, including 181 children from 53 apartments in Hanberg and 178 children from 77 apartments in Tömmenson. Initial home visits were carried out between May 27, 2010, and May 29, 2011, by health-care professionals - investigators fluent in the native language of the family. Interview questionnaires were used to collect demographic and lifestyle information for all core family members, subjective assessment of physical appearance characteristics, and health information for children aged 0-13 years at the time of visit with a focus on respiratory, allergic, and dermatological symptoms. Usually, the mother was the informant. A standardized visual assessment of multiple areas of all homes was carried out in all apartments, together with multiple sampling of dust for analysis of mites and cockroach antigens.

Methodology

Allergen levell measurements.
Airborne allergen levels in dust were measured in dust samples collected from the apartments at several locations. If consent was given by the occupants: the kitchen, the child’s bed and/or a parent’s bed and a carpet or the living room, if present. All samples were washed with 70% ethanol. The extraction was evaporated, resp. rinsed in 9g dust. The lowest level of detection was set at 50 ng/mL. A level of >2000 ng/mL (■■■■) was defined as high (corresponding to the level usually measured to be indicative of risk for asthma and symptoms of wheeze).

Family study setup
All children from the baseline study, together with parents and siblings regardless of age were invited to skin prick tests against a standard panel of airborne allergens, including house dust mites plus cockroach at a local community center. Tests were carried out by qualified study nurses according to usual international guidelines.

RESULTS

Subcutaneous dust samples were collected using sandwich ELISA.

• 12 households had measurable quantities of both Der p 1 in dust samples. All households with detection of Der p allergen also had detectable Der f 1 allergen, and in all of these cases Der f 1 concentrations were high or very high.

• All 12 of these households had either objective or subjective signs of mites in the apartment, but were not in the worst category of damaged apartments. There was no statistically significant association between household status “crowded” and presence of both antigens in the dust.

• In general there was some overlap between apartment characteristics and the presence of HDM allergen in dust samples, but none of the discernible trend was sufficiently strong to allow a statistical association.

Cockroach infestation and cockroach allergen in house dust

• According to the questionnaires, 49 households had ever had a presence of cockroaches in the apartment in 2010, which currently, only 6 households had any measurable corresponding allergen content in their dust samples. In only 2 of the 20 apartments with reported current presence of cockroaches was there any detectable antigen in the dust, and only in 1 of the 48 apartments with reported ever presence of cockroaches were there any detectable allergen in dust.

Allergen in dust samples and health data

• On a family level, presence of measurable allergen content of Der p 1 dust from the apartment was significantly associated with a higher risk of any family member being sensitised against Der p 1 (p=0.038). This also was seen for Der f 1 allergen presence and sensitization of any family member (p=0.020).

• Presence of HDM allergen in dust samples was not associated with other health outcomes on a family or individual level.

DISCUSSION

Considering the high number of apartments with reported indoor mould/dampness problems it was somewhat surprising to find HDM antigen below the level of detection in so many instances. When examining the connection between HDM-allergens in dust and health data, there was indeed a signal on the family level. Sensitization as determined on nasal smear was only 3% higher (and not decisive) and was rather a signal of IgE-mediated reactivity which could or could not put the individual at risk for symptoms of allergic disease.

The signal detected in this study was not of a strong and uniform nature. No significant connection between allergen levels in dust samples and measurable health outcomes could be detected on an individual level.

The striking lack of association between reports of cockroach infestation and detection of the corresponding allergen in dust samples could be due to low reporting errors, or due to technical issues with the dust collection and test. The environmental and sociocultural conditions of our study may not be entirely unique. A certain degree of transferability of the results to similar climatic and societal conditions in high-income countries of the global North may be present.

CONCLUSIONS

Collection of dust samples and measurement of allergen concentrations for house dust mites and cockroach did not add discernible value in our investigation into the health in its social context in immigrant families in Malmö. Resources in this context might be better spent in proper documentation of social and environmental factors influencing health during the home visits in which we have little doubt.

The addition of “objectively” measured variables to the evaluation of the social determinants of health could indeed be challenging, as this represents a complex system of potentially harmful and protective factors – attempting to isolate simple components may be tempting, but may not lead to meaningful interventions.

Addressing housing related health variables will be of continued importance as housing in many parts of the world will have to be reordered in terms of its climate impact in the very near future.

ACKNOWLEDGMENTS

The Hagström Study Group: Kristine Jakobsson MD PhD, Division of Occupational and Environmental Medicine, Lund University; Taty H T Yang MD, Division of Occupational and Environmental Medicine, Lund University, Sweden; Anna Oskil PhD, Division of Occupational and Environmental Medicine, Lund University, Sweden; Rune Elfman MD, PhD, University of Uppsala, Sweden; Dust Sample Analysis: Lena Elfman, University of Uppsala, Sweden. Funding: This project was supported by a travel grant from the Lund Medical Society.