

Immunology & Allergy Practice

Official Publication of the American Association for Clinical Immunology and Allergy



Scanning Electron Micrograph of the House Dust Mite (X300) (Dermatophagoides Farinae)

The Role of the House Dust Mite in
Clinical Allergy in Corpus Christi, Texas
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Abstract

This study explores the relationship among house dust, mite and cockroach allergy in atopic patients in the Corpus Christi area. A correlation of skin test reactivity between house dust and mite (*D. farinae*) reemphasized the importance of the mite as an allergenic component of house dust. This correlation was compared to a similar study in an atopic population in the Midwest. It was demonstrated that this correlation was much higher in Corpus Christi than in the Midwest, which probably reflects differences in climatic conditions. Also, the incidence of cockroach sensitivity was evaluated and it was found that the cockroach antigen may be as important as the mite in the etiology of house dust allergy in this population.

The discussion includes an explanation for the relatively higher incidence and importance of mite allergy in the Corpus Christi area. The importance of factors such as the consistently high relative humidity and temperatures, as well as differences in elevation are discussed. An explanation is made for the exacerbation of symptoms during the winter months experienced by patients sensitive to house dust. The rationale for commonly employed house dust avoidance measures are discussed and their

importance re-emphasized. The significance of specific immunotherapy is demonstrated.

A recent study from Kansas City¹ confirmed the importance of the mite as an allergenic component of house dust. However, this correlation was lower than that found by other workers on the West Coast and in Europe which probably reflects differences in climatic conditions. This study also suggested that the cockroach antigen may be as important as the mite in the etiology of house dust allergy in the Kansas City area.

In a group of 72 patients clinically sensitive to house dust, 82 % had positive skin reactions to house dust while only 57% had positive skin reactions to the house dust mite (Table 1).¹

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Table I**Group A (72 patients clinically sensitive to house dust)**

	House Dust	Mite	Cockroach
Scratch	6 (8%)	6 (8%)	9 (13%)
Prick plus scratch	34 (47%)	23 (31%)	37 (51%)
Intradermal plus Scratch and Prick	59 (82%)	41 (57%)	41 (57%)
RAST	32 (44%)	20 (28%)	16 (22%)

Group B (13 patients not clinically sensitive to house dust)

	House Dust	Mite	Cockroach
Scratch	0	0	0
Prick plus scratch	3 (23%)	1 (8%)	3 (23%)
Intradermal plus Scratch and Prick	7 (54%)	2 (16%)	4 (31%)
RAST	3 (23%)	3 (23%)	1 (8%)

Skin reactivity and RAST for both groups of patients. (Reproduced from the Annals of Allergy, 1979, 42: 160-165, by Copyright Permission of the American College of Allergist)

In the group of patients who were clinically sensitive to house dust and also had a positive skin test to house dust, 51 % also had a positive skin test to the mite (Table II).¹

In this study, the skin tests were correlated with the RAST and there was good general agreement between the two techniques.

Excellent evidence exists that in southern coastal areas, such as Corpus Christi, Texas, with consistently high relative humidities and temperatures and near sea level elevation, the house dust mite may be a more important factor in the etiology of house dust allergy.

With these considerations in mind and because of our clinical observations, we decided to study the relationship among house dust, mite and cockroach allergy in atopic patients in the Corpus Christi area. Our sample population consisted of patients with asthma and/or rhinitis, with a positive family history of atopy, who were clinically sensitive to house dust, and who had positive skin tests to Hollister-Stier house dust extract.

In our series of 76 patients, 53, or 70%, had a positive scratch or intradermal skin test to the mite. This compares with the 51 % incidence in Kansas City. Also, 50, or 94 %, of these mite-sensitive patients also had a positive

Table II

	HD+M+	HD+M	HD-M+	HD-M	Total Patients	Agreement
Scratch tests for HD and M	1	5	5	61	72	
Prick plus scratch tests for H D and M	11 (15%)	23	12	26 (36%)	72	37 (51%)
Intradermal plus scratch and prick tests for HD and M	37 (51%)	22	4	9 (13%)	72	46 (64%)

Skin tests (ST) correlation for house dust (HD) and mite (M) in 72 patients clinically sensitive to house dust. (Reproduced from The Annals of Allergy, 1979,42:160-165, by Copyright Permission of the American College of Allergist)

skin test to the cockroach antigen. This data suggests that the mite is significantly more important as an allergenic component of house dust in the Corpus Christi area as compared to the Kansas City area, which probably reflects differences in climatic conditions. Also, our experience with the cockroach antigen supports the Kansas City study, and suggests that the cockroach antigen may be as important as the mite in house dust allergy in the Corpus Christi area.

Why is the mite so important in house dust allergy in Corpus Christi?

It is well-known that the density of the mite population varies greatly in different parts of the world, and that mite prevalence is much greater in geographic areas with consistently high relative humidity (RH) and temperature as is found in the southern and western coastal areas such as Corpus Christi.

An 80% RH and 25 C (77 F) temperature are known to be optimal for cultivating the house dust mite. It has been demonstrated that in geographic areas where the relative humidity and temperature are low for substantial portions of the year, mite density is less substantial.²

Therefore, at least two important factors seem to favor proliferation of the house dust mite--high outdoor temperature and a high degree of relative humidity.

Another factor which makes the mite such an important allergen in the Corpus Christi area is its sea level elevation. The content of the mite in house dust varies inversely with elevation. Comparisons of samples of house dust show a decreasing content of mites with higher elevations.³ Very few mites were found in the dust of an Alpine resort for asthmatic children.³ This may be related to the low temperature and especially the low relative humidity. After a prolonged stay in such an Alpine environment, it was demonstrated that dust-sensitive asthmatic children not only improved clinically, but also had significant decreases both in total IgE and

in specific IgE antibodies to the house dust mite and domestic house dust.⁴

This makes one wonder if the high elevation is not the most important factor responsible for the observed improvement in asthmatic children hospitalized for extended periods in institutions in the Denver area. Several investigators have found that as many as 85 % of children with moderate to severe asthma are allergic to the house dust mite.⁵ In San Francisco, a study demonstrated that allergy to mites was found in almost all house dust-allergic children.⁶ In another study of children with moderate to severe asthma, 81 % had a positive bronchial provocation test to the house dust mite, and all of these had a positive prick test.⁷

Figure 1 represents the mite density per gram of house dust collected from homes in Cincinnati and Dayton and clearly demonstrates the fact that mite density exhibits a seasonal fluctuation with the highest density occurring in the humid summer months.⁹

The significant association between the presence of live mites and indoor ambient relative humidity is readily apparent in Figure 2.⁹ There is an exponential increase in mite concentration when the absolute indoor air humidity exceeds 45 % at indoor temperatures of 20-21 C.⁸

The only significant source of water for the mite is water gained from water vapor in the ambient air. When the relative humidity is sufficiently high, mites actively absorb sufficient water from the air to compensate for that lost by transpiration. At 25 C, this occurs between 55% and 65% RH.⁹

At the onset of cold weather with increased heating requirements, relative humidity drops below 50 % for extended periods when furnaces are operating.² These conditions favor mite dehydration, death, and a decreased population. In Corpus Christi, heating is generally not required until December or even later providing a much longer season for optimal conditions for additional exponential expansion of the mite population.

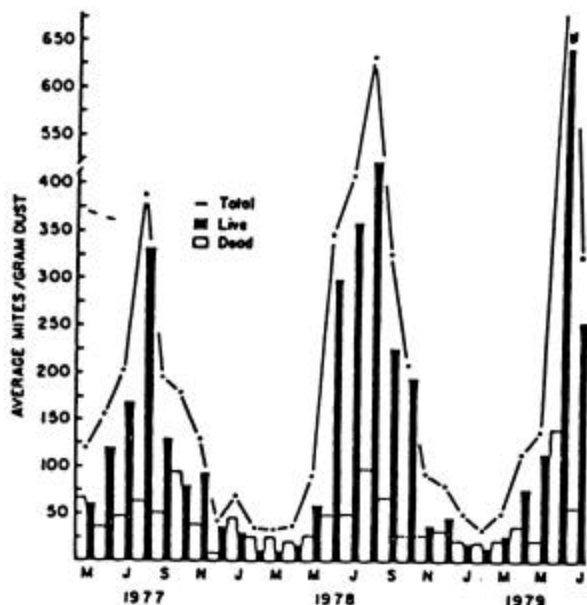


Figure 1. Seasonal fluctuations for live and dead dermatophagoides spp in dust collected from four sites in homes of dust-allergic patients in Cincinnati and Dayton, Ohio, from May 1977-July 1979. (Reproduced from the Journal of Allergy and Clinical Immunology, 1982, 69:527-532, by Copyright Permission of the American Academy of Allergy and Immunology)

Laboratory studies indicate that 100 % mortality will occur in adult mites within 4-11 days at 40 % -50 % RH and temperatures above 25 C.⁹

When the furnaces turn on with the onset of cold weather it can be seen that the population of live mites rapidly diminishes. Furthermore, as can be seen in Figure 1, the absolute sum of live mites (black bars) and dead mites (white bars) is much less in the winter months indicating that when the mites dehydrate and die, their bodies disintegrate into fine particles which can easily become airborne and inhaled during domestic cleaning activities and movement in bed.

The P₁ antigen has been identified as the major allergen of the house dust mite and it has also been associated with particles less than 10 μ ¹⁰, which probably represent fragments of the desiccated exoskeletons of mites. The P₁ antigen has also been associated with particles 10-40 μ , which have been identified as fecal particles.¹⁰ Also, it has been

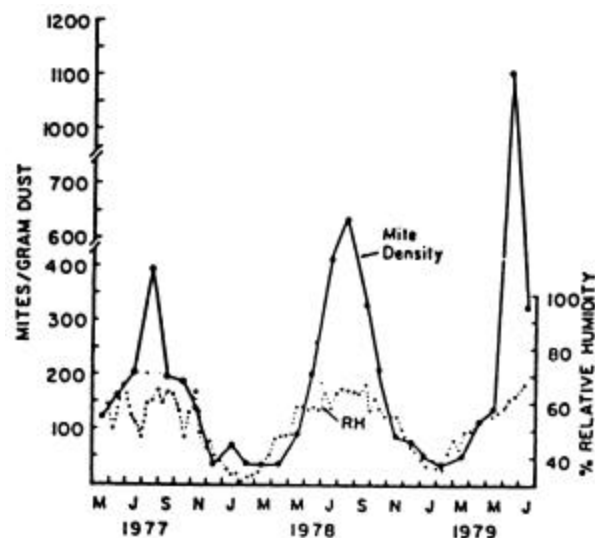


Figure 2. Seasonal relationship between average mite prevalence (Dermatophagoides spp per gram of dust) in four sites and indoor ambient RH in houses of dust-allergic patients in Dayton and Cincinnati, Ohio, from May 1977 to July 1979. (Reproduced from The Journal of Allergy and Clinical Immunology, 1982,69:527-532, by Copyright Permission of the American Academy of Allergy and Immunology)

shown that the bodies of mites have identical antigenicity with the excreta.¹¹

This data explains why house dust-allergic patients are much worse in winter months when the furnaces turn on and the relative humidity drops below 50 % for extended periods. The mites dehydrate, die and their bodies disintegrate into fine particles which can easily become airborne and inhaled.

The late onset of cold weather in Corpus Christi, combined with the high relative humidity and average temperature, and the near sea level elevation all serve to promote proliferation of the mite and an exponential expansion of the population so that when the furnaces do turn on, late in the winter, there is a tremendous amount of this extremely allergenic material present.

A review of the literature reveals other clinically useful bits of information concerning the house dust mite.

Measures aimed at the reduction of the

mite population in the bedroom can be effective and these result in symptomatic improvement in asthmatic children with proven mite sensitivity.¹²

The single most important step in avoidance procedures is the covering of the mattress with a plastic cover. The fine dust particles which carry the mite allergen probably cause the allergic wheezing. These are deeply ingrained in the mattress substance and are only minimally removed by sweeping or simple vacuum cleaning. An impervious cover prevents them from rising and being inhaled.¹² The importance of plastic covers also probably reflects the requirement of the house dust mite for human skin scales as its major source of food.¹³

There is a relatively low degree of mite infestation present in sleeping situations where plastic covered mattresses are used as can be seen in Table III. Mites are absent from hospital beds¹³ and in Corpus Christi we have frequently seen many mite-sensitive asthmatics improve just by putting them in the hospital, before they received any additional treatment. Only a very low level of mite infestation could be detected in residential schools for "delicate" children to which asthmatic children are sometimes referred.¹³ This study was conducted in Leeds, England and we suspect that in the U. S. the sleeping environment of similar residential schools more closely resembles a hospital ward mattress.

At any rate, this could account for the frequently observed spontaneous improvement in symptoms after admission to these institutions. Hence, avoidance of this potent allergen, as well as cats and dogs and other allergens and irritants may well replace the old concept of "parentectomy" as the mechanism for this spontaneous improvement.¹³

Mite infestation of stuffed animals has also been detected regularly and the importance of them as vectors of the mite allergen is obvious.¹³

A very important factor which correlates with the level of mite prevalence is the presence or absence of carpeting. Carpeted floors contain significantly more mites than tile or wood floors. Apparently long-piled carpets reduce the efficiency of vacuuming and provide an excellent microhabitat for accumulation of food material and moisture for mite survival and breeding.⁹

Household cleaning and dusting is accompanied by a significant rise in the number of small particles in the air.¹⁰

Differences in concentrations of house dust mites found in different homes has been shown to be caused by differences in the indoor air humidity instead of the amount of house dust present. Therefore, the frequency of cleaning plays only a minor role, if any. Preventive measures aimed at reducing the concentration of the house dust mite should probably be directed towards a lowering of

Table III
Mite Infestation in Relation to Sleeping Environment of Children

Environmental Source of Samples	No. of Samples Collected	No. Infested	Mean Mite Count/m² of All Samples
Perambulator mattresses	10	1	2•08
Cot mattresses	10	9	6•48
Domestic single-bed mattresses	10	10	24•00
Hospital-ward mattresses	15	0	0
Residential school dormitory mattresses	17	13	2•48

*Reproduced from the Archives of Disease in Childhood, 1974, 49:711-715, by Copyright Permission of the British Pediatric Association)

the indoor air humidity, although at present, there is no direct evidence to support this.⁸ Nevertheless, we do have one severe mitesensitive asthmatic who has recently purchased a dehumidifier and is attempting to keep the relative humidity in his bedroom below 45 % at all times. Next winter, we will see if this makes a difference.

With regards to immunotherapy, it is well known that commercial house dust extracts vary greatly both in their allergenicity and their mite antigen content. The mite extract has been shown to be 100-1000 times more allergenic than various house dust extracts.⁶ Assuming the principle that high-dose immunotherapy is more efficacious than

low dose immunotherapy, it would make good sense to treat mite-sensitive individuals with the pure mite extract as well as standard house dust extracts.

One study¹⁴ in England found that mitesensitive patients who were treated with house dust immunotherapy did not have significant improvement of clinical symptoms unless house dust environmental control procedures were also observed. Most of the patients treated with mite immunotherapy who did not use environmental control did have improvement of allergic symptoms, but those treated with both mite immunotherapy and environmental control had an even greater success rate.

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