

Antigenic Analysis of Household Dust Samples¹⁻⁴

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Introduction

House dust has long been recognized as a major perennial allergen. Over the last 20 years, it has been shown that pyroglyphid dust mites are the source of the major allergens in house dust in many areas of the world (1-8). A causal relationship between mite antigens and the development of asthma has been proposed in both Western Europe and the United States (7, 9). Further, it has been shown that mite elimination has a markedly salutary effect on mite-sensitive asthmatics, even leading to a reduction in generalized bronchial hyperreactivity (10, 11).

Despite the importance of the dust mite, however, it is also clear that house dust is a complex mixture that may contain a variety of potent allergens. Most commonly, animal danders (12-16) and molds (17) join dust mites as highly allergenic components of house dust. The concept of house dust allergy is thus a very complicated one. A patient may indeed demonstrate house dust sensitivity without being mite allergic.

The study of this complex mixture has been a difficult one. Techniques such as counting mite numbers are cumbersome and often only provide an indirect estimate of the true antigenic content of a home. Over the last several years, however, immunochemical assays have been developed that allow for the specific quantitation of many of the major allergens in house dust (18-24). These assays provide the means for the analysis of large numbers of house dust samples for multiple allergens.

We undertook this study as an initial effort to devise a simple and readily available method of house dust collection and extraction that could be combined with immunochemical techniques for the analysis of house dust samples. In doing so, we also sought to characterize in a quantitative fashion the significance of antigens from dust mite, dog, cat, and molds in Baltimore homes.

SUMMARY Household dust samples from the homes of 106 allergy clinic patients in Baltimore were analyzed for specific allergen content. Dust mite antigen content was determined by enzyme-linked immunosorbent assays (ELISA) specific for the major allergens of *Dermatophagoides pteronyssinus*, *D. farinae*, and *D. microceras*. Cat and dog antigen content were determined by ELISA using antisera for *Fel d 1* (formerly cat allergen 1) and dog allergens 3 and 13, respectively. Mold content was assessed by culture with microscopic identification.

Dust mite antigen was detected in 99% of homes (*D. farinae*, 95%; *D. pteronyssinus*, 88%; *D. microceras*, 31%), with total antigen content ranging from 50 ng/g dust (the lower limit of detection) to 30,170 ng/g (median, 1,123 ng/g). Animal allergens were found in 100% of samples (cat: range, 2 to 130,000 ng *Fel d 1*/g; median, 90 ng/g; dog: range, 112.5 to 585,000 IU/g; median, 2,719.5 IU/g). Although there were highly significant differences in antigen content ($p < 0.001$) between homes with and without a particular pet in residence, many homes without pets contained pet allergens at high concentrations. Molds were also detected in 100% of homes (range, 4 to 761 colonies/30 mg dust; median, 72 colonies/30 mg).

No correlation was demonstrated between antigen content and skin test results, a history of asthma, symptoms on allergen exposure, or the age of the home (except for molds) for any of the allergens detected. We conclude that dust mite allergens, cat and dog allergens, and molds are virtually ubiquitous in Baltimore homes and that our ability to predict the presence and relative quantities of these allergens on clinical grounds is very limited.

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Methods

Patients and Home Environments

One hundred and six volunteers were recruited from consecutive patients of the Internal Medicine and Pediatric Allergy clinics of the Johns Hopkins Hospital and the Good Samaritan Hospital in Baltimore. Recruitment and sampling took place from January to early March 1985. Patient volunteers ranged in age from 3 to 67 yr. Fifty-five patients had a history of asthma, 68 a history of rhinitis, and 8 a history of eczema. Histories were obtained regarding the exacerbation of these symptoms on exposure to dust, dog, cat, and mold. Environmental history revealed that 15 homes were less than 10 yr old, 33 were between 10 and 30 yr old, and 45 were greater than 30 yr old. Thirty-five homes contained a dog at the time of sampling, 25 contained a cat, 5 contained both, and 40 contained neither a dog nor a cat.

Skin testing was performed within 1 yr of the time of sampling using commercially available extracts, including *D. farinae* antigen (Hollister-Stier, Spokane, WA), dog and cat epidermal extract (Center Labs, Port Washington, NY; and Allergy Labs of Ohio, Columbus, OH), mold extract mixtures (Center Labs), and, if indicated, individual extracts of *Aspergillus*, *Penicillium*, *Alternaria*, and *Cladosporium*. Prick testing was performed with 10^4 PNU/ml extracts and intradermal

testing with 10^2 PNU/ml and 10^3 PNU/ml extracts. Not all patients had both prick and intradermal testing. Skin test results were positive to dust mite in 42 patients, to cat in 44 patients, to dog in 42 patients, and to mold in 46 patients. Seventeen patients were skin test negative to all of these allergens.

Dust Collection

Dust samples were collected by the patient volunteers using a rechargeable hand-held vacuum (Douglas Read Vac Model No. 6730). The vacuum has a filter that can be easily re-

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moved for dust collection. Homes were vacuumed for a total of 9 min: bedroom, 4 min (mattress, under bed, beside bed, closet floor); bathroom, 2 min (floor, shower curtain); TV area, 2 min (sofa, floor); and basement floor, 1 min. Vacuums were returned within 7 days. Dust samples were collected from the removable filter. No sieving or other separation process was used. Eighteen samples, however, were divided into 3 aliquots in order to assess the homogeneity of our sampling and the reproducibility of our extraction and assay techniques. The samples were weighed, sealed in plastic bags, frozen (-20°C), and shipped to ALK Labs in Copenhagen, Denmark, where analysis was undertaken.

Dust Analysis

Aqueous extracts were performed as previously described by suspending each gram of the dust sample in 5 ml of 0.9% NaCl (18). For most samples, one half of the vacuum filter was also included with the dust mixture for extraction. Dust mite antigen content was determined by an ELISA using species-specific rabbit antibody absorbed to render them specific for the non-cross reacting epitopes of the major allergens of 3 *Dermatophagoides* species: *pteronyssinus* (antigen *Der p* 1, formerly Dp 42 or P1), *farinae* (antigen *Der f* 1), and *microceras* (antigen *Der m* 1) (24). Less than 0.1% cross reactivity is observed among these species-specific antigens in the ELISA assay (24). Mite antigen content is expressed as nanograms of species-specific antigen per gram of dust. Because each result is species-specific with negligible cross reactivity, the total mite antigen content was determined as the sum of the 3 individual mites. The lower limit of sensitivity of the ELISA is 10 ng/g for *D. farinae* and 20 ng/g for *D. pteronyssinus* and *D. microceras*.

Dog and cat antigen content was determined by ELISA techniques similar to those described for dust mite antigen detection. Cat major allergen, *Fel d* 1 (25), was partially purified from a cat dander extract by Sephadex G-75 gel filtration. Fractions, pooled according to fused rocket immunoelectrophoresis (FRIE), contained *Fel d* 1 with traces of albumin and a second prealbumin (Cat Ag 2 [26]). Rabbits injected with this preparation produced antiserum with dominant antibody activity against *Fel d* 1 as shown by crossed immunoelectrophoresis (CIE). Specificities against albumin and Cat Ag 2 were removed by column absorption on Sepharose 4B coupled with pooled Sephadex G-75 fractions with maximal content of these components as shown by FRIE. The absorbed antiserum, monospecific to *Fel d* 1 as shown by CIE, was affinity-purified by acid elution from a column with Sepharose 4B coupled with cat dander extract.

Two IgE-binding dog dander antigens (Dog Ag 3 and Ag 13 [27]) were purified by Sepharose S200 gel filtration. The 2 antigens eluted with molecular weights in the range 15,000

to 30,000 daltons and were of nonserum origin. Antiserum from rabbits injected with pooled, freeze-dried fractions contained high titers of antibodies against Ag 3 and Ag 13 as shown by CIE. Traces of antibodies against albumin and other serum proteins were removed by column absorption on Sepharose coupled with dog serum. Finally, affinity purification took place by acid elution from a column with Sepharose 4B, coupled with the Ag 3 and Ag 13 fraction.

Conjugation of antibodies with horse radish peroxidase, coating of polystyrene microtiter trays with antibodies, and performance of the sandwich ELISA took place essentially as described for the analogous dust mite allergen assay (24). A reference cat dander preparation (ALK, batch 209) with known content of *Fel d* 1 (labeled in nanograms) and a reference dog dander extract, containing 30 International Units (IU) of Ag 3 + Ag 13 per microgram, was used for construction of standard curves. Lower limits of detection were 0.5 ng *Fel d* 1 and 75 IU of Dog Ag 3 + Ag 13 per gram of dust.

In addition to the analysis for dust mite, dog, and cat antigens, mold content was determined by culturing 30 mg of the dust sample on V-8 agar with added penicillin and streptomycin and incubating for 1 wk at 26°C . Mold quantitation and identification were then performed, with mold content expressed as colonies per 30 mg of dust.

Statistics

Possible correlations between the concentrations of the different allergens and the various clinical and environmental parameters that we studied were determined by the Spearman rank correlation coefficient. Differences in distribution of various environmental al-

lergens were evaluated using the Wilcoxon nonpaired rank sum test, except where noted in the text.

Results

Dust sample weights varied widely from 0.14 to 38.4 g, with a median weight of 3.5 g. Likewise, the physical appearance of the samples varied greatly, ranging from small amounts of fine dust to large quantities of hair, fuzz, and debris.

In order to assess the reproducibility of our extraction and assay techniques, 18 samples were divided into 3 aliquots, extracted separately, and assayed for dust mite, dog, and cat antigens. For each triplicate, 1 aliquot contained the vacuum filter in the extraction process and 2 aliquots did not. For dust mite antigens, linear regression analysis between paired samples showed r values of 0.82 to 0.96 ($p < 0.001$). Replicate aliquots with filters had 9.1% to 15% higher dust mite content than paired replicates without filters, indicating that small amounts of recoverable dust mite antigens may be contained in the filter. For dog and cat antigens, results were highly reproducible between split samples ($r = 0.90$ to 0.98 , $p < 0.001$), and inclusion of the filter had no significant effect on antigen levels or reproducibility.

Dust mite antigens were detectable in 96 of 97 samples analyzed (99%). As seen in figure 1, *D. farinae* antigen was present in 95% of the homes studied, with a range from 10 ng/g, the lower limit of

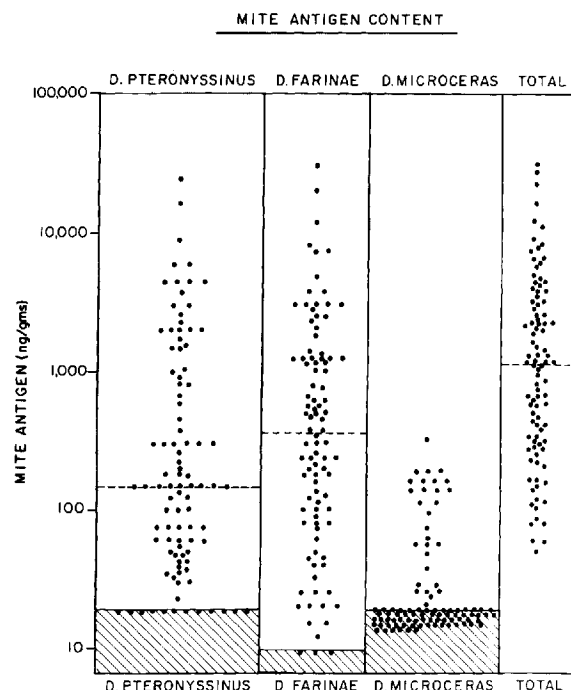


Fig. 1. Mite antigen content (ng/g) as determined for 97 homes by ELISA for 3 mite species (*Dermatophagoides pteronyssinus*, *D. farinae*, and *D. microceras*) and total mite content (determined as sum of the 3 individual mites). Dotted lines indicate medians. Hatched areas below solid lines indicate lower limits of sensitivity of the assays (20 ng/g for *D. pteronyssinus* and *D. microceras*, 10 ng/g for *D. farinae*).

TABLE 1
CORRELATION OF TOTAL MITE CONTENT WITH CLINICAL AND ENVIRONMENTAL PARAMETERS

	n	Median (ng/g)	Range (ng/g)	Significance
History of asthma	55	1,215	50 to 30,170	p = 0.87
No history of asthma	41	865	60 to 28,020	
Positive skin test to <i>D. farinae</i>	42	1,318	58 to 30,170	p = 0.64
Negative skin test to <i>D. farinae</i>	49	680	50 to 16,615	
Home less than 10 yr old	15	1,970	255 to 30,170	p = 0.36
Home 10 to 30 yr old	33	970	58 to 28,020	
Home greater than 30 yr old	45	1,142	50 to 9,203	
Symptoms on dust exposure	68	917	50 to 30,170	p = 0.054
No symptoms on dust exposure	22	2,197	230 to 20,320	

detection of the assay, to 30,000 ng/g and a median of 360 ng/g. *D. pteronyssinus* antigen was present in 88% of the samples, with a peak value of 25,000 ng/g and a median of 150 ng/g. *D. microceras* antigen was found in 31% of the homes, with a peak concentration of 340 ng/g and a median of 20 ng/g. The total mite antigen burden, determined as the sum of the 3 individual mites, showed a range from 50 ng/g to 30,170 ng/g, with a median of 1,123 ng/g.

Most samples contained the antigens of multiple mite species. Only 1 home had no mite antigen detectable, while 11 homes had a single species, 57 had 2 species, and 28 had all 3. *D. farinae* was the dominant species in 49 homes, whereas *D. pteronyssinus* was dominant in 41 and *D. microceras* in 7. Thus, 99% of the homes studied had at least 1 mite species in residence, 88% had multiple species and, in those, *D. farinae* was most commonly found to be the dominant species.

Analysis was performed to determine if total mite antigen content correlated with any of the clinical or environmental history obtained from our patients (table 1). Mite content in homes of patients with a positive skin test to *D. farinae* antigen was not significantly different from the content in those with a negative skin test. Likewise, no correlation was found between mite antigen content and a history of asthma or the age of the home ($p = 0.36$, determined by Kruskal-Wallis 1-way analysis of variance by ranks [28]). A p value of 0.054 was obtained when comparing the homes of patients with symptoms on exposure to dust with those of patients without symptoms on dust exposure. Although not statistically significant, it does suggest that symptomatic patients may maintain, or seek out, an environment lower in mite antigen content.

Both cat and dog antigens were detected in 100% of homes, with ranges of 2 ng/g to 130,000 ng/g (median, 90 ng/g) for cat and 112.5 IU/g to 585,000 IU/g (median, 2,719.5 IU/g) for dog (figures 2 and 3). There was a highly significant difference in median antigen concentration in homes with and without a particular pet in residence (figures 2 and 3). For the 56 homes without a dog, dog antigen concentrations ranged from 112.5 to 82,500 IU/g, with a median of 1,132.5 IU/g. In the 33 homes known to currently house a dog, dog antigen levels ranged from 1,134 to 585,000 IU/g, with a median of 172,500 IU/g ($p < 0.001$). Similarly, cat antigen content in the 23 homes with a known cat (median, 31,000 ng/g; range, 6 to 130,000 ng/g) differed significantly ($p < 0.001$) from the antigen content of homes without cats (median, 63 ng/g; range, 2 to 7,500 ng/g). Thus, al-

though significant differences exist in antigen content between homes with or without a dog or cat in residence, many homes nominally without pets contain pet antigens at significant concentrations.

As was true for dust mite, dog and cat antigen content did not correlate with symptoms on exposure to the appropriate animal, skin test results, or the age of the home (tables 2 and 3). A history of asthma was associated with lower cat antigen content in the home ($p = 0.03$).

Mold colony counts were performed on samples from 84 homes. All homes contained detectable mold spores with a range of 4 colonies per 30 mg of house dust to 761 colonies/30 mg and a median of 72 colonies/30 mg (figure 4). A total of 36 fungal genera were identified with the 5 most common genera, including *Penicillium*, *Aspergillus*, *Rhodotorula*, *Alternaria*, and *Cladosporium*, comprising 65% of the total colony counts (table 4). As also shown in Table 4, 6 separate genera were identified in more than 50% of all dust samples.

No association was demonstrated between mold colony counts and skin test results, a history of asthma, or symptoms on mold exposure (table 5). A weak but significant positive correlation was detected, however, between total mold colony count and total dust mite antigen content (Spearman rank correlation $r = 0.22$, $p = 0.044$). Mold content was higher in homes with a positive history of having mildew for greater than 3 months of the year (median colony counts 58 versus 84, $p = 0.024$). For mold

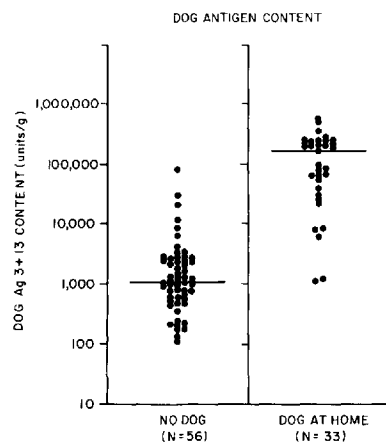


Fig. 2. Dog antigen content (IU/g) as determined for 90 homes by ELISA specific for dog antigens 3 and 13. Homes without a dog represented on the left, homes with a dog on the right. Lower limit of sensitivity is 75 IU/g. Difference between median antigen content (solid lines) of homes with and without a dog statistically significant (medians, 1,132.5 versus 172,500 IU/g; $p < 0.001$).

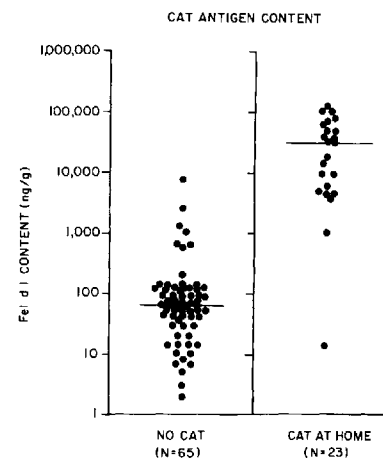


Fig. 3. Cat antigen content (ng/g) as determined for 90 homes by ELISA specific for *Fe d 1*. Homes without a cat represented on left, homes with a cat on the right. Lower limit of sensitivity is 0.5 ng/g. Difference between median antigen content (solid lines) of homes with and without a cat statistically significant (medians, 63 versus 18,000 ng/g; $p < 0.001$).

TABLE 2
CORRELATION OF DOG ANTIGEN CONTENT WITH CLINICAL AND ENVIRONMENTAL PARAMETERS

	n	Median (IU/g)	Range (IU/g)	Significance
Dog at home	33	172,500	1,134 to 585,000	p < 0.001
No dog at home	56	1,132.5	112.5 to 82,500	
History of asthma	50	2,400	112.5 to 510,000	p = 0.85
No history of asthma	40	2,760	187.5 to 585,000	
Positive skin test to dog extract	56	3,375	112.5 to 585,000	p = 0.62
Negative skin test to dog extract	34	2,232	225 to 510,000	
Home less than 10 yr old	12	7,200	450 to 255,000	p > 0.7
Home 10 to 30 yr old	33	2,775	217.5 to 375,000	
Home greater than 30 yr old	45	1,869	112.5 to 585,000	
Symptoms on dog exposure	32	2,820	112.5 to 8,500	p = 0.88
No symptoms on dog exposure	58	2,475	187.5 to 585,000	

TABLE 3
CORRELATION OF CAT ANTIGEN CONTENT WITH CLINICAL AND ENVIRONMENTAL PARAMETERS

	n	Median (ng/g)	Range (ng/g)	Significance
Cat at home	23	31,000	6 to 130,000	p < 0.001
No cat at home	65	63	2 to 7,500	
History of asthma	51	63	3 to 100,000	p = 0.03
No history of asthma	39	128	2 to 130,000	
Positive skin test to cat extract	58	90	2 to 130,000	p = 0.88
Negative skin test to cat extract	32	91	5 to 80,000	
Home less than 10 yr old	11	68	3 to 13,000	p > 0.3
Home 10 to 30 yr old	32	92	15 to 80,000	
Home greater than 30 yr old	47	90	2 to 100,000	
Symptoms on cat exposure	38	90	3 to 100,000	p = 0.75
No symptoms on cat exposure	52	112.5	2 to 130,000	

content versus the age of the home, a p value of less than 0.02 was found, with mold content highest in homes less than 10 and greater than 30 yr old.

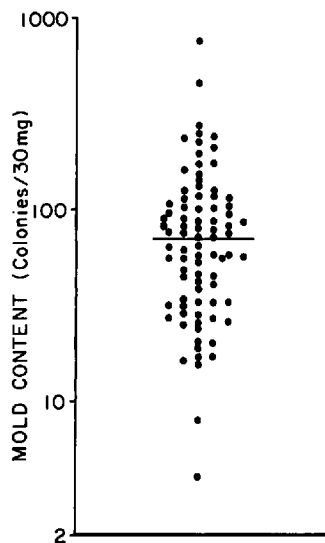


Fig. 4. Total mold content (colonies per 30 mg of dust) as determined by culture of samples from 84 homes (range, 4 to 761 colonies/30 mg; median, 72 colonies/30 mg).

Discussion

The data presented here demonstrate that house dust contains a variety of potent allergens. We found dust mite antigens, dog and cat antigens, and molds to be highly prevalent in the Baltimore homes studied. Further, we found that we were very limited in our ability to predict the presence of these allergens using standard environmental histories or clinical data.

Although we found the dust mites *D. pteronyssinus* and *D. farinae* to be virtu-

ally ubiquitous in Baltimore homes, the actual levels of antigen detected were not particularly high. Although no exact standards exist in this regard, the quantitative analysis of mite antigen has allowed for the development of certain guidelines (20). It has been suggested that levels of greater than 10,000 ng/g of antigen P₁ equivalent, a cross-reacting determinant of the major antigens of *D. pteronyssinus* and *D. farinae*, be regarded as high, that levels greater than 2,000 ng/g be regarded as significant, that levels less than 2,000 ng/g be considered low, and that levels less than 400 ng/g be regarded as very low (20). When considering total mite antigen content, our median value was 1,123 ng/g. Six homes had levels greater than 10,000 ng/g, and 30 had levels between 2,000 and 10,000 ng/g, while an additional 30 homes had levels of less than 400 ng/g. Thus, using the above guidelines, 38% of the homes studied had total mite antigen levels in the high or significant range, while the remaining 62% would be considered to be in the low or very low range. The levels we found are most comparable to those reported from Austria (unpublished observation), Belgium (29), and in a previous study from Baltimore (30). We appear to have considerably lower mite antigen levels, however, than homes in England (3), Atlanta (7), Charlottesville (5), and Seattle (5).

The relatively low levels of mite antigen that we detected could be the result of several factors. First, mite antigen is normally found in the highest concentration in fine dust or mattress dust (24, 31). In our study, no sieving process was used, and the mixed, raw dust that was extracted contained large amounts of potentially nonantigenic material. Second, mite counts and antigen levels have been found to reach their natural nadir in the winter and early spring (6, 7), the time that our sampling was performed.

TABLE 4
MOLD CONTENT

Fungal Genera Identified	% of Total Colonies	% of Samples Positive
<i>Penicillium</i> spp.	28.8	80
<i>Aspergillus</i> spp.	10.1	81
<i>Rhodotorula rubra</i>	9.0	50
<i>Alternaria</i> spp.	8.7	65
<i>Cladosporium</i> spp.	8.2	22
<i>Chaetomium</i> spp.	6.0	60
Yeasts	5.6	39
<i>Aspergillus niger</i>	4.9	—
<i>Scopulariopsis</i> spp.	3.7	30
<i>Mycelia</i> spp.	3.3	48
<i>Mucor</i> spp.	2.6	59
Other (28 genera)	9.1	—

Third, several prior studies have included only the homes of mite-sensitive asthmatics (3, 7), a population that Korsgard found to have significantly greater mite numbers than matched controls (9, 32). Our study population was chosen from an allergy clinic but had no positive selection bias for patients with either asthma or mite sensitivity. Finally, it could be of course that there is truly a lesser mite burden in Baltimore compared with the other geographic locations noted. Because of the limitations detailed here, however, no final conclusion can be made in this regard.

D. microceras is another pyroglyphid mite that has been found in high concentrations in Denmark, where it rivals *D. pteronyssinus* as the dominant species (24). *D. microceras* antigen was present in 31% of our samples but was the dominant species in only 6 homes. Its peak concentration, moreover, was only 340 ng/g. Therefore, in agreement with prior data, this mite species appears to be of little or no clinical significance in Baltimore (30).

We could find no correlation between total mite antigen content and mite sensitivity, defined by a positive skin test to *D. farinae* extract. This differs from prior studies in which a positive association was noted between mite sensitivity and mite numbers in the home (7, 9, 32). It is possible that it takes relatively little mite exposure to produce sensitivity in predisposed individuals. There also remains the possibility that each of our mite-sensitive patients had had an exposure to high mite antigen levels at some time in their past, or, that the association might have been missed because of our winter sampling period.

We also could not detect an association between mite burden in the home and a history of asthma. Such a correlation has been previously described by both Korsgard (9) and Smith and colleagues (7), but in highly selected populations. Smith and colleagues found that 17 of 20 mite-sensitive asthmatics had high levels of mite antigen in their homes (> 10,000 ng/g) and speculated that mite sensitivity was the direct result of exposure to high levels of mite antigen and that the mite sensitivity played a causative role in the development of asthma.

Similarly, we could demonstrate no correlation between mite antigen content and the age of the home. This agrees with data from Dayton and Cincinnati, Ohio (4). It differs from a study in Denmark, however, where homes containing the

	n	Median (col/30 mg)	Range (col/30 mg)	Significance
Mildew in home	41	84	17 to 761	p = 0.024
No mildew in home	43	58	4 to 461	
History of asthma	45	59	4 to 761	p = 0.49
No history of asthma	38	77	16 to 461	
Positive skin test to mold extract	37	77	8 to 761	p = 0.11
Negative skin test to mold extract	29	58	4 to 160	
Home less than 10 yr old	12	86.5	21 to 217	p < 0.02
Home 10 to 30 yr old	30	48.5	16 to 276	
Home greater than 30 yr old	40	82.5	4 to 761	
Symptoms on mold exposure	27	82	8 to 761	p = 0.064
No symptoms on mold exposure	52	58.5	4 to 461	

highest mite numbers were found to be older than their random matched controls (9). The question of the rapidity with which a home becomes inhabited by mites remains unanswered.

Our analysis of dog and cat antigen content showed that these antigens are remarkably ubiquitous, being detected in 100% of homes. Although we demonstrated highly significant differences in median antigen content when homes with and without a particular pet were compared, we also found that many homes nominally without a pet contained significant pet antigen levels. Similar results were recently reported from Sweden (14). Several factors may contribute to this finding. First, the antigen could be due to an unknown prior pet, such as with a prior owner of the home. We did not find that this made a significant contribution in the relatively few cases in which that history was known. Second, it could be the result of external contact with pet antigen. Vanto and Koivikko (33) demonstrated this possibility by showing decreasing antigen levels as one went from homes with a dog, to homes with a dog in the surroundings, to homes with indirect contact, and finally to homes with no dog contact at all. Alternatively, because we did not actually visit our patients' homes, our data could in part be explained by a false history regarding pets. This possibility is most likely in those homes with no pet history but very high antigen levels. Thus, although the reasons are still unclear, it is apparent that animal allergens are extremely prevalent in house dust, even in many homes without a pet. The clinical significance of this finding has yet to be determined.

Finally, cultures of our dust samples demonstrated the presence of molds in 100% of homes, with a median colony

count of 72 per 30 mg dust. Analysis of Danish dust samples by similar techniques showed a range of 9 to 168 colonies/30 mg dust, with a median of 20 (unpublished observation). Our high colony counts are particularly striking in view of the fact that the freezing of the dust samples used to preserve the other dust antigens under study would be expected to have a deleterious effect on subsequent mold growth, and may have caused an underestimation of true mold spore content. The correlation of mold colony counts with total mite content suggests that similar environmental conditions, such as temperature and humidity, may promote the growth of each.

The immunochemical techniques employed in this study offer great potential for the analysis of large numbers of dust samples in an efficient, standardized fashion. We sought to develop a simple field method for dust collection that could be combined with these techniques for the routine analysis of the atopic patient's home environment. Although only a pilot project, we are encouraged that the concept of environmental analysis for allergen is feasible and of potential clinical significance. It provides an important tool for the study of the indoor environment as we use pollen and spore counts to study the outdoor environment.

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