Evaluating exposure to mite allergens

Adnan Custovic, MD, MSc, Simon C. O. Taggart, MD, MRCP, Robert McL Niven, MD, and Ashley Woodcock, MD, FRCP
Manchester, England

Standardized methods for measuring mite allergen exposure are essential for assessing the relationship between exposure and sensitization and the degree of exposure associated with provocation of asthma symptoms. However, there is still considerable debate as to whether exposure should be assessed by measuring settled dust from allergen reservoirs or by sampling ambient air and whether results for settled dust should be expressed as recoverable allergen per unit weight or per unit area.[1-5] The aim of this study was to compare methods for collecting and analyzing allergen samples.

METHODS

House dust samples were collected from 53 homes of patients with asthma by vacuuming 1 m^2 areas of mattress and bedroom carpet for 2 minutes.

Personal airborne sampling

Three types of air samples were collected with Casella personal samplers (Casella Ltd., Bedford, U.K.) with a flow rate of 2 L/min: (1) for 8 hours during usual domestic activities (n = 7), (2) for 2 to 3 hours during sieving of domestic dust in the laboratory (n = 8), and (3) for 8 hours overnight in bed by individuals wearing a continuous positive airway pressure nasal mask, which was modified by the replacement of elbow joint with sampling head.

Fixed location airborne sampling

Eight paired airborne samples were collected with a high-volume dust sampler situated 1 m above the floor (flow rate of 60 L/min) for 4 hours before and after disturbance (vacuuming with a 1000 W vacuum cleaner without a bag or filters for 5 minutes at a flow rate of 45 L/sec).

Twenty-four samples were collected overnight (8 hours) with a Casella personal sampler attached to patients' pillows.

Airborne samples were collected onto 0.3 μm glass fiber filters. Each filter was extracted in 1 to 2 ml of 1% bovine serum albumin in phosphate-buffered saline, pH 7.4, overnight. One of each pair of the eight high-volume samples was sonicated for 10 seconds (amplitude, 22 μm). Group I mite allergens were measured by a two-site monoclonal antibody–based ELISA (antibodies kindly provided by Dr. Martin Chapman, University of Virginia, Charlottesville).

RESULTS

Linear regression analysis showed an excellent correlation between the results of Der p 1 assays of dust samples expressed either as micrograms per gram or micrograms per square meter in both mattresses and in carpets ($r = 0.95, p < 0.0001$) (Fig. 1).

Der p 1 was undetectable (<1 ng/ml) in all personal airborne samples collected overnight or during usual daytime domestic activity (mean sample volume, ~1 m^3). Airborne Der p 1 was readily detected by individuals wearing personal samplers while sieving domestic dust samples (geometric mean, 40 ng/m^3; range, 18 to 73 ng/m^3; mean sample volume, 0.3 m^3).

Der p 1 was undetectable in all fixed location samples (mean sample volume, 15.5 m^3) collected before disturbance. Low levels were detected in all samples after disturbance (1 to 4 ng/ml), but there was no difference between sonicated or nonsonicated samples. Der p 1 was undetectable in all overnight samples collected on pillows.

DISCUSSION

Assessment of exposure to mite allergens is essential in understanding allergic disease. Sampling of dust reservoirs within the house and expression of results as micrograms of group I mite allergens per gram of dust has been considered the best index of exposure,[1] but it has been suggested that recoverable allergen per unit area is more appropriate and that airborne sampling ought to be regarded as "the gold standard for allergen measurement."[2] The results of this study show that expressing results of reservoir sampling as allergen recovered per unit surface area provides no further information than expressing results as micrograms per gram of fine dust. Measurements per gram of dust are therefore appropriate for the majority of

From North West Lung Centre, Wythenshawe Hospital, Manchester.
Reprint requests: Ashley Woodcock, MD, FRCP, North West Lung Centre, Wythenshawe Hospital, Southmoor Rd., Manchester M23 9LT, U.K.
J ALLERGY CLIN IMMUNOL 1995;96:134-5.
Copyright © 1995 by Mosby–Year Book, Inc.
0091-6749/95 $3.00 + 0 **1/54/63270**

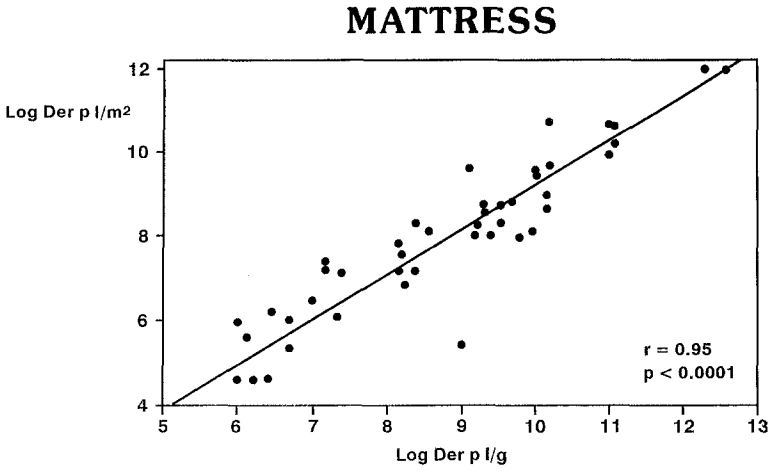

FIG. 1. Correlation of mite allergen Der p 1 expressed as recoverable allergen per unit area against allergen per unit weight in 53 mattress samples of dust. Samples were collected with a vacuum cleaner (Medivac; Wilmslow, Cheshire, U.K.) with a flow rate of 45 L/sec.

epidemiologic studies. It is possible that expressing the results per unit area could be useful in certain circumstances in trials in which size of the dust reservoir is changed by intervention (e.g., by application of chemicals).

Airborne sampling is widely used in the assessment of occupational exposure and might be considered more representative as a measure of inhaled allergen than of reservoir levels. It is a useful tool in the assessment of exposure to cat and dog allergens. However, as yet airborne sampling has serious limitations as a method for measurement of mite allergen exposure: it requires very sensitive assays, and in the absence of disturbance, mite allergen concentrations are generally below the detection limits.[1] Two studies have reported a good correlation between sensitization and airborne levels of mite allergen.[3,7] However, these data were not confirmed in other laboratories.[4] In some studies in which detectable airborne Der p 1 was found, sonication was used for the preparation of extracts.[7] In our studies we were unable to detect airborne allergen either by personal samplers or high-volume samplers in the absence of disturbance. However, Der p 1 was measured in high concentrations during sieving of dust. Detectable airborne Der p 1 in homes was found only after vigorous disturbance. Sonication did not alter the measured values. As yet, airborne sampling is insufficiently sensitive to produce reliable and repeatable results and should be avoided as a method for the assessment of exposure to mite allergen until more sensitive assays or better sampling methods are developed.

In conclusion, these findings are in agreement with the recommendation to sample the reservoirs of dust and express the results as micrograms of group I allergen per gram of dust.[1]

REFERENCES

1. Platts Mills TAE, Thomas W, Aalberse RC, Vervloet D, Chapman MD. Dust mite allergens and asthma: report of a second international workshop. J ALLERGY CLIN IMMUNOL 1993;89:1046-57.
2. Collof MJ, Ayers J, Carswell F, et al. The control of allergens of dust mites and domestic pets: a position paper. Clin Exp Allergy 1992;22(suppl 2):1-28.
3. Price JA, Pollock J, Little SA, Longbottom JL, Warner JO. Measurement of airborne mite allergen in homes of asthmatic children. Lancet 1990;336:895-7.
4. Sporik R, Chapman M, Platts-Mills T. Airborne mite antigen [Letter]. Lancet 1990;336:1507-8.
5. Warner JO, Warner JA. Airborne mite allergen [Letter]. Lancet 1991;337:1038.
6. Luczynska CM, Arruda LK, Platts-Mills TAE, Miller JD, Lopez M, Chapman MD. A two-site monoclonal antibody ELISA for the quantification of the major *Dermatophagoides* spp. allergens, Der p I and Der f I. Immunol Methods 1989;118:227-35.
7. Warner JA, Little SA, Pollock I, Longbottom JL, Warner JO. The influence of exposure to house dust mite, cat, pollen and fungal allergens in the home on primary sensitisation in asthma. Pediatr Allergy Immunol 1990;1:79-86.