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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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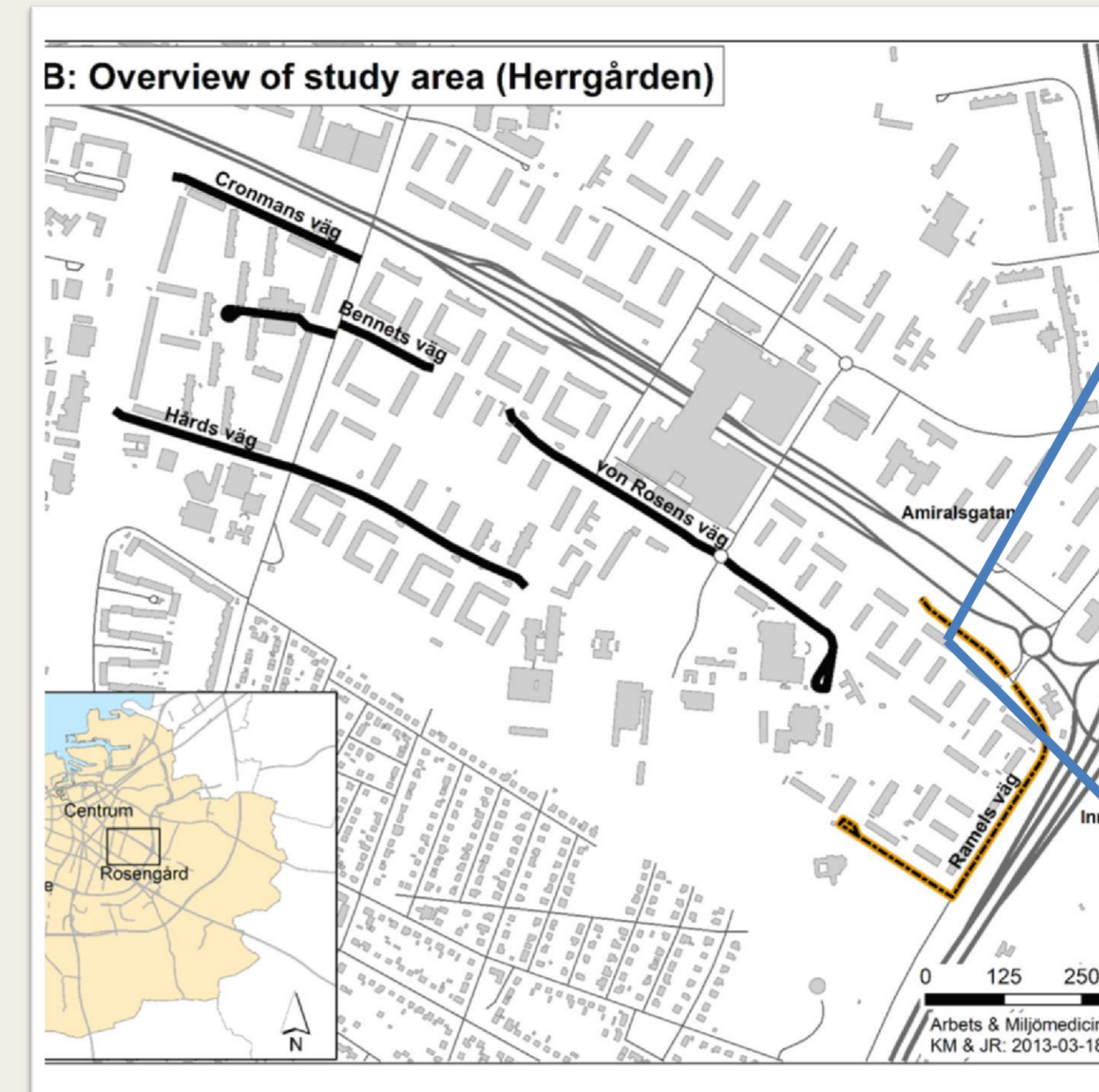
## Abstract

**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 aeroallergens 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. Family and individual level health data, including skin-prick-tests for a standard panel of aeroallergens, were analyzed together with environmental exposures (mould, dampness, ETS, crowding and allergen content- in the part of the study presented here). Allergen content was analyzed for house dust mite and cockroach allergens: Der pt1, Der f2, and Bla g, 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.



## RESULTS 1

There was an overall number of 650 participants from 130 families. The place of birth was known for all participants: 89% 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 pt 1	Der f 1	Bla g
High n=1 (above 2000 ng/g)	High n=36 (above 2000 ng/g)	High n=2 (above 2000 ng/g)
Low n=11 (50 to 2000 ng/g)	Low n=56 (50 to 2000 ng/g)	Low n=4 (50 to 2000 ng/g)
Present n=12	Present n=92	Present n=6
Under detection level n=118	Under detection level n=38	Under detection level n=124

Subjective/objective dampness and elevated house dust mite allergen concentrations in dust

- 12 households had measurable quantities of both Der pt. and Der f. allergens in their dust samples. All households with detection of Der pt. allergen also had detectable Der f. allergen, and in all of these cases Der f. concentrations were high or very high.
- All 12 of these households had either objective or subjective signs of moisture 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 more an observable trend rather than solid statistical association.

Cockroach infestation and cockroach allergen in house dust

- According to the questionnaires, 48 households had ever had a presence of cockroaches in the apartment 20 of which currently. Only 6 households had any measurable corresponding allergen content in their dust samples. Only in 2 of the 20 apartments with reported current presence of cockroaches was there any detectable antigen in the dust, and only in 4 out of the 48 apartments with reported ever presence of cockroaches was there any detectable allergen in dust.

Allergen in dust samples and health data

- On a family level, presence of measurable allergen content of Der pt 1 in dust from the apartment was significantly associated with a higher risk of any family member being sensitized against Der pt ( $p=0,038$ ). This also was seen for Der f. 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.

## RESULTS 2

Allergens in dust samples and health data

- On a family level, presence of measurable allergen content of Der pt 1 in dust from the apartment was significantly associated with a higher risk of any family member being sensitized against Der pt ( $p=0,038$ ). This also was seen for Der f. allergen presence and sensitization of any family member ( $p=0,020$ ). This association could not be demonstrated for cockroach (9 families with any sensitized member and 6 apartments with measurable allergen content – no overlap observed)
- Presence of HDM allergen in dust samples was not associated with other health outcomes, either on a family or individual level.

## DISCUSSION

Considering the high number of apartments with reported indoor moisture/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 by skin prick test is of course not a disease, rather it indicates an 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 meaningful 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 over-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

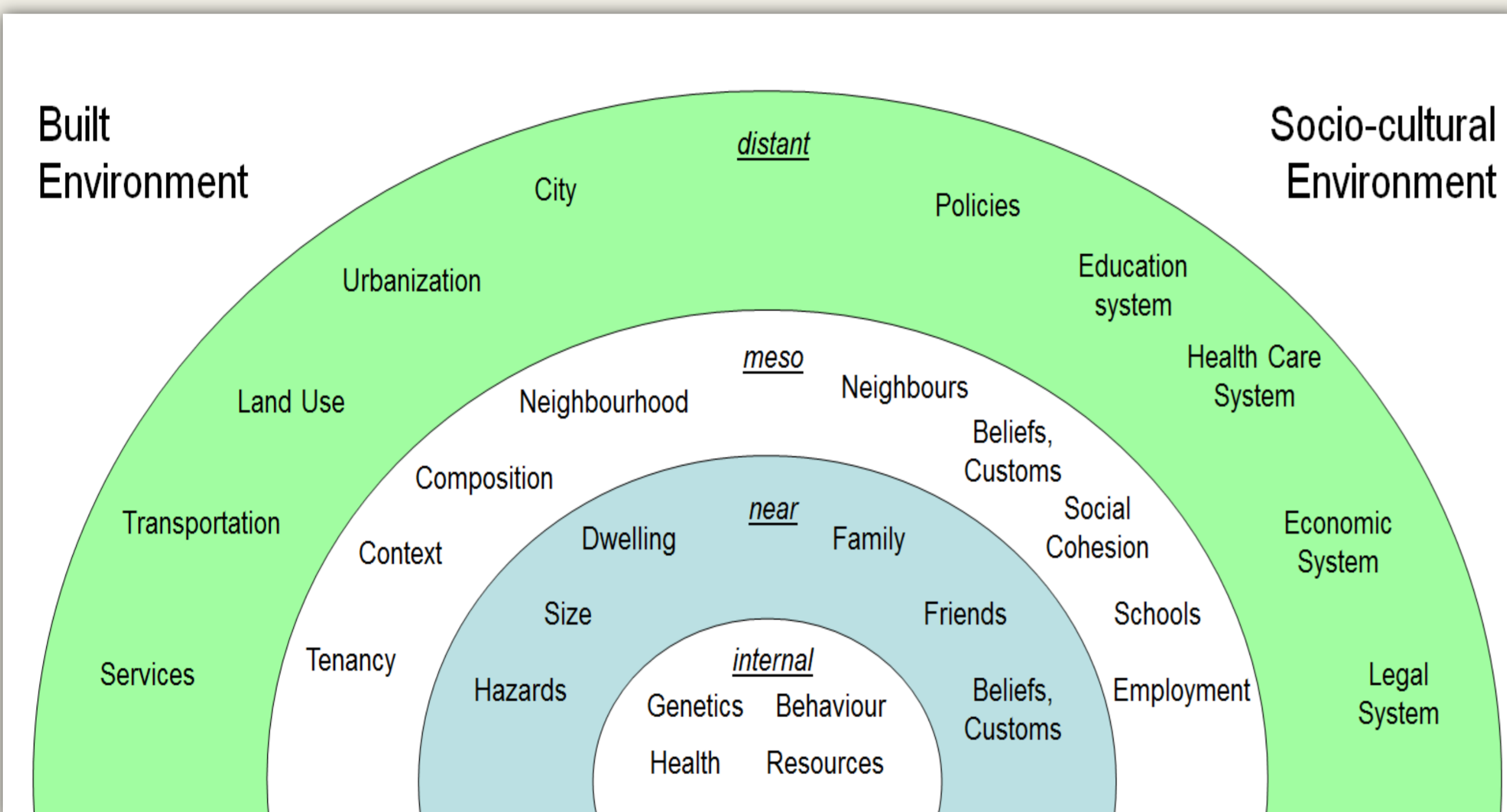
Collection of dust samples and measurement of allergen concentrations for house dust mites and cockroach did not add discernible value in our investigation into the health in its social context in immigrant families in Malmö. Resources in this context might be better spent in proper documentation of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

The addition of "objectively" measured variables into the evaluation of the social determinants of health continues to be challenging. There is always a complex system of potentially harmful and protective factors – attempting to isolate single 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 reconsidered in terms of its climate impact in the very near future.

## BACKGROUND

In 2008, the public in Sweden became aware of the extremely poor housing conditions in certain areas of Rosengård, a predominantly immigrant neighbourhood in Malmö (county of Skåne, southern Sweden). Upkeep 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 in more than 800 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; anecdotal reports from primary 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 renovations on respiratory health in vulnerable children, children with respiratory symptoms were over-sampled at 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, Törnrosen, 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 Törnrosen. Initial home visits were carried out between May 27, 2010, and May 29, 2011, by „health communicators“ - 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 apartment characteristics, and health information for children aged 0-13 years at the time of visit with a main focus on respiratory, allergic, and dermal 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 mite and cockroach antigens.

### Methodology allergen level 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 parental bed and a carpet in the living room, if present. All sample results were analysed 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 min each with a dust collector equipped with a Millipore filter (ALK, Copenhagen, Denmark). 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, Uppsala University Hospital, Sweden.

House dust mite (*D. pteronyssinus* and *D. farinae*, D. pter 1, and D. far 1, resp.), and cockroach allergen (Bla g) concentrations were measured using a Sandwich ELISA methodology using reagents from Indoor Biotechnologies (Charlottesville, VA, USA) expressing the allergen load in ng/g dust. The lowest level of detection was set at 50 ng/g. A level of > 2000 ng/g (=2µg/g) dust was defined as high (corresponding to the level usually considered to be indicative of risk for sensitization and symptoms of asthma).

### Family atopy study

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 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.