Sensitivity to Five Types of House Dust Mite in a Group of Allergic Egyptian Children

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Background: The published data on house dust mite (HDM) sensitization from Egypt are scanty. We sought to investigate the sensitization to five different types of HDM among a group of allergic children in a trial to outline the most frequent sensitizing strains in the Cairo Province.

Methods: We consecutively enrolled 100 asthmatic patients, aged 1–7 years, of whom 22 had concomitant skin allergy. Skin prick testing was performed using allergen extracts of *Dermatophagoides pteronyssinus*, *Dermatophagoides farinae*, *Lepidoglyphus destructor*, *Tyrophagus putrescentiae*, and *Acarus siro*.

Results: Twenty-four patients (24%) were sensitized to one or more strains of HDM. Sensitization to one strain was revealed in 12% of the studied sample, while sensitization to two or three strains was detected in 8% and 4% respectively. Twelve percent of the enrolled children were sensitive to *D. pteronyssinus*, 11% to *D. farinae*, 7% to *L. destructor*, 6% to *T. putrescentiae*, and 4% to *A. siro*. Eight out of the 12 (66%) children sensitive to one strain had mild intermittent asthma, while five out of eight (62.5%) sensitive to two strains had moderate persistent asthma. All children sensitized to three strains of HDM had persistent rather than intermittent asthma. HDM sensitization did not correlate significantly to the history of sun exposure, bed mattresses and pillows, living in farms, or exposure to stored grains. The co-existence of atopic dermatitis tended to have a higher rate of HDM sensitization.

Conclusion: *D. pteronyssinus* and *D. farinae* represent the most common sensitizing strains in the studied sample. Wider-scale population-based studies are needed to assess the prevalence of HDM allergy and its clinical correlates in our country.

Introduction

HOUSE DUST MITES (HDM) are the most prevalent source of indoor allergens shown by multicenter studies across Europe, the United States, Asia, South America, New Zealand, and Australia. HDM allergy has also been reported from Africa.¹ Regions with a few months of relative humidity below 50% have low infestations.² In temperate regions, *Dermatophagoides pteronyssinus*, *Dermatophagoides farinae*, and *Euroglyphus maynei* (family: Pyroglyphidae) are the most commonly species found. In tropical and subtropical areas, *Blomia tropicalis* (family Glycyphagidae) and *D. pteronyssinus* are the most frequent species, while *D. farinae* is rarely found.³

The majority of HDM-allergic patients are co-sensitized to *D. pteronyssinus* and *D. farinae*. Allergens from both species are normally present in any sample of house dust from most of the temperate zones.⁴ Several researchers using different methodologies described common allergenic extract components obtained from *D. pteronyssinus* and *D. farinae* cultures. It was found that IgE cross-reactivity

between Der p1 and Der f1 and between Der p2 and Der f2 is higher than 80%. Both species contain a significant amount of equal or very similar epitopes causing immunological cross-reactions caused by different described allergens.⁵

Storage mites of the families Acaridae (*Acarus siro* and *Tyrophagus putrescentiae*) and Glycyphagidae (*Lepidoglyphus destructor* and *Blomia tropicalis*) are often found in dry food items that contain some amount of moisture (<10%), providing an optimum breeding ground for the storage mites. Infestations have been found in cheese, grain, seeds, bulbs, straw, dried fruits, cereal, wallpaper, and furniture. The fauna of storage mites in house dust was represented by the previous two families.⁶ HDM species such as *D. pteronyssinus*, *D. farinae*, and *Euroglyphus maynei* feed mainly on human desquamated skin scales, while storage mites (most commonly *A. siro*, *L. destructor*, *Glycyphagus domesticus*, and *B. tropicalis*) feed mainly on plant material, fungi, and organic degradation products; they are also frequently found in house dust.⁷

HDM sensitization is strongly linked to asthma. The higher the level of dust mite exposure at the age of 1 year,

the earlier the first episode of wheezing occurred. The relative risk of asthma (which includes exposure to indoor allergens as HDM, male gender, family history of asthma, atopy and airway hyper-reactivity) was almost five times greater in the subjects who were exposed to high levels of dust mite allergen ($>10 \mu\text{g/g}$).⁸

HDM sensitivity and allergy in Egypt have not been sufficiently studied. We therefore sought to study the frequency of sensitization to five types of HDM in a group of asthmatic Egyptian children in a pilot trial to outline the most frequent sensitizing strains in the Cairo Province.

Methods

Study population

This cross-sectional study comprised 100 asthmatic children. They were enrolled consecutively from the Pediatric Allergy and Immunology Clinic of the Children's Hospital, Ain Shams University, Cairo. The inclusion criteria were physician-diagnosed asthma in childhood and living in the Greater Cairo Province, Egypt. The study gained approval from the ethics' committee of the Department of Pediatrics, Ain Shams University. An informed oral consent was obtained from the parents or caregivers prior to enrollment.

Study measurements

Patients included in the study were subjected to detailed clinical history and examination, with special emphasis on factors that might influence HDM exposure, including the exposure to stored grains and living in a farm. The family history of allergy was traced in the first- and second-degree relatives of subjects.

Skin prick tests (SPT) were performed for each patient using allergen extracts of *D. pteronyssinus*, *D. farinae*, *L. destructor*, *T. putrescentiae*, *A. siro*, as well as positive histamine (1 mg/mL) and negative saline controls (Omega Laboratories, Montréal, Canada). First-generation short-acting antihistamines were avoided for at least 72 hours, and second-generation antihistamines were avoided for at least 5 days before testing. The test sites were marked and labeled at least 3 cm apart to avoid the overlapping of positive skin reactions. The marked site was dropped by the allergen and gently pricked by sterile skin test lancet. Positive and negative control solutions were similarly applied. Test results were read at 20 minutes. Largest and orthogonal diameters of any resultant wheal and flare were measured. A positive response was defined as a wheal size ≥ 3 mm above the negative control. Subjects who showed no wheal formation in response to the positive control, or who presented a wheal in response to the negative control were excluded from the study.^{9,10}

Five mL of blood were aseptically collected in aliquots by venepuncture from each subject in sterile tubes for complete blood cell counting and total IgE assay. Complete blood counting was done using an automated cell counter (Coulter MicroDiff 18, Fullerton, CA) and manual differential. Serum total IgE was measured using the enzyme-linked immunosorbent assay (ELISA) technique (Medix Biotech, Inc., San Carlos, CA). The value of IgE used for data analysis was the percentage calculated from the highest normal for age¹¹ as follows: patient's value/highest normal for age $\times 100$.

Statistical analysis

Data were analyzed by a standard computer program using the statistical software package SPSS for Windows v13 (Chicago, IL). The mean, standard deviation (SD), median, and interquartile (IQ) range presented the descriptive data. Groups were compared using the Kruskal–Wallis and Mann–Whitney Z tests for nonparametric data. Fisher's exact and chi square tests were used for comparison of categorical data. Pearson and Spearman coefficient tests were used to correlate the numeric data. For all tests, p values <0.05 were considered statistically significant.

Results

The studied sample included 78 patients with bronchial asthma only, and 22 had concomitant skin allergy (17 patients with urticaria/angioedema, and five with atopic dermatitis). They were 56 males and 44 females. Their ages ranged from 1 to 17 years, with a mean (SD) of 7 (3.7) years. Their duration of illness ranged from 2 months to 15 years, with a mean (SD) of 4.93 (3.78) years. Their duration of exclusive breast-feeding ranged from 0 to 15 months, with a mean (SD) of 4.76 (2.433) months. Serum total IgE % values from normal ranged between 5% and 1,868% with a median (IQR) of 56.7% (99%) and mean (SD) of 160.7 (290.1%). The absolute eosinophil counts (AEC) ranged from 0 to 1,400 cells/mm³ with a median (IQR) of 200 (300) and mean (SD) count of 302 (299)/mm³.

Skin prick testing with five types of HDM revealed that 24 children (24%) were sensitive to one or more strains of HDM; 12 children were sensitized to one type of HDM, eight to two types of HDM, and four were sensitized to three types of HDM. Twelve percent of the whole sample were sensitized to *D. pteronyssinus*, 11% to *D. farinae*, 7% to *L. destructor*, 6% to *T. putrescentiae*, and 4% to *A. siro* (Fig. 1). Out of the 24 HDM sensitive children, 50% were sensitized to *D. pteronyssinus*, 45.8% to *D. farinae*, 29.2% to *L. destructor*, 25% to *T. putrescentiae*, and 16.7% to *A. siro*. *D. pteronyssinus* and *D. farinae* represented the most common sensitizing strains in our series. Among our 24 HDM sensitized children, six (25%) were sensitized to *D. pteronyssinus*, five (21%) to *D. farinae*, and six (25%) were sensitive to both.

Most of the children who were sensitized to one strain of HDM (8 out of 12; 66%) had mild intermittent asthma,

FIG. 1. Sensitization rates (%) to the five types of house dust mite in the studied sample.

while four out of six children sensitized to two strains of HDM had moderate persistent asthma. All those sensitized to three strains suffered from persistent rather than intermittent asthma.¹² No significant relationship could be elicited between the clinical severity of asthma and the wheal size of reactivity to *D. pteronyssinus* or *D. farinae*.

Among the 22 children with concomitant skin allergy, six patients (27%) were sensitive to one or more strains of HDM. Three children were sensitive to one strain, two were sensitive two strains, and one child was sensitive to three strains of HDM. Sensitivity to *D. pteronyssinus* was found in three children, *D. farinae* in three, and *L. destructor* in two, while one child was sensitive to *T. putrescentiae*, and one to *A. siro*. Three out of the five children who had concomitant atopic dermatitis (60%) were HDM sensitive compared to 3 out of 17 (18%) children with concomitant urticaria/angioedema and 18 out of 78 (23%) children with exclusive respiratory allergy (Fig. 2). The relation, however, did not reach statistical significance ($p=0.137$).

Nine patients had history of exposure to stored grains, and 25 patients had a history of living on farms. Only 8% of patients living on farms had positive *D. pteronyssinus* sensitization compared to 13.3% of patients living in urban communities. Concerning *D. farinae*, the corresponding figures were 4% (one patient) and 13.3% (10 patients) respectively. The differences did not reach statistical significance.

Patients who reported exposure to stored grains were sensitive to *D. pteronyssinus* with a frequency of 22.2% (two out of nine patients) compared with 11% (10 out of 91 patients) with no such history. The corresponding values for *D. farinae* were 22.2% (two out of nine patients) and 9.9% (9 out of 91 patients) respectively. The relations were statistically insignificant.

Eighty-three patients in our series had positive family history of allergy, but this did not influence the rates of HDM sensitization ($p=0.231$). Worth mentioning is that many of these children had sensitivities other than HDM. No significant correlations could be elicited between the number of sensitizing strains and other numerical clinical and laboratory data studied, including age, duration of breastfeeding, age at weaning, duration of illness, total leukocyte count, AEC, total IgE concentration, and IgE % values from normal for age (Tables 1 and 2).

FIG. 2. Variation of sensitization with diagnosis. BA, bronchial asthma; AD, atopic dermatitis; U/A, urticaria/angioedema.

TABLE 1. VARIATION OF THE PATIENTS' CLINICAL DATA ACCORDING TO HOUSE DUST MITE SPT RESULTS

Variables	Count (%)		p
	SPT–	SPT+	
Gender			
M	43 (76.8)	13 (23.2)	0.836
F	33 (75.0)	11 (25.0)	
Living in farms			
–	54 (72.0)	21 (28.0)	0.105
+	22 (88.0)	03 (12.0)	
Storage mite exposure			
–	69 (75.8)	22 (24.2)	0.896
+	07 (77.8)	02 (22.2)	
Diagnosis			
BA	49 (77.8)	14 (22.2)	0.587
BA+	27 (73.0)	10 (27.0)	
FH of allergy			
–	11 (65.0)	06 (35.0)	0.231
+	65 (78.3)	18 (21.7)	

BA, bronchial asthma; BA+, bronchial asthma plus other allergies; F, female; FH, family history; M, male; SPT, skin prick test; –, negative; +, positive.

Discussion

Sensitization to one or more strains of HDM tested was evident in 24% of the studied sample. *D. pteronyssinus* and *D. farinae* were the most prevalent strains. Among our 24 HDM sensitized children, 12 (50%) were sensitized to *D. pteronyssinus*, and 11 (45.8%) to *D. farinae*. Similar results have been noted in European studies on atopic populations. A relevant study from Turkey that included 1279 children and adults with various atopic diseases reported HDM sensitization in 25% of cases of whom 46.9% were sensitive to *D. pteronyssinus*, 46% to *D. farinae*, and 7% were sensitized to both strains.¹³ Akcakaya *et al.*¹⁴ investigated 5,080 Turkish asthmatic children, 1–18 years old, and found that 50% of their HDM sensitive patients were sensitized to *D. pteronyssinus* and 49% to *D. farinae*.

A study on 100 Mexican children with allergic asthma reported that *D. pteronyssinus* was positive in 96%, *D. farinae* in 80%, *T. putrescentiae* in 12%, and *L. destructor* in 7% of subjects.¹⁵ Seven children in our series (7%) were sensitive to *L. destructor*, six (6%) to *T. putrescentiae*, and four (4%) patients to *A. siro*. Soares *et al.*¹⁶ studied sensitization to HDM in 212 allergic Brazilian patients, 4–65 years old, who had allergic rhinitis as the main clinical diagnosis with or without concomitant asthma, and/or atopic dermatitis. Asthma constituted only 1.9% of the studied sample. They reported that the total sensitization to HDM was 73.5%, of which 61.7% and 59.9% were sensitized to *D. pteronyssinus* and *D. farinae* respectively.

We investigated the influence of some indoor environmental factors on HDM sensitization. Rural residency did not significantly influence the frequency of HDM sensitization, neither did the history of exposure to stored grains (mostly wheat). Our data show that 7% of the children reacted to *L. destructor* and 4% to *A. siro*. Although not universally classified as storage mites, *D. farinae* and *D. pteronyssinus* were reported to cause oral mite

TABLE 2. VARIATION OF THE PATIENTS' NUMERICAL DATA ACCORDING TO HDM SPT RESULTS

Variables	SPT–			SPT+			p
	Mean (SD)	Range	IQ range	Mean (SD)	Range	IQ range	
Age (years)	9.92 (3.80)	16	6	7.37 (3.64)	13	5.6	0.467
Duration of exclusive breast feeding (months)	4.87 (2.62)	15	2	4.41 (1.72)	6.0	2.0	0.462
Duration of illness (years)	5.26 (3.84)	14.8	7	3.90 (3.47)	14.8	3.4	0.128
TLC (1,000/mm ³)	8.62 (2.93)	14.1	3.6	7.35 (2.69)	12.1	4.2	0.103
AEC (1,000/mm ³)	0.31 (0.30)	1.40	0.4	0.29 (0.921)	1.0	0.2	0.792
IgE %	158 (260)	1045	92	169 (375)	1857	113	0.783

AEC, absolute eosinophil count; BF, breast-feeding; DOL, duration of illness; HDM, house dust mites; IgE %: percentage from highest normal for age; IQ, interquartile; SD, standard deviation; SPT, skin prick test; TLC, total leukocyte count.

anaphylaxis (OMA) due to contamination of wheat flour.^{17,18} Musken *et al.*¹⁹ studied the frequency of skin test sensitivity to *D. pteronyssinus*, *A. siro*, *L. destructor*, and *T. putrescentiae* in 512 consecutive patients (children and adults) with rhinitis and/or asthma living in urban or rural areas in Germany. They reported that 20.1% reacted to at least one of the storage mites. From this latter group, 85.4% skin tested positive to *D. pteronyssinus*. A study on 2,021 children did not find a relation between type of house flooring and the prevalence of HDM sensitization, but reduced risk of sensitization was documented in children with nonsynthetic bedding material. The risk of sensitization to HDM was not increased in children having stuffed toys in their bedroom.²⁰ Indoor materials can be considered not only as reservoirs of HDM but also of microbes and endotoxin. It was reported that exposure to higher levels of house dust endotoxin is associated with lower prevalence of allergic sensitization in children to one or more allergens.²¹ This may partly explain the poor influence of indoor environmental factors on HDM sensitization in our series.

A majority of our asthmatic children who were sensitized to one strain of HDM (66.7%) had mild intermittent asthma, and most of those sensitive to two strains of HDM had moderate persistent asthma, while all patients sensitive to three strains suffered from persistent rather than intermittent asthma. A study of 6,300 asthmatic and rhinitis patients with varying disease severity in China revealed a significant association between increased HDM sensitization and severity of asthma.²²

Although HDM sensitivity in the current study seemed to be more frequent in asthmatic children with concomitant atopic dermatitis (AD) as compared with children with concomitant urticaria/angioedema or those with exclusive respiratory allergy, the difference did not reach statistical significance probably due to the limited sample size in each category. The association between AD and sensitivity to *D. pteronyssinus* and/or *D. farinae* was reported in 74.5% of a group of 98 Saudi children.²³ Again, 90% of a group of children with eczema from Hong Kong were sensitive to aeroallergens with the mites *D. pteronyssinus*, *D. farinae*, and *B. tropicalis* being the most prevalent aeroallergens, regardless of age and bronchial hyperreactivity.²⁴ An association between the severity of AD symptoms and indoor concentrations of HDM was reported from Korea. HDM was assumed to act not only as an allergen but also as a nonspecific irritant in AD skin lesions via a proteolytic activity of the HDM allergens.^{25–27}

In conclusion, this pilot study revealed that 24% of a group of allergic children from Cairo were sensitized to one or more of five strains of HDM, *D. pteronyssinus* and *D. farinae* being the most common. Testing children with several mite species would give information on the varied geographic distribution and might help efforts to develop more targeted specific immunotherapy. Our conclusions are limited by the sample size. Being extrapolated from cases of physician-diagnosed asthma, the findings do not reflect the situation in the general population. Further wider-scale population-based studies as well as a national registry are needed to outline the real magnitude of sensitivity to various strains of HDM and its clinical correlates in our country.

Author Disclosure Statement

No competing financial interests exist.

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