

Allergic sensitization to domestic mites in Corpus Christi, Texas

James Caplin, M.D.,* Arnaldo Capriles-Hulett, M.D.,# Victor Iraola, Ph.D.,§ Helder Pinto, Ph.D.,§ Mario Sánchez-Borges, M.D.,|| Gloria de los Santos, R.N.,* and Enrique Fernández-Caldas, Ph.D.||

ABSTRACT

Corpus Christi, TX, is a Gulf Coast city with high humidity levels year-round. There is little available data on mite species in mattress dust, allergen levels, and sensitization to different mite species in allergic patients. This study was designed to determine skin sensitization and specific serum IgE to *Dermatophagoides* spp. and *Blomia tropicalis* in patients attending an allergy clinic and to explore the mite fauna and allergen content of their mattresses. Skin-prick tests to *Dermatophagoides* spp. and *B. tropicalis* along with mite-specific IgE in the serum by enzyme-linked immunosorbent assay (ELISA) and ImmunoCAP tests were performed in allergic patients attending an outpatient allergy clinic in Corpus Christi, TX. Mite species and allergen levels were determined in mattress dust. Forty-five consecutive patients were evaluated; 10 patients had positive skin tests to *Dermatophagoides pteronyssinus* and *B. tropicalis*, 32 patients reacted only to *D. pteronyssinus*, and 3 patients reacted exclusively to *B. tropicalis*. Increased titers of *D. pteronyssinus*- and *D. farinae*-specific IgE were present and *B. tropicalis*-specific IgE titers were lower. Significant amounts of mites were observed in 79.5% of dust samples, with a predominance of *D. pteronyssinus* and *D. farinae*. Other mite species, such as *B. tropicalis*, *Euroglyphus maynei*, *Tarsonemus* spp., *Tyrophagus putrescentiae*, *Cheyletus* spp., and *Oribatidae* were also observed. Greater levels of Der p and Der f 1 than of Blo t 5 were present in the mattresses. *D. pteronyssinus* and *D. farinae* are the prevalent mite species in houses of allergic patients from Corpus Christi, TX. Other mite species are also found.

(Allergy Asthma Proc 30:166–170, 2009; doi: 10.2500/aap.2009.30.3209)

Key words: Allergic rhinitis, allergic sensitization, asthma, atopic dermatitis, Corpus Christi, *Blomia tropicalis*, *Dermatophagoides pteronyssinus*, *Dermatophagoides farinae*, dust mite, IgE, mites

Dust mite allergy is one of the most important causes of worldwide respiratory diseases such as asthma and rhinitis.¹ Allergens from multiple mite species elicit IgE-mediated reactions in predisposed individuals. High levels of ambient humidity (>75% relative humidity and warm temperatures) are a risk factor for mite proliferation and growth.² These conditions prevail throughout the year in many subtropical regions, such as the Gulf Coast of the United States, where cities such as Corpus Christi, TX, and others are located. However, there is scarce data about the mite fauna of this region in the United States. *Blomia tropicalis*, a previously considered storage mite, endemic to tropical and subtropical regions of the world, heavily infests human dwellings³ and has been considered, nevertheless, of a lesser importance in the United States.⁴ Notwithstanding this consideration, reports from the western coast of Florida have shown signifi-

cant amounts of *B. tropicalis* in homes from Tampa,⁵ contrasting with those from other similar Gulf Coast cities such as New Orleans, LA, and Galveston, TX.⁴ Sensitization to *B. tropicalis* has also been shown in the USA using skin and nasal provocation tests.^{6,7}

Mite sensitization (*Dermatophagoides* spp.) has been described by means of skin testing in Corpus Christi, TX.⁸ Because of the climatic conditions and the high prevalence of allergic respiratory diseases in this area, a study of the mite population and allergen content of mattress dust, is warranted. The results could have important clinical implications for the diagnosis and treatment of allergic patients.

METHODS

Patients

Unselected consecutive patients with rhinitis, asthma, or atopic dermatitis attending an outpatient allergy clinic in Corpus Christi, TX (Corpus Christi Allergy and Asthma Center, Corpus Christi, TX), from August 2006 to June 2007, were studied. The protocol was approved by the Institutional Review Board of the participating institution and patients or parents signed the informed consent forms before skin testing and blood drawing, and dust collections were performed.

From *Corpus Christi Allergy and Asthma Center, Corpus Christi, Texas, #Allergology Unit, Hospital San Juan De Dios, Caracas, Venezuela, §Laboratorios Leti, Madrid, Spain, ||Allergy Service, Clínica El Avila, Caracas, Venezuela, and ||Allergy Innovations GmbH, Seefeld, Germany

Address correspondence and reprint requests to Arnaldo Capriles-Hulett, M.D., P.O. Box 025323, Miami, FL 33102

E-mail address: arnaldocapriles@gmail.com

Copyright © 2009, OceanSide Publications, Inc., U.S.A.

Skin Tests

Patients were skin-prick tested with 50% glycerinated extracts of *Dermatophagoides pteronyssinus* and *B. tropicalis* from Laboratorios LETI (Tres Cantos, Madrid, Spain [100 histamine equivalent potency/mL]). The reaction was read 15 minutes after application and was considered positive if a wheal size of ≥ 3 mm than the glycerosaline control was present; 1 mg/mL of histamine phosphate was used as positive control.

Sera

Blood was drawn from the antecubital veins, and serum was spun, separated, and stored at -20°C until analysis. Specific IgE in the serum was measured through two quantitative enzyme-linked immunosorbent assay (ELISA) methods.

Direct ELISA

Serum samples were tested using direct ELISA to determine specific IgE levels to *D. pteronyssinus*, *Dermatophagoides farinae*, and *B. tropicalis* extracts. Briefly, 20 $\mu\text{g/mL}$ of material was dissolved in carbonate/bicarbonate buffer, pH 9.6, and coated onto plastic microtiter plates (Immulon IV; Dynex Technologies, Chantilly, VA). Each serum sample was diluted 1:2 v/v in 0.01 M of PBS and incubated (100 μL) for 2 hours in the wells. The plates were washed and incubated for 2 hours in anti-human IgE conjugated with peroxidase. After five washes, the reaction was developed for 30 minutes and then stopped with 1 N sulfuric acid. Three individual serum samples from nonallergic patients were used as negative controls. Optical densities three times the mean value of the negative controls or greater were considered positive.

ImmunoCAP

Serum samples were tested to determine IgE antibody to *D. pteronyssinus*, *D. farinae*, and *B. tropicalis* using the ImmunoCAP technology (UNICAP 100; Pharmacia AB Diagnostics, Uppsala, Sweden). A positive test was defined as values higher than 0.35 kUA/L.

Collection and Analysis of Dust Samples

Dust vacuum collections were done on the surface of the mattresses in use by patients for at least 2 years. One square meter was vacuumed (INDOOR Biotechnologies Mitest Filter Unit; Indoor Biotechnologies, Charlottesville, NC). Samples were collected by trained personnel and, after collection, they were immediately frozen. Once in the laboratory, dust samples were weighed and aliquots were separated for mite identification and counting and for allergen determinations. Mites were isolated using the flotation method previously described.⁹ Briefly, dust samples were sus-

Table 1 Demographics and clinical picture

Age	
Mean $\pm$ SD (yr)	41.3 $\pm$ 17.2
Range (yr)	8–73
Gender	
Female	31
Male	14
Clinical diagnosis	
Atopic dermatitis	20
Asthma	11
Allergic rhinitis	7
Urticaria/angioedema	4
Allergic conjunctivitis	2
Unspecified pruritic disorder	1
Skin-prick tests	
<i>D. pteronyssinus</i> negative; <i>B. tropicalis</i> positive	3
<i>D. pteronyssinus</i> positive; <i>B. tropicalis</i> negative	32
<i>D. pteronyssinus</i> positive; <i>B. tropicalis</i> positive	10

B. tropicalis = *Blomia tropicalis*; *D. pteronyssinus* = *Dermatophagoides pteronyssinus*.

pended in 5 mL of saturated saline and individual mites were removed using a fine needle and placed into 1 drop of Hoyer's medium. Afterward, they were counted by trained personnel and identified using standard keys and reference preparations. The results are expressed as the number of mites per gram of dust.

Determination of Allergen Concentrations

Der p 1 and Der f 1 allergens were quantified using monoclonal antibodies (Indoor Biotechnologies, Ltd., Manchester, United Kingdom) according to the manufacturer's instructions. Blo t 5 was quantified using a two-site ELISA assay kit developed by the Asthma and Allergy Group, National University of Singapore.¹⁰

RESULTS

Demographics

Forty-five consecutive atopic, unselected patients were studied. Table 1 shows the demographic and clinical data of the evaluated patients.

Skin Tests

Ten patients of 45 showed positive skin tests to both *D. pteronyssinus* and *B. tropicalis*, 32 were single reactors to *D. pteronyssinus* and 3 single reactors to *B. tropicalis* (Table 1).

Table 2 Mite-specific IgE in the serum, as assayed by ELISA and ImmunoCAP tests

Mites	ELISA (OD)*	<i>p</i> Value vs <i>B. tropicalis</i>	ImmunoCAP (kUA/l)*	<i>p</i> Value vs <i>B. tropicalis</i>
<i>D. farinae</i>	0.28 ± 0.48	<0.001	8.63 ± 19.5	0.018
<i>D. pteronyssinus</i>	0.15 ± 0.2	<0.001	5.75 ± 13.71	0.003
<i>B. tropicalis</i>	0.08 ± 0.1	—	0.44 ± 0.85	—

*Mean ± 1 SD.

B. tropicalis = *Blomia tropicalis*; *D. farinae* = *Dermatophagoides farinae*; *D. pteronyssinus* = *Dermatophagoides pteronyssinus*; ELISA = enzyme-linked immunosorbent assay; OD = optical density.

Table 3 Quantification of mites in mattress dust

Mites	Mattresses Positive for Mites (%)	No. of Mites/g of Dust*
Total mites	79.5	1526.4 ± 3410.7
<i>D. farinae</i>	54.5	891.2 ± 2897.3
<i>D. pteronyssinus</i>	45.4	571.2 ± 2015.3
<i>E. maynei</i>	11.4	37.1 ± 124.4
<i>B. tropicalis</i>	6.8	7.9 ± 32
<i>Tarsonemus</i> sp.	6.8	7.4 ± 27.8
<i>T. putrescentiae</i>	4.5	4.3 ± 19.9
<i>Cheyletus</i> sp	4.5	3.5 ± 16.4
Oribatidae	2.2	2.2 ± 14.6

*Mean ± 1 SD.

B. tropicalis = *Blomia tropicalis*; *D. farinae* = *Dermatophagoides farinae*; *D. pteronyssinus* = *Dermatophagoides pteronyssinus*; *E. maynei* = *Euroglyphus maynei*; *T. putrescentiae* = *Tyrophagus putrescentiae*.

Table 4 Quantification and prevalence of mite allergens

	Der p 1	Der f 1	Group 1	Blo t 5
Mean ± SD	2.0 ± 3.1	9.9 ± 12.7	11.9 ± 13	—
Percent >0.01 µg/g	59.5	73.8	85.7	0
Percent >2 µg/g	26.2	59.5	71.4	0
Percent >10 µg/g	4.8	33.3	40.5	0

Specific IgE In Vitro

Mite-specific IgE was measured *in vitro* by means of ELISA technique and ImmunoCAP. Results of ELISA measurements are shown in Table 2. The levels of *B. tropicalis*-specific IgE were low. Levels were significantly greater to *D. pteronyssinus* and *D. farinae*. Table 2 also shows the results of the ImmunoCAP technique, which clearly indicated a significant increase of *Dermatophagoides*-specific IgE levels in the sera of these patients.

Mites in Mattress Dust

The numbers of mites per gram of mattress dust are shown in Table 3; 79.5% of dust samples contained mites. The most prevalent mite species were

D. farinae and *D. pteronyssinus*. Regarding the prevalence of *Dermatophagoides* spp., 22.7% of the homes contained only *D. pteronyssinus*, 31.8 exclusively contained *D. farinae*, and in 22.7% of both species were present. Only 3 of 45 samples (6.6%) contained *B. tropicalis*; its presence did not correlate with skin test results and only one of them had low titers of *Blomia*-specific serum IgE; other species were infrequently found.

Allergen Levels in Mattresses

Table 4 shows Der p 1, Der f 1, and Blo t 5 levels in mattress dust. Patients were exposed to significant levels of Der p 1 and Der f 1, whereas Blo t 5 was virtually absent.

DISCUSSION

In tropical and subtropical regions of the world, indoor allergens are the most important sources of sensitization in genetically predisposed individuals.¹ Pollination is carried mostly *via* insects and prolonged rainy seasons and heavy precipitations promote a fall to the ground of outdoor airborne and other suspended particles, minimizing chances for immune responses.

Many coastal areas in subtropical and tropical regions of the world have high humidity levels throughout the year, becoming ideal places for many species of mites to proliferate,² grow, and develop into most important sources of indoor allergens. The genus *Dermatophagoides* spp is the most important species worldwide¹ and its partial cross-reactivity with other mite species, mainly *B. tropicalis*, has become an important study subject for practicing allergists.^{11–13} These physicians should know the patient's mite fauna, in similar manner as their respective mold spore and pollinating seasons.

As previously shown in a mite fauna study, which included eight locations across the United States,⁴ mite species representation vary within and between geographic areas. A total of 252 homes were surveyed and mites were found in all samples. *D. farinae* and *D. pteronyssinus* represented the two most important species found in 91% of dwellings and in significant numbers. *Euroglyphus maynei* was found in 15.5% and *B. tropicalis* was found in only 9.2% of homes. Predatory mites belonging to the family Cheyletidae were also frequently identified but not quantified. Two Gulf Coast cities were surveyed and *B. tropicalis* was found in 18.8% of homes in Galveston, TX, while it was present only in 5.2% of homes in New Orleans, LA⁵; *B. tropicalis* constituted <20% of the total mite population in any home across the United States.⁴

In our survey in Corpus Christi, TX, close to 80% of homes had mites in the patients' mattresses, with *D. pteronyssinus* and *D. farinae* being the most important species. Other mites were identified (Table 3). *B. tropicalis* was found in 6.8% of samples. However, skin testing with *B. tropicalis* extract was positive in 28.8% of allergic patients, allowing for the speculation of certain patients recognizing cross-reactive allergens in extracts of *B. tropicalis* and *D. pteronyssinus*. Interestingly, 6.6% of patients had isolated skin testing sensitization to *B. tropicalis*, a finding reported previously not to be uncommon in tropical and subtropical climates in cities such as Caracas, Venezuela,^{14–17} and Tampa, FL,⁷ among others.¹⁸

As in Corpus Christi, a city such as Tampa with similar high humidity and Gulf Coast location, *B. tropicalis* plays as a significant source of sensitization. No

data on sensitization to *B. tropicalis* exist for cities such as New Orleans and Galveston.

Although our findings contribute to the study of mite fauna in homes of allergic patients from the United States, with a focus on the Gulf Coast, additional data is needed for better guidance in diagnostic and immunotherapy efforts. Also, these observations reinforce a previously expressed need for U.S. availability of mite allergenic extracts different from those of the genus *Dermatophagoides*, for skin testing and possible immunotherapy.^{4,19} Data for indoor mite species representation and allergen content determination, as presented here, will help provide orientation to fellow physicians in daily care of patients.

REFERENCES

1. World Health Organization. Dust mite allergens and asthma: A worldwide problem. International Workshop Report. Bull World Health Organ 66:769–780, 1988.
2. Arlian LG, Morgan MS, and Neal JS. Dust mite allergens: Ecology and distribution. Curr Allergy Asthma Rep 2:401–411, 2002.
3. Fernández Caldas E, and Lockey RF. *Blomia tropicalis*, a mite whose time has come. Allergy 59:1161–1164, 2004.
4. Arlian L, Bernstein D, Bernstein L, et al. Prevalence of dust mites in the homes of people with asthma living in eight different geographic areas of the United States. J Allergy Clin Immunol 90:292–300, 1992.
5. Fernández-Caldas E, Fox RW, Buckholtz GB, et al. Mite survey in households of mite sensitive individuals in Tampa, Florida 1990. Allergy Proc 11:263–267, 1990.
6. Stanaland BE, Fernández-Caldas E, Jacinto CM, et al. Positive nasal challenge responses to *Blomia tropicalis*. J Allergy Clin Immunol 97:1045–1049, 1996.
7. Stanaland BE, Fernández-Caldas E, Jacinto CM, et al. Sensitization to *Blomia tropicalis*: Skin test and cross-reactivity studies. J Allergy Clin Immunol 94:452–457, 1994.
8. Caplin J, Capriles-Hulett A, Crozier W, and Caplin I. The role of the house dust mite in clinical allergy in Corpus Christi, Texas. Immunol Allergy Pract 8:24–29, 1986.
9. Fernández-Caldas E, Puerta L, Mercado D, et al. Mite fauna, Der p I, Der f I and *Blomia tropicalis* allergen levels in a tropical environment. Clin Exp Allergy 23:292–297, 1993.
10. Lee A, Sangsupawanich P, Ma S, et al. Endotoxin levels in rural Thai and urban Singaporean homes. Int Arch Allergy Immunol 141:396–400, 2006.
11. Chew FT, Yi FC, Chua KY, et al. Allergenic differences between the domestic mites *Blomia tropicalis* and *Dermatophagoides pteronyssinus*. Clin Exp Allergy 29:982–988, 1999.
12. Chua KY, Cheong N, Kuo IC, et al. The *Blomia tropicalis* allergens. Protein Pept Lett 14:325–333, 2007.
13. Arias-Irigoyen J, Lombardero M, Arteaga C, et al. Limited IgE cross-reactivity between *Dermatophagoides pteronyssinus* and *Glycyphagus domesticus* in patients naturally exposed to both mite species. J Allergy Clin Immunol 120:98–104, 2007.
14. Sánchez-Borges M, Capriles-Hulett A, and Malka S. Inhalant allergens clinically significant in Latin-America. Allergy Clin Immunol Int (J World Allergy Org) 16:28–32, 2004.
15. Capriles-Hulett A, and Sánchez-Borges M. *Dermatophagoides* and *Blomia* skin sensitization in allergic patients. Prevalence in a tropical environment. Allergy Clin Immunol Int (J World Allergy Org) 17:224–228, 2005.

16. Puccio FA, Lynch NR, Noga O, et al. Importance of including *Blomia tropicalis* in the routine diagnosis of Venezuelan patients with persistent allergic symptoms. *Allergy* 59:1161–1164, 2004.
17. Sanchez-Borges M, Capriles-Hulett A, and Fernandez-Caldas E. Mite and cockroach sensitization in allergic subjects from Caracas, Venezuela. *Ann Allergy Asthma Immunol* 90:664–668, 2003.
18. Garcia Robaina JC, Sanchez Machin I, Fernandez Caldas E, et al. Skin tests and conjunctival and bronchial challenges with extracts of *Blomia tropicalis* and *Dermatophagoides pteronyssinus* in patients with allergic asthma and or rhinoconjunctivitis. *Int Arch Allergy Immunol* 131:182–188, 2003.
19. Kemp SF, Lockey RF, Fernández-Caldas E, and Arlian LG. Skin test crossreactivity studies with *Euroglyphus maynei* and *Dermatophagoides pteronyssinus*. *Clin Exp Allergy* 27:893–897, 1997. □

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.