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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 homes by health communicators fluent in their language. For infrequent communicators (or the part of the study presented here), allergen content was analyzed for house dust mites and cockroach allergens: Der p1, Der f1, and Bla g1 from dust samples collected in the affected apartments. 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 neighbourhood in Malmö (county of Skåne, southern Sweden). Uptake had been severely neglected by the proprietors for many years. Apartments in the affected neighbourhood, Herrgården, were overcrowded, damp, affected by mould, and infested 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 repairs to more than 900 housing units. This provided a unique opportunity to examine whether the health of children living in this neighbourhood had been affected by poor indoor environment. Preceding visits from local public care centres had 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 housing renovation on respiratory health in primary schoolchildren, children with respiratory symptoms within the last 12 months, and baseline, identified from records at the local health centres. These children and their siblings along with the parents were invited to participate in the study. In addition, a second set of children were defined from class lists at the local schools, together with their siblings and parents. These families lived in a nearby area, Tömmossen, with buildings of similar age and construction, but with appropriate upkeep.

Base-line study

A total of 359 children were recruited, including 161 children from 53 apartments in Herrgården and 198 children from 77 apartments in Tömmossen. Initial home visits were carried out between May 27, 2010, and May 29, 2011, by health communicators - investigation 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 apartment characteristics, and health information for children aged 0-13 years at the time of visit with a main focus on respiratory, allergic, and dental 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 allergens.

Methodology

Allergen levels were measured. 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 in the living room, if present. All samples were measured together, to reflect the nature of general exposure in the apartment. The health communicators visiting the home vacuumed the floor, mattress, carpet separately for 5 mm each with a dust sample recorder (DustTrak model 8530, TSI Inc., Copenhagen, Denmark). The minimum sampling time was 1 min. The dust samples were stored at -18°C for at least 3 days to kill possible house dust mites before sending them in batches to the laboratory at Occupational and Environmental Medicine, Skåne University Hospital, Malmö, Sweden. House dust mite (D. pteronyssinus and D. farinae, Der 1, and D. f. I 1, respectively, and cockroach allergens (Bla g) concentrations were measured using a Sandtech ELISA methodology using reagents from Immuno-Biosciences (Charlottesville, VA, USA) expressing the allergens in ng/g dust. The lowest level of detection was set at 50 ng/g. A level of ≥2000 ng/g (≥2.0 μg/g) was defined as high (corresponding to the level usually measured to be indicative of risk for sensitization and symptoms of rhinitis).

Family study visit

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

RESULTS

There was an overall number of 650 participants from 130 families. The place of birth was known for all participants: 85% of all children between 0 and 13 years had been born in Sweden. All children that had been born outside of Sweden entered the country well before their second birthday. All parents had been born outside of Sweden.

Allergen content for dust samples from 130 apartments:

- Der p1 
  - High n=1 (≥2000 ng/g) 
  - Low n=0 (≥200 ng/g) 
  - Present n=12 
  - Under detection level n=118

- Der f1 
  - High n=6 (≥2000 ng/g) 
  - Low n=0 (≥200 ng/g) 
  - Present n=2 
  - Under detection level n=10

- Bla g 
  - High n=2 (≥2000 ng/g) 
  - Low n=0 (≥200 ng/g) 
  - Present n=0 
  - Under detection level n=124

CONCLUSIONS

The striking lack of association between reports of cockroach infestation and detection of the corresponding allergens in dust samples could be due to 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.