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Measurement of mite allergen in the environment

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Mite-allergen exposure is important in the pathogenesis of common allergic disorders such as asthma, chronic rhinitis, and atopic dermatitis. Therefore, numerous scientific publications have addressed the measurement of mite-allergen exposure in the environment. Two reports of large workshop meetings suggest that in large parts of the world mite allergens are the most important environmental agents causing allergic symptoms (1, 2). However, in some regions with special climatic conditions, other allergens predominate (3). Besides description of its distribution, the dose-dependent effects of mite-allergen exposure have been investigated by several works. In principle, the measurement of allergen exposure can be informative with respect to the IgE immune response, the clinical disorder, and avoidance measures. It has been shown that production of specific IgE antibodies and asthma are associated with increased allergen concentrations in the environment (4, 5). Moreover, development of symptoms and acute attacks of asthma have been shown to be positively related to mite-allergen exposure (6). Recently, relative risk was found to increase continuously with increasing allergen load in the dust of children's mattresses (7). In the same longitudinal study, the children were at increased risk of the prevalence, incidence, and persistence of asthmatic symptoms when sensitization to mite allergens was demonstrated at the age of 7 years (8). The study results encouraged scientists to investigate allergen avoidance as a strategy to prevent allergic morbidity at different levels: prevention of sensitization (primary prevention), prevention of symptoms (secondary prevention), and prevention of chronicification of the disease (tertiary prevention). In

some studies, measurement of allergen exposure was used to underline the effectiveness of reduction in exposure (9).

Thus, it can easily be understood that in the past scientists and clinicians concentrated on the development of techniques to quantify the mite-allergen load. Allergens can be analyzed in samples of so-called house dust, and most earlier studies collected samples of this important reservoir with vacuum cleaners (4, 7). A sophisticated suction device, which is commercially available, can be connected to most conventional vacuum cleaners (10). It accommodates a filter dish, and it allows standardized vacuuming from floors, mattresses, and upholstered furniture. Dust samples from homes contain multiple allergenic molecules and are mixtures of mite allergens, molds, and animal danders. Since large particles are not inhalable, it should be reasonable to separate coarse material from the sample in order to quantify the allergen content in the fine-particle fraction only (11). Enzyme immunoassays employing monoclonal antibodies against the major allergens of *Dermatophagoides pteronyssinus* and *D. farinae* are commonly used to measure the concentration of Der p 1 and Der f 1, respectively (12). The result is gathered when the photometric absorption of the sample is related to the standard curve and to the amount of sampled dust (13). A less specific method of detection is the measurement of the guanine content (14). Usually, the allergen load is expressed as mass antigen per mass of sampled dust. Thus, these kinds of measurements represent an allergen concentration found in dust samples. Nevertheless, these measurements are frequently undertaken in order to estimate exposure of subjects. However, the repre-

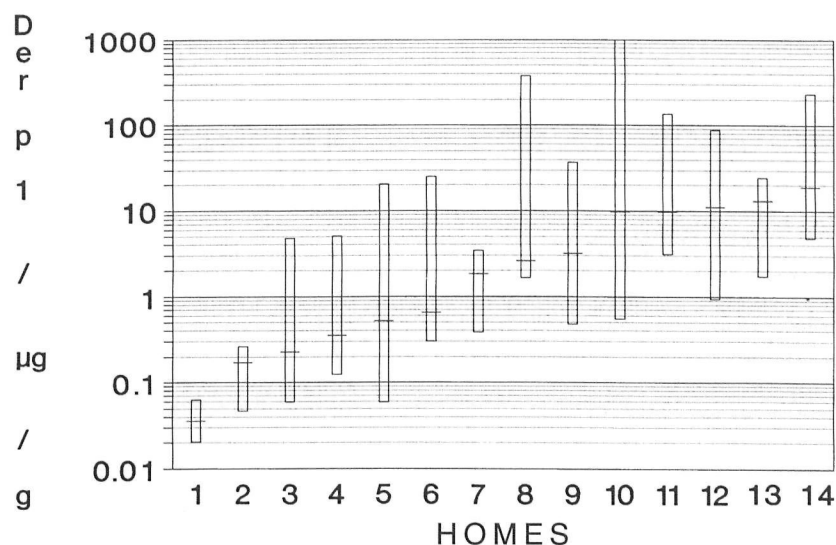


Fig. 1. Intrahome variation of Der p 1 – range and median – in 14 homes.

representativeness of spot measurements for personal exposure includes several assumptions.

Firstly, measurement of one allergen as Der p 1 can reflect effects which are caused by another allergen of the same source as Der p 2. However, a recent publication showed that Der p 1 concentrations are closely related to Der p 2 concentrations in dust samples from the same sampling procedure and the same location (15). Secondly, samples from different sources of the same home can reveal different estimations of exposure. In the homes of schoolchildren from Sydney, Australia, different rooms of the same home were examined, and it seemed that lower concentrations were found in the floor dust of the living room, somewhat higher in floor dust of the bedroom, and the highest in bed dust (16). However, none of the three rooms could represent the maximum concentration in each home (16). Similarly, findings from Germany showed that the concentrations of Der p 1 in dust from several locations in 14 homes varied greatly between homes and also within the same home (Fig. 1). In most of these homes, the maximum concentration of Der p 1 as well as of Der f 1 was found in mattress dust, a finding which might underline the importance of mattress covers for the effectiveness of allergen avoidance (Table 1). On the other hand, other places of mite infestation, such as carpets and upholstered furniture, must not be neglected, especially when allergen avoidance in highly sensitive patients is necessary. Another potential source of mite-allergen exposure which could be particularly relevant to exposure of babies is soft toys. Nagakura et al. found that Der 1 allergens are detectable even in new soft toys and that the allergen concentration increases sharply when the toys have been used for about 1 year (17).

Sampling of airborne particles requires a special air sampler; however, the use of this method might allow one to assess exposure by inhalation of allergenic particles (18). Moreover, consideration of the particle size allows quantification of the inhalable fraction of particles. In six different rooms, changing the mattress was associated with a change in the concentration of airborne allergen (18), and in each of the six cases, this could be suggested by measuring on two occasions. Thus, measurement on airborne allergens can be useful for special purposes.

In addition to variation of allergen load between places, seasonal variation can limit the representativeness of a single measurement for average exposure (6). In contrast, a study from Taiwan did not find a clear trend over the year, at least for dust from mattresses (19). However, such a trend can be more or less pronounced, depending on the climate conditions of the country and the microclimate (6). In summary, many methodological and natural variables can cause poor reproducibility of measurements and study results. Thus, it is not surprising that Marks et al. in Australia reported up to 16-fold differences in replicated measurements (20). Nevertheless, as many authors found, measurement of the allergen load can deliver a reliable index of exposure. For scientific purposes, suggestions should be based on a statistically sufficient number of samples; otherwise, the potential variability of allergen measurements in the environment is likely to cause conflicting results (20). The latter problem can also occur if individual susceptibility is neglected or the biologic end-point is not sufficiently defined (21). Moreover, conclusions about the role of allergen exposure can be different, if a retrospective study design is used and

Table 1. Place with maximum antigen concentration of home (N=14)

Place	Der p 1 (n/N)	Der f 1 (n/N)	Same location for both antigens (n/N)
Sofas (n=8)	1/14	3/14	1/14
Mattresses (n=62)	10/14	11/14	5/14
Carpets (n=30)	3/14	0/14	0/14

an affected population is analyzed (22), from those of a longitudinal approach, which allows analysis of changes and estimation of allergen exposure at a defined point in time (5, 7).

With regard to practical recommendations, a group of investigators briefly proposed standardization of the sampling of dust (10). Attention should be paid to the kind of reservoir which is of interest, to the duration of vacuuming, and to the size of area (10). However, these suggestions are partly a result of personal experiences and should be evaluated systematically in the future. General requirements for useful measurement and interpretation of mite-allergen levels in the environment include appropriate selection of place and time of taking the sample, sufficient number of dust samples (to avoid false-negative results), a reliable end-point definition of the health effect, and consideration of individual susceptibility.

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