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ORIGINAL ARTICLE

Early House Dust Mite Sensitivity in Mumbai Children

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Abstract
Objective To identify house dust mite (HDM) sensitivity by skin prick test in children with allergic rhinitis, allergic wheezing and eczema.
Methods In this prospective study, children with persistent or recurrent allergic symptoms of rhinitis, wheezing and eczema were enrolled to undergo skin prick testing. Sensitivity was checked for three mites: *Dermatophagoide farinae*, *Dermatophagoide pteronyssinus*, and *Blomia tropicalis*.
Results Total 92 children underwent skin prick test; 49 (53.2 %) showed significant positivity to one or more dust mite. In the HDM sensitized group, a positive family history of allergic disorders was present in 32 children (65.3 %). In the HDM sensitized group, 18 (36.7 %) children had allergic rhinitis. The youngest child in this group was 12-mo-old. Ten (55.55 %) children were less than 24 mo of age. Significant sensitization to mites was detected in 7 (14.28 %) children with eczema. All children were below 24 mo of age.

In children with a tendency to wheeze frequently without any evidence of infections or other systemic disease, 24 (48.9 %) had sensitization to HDM. The youngest child was 15 mo of age. Ten (41.6 %) children were below 24 mo of age.

Sensitivity to *Blomia tropicalis* was detected in 6 (12.24 %) children. Significantly more number of children were sensitive to *D. pteronyssinus* as compared to *D. farinae* (65.31 % *vs.* 46.94 %; p=0.034).
Conclusions Children in Mumbai show early sensitization to HDM. *D. pteronyssinus* is the commonest offending allergen in the index study.

Keywords House dust mites · Sensitization · *Blomia tropicalis*

Introduction

Mumbai is a metropolitan city of India. The relative humidity (RH) typically ranges from 33 to 95 % over the course of the year, rarely dropping below 20 % (dry) and frequently reaching as high as 100 % (very humid).

The house dust mite (HDM) is a cosmopolitan pyroglyphidae that lives in human habitation.

The most important allergy-causing mites found in homes worldwide are the HDMs: *Dermatophagoides farinae*, *D. pteronyssinus*, *Euroglyphus maynei* and the storage mite *Blomia tropicalis*. Most homes contain multiple species. The most prevalent mite species and allergens in homes differ geographically, between homes within a geographical region, and among areas within a home [1].

HDM is the most common cause of respiratory allergy worldwide and triggering 50 % of overall allergic rhinitis [2]. To date, 17 groups of allergens from *Dermatophogoides* sp. with diverse biological functions have been described (www.allergen.org) [3].

The 1989 Isle of Wight birth cohort study followed up children from birth to 18 y of age, found that the prevalence of HDM sensitivity increased annually by 7 % [4].

The presence of allergic rhinitis increases the risk of asthma and compared to other allergens, sensitization to HDM is

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greatly associated with an increased risk of asthma [5]. Early sensitization to HDM is a harbinger to later asthma in children with eczema [6]. Children tend to be exposed early in life to this allergen [7]. Exposure to high levels of HDM (≥10 μg/g) in the first months of life is associated with a 3-fold greater risk of asthma at age 7, and a 5-fold increase in the risk of wheezing [8]. Multiple studies have demonstrated the advantages of allergen avoidance on delaying the onset of atopic diseases like asthma [9].

Skin allergy testing in Indian adults showed that in patients with allergic rhinitis sensitized to HDM; *Dermatophagoides farinae* was the most common allergen [10].

The profile of adults with allergic respiratory diseases showed that 27 % of HDM allergic patients were bothered year-round. The main impact on quality of life was reported on daily activities (62 %) (social activities, sports, housework) and sleep (54 %) [11]. Another European survey found that 57 % of respondents had symptoms of HDM allergy, whereas only 15 % had actually been diagnosed, indicating an urgent need for physician and patient education [12].

There are scanty reports of HDM sensitivity in children in India; the authors present data on trends in HDM sensitization in allergic children in one of the most populous metropolitan cities in India.

Material and Methods

This study was done at the outpatient department of a tertiary care hospital in the suburbs of Mumbai. Children with persistent or recurrent allergic symptoms of rhinitis, wheezing and eczema were enrolled to undergo skin prick testing if they met the inclusion criteria and after informed parental consent. The study was conducted in accordance with Good Clinical Practice guidelines and Schedule Y. Sensitivity was checked for three mites: *Dermatophagoide farinae*, *Dermatophagoide pteronyssinus*, *and Blomia tropicalis*. Modified skin prick test (SPT) was performed using allergens provided by Creative Diagnostic Medicare, Mumbai. Readings were obtained at 15 min and recorded as wheal size in millimeters.

Children who presented with a history of persistent or recurrent nasal blockage or recurrent colds and sneezing not attributable to infective causes were classified as having probable allergic rhinitis and were included for SPT. Children with recurrent or persistent wheeze not attributable to infection or any other systemic illness were classified as having allergic wheeze and were also included for SPT. Children with atopic dermatitis and no other systemic illness were also included for SPT.

Skin prick testing was postponed if the child was previously administered anti histamines or systemic steroids and such children were recalled at appropriate drug free intervals to undergo SPT.

The information pertaining to child's age, sex, symptom duration and SPT result was recorded. A wheal size greater than the glycerol-saline control and greater than or equivalent to the histamine control was considered positive and termed as significant sensitization. Parents of children demonstrating sensitization to HDM were counseled for avoidance measures.

Data was analyzed using the STATA software version 11. Chi square test was used for categorical variables or Fisher exact test was used for cell frequencies less than 5. Level of significance was set at $p<0.05$.

Results

Total 92 children underwent SPT: 28 with allergic rhinitis, 15 with eczema, and 49 with wheeze (Table 1).

Forty nine (53.2 %) children tested positive to one or more types of HDM; the youngest child was 9-mo-old and the oldest child was 46 mo of completed age. A family history of allergic disorders was present in 56(60.86 %) of these children. In the HDM sensitized group of 49 children, 32(65.3 %) had a family history of atopy (Table 1).

Of the total 28 children with allergic rhinitis, 18(64.28 %) children had significant sensitization to one or more HDM. In this group of 18 children, 10(55.55 %) children were below 24 mo of age, the mean age of children was 24.72±9.35 mo. Twelve (66.66 %) children had symptoms of nasal blockage. The remaining children had running nose and sneezing as a major complaint. The youngest child in this group was 12-mo-old and had no family history of any allergic disorders; a family history of allergic conditions was present

Table 1 Demography of children included in the study

	Total N	Mean age in months	Positive family history (*N*=92) (%)	HDM sensitized	
				N (%)	Positive family history (*N*=49) (%)
Allergic rhinitis	28	24.72±9.35	15 (53.57)	18 (64.28)	10 (55.55)
Eczema	15	10.71±1.49	9 (60)	7 (46.66)	5 (71.43)
Allergic wheezing	49	28.67±10.75	32 (65.3)	24 (48.97)	17 (70.83)
Total	92	24.65±11.09	56 (60.86)	49 (53.2)	32 (65.3)

Table 2 Pattern of HDM sensitization in children with allergic disease

	N	*D.pteronyssinus* (P)	*D. farinae* (F)	*Blomia* (B)	P+F	P+B	F+B	*P* value*
Allergic rhinitis	18	8 (44.44 %)	7 (38.89 %)	1 (5.56 %)	2 (11.11 %)	0	0	0.635
Eczema	7	4 (57.14 %)	2 (28.57 %)	0 (0 %)	1 (14.29 %)	0	0	
Allergic wheezing	24	11 (45.83 %)	3 (12.5 %)	1 (4.17 %)	5 (20.83 %)	1 (4.17 %)	3 (12.5 %)	
Total	49	23 (46.93 %)	12 (24.49 %)	2 (4.08 %)	8 (16.32 %)	1 (2.04 %)	3 (6.12 %)	

*Fisher exact test used for comparison

in 10(55.55 %) children. Within this group, 8(44.44 %) children had sensitivity to *D. pteronyssinus*, 7(38.89 %) children showed sensitivity to *D. farinae*, and 1(5.56 %) child was sensitive to *Blomia* sp. Two (11.11 %) children exhibited sensitivity to both *D. farinae* and *D. pteronyssinus*. Sensitivity to *D. pteronyssinus* was more frequent compared to the other two mites (Table 2).

Of the total 15 children with atopic eczema, significant sensitization to mites was detected in 7 (46.6 %) children. Within this HDM sensitized group all children were below 24 mo of age with a mean age of 10.71±1.49 mo, a positive family history of atopy was present in 5(71.43 %) children (Table 1). Four (57.14 %) children were sensitive to *D. pteronyssinus*, 2(28.57 %) children were sensitive to *D. farinae* and 1(14.29 %) child was sensitive to both *D. farinae* and *D. pteronyssinus*. Sensitivity to *D. pteronyssinus* was again more frequent compared to the other two mites (Table 2).

In 49 children with a tendency to wheeze frequently and without any evidence of infections or other systemic disease, 24 (48.9 %) had sensitization to HDM. The mean age of children in this group was 28.67±10.75 mo; the youngest child was 15 mo of age. A family history of allergic disorders was obtained in 17(70.83 %) children (Table 1). Fourteen (28.5 %) children were below 24 mo of age. Within the wheeze group of HDM sensitized children, 11(45.83 %) children were sensitive to *D. pteronyssinus*, 3(12.5 %) children were sensitive to *D. farinae*, 1(4.17 %) child was sensitive to *Blomia* and 5 (20.83 %) children were sensitized to both *D.farinae* and *D.pteronyssinus*. One child was sensitive to *D.pteronyssinus* and *Blomia* and 3(12.5 %) children were sensitized to *D. farinae and Blomia*. Sensitization to *D.pteronyssinus* was the commonest and 9 (37.5 %) children showed significant sensitivity to two mites (Table 2).

Discussion

The humidity and temperature of Mumbai is conducive to high mite density. Children at young age are predominantly kept indoors and frequently in the cots or on mats. The frequent soiling and urination increases moisture content of their bedding and increases the risk of early sensitization to HDM. With these risk factors it seemed rational to assess early sensitization in children especially those who had recurrent or persistent allergic events. In the index study, children as young as 9 mo of age showed sensitization to HDM.

Mites produce and excrete numerous allergens into the environment, including cysteine proteases such as Der p 1 and Der f 1, serine proteases including Der p 3, 6 and 9, and proteases that can activate protease-activated receptor-2, which are pro-inflammatory in humans through a non IgE-dependent mechanism. Mites also produce glycosidases and carbohydrate-binding proteins and muscle, cytoskeleton, and calcium-binding proteins. There is cross-reactivity among various mite species and between mites and other related families, such as crustaceans and cockroaches [13].

In the index study, sensitization to HDM was observed in 53.2 % cases with allergic disorders.

A large proportion (64.28 %) of young children with allergic rhinitis were sensitized to HDM and similarly; in children with allergic wheezing, 48.97 % showed sensitization to HDM. In young children with atopic eczema, sensitization to HDM was observed in 46.66 % cases (Table 1).

Early sensitization to HDM is a well-documented risk factor for later asthma [14–16].

The presence of family history of allergic disorders is also a strong risk factor to develop atopy. In the index study authors found that a positive family history was present in 32(65.3 %) children in the HDM sensitized group. However no such history could be elicited in the remaining children. No significant association was detected between HDM sensitization and positive family history of atopy (Table 3).

Table 3 Comparison of HDM sensitized and positive family history

HDM sensitization	Positive family history		*p* value
	No	Yes	
No	19 (52.78)	24 (42.86)	0.352
Yes	17 (47.22)	32 (57.14)	
Total	36 (100)	56 (100)	

Comparisons were done by using Chi square test

Table 4 Pattern of HDM sensitization

Diagnosed group	Sensitive	Mite		Difference (95%CI)	*P* value
		D. pteronyssinus (*P*)	*D. farinae* (*F*)		
Overall	Yes, n(%)	32 (65.31)	23 (46.94)	18.35 (−0.94 to 37.68)	0.034
Allergic Wheezing	Yes, n(%)	17 (70.83)	11 (45.83)	25.0 (−1.98 to 51.98)	0.039
Allergic Rhinitis	Yes, n(%)	10 (55.56)	9 (50.0)	5.6 (−27.0 to 38.12)	0.369
Eczema	Yes, n(%)	5 (71.43)	3 (42.86)	28.57 (−21.07 to 78.2)	0.140

Compared using two sample proportion test

It is plausible that other environmental factors contribute to HDM sensitization in such cases. Components of gas, dust and fumes may act as adjuvants that facilitate sensitization to mites [17]. Studies in adults have shown that the commonest sensitization is to *D. farinae* in adults with allergic rhinitis in India [10]. In the index study, the commonest sensitization was to *D.* pteronyssinus (46.93 %) (Table 2).

Significantly more number of children were sensitive to *D. pteronyssinus* as compared to *D. farinae* (65.31 % *vs.* 46.94 %; p=0.034). Children with allergic wheeze were also more sensitized to *D. pteronyssinus* as compared to *D. farinae* (70.83 % *vs.* 45.83 %; p=0.039). No significant difference was detected in the proportion of sensitivity to *D. pteronyssinus vs. D. farinae* in children having allergic rhinitis or eczema (Table 4).

Children at a younger age tend to spend significant time on mattresses or cribs and hence are more exposed to bed dust. Bed dust has a greater concentration of both *Blomia* and *D. pteronyssinus*, while *D. farinae* is more dominant in floor dust [18, 19].

Mono sensitization to *Blomia tropicalis* was observed in 2(4.08 %) out of the total 49 children, 6(12.24 %) children in all exhibited sensitization to *B. tropicalis* (Table 2). There is always the possibility of sensitization being missed if not considered in the allergen panel. RAST and RAST inhibition data indicate that *B. tropicalis* contains unique allergens [20] and hence is an important consideration in immunotherapy.

The results of the index study has certain limitations. The index study has a small number of children and it is difficult to draw significant conclusions to the occurrence of mite sensitization and frequency. Studies with larger number of children with allergic diseases in early age group are needed to further enlighten the frequency of mite sensitization and institute appropriate measures to decrease risk of future asthma in these children.

Conclusions

HDM causes sensitization at an early age in children in Mumbai. *D. pteronyssinus* sensitization appears to be the commonest mite allergen due to its habitat coupled with the life style of young children. Sensitization to *Blomia tropicalis* can be missed if not considered in the allergen panel. Children with allergic rhinitis, allergic wheezing, and eczema with HDM sensitivity can be helped with advice on appropriate avoidance measures.

Contributions Both authors planned, executed, construction of research, analysis and interpretation of data and approved the final version of the manuscript. AD will act as guarantor for this paper.

Compliance with ethical standards

Conflict of Interest None.

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