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House-dust mite sensitivity among rural and urban asthmatics of West Bengal, India: a comparison

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Abstract

House-dust mite allergy is a fairly common problem in West Bengal among individuals sensitive to dust inhalation. House-dust mites belonging to the genus *Dermatophagoides* are abundant in the homes of asthmatic patients residing in urban as well as rural areas of West Bengal. The frequency of positive skin reaction to different dust-related allergens tested was higher ($\chi^2 = 5.4777$, $df = 1$; $P < 0.05$) among patients of urban areas compared with that among the patients of rural areas. Urban patients showed more frequent skin reaction towards cockroach allergen, while rural patients are more sensitive to hay-dust allergen and these are very much related to their local environmental conditions. Analysis of radioallergosorbent test (RAST) results against house dust (HD) and mites reveal that 73 and 90% patients of both urban and rural areas responded positively towards *Dermatophagoides pteronyssinus* (DP) and *Dermatophagoides farinae* (DF) antigens, respectively. The present study indicates no significant difference in house-dust mite sensitivity and mite levels in homes among the rural and urban asthmatics of West Bengal, India as evidenced from the results of analysis of dust samples, allergy skin test and detection of mite-specific IgE antibodies by RAST. © 1997 Published by Elsevier Science Ireland Ltd.

Keywords: Dermatophagoides; House dust; Skin test; Radioallergosorbent test

1. Introduction

The importance of house-dust mites, particularly the genus *Dermatophagoides* in the aetiology of bronchial asthma is now well documented (Voorhorst et al., 1964; Oshima, 1967; Spieksma, 1967; Van Bronswijk and Sinha, 1971; Platts-Mills et al., 1992; Saha, 1994; Saha et al., 1995). People handling materials heavily infested with mites are known to suffer from various types of allergic manifestations including asthma. It could normally be expected that the degree of house-dust allergenicity is proportional to the concentration of mites prevalent in their surroundings and thus the physical appearance of these mites in higher concentration in the patients environment may lead us to search for an allergic aetiology towards these mites. However, it was also established that the population density of house-dust mites is influenced by some physical factors (structure and material of the houses, ground water level of the area), climatic conditions (temperature, humidity, dampness etc.) and the socio-economic status of the individuals (Frankland and El-Hefney, 1971; Nayar et al., 1974; Blythe, 1976; Wharton, 1976; Maurya and Jamil 1980; Modak et al., 1991). The present study was designed to observe the variations, if any, in house-dust mite sensitivity among asthmatic patients residing in two ecologically distinct zones—one being urban and the other rural in the state of West Bengal, India.

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Table 1
Results of analysis of bed dust collected from the homes of urban and rural asthmatic patients of West Bengal

Study area	Total mite count	DP count	DF count	*Dermatophagoides* count (%)
Urban (62)[a]	49488 (798 ± 1232/g)	18817 (304 ± 604/g)	9289 (150 ± 346/g)	28106 (57)
Rural (31)[a]	32225 (1040 ± 1619/g)	12929 (417 ± 698/g)	6770 (218 ± 449/g)	19699 (61)
F value*	0.6245	0.6432	0.6467	
(df = 1.91)	($P \gg 0.05$)	($P \gg 0.05$)	($P \gg 0.05$)	

[a] Number of 1 g dust samples analysed.
* ANOVA test (one-way classified data).

2. Materials and methods

A total of 188 established cases of bronchial asthma patients (116 from urban areas of Calcutta and 72 from adjoining rural areas of West Bengal) aged between 15 and 45 years (mean 29 years) were selected for the present study following the criteria mentioned earlier (Saha, 1993). All the patients had a history of sensitivity to dust inhalation and with either a family and/or a personal history of any atopic diseases. The houses of the selected sample-patients in urban areas were constructed of brick with plastered walls and cemented floors while those in rural areas were mostly mud-houses with high humidity levels. Since vacuum cleaners are not normally used in Indian conditions, bed-dust samples were collected manually from individual patient's beds by dusting and brushing the mattresses, bed linen and pillows on a clean sheet of paper between the month of April and November, at an average temperature of 28 ± 2°C and 78–80% relative humidity. From each sample, 1 g of dust was then processed following the method of Channa Basavanna et al. (1984). The number of mites in each sample was counted, and the mites were temporarily mounted in lactic acid and identified according to the classification of Hughes (1961).

Skin-prick tests against eight common dust-related allergenic extracts (E. Merck Desensol prick-test solution), namely paper dust (5000 PNU/ml), cotton dust (5000 PNU/ml), hay dust (5000 PNU/ml), cockroach (1000 PNU/ml), housefly (2000 PNU/ml), house dust (HD) (5000 PNU/ml) and two different species of house-dust mites (each 1500 PNU/ml) viz., *Dermatophagoides pteronyssinus* (DP) and *Dermatophagoides farinae* (DF) were done on each patient. The test was performed in duplicate on the flexor side of the forearm of each patient following the methods mentioned earlier (Tandon et al., 1988; Saha et al., 1995). Histamine acid phosphate and normal saline were used to serve as positive and negative controls, respectively. All antiallergic and steroid drugs were withdrawn from each patient 72 h prior to the skin testing. The results were interpreted in comparison to reactions obtained against the negative and positive control as suggested by the American College of Allergists (Grater et al., 1982).

Detection of allergen-specific IgE antibodies in patients' sera against HD, DP and DF was carried out by employing radioallergosorbent test (RAST), details of which were reported earlier (Saha, 1993) with the help of Allercoat™ allergen discs supplied by Kallestad Laboratories (TX, USA). To classify the test result, patients' blood sample counts were compared directly with counts of reference sera run parallel and graded as 1, 2, 3, 4 or negative etc.

3. Results

Dust samples from the beds of 62 patients residing in urban Calcutta and 31 from rural West Bengal were collected. The dust mite fauna comprised of 28 species of mites belonging to 16 families. A total of 22 species of mites from 12 families were recorded from bed-dust samples of urban areas with an average mite density of 798 ± 1232/g of dust, of which *Dermatophagoides* alone comprised 57%. Mite species belonging to Cheyletidae, Tydeidae, Tersonemidae, Scutacaridae, Stigmoeidae, Ascaridae, Ameroseiidae, Phytoseiidae, Laelapidae, Acaridae and Glycyphagidae altogether formed the remaining part of the population. The acarological fauna in bed dust of rural areas was composed of 23 species of mites from 13 families (Cheyletidae, Pseudocheyletidae, Tydeidae, Tersonemidae, Tenuipalpidae, Pyemotidae, Erythrasidae, Ascidae, Ameroseiidae, Laelapidae, Acaridae, Glycephagidae and Pyroglyphidae) and the average mite density was 1040 ± 1619/g of dust. The most predominant genus was *Dermatophagoides* constituting 61% of the total acarine population. Statistical analysis showed that there was no significant difference ($P \gg 0.05$) between patients of urban and rural areas with respect to their total as well as *Dermatophagoides* mite count (Table 1).

Of the 188 patients comprising our study group, 116 (61.70%) were the residents of Calcutta metropolis and the remaining 72 (38.29%) of adjoining rural areas. The results of skin tests showed that the frequency of positive skin reaction to different dust-related allergens varied considerably in two groups of patients studied (Table 2). The frequency of positive skin reaction to at least one allergen was higher ($P < 0.05$) in urban pa-

Table 2
Frequency of positive skin-prick reaction to eight dust-related allergens among asthmatic patients residing in rural and urban areas of West Bengal

Allergen	Urban		Rural		χ^2 Value	Remark*
	Number of positive patients (%)	Major reaction (%)	Number of positive patients (%)	Major reaction (%)		
Paper dust	27 (30.68)	2 (7.40)	15 (34.88)	1 (6.66)	0.15276	NS
Cotton dust	35 (39.77)	5 (14.28)	14 (32.55)	4 (28.57)	2.6532	NS
Hay dust	31 (35.22)	6 (19.35)	19 (44.18)	8 (42.10)	0.002557	NS
Cockroach	24 (27.27)	3 (12.50)	9 (20.93)	1 (11.11)	1.0589	NS
House fly	21 (23.36)	4 (19.40)	9 (20.93)	—	1.0401	NS
HD	43 (48.86)	17 (39.53)	20 (46.51)	6 (30.00)	1.7212	NS
DP	39 (44.31)	11 (28.19)	21 (48.83)	8 (38.09)	0.40559	NS
DF	71 (80.68)	46 (64.77)	34 (79.06)	19 (55.88)	2.48005	NS
At least one	88 (75.86)		43 (59.72)		5.4777	$P<0.05$

Number of patients positive to one of the mite allergens: urban, 74(63.79%); rural, 36 (50%).
* Difference in positive reaction between urban and rural patients against individual allergen (2×2 contingent χ^2 test, df = 1 in all cases); NS, not significant.

tients (75.86%) than in patients of rural West Bengal (59.72%). It is interesting to note that the frequency of positive skin reaction to cockroach extract was higher in patients of urban areas, while rural patients showed more frequent skin reaction against hay-dust allergen than their urban counterparts.

Analysis of results of skin tests against HD, DP and DF allergens revealed that the number and percentage of patients with major skin reaction (3^+ and 4^+) against HD and DF allergen were higher in urban patients in comparison with rural ones, while larger numbers of rural patients showed major skin reactions to DP extract.

Out of 105 serum samples on which RAST were performed, 72 (68.57%) samples were collected from patients residing in urban areas and the remaining 33 (31.42%) from patients of rural areas. Statistical analysis (normal deviate test Z) showed that the frequency of positive RAST response against at least one of the three allergens tested did not differ between two groups of patients ($Z = 1.186$; $P \gg 0.05$). Similarly, when each individual allergen was considered, no significant difference was observed in the frequency of positive RAST response between them (Table 3).

4. Discussion

It is now well documented that the mites of the genus *Dermatophagoides* are considered as one of the allergens most responsible for nasobronchial allergic disorders in sensitive individuals. Dixit and Mehta (1973), Lal et al. (1973), Dar and Gupta (1979), Tripathi and Parikh (1983), Tandon et al. (1988, 1990), and Saha (1993) incriminated DF as the main cause of respiratory allergy from different parts of India. In the recent past Saha (1993, 1994) and Saha et al. (1995) opined that among the possible allergens in our surroundings, house-dust mites, particularly the genus *Dermatophagoides* are the most potent allergen in HD responsible for the precipitation of attack of bronchial asthma and they also estimated that more than 80% of the asthmatic patients of Calcutta, India are sensitive to DF mites. In our present observation, results of dust analysis indicate no significant difference ($P \gg 0.05$) between patients of urban and those of rural areas with respect to their total as well as *Dermatophagoides* mite count. However, the total mite density and the *Dermatophagoides* mite density were somewhat higher in dust samples collected from rural areas. This may be due to the poor construction and higher level of humidity, as most of the rural houses are built on heavy soil in areas with a higher ground water level as also pointed out by Voorhorst (1962).

In regard to skin test sensitivity, it is to be noted that the frequency of positive reactions to at least one of the allergens tested was higher ($P < 0.05$) in urban patients than that in patients of rural areas. However, when an individual allergen was considered, no significant difference was observed in the frequency of positive skin reaction between them. The results of specific IgE detection by RAST method also revealed that the frequency of positive RAST response to three allergens of choice does not differ significantly among urban and rural asthmatics.

The present study indicates that apparently there was no significant difference regarding house-dust mite sensitivity among rural and urban asthmatics of West Bengal, India as shown by the analysis of HD sample, allergy skin test and detection of allergen-specific IgE antibodies against HD and mites. Pepys et al. (1968), however, reported that asthma is more prevalent in under-developed urban areas and among industrialised communities, while Turner (1978) observed a higher

Table 3
Frequency of positive RAST response among rural and urban patients against HD, DP and DF allergen

Allergens	Number of RAST positive patients		Normal deviate Z-value	Remarks
	Urban (%) ($n = 72$)	Rural (%) ($n = 33$)		
HD	49 (68)	22 (66)	0.1403	NS
DP	43 (59.72)	21 (63.63)	−0.3812	NS
DF	53 (73.61)	27 (81.81)	−0.9159	NS
At least one of the three	59 (81.94)	30 (90.90)	1.186	NS

Any mite positive: urban, 54 (75%); rural, 29 (87.87%); NS, not significant.

incidence of skin test reactivity towards mite allergen in case of urban children than in children of rural areas. The low occurrence of allergic diseases in rural communities of developing countries, particularly those located in the tropical region, has been ascribed to a variety of factors, particularly the socio-economic status of the subject. Besides, the high susceptibility to heavy helminthic infections among rural people of the developing countries may be attributed to the low prevalence of these diseases in those areas as also suggested by Turner (1978). Perusal of literature shows that the environmental factors are more responsible for the occurrence of mite-induced common allergic diseases than geographic and racial factors as they are directly related to the population dynamics of mites in the patient's environment.

On analysis of skin test results it is interesting to note that the urban patients were proved to be more sensitive to skin reaction against cockroach allergen than their rural counterparts. In our earlier finding (Tandon et al., 1990) we also suggested that patients residing in Calcutta were considered positive for significant cockroach exposure as the majority of them reported cockroach infestation in their homes. In rural homes, cockroach infestation was negligible as reported by the patients of that area. As a matter of fact, urban patients were exposed to conditions in households heavily infested with cockroaches contrary to rural patients with lesser exposure. On the basis of the present observation, it may be stated that cockroach forms a specific allergen, independent from HD and mites and could act as a mild antigenic stimulant. Therefore, its significance should not be underestimated, particularly in urban areas, as also suggested by other workers (Bernton and Brown, 1970; Tandon et al., 1990; de Blay et al., 1997). On the contrary, patients residing in rural areas showed higher degree of skin reactions to hay dust and the majority of them had a history of having stacks of hay and straw in and around their residences, which probably explains the higher degree of sensitivity of rural patients to such agents.

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