

Sensitization to *Lepidoglyphus destructor*, *Tyrophagus putrescentiae*, and *Acarus siro* in patients allergic to house dust mites (*Dermatophagoides* spp.)

Carmen Vidal, PhD,^a Benilda Chomón, PhD,^b Celsa Pérez-Carral, MD,^a and A. González-Quintela, PhD^c Santiago de Compostela, Spain

Besides pyroglyphid mites (*Dermatophagoides pteronyssinus* and *D. farinae*), many other mites, commonly referred to as storage mites (SMs), are documented as causes of allergic symptoms, especially in cases of rural occupational exposure (e.g., in farms, dairy barns, bakeries, and grain elevator stores).^{1,2} In recent years, much attention has been paid to SM allergy in nonoccupational environments, and results indicate that sensitization is not restricted to those with occupational exposure.^{3,4} As van-Hage Hamsten and Johansson⁵ noted, epidemiologic studies of mite allergy are needed in various parts of the world to reveal the actual importance of SMs. The aim of this study was to determine the prevalence of sensitization to certain SMs (*Lepidoglyphus destructor*, *Tyrophagus putrescentiae*, and *Acarus siro*) in patients allergic to house dust mites (HDMs) in a humid and temperate region in the northwest of Spain. In this region HDMs (*Dermatophagoides* spp.) are the most important allergens producing respiratory symptoms. Associated environmental factors were also studied.

METHODS

Patients

In this cross-sectional study, a total of 310 patients (149 men and 161 women) aged 20.3 ± 9.6 years (range, 4 to 64 years), were studied in the allergy unit from January 1994 to March 1996. All of the patients were found to be allergic to HDMs on the basis of case history (perennial rhinitis in 287 and/or bronchial asthma in 195) and having positive responses to skin prick tests (SPTs) with *D. pteronyssinus*, *D. farinae*, or both. Housing conditions were assessed by questionnaire. Patients living in the countryside were defined as being of rural origin. Indoor humidity was considered high when central heating was not used and when the patient noticed the presence of mold growth or water condensation on the inside of windows. The presence of domestic animals (cats or dogs), livestock (cows,

Abbreviations used

HDMs:	House dust mites
SMs:	Storage mites
SPTs:	Skin prick tests

sheep, and chickens), and grain storage facilities was also registered. All patients came from the health care area of Santiago de Compostela (520,000 inhabitants). The climate tends to be rainy and temperate, and indoor humidity can quite easily reach the 80% mark or more. Mean annual maximum and minimum temperatures are 19.8° C and 9.5° C, respectively. The number of rainy days per year exceeds 200 (55%), and pluviometry per year is around 1980 L/m² (data obtained from the Spanish National Institute of Meteorology).

Study methods

SPTs were carried out with commercially available reagents of *D. pteronyssinus*, *D. farinae*, *L. destructor*, *T. putrescentiae*, and *A. siro* (ALK-Abelló Laboratories). Control tests included 10 mg/ml histamine and saline solution. The size of the papule was measured after 15 minutes, and the reaction was considered positive when the papule was at least similar to the histamine control and 3 mm greater than the saline control. For serum-specific IgE, CAP Pharmacia immunoassay was used (Pharmacia Lab., Uppsala, Sweden). A CAP score greater than 0.35 IU/ml was considered positive, with an upper limit of 100 IU/ml. All patients had CAP immunoassays performed with all the aforementioned HDM and SM allergens. Total serum IgE was determined by the Microparticle Enzyme Immunoassay (Abbott Laboratories, Chicago, Ill.). In 31 randomly selected cases, dust samples were collected from the patients' mattresses and from a floor area under the bed of 2 m². The families' own vacuum cleaners, with new disposable bags, were used to collect the samples. Each area was vacuumed for 2 minutes. Samples were mixed in 70% ethanol until examined in blinded fashion for mite identification (species and proportion in the sample) at the Parasitology Department of the Universidad Complutense of Madrid.

Statistical analysis

The chi-square test and the two-tailed Mann-Whitney U test were used to compare dichotomous and continuous variables, respectively. Correlation between continuous variables was assessed with Spearman's rank test. For statistical calculations, CAP values lower than 0.35 IU/ml were considered as zero, and CAP values higher than the upper limit of quantification were considered as 100 IU/ml. To assess the

From the Divisions of ^aAllergy, ^bBiochemistry, and ^cInternal Medicine, Complejo Hospitalario Universitario de Santiago, Santiago de Compostela.

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Reprint requests: Carmen Vidal, PhD, Unidad de Alergia, Hospital de Conxo (Complejo Hospitalario Universitario de Santiago), Rua Ramón Baltar sn, 15706 Santiago de Compostela, Spain.

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TABLE I. Comparison of epidemiologic and clinical data from patients with and without SM sensitization

	Sensitized (n = 274)	Not sensitized (n = 36)	p Value
Age (yr)	24.4 ± 9.6	19.6 ± 9.7	NS
Gender (male)	131 (48%)	18 (50%)	NS
Asthma	175 (64%)	20 (56%)	NS
Rhinitis	255 (93%)	32 (89%)	NS
Dermatitis	26 (9%)	1 (3%)	NS
Pets	146 (53%)	15 (42%)	NS
Rural origin	124 (45%)	10 (28%)	0.04
Livestock	88 (32%)	5 (14%)	0.02
Indoor humidity	195 (71%)	16 (44%)	0.001
Grain storage	95 (35%)	4 (11%)	0.004

The four variables with statistical significance were made to enter a multiple logistic regression model. Only high indoor humidity and the presence of grain storage facilities maintained a significant association with SM sensitivity (odds ratio, 2.75; 95% confidence interval, 1.3 to 5.8; $p = 0.03$; and odds ratio 22.6; 95% confidence interval, 1.3 to 379.9; $p = 0.008$, respectively).

NS, Not significant.

effects of potential confounding variables, a multiple logistic regression model was used. A p value less than 0.05 was considered to be significant.

RESULTS

Two hundred seventy-four (88.4%) of the 310 patients allergic to HDMs were found to have sensitization to SMs (reaction to at least one of the SMs examined with the SPT- and/or CAP-specific serum IgE). Most of these patients (252, 92%) had positive responses to both SPT- and CAP-specific serum IgE. Eight patients had some positive SPT results but negative CAP-specific serum IgE results against SMs, and 14 patients had negative SPT responses and positive CAP responses to any of these mites. The vast majority of patients (227, 73%) were sensitized to all three species. However, 18 patients had positive results only when tested against *L. destructor*, and four had positive results only when tested against *T. putrescentiae*. No patients had positive results when tested against *A. siro* alone. Specific serum IgE levels were similar among those patients tested with *T. putrescentiae* (median, 2.61 IU/ml) and *A. siro* (median, 2.24 IU/ml). The highest levels were found against *L. destructor* (median, 4.72 IU/ml). A similar pattern was observed with SPTs (Fig. 1).

Epidemiologic and clinical characteristics of patients with and without sensitization to SMs are presented in Table I. High indoor humidity and the presence of grain storage facilities were the variables independently associated with SM sensitization. When both conditions existed, 97% of patients had specific IgE against SMs. However, even when both conditions did not exist, as many as 77% of patients showed specific IgE against SMs. Patients allergic to SMs had

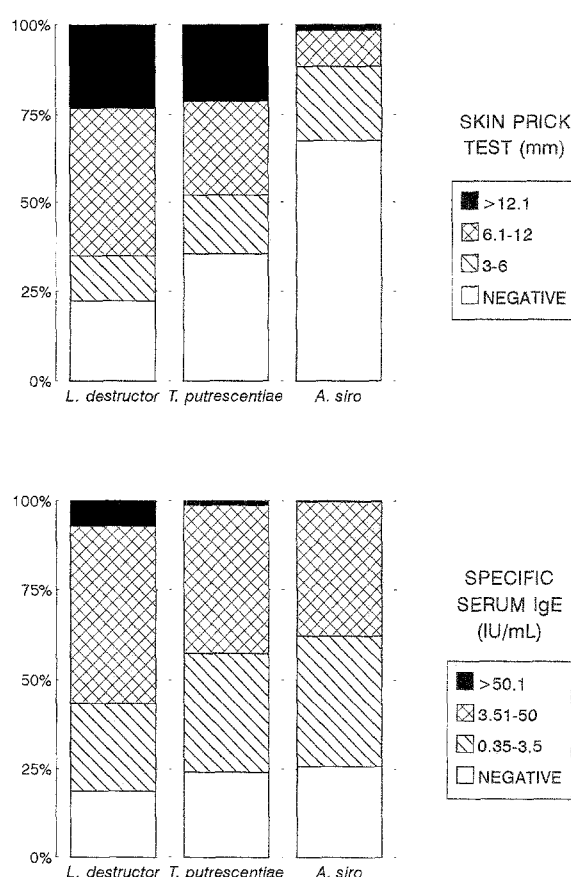


FIG. 1. Diameters of SPTs and specific serum IgE levels against *L. destructor*, *T. putrescentiae*, and *A. siro*.

higher levels of both total serum IgE (median, 374 IU/ml [range, 22 to 7548 IU/ml] vs median, 137 IU/ml [range, 7 to 1968 IU/ml]) and specific serum IgE to *D. pteronyssinus* (median, 48.6 IU/ml [range, 0 to >100 IU/ml] vs median, 20.4 IU/ml [range, 1 to >100 IU/ml]) and *D. farinae* (median, 28.5 IU/ml [range, 0 to >100 IU/ml] vs median, 10.6 IU/ml [range, 0 to >100 IU/ml]) than patients without allergy to SMs ($p < 0.0001$, $p = 0.0037$, and $p = 0.0002$, respectively). Correlation of CAP values was very strong between the two species of HDMs and among the three species of SMs. However, correlation of CAP titers between HDMs and SMs was much weaker (Table II). Of the 31 house dust samples studied, SMs were present in 20 of 28 cases with SM sensitization and in 2 of 3 cases without SM sensitization. The median proportion of SMs (relative to the total number of mites in each sample) was 19% (range, 0% to 93%). The most frequently found SM was *L. destructor* (present in 17 samples [55%]). A significant correlation was observed between the proportion of *L. destructor* in dust samples and specific serum IgE against this mite ($r = 0.517$, $p = 0.003$). Other SMs identified in dust samples were *Chortoglyphus arcuatus* ($n = 8$), *T.*

TABLE II. Coefficients of correlation between serum-specific IgE values

	Dpt	Df	Acs	Lepd
Df	0.939 <i>n</i> = 309			
Acs	0.362 <i>n</i> = 309	0.430 <i>n</i> = 305		
Lepd	0.308 <i>n</i> = 309	0.391 <i>n</i> = 307	0.662 <i>n</i> = 259	
Typr	0.385 <i>n</i> = 310	0.465 <i>n</i> = 306	0.801 <i>n</i> = 243	0.721 <i>n</i> = 266

Only cases with positive specific serum IgE (≥ 0.35 IU/ml) to at least one of the two paired mites were included.

$p < 0.001$ for each pair of variables.

Dpt, *Dermatophagoides pteronyssinus*; Df, *Dermatophagoides farinae*; Acs, *Acarus siro*; Lepd, *Lepidoglyphus destructor*; Typr, *Tyrophagus putrescentiae*.

putrescentiae ($n = 6$), *Gohieria fusca* ($n = 4$), *Glycyphagus domesticus* ($n = 2$), and *A. siro* ($n = 2$).

DISCUSSION

Several studies have demonstrated the importance of SMs in occupationally exposed individuals.^{1,2} More recently, studies have been focused on the importance of SM allergy in nonoccupationally exposed subjects. The prevalence of SM sensitization in individuals allergic to HDMS ranged from 28% to 62% depending on the country, the SM species studied, and the methods used.^{3,4,6,7}

In this study a very high (up to 88%) prevalence of allergy to SMs among individuals allergic to HDMS in the Santiago de Compostela area was found. The most frequently detected species of SM was *L. destructor*, and it was in reaction to this mite that the highest levels of serum IgE were found. To our knowledge, the prevalence detected in this study is the highest reported to date in nonoccupationally exposed patients. Patients sensitized to SMs came more frequently from rural rather than urban areas, as previously reported.³ However, the rural environment loses its significance when included in a multivariate analysis, and only high indoor humidity and the presence of grain storage facilities at or near the home remained significant factors influencing SM sensitization. This is not surprising because both conditions favor SM growth.⁶

Whether the frequency of sensitization to the different types of mites is due to cross-reactions with HDMS or to multiple sensitizations must be elucidated. Patients sensitized to SMs had higher values of both total and specific IgE against HDMS, which could be explained by cross-reaction. In fact, significant correlations were observed between the titers of serum-specific IgE to SMs and HDMS, but correlations between specific IgE levels

are much stronger among the three SMs than between SMs and HDMS. This suggests that epitopes exist that are shared by the three SMs but are not present in the HDMS. Thus there must have been primary sensitization to SMs among the patients. Other groups have reported non-cross-reactivity by using RAST-inhibition experiments⁷ and crossed immunoelectrophoresis.⁸ In this study the relationship of SM sensitization to conditions that favor exposure to SMs (e.g., the presence of grain storage facilities near the home) and the presence of SMs in dust samples taken from patients' mattresses may support the idea of multiple sensitizations.⁹ These hypotheses are not mutually exclusive because, as some authors suggest, there are unique and common allergenic determinants in these species.⁵

In conclusion, the prevalence of SM sensitization in patients allergic to HDMS seems to be very high in the studied area. High indoor humidity and the presence of grain storage facilities near the home seem to be the most important environmental factors for SM sensitization. Further studies are needed to determine whether this phenomenon is due to multiple sensitization or to cross-reactivity with *Dermatophagoides* spp.

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