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HOUSE DUST MITES IN RELATION TO DIFFERENT HABITAT CONDITIONS OF KOLKATA METROPOLIS, INDIA

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ABSTRACTS: House dust mites play an important role in the pathogenesis of allergic diseases. Both the common species of the genus *Dermatophagoides* viz. *Dermatophagoides pteronyssinus* and *D. farinae* and other two allergenic species *Blomia tropicalis* and *Austroglycyphagus geniculatus* are found to be abundant in the dust samples collected from beds of patients suffering from nasobronchial allergic disorders residing at Kolkata metropolitan areas. The presence of these four mites in large quantity in the patients environment are clinically correlated with the aetiopathology of various allergic manifestations like allergic rhinitis, bronchial asthma etc. House dust mites usually occupy different niches in the homes of asthmatics and are significantly higher in beds than else where in the house. However, the distribution and abundance of these mites are influenced by several microclimatic conditions. The aim and objective of the present study is to assess the impact of different microclimatic conditions like type of houses, type of mattresses and bed and floors of the room on the distribution and abundance of house dust mite population. In view to provide the patients with best possible diagnosis and treatment, proper identification of offending allergens and their subsequent reduction from the patient's environment is of outmost importance which in turn may be helpful for the prophylactic management of these dreadful diseases in Kolkata metropolis.

KEY WORDS: Dust allergy, India, *Dermatophagoides, Blomia, Austroglycyphagus*, microclimatic conditions

INTRODUCTION

There has been a spurt in the prevalence and incidence of nasobronchial atopic diseases both in developed and developing countries and there are many factors that appear to contribute to this trend. Considerable variation within and between different habitat has been attributed to factors such as home standards, type of mattresses, beds and floors of the room (Koosgaard 1998). It is now well documented that house dust mites such as *Dermatophagoides pteronyssinus* (DP)*, D. farinae* (DF)*, Blomia tropicalis* (BT) and *Austroglycyphagus geniculatus* (AT) are the major source of allergens in house dust responsible for the precipitation of allergic manifestations among sensitive individuals (Voorhorst et al. 1964; Saha 1993, 1994; Fernandez-Caldas et al. 2004; Podder et al. 2006). A comprehensive study to ascertain the role of house dust mites on bronchial asthma in and around Kolkata metropolis has been carried out by the present authors (Podder et al. 2006). The study reveals that more than 84% of asthmatic patients of Kolkata are sensitive to *Dermatophagoides* and *Blomia* mites as evidenced from the data of dust analysis and allergy skin test. House dust mites have a world wide distribution and may exist in different niches of homes and their distribution and rate of abundance varies greatly in response to various microclimatic conditions. According to Saha (1994), the degree of house dust allergenecity is closely related to the density of mite populations. Thus, it is reasonable to think that the physical appearance of these mites in higher concentrations in the patient's environment may lead us to search for an allergic aetiology towards these species of mites. The aim of the present study was to assess the influence of different microclimatic conditions like a type of houses, type of mattresses and beds and floors on the distribution and abundance of house dust mites.

MATERIALS AND METHODS

Dust samples were collected by means of a vacuum cleaner (Model No. SA-300DX) from the beds and bedroom floors of asthmatic patients residing in Kolkata metropolis. The dust samples were processed following the methods of ChannaBasavanna et al. (1984) as mentioned elsewhere (Podder et al. 2008). Individual dust samples were thoroughly mixed and sieved in a mechanical sieve shaker, using a series of sieves with different mesh size placed one above the other. Dust collected on sieve with mesh size 75µ and 45µ were considered for further processing through flotation technique, using kerosene oil and carbon tetra choloride in different concentrations. One gram sieved dust was taken in a centrifuge tube, mixed with pure kerosene oil, stirred constantly for 10 minutes and centrifuged at 2000 rpm for two minutes and the supernatants was filtered using Whatman No.1 filter paper. The sediment left in the centrifuge tube was then mixed with a mixture of kerosene oil and carbon tetra choloride having specific gravity 1.3 and after centrifugation at the same speed and time, decanted on the same filter

Table 1.
Details of study design

Type of study	Categories of sampling	No of cases surveyed
1. Different niche of house	Bed dust	20
	Floor dust	20
2. Type of construction of houses	Mud house	10
	Concrete house	10
3. Type of Mattresses used	Cotton mattress	10
	Foam mattress	10

Table 2.
Density (Mean ± S.E.) of total mites and four allergenic mites (DP, DF, AT and BT) in the bed and floor dust

Habitats	TMC	DP	DF	AT	BT
BD	146 ± 68.31	69.63 ± 34.42	19.21 ± 7.1	17.63 ± 3.56	38.54 ± 15.79
FD	102.49 ±51.87	43.24 ± 20.53	8.91 ± 5.67	12 ± 6.28	29.16 ± 18.51
df	3	3	3	3	3
t-value	4.494	3.879	2.319	2.987	5.63
Remark	$p < 0.05$	$p < 0.05$	$p > 0.05$	$p < 0.05$	$p < 0.05$

BD — Bed dust and FD — Floor dust

paper. The same procedure was repeated twice with a mixture of kerosene oil and carbon tetra choloride having specific gravities 1.4 and 1.5 respectively. The supernatants were filtered and the residue collected on the filter paper was washed with a fine jet of 70% alcohol in a watch glass. The specimens were then counted and identified following the classification of Hughes (1976) and Colloff and Spieksma (1992).

Paired t-test was done to assess the effects of different types of habitats on the abundance of mite species. In all cases mite density is shown as average number of mites per gram of dust. All statistical analyses were carried out following Zar (1999) and SPSS ver. 10 software (Kinnear and Gray 2000). To fulfill the objective of the present study the samples were categorized in different ways as follows (Table 1).

RESULTS

Effect of microhabitat on the mite densities

For this study the dust samples were collected from the bed as well from the corresponding bedroom floor. It was observed that the average number of total mites (TMC) as well as DP, DF, AT and BT (146 ± 68.31, 69.63 ± 34.42, 19.21 ± 7.1, 17.63 ± 3.56 and 38.54 ± 15.79/ gm dust, respectively) were higher than in the corresponding bedroom floor dust (102.9 ± 51.87, 43.24 ± 20.53, 8.91 ± 5.67, 12 ± 6.28 and 29.16 ± 18.51, respectively). The statistical analysis revealed that the differences in the density of total mites as well as the densities of the most species (*Dermatophagoides pteronyssinus*, *Austroglycyphagus geniculatus* and *Blomia tropicalis*) in these two habitats were statistically significant ($p<0.05$), however, the difference in the density of *D. farinae* in two habitats was not statistically significant (Table 2).

Effect of construction of houses on the mite density

During the course of study, a comparison of the total mite (TMC) as well as that of four allergenic mites, namely *Dermatophagoides pteronyssinus* (DP), *D. farinae* (DF), *Austroglycyphagus geniculatus* (AT) and *Blomia tropicalis* (BT) in the mud and concrete house has been made. Results revealed that the average number of TMC as well as DP, DF, AT and BT are markedly higher (126.35 ± 57.92, 55.10 ± 28.36, 14.12 ± 4.63, 13.54 ± 7.01 and 16.92, respectively in concrete house and 214.04 ± 89.09. 94.49 ± 49.08, 26.03 ± 9, 22.29 ± 11.28 and 60.40 ± 26.41, respectively in mud houses) in mud house than the concrete house (Table 3). Statistical analysis (Paired t-test) showed that the average mite densities in the mud houses were significantly higher than the concrete houses (Table 3).

Effect of type of mattress on the mite density

For conducting this study, ten houses were selected, where both the foam and cotton mattresses

Table 3.
Density (Mean ± S.E.) of total mites and four allergenic mites (DP, DF, AT and BT) in the concrete and mud houses

Habitat	TMC	DP	DF	AT	BT
CH	126.35 ± 57.92	55.10 ± 28.36	14.12 ± 4.63	13.54 ± 7.01	35.75 ± 16.92
MH	214.04 ± 89.09	94.49 ± 49.08	26.03 ± 9	22.29 ± 11.28	60.40 ± 26.41
df	3	3	3	3	3
t-value	5.577	3.792	5.119	2.731	4.485
Remark	$p < 0.005$	$p < 0.005$	$p < 0.005$	$p < 0.05$	$p < 0.005$

CH — Concrete house, MH — Mud house

Table 4.
Densities (Mean ± S.E.) of total mites (TMC) and four allergenic mites (DP, DF, AT and BT) in the foam and cotton mattresses

Mattresses	TMC	DP	DF	AT	BT
Foam	232.5 ± 17.7	108.6 ±10.08	21.3 ± 5.21	21.2 ± 3.34	63.88 ± 10.55
Cotton	54.88 ± 3.98	24.55 ±2.64	7.88 ± 1.11	7.44 ± 0.60	11.22 ± 1.22
df	9	9	9	9	9
t-value	14.170	11.33	3.445	5.031	5.025
Remark	$p < 0.0005$	$p < 0.0005$	$p < 0.005$	$p < 0.0005$	$p < 0.0005$

in the same homes were occupied by the patients. Bed dust samples were collected separately from both the foam and cotton mattresses of each of those houses. Results revealed that the average number of total mites as well as the density of four other allergenic mites, *D. pteronyssinus*, *D. farinae*, *A. geniculatus* and *B. tropicalis* were markedly higher in the foam mattresses in comparison to that in the cotton mattresses (232.5 ± 17.7, 108.6 ± 10.08, 21.3 ± 5.21, 21.2 ± 3.34 and 63.88 ± 10.55, respectively in foam mattresses and the values in cotton mattresses were 54.88 ± 3.98, 24.55 ± 2.64, 7.88 ± 1.11, 7.44 ± 0.60 and 11.22 ± 1.22, respectively). Statistical analysis (paired t-test) of the data revealed that the difference was highly significant in all cases (Table 4).

DISCUSSION

Although mites can exist in different niches in a particular house, their density depends on some basic ecological requirements, both physical and biological. The physical factors like light, temperature, relative humidity, mechanical disturbances and biological factors like predation or parasitism, inter- and intraspecific competition along with sufficient and right type of food are the prime requisite for the successful growth and multiplication of mite population. According to Bronswijk (1981), *Dermatophagoides pteronyssinus*, and *D. farinae* occupied the same niche, although *D. farinae* tended to crawl on top of the substrate while *Dermatophagoides pteronyssinus* remains beneath it. As a matter of fact, it is very difficult to generalize about where house dust mites are most abundant within houses since the population size may be influenced by a number of factors including variations in the microclimatic conditions like a bed and bedroom floor, foam and cotton mattresses, mud and concrete houses. To give an insight about the abundance of mite density in different microclimatic conditions, the study of the population structure of mites in the above mentioned habitat were analyzed

The present study reveals that the significantly higher densities of mites except *D. farinae* are present in bed dust samples in contrast to the number present in corresponding bed-room floor dust samples. This observation confirms the earlier observations of Sesay and Dobson (1972) and Tripathi and Parikh (1983), who also observed a significant difference in mite densities between the bed and corresponding bedroom floor dust. However, Ho and Nadchatram (1984) did not observe any difference in the mite densities in different niches. Isolation of higher mite population from the bed dust sample than the corresponding bedroom floor dust sample may be attributed to the presence of ideal living conditions with regards to temperature, required humidity and availability of preferred foods (human skin scales) in the beds which are essential for the growth and multiplications of mite fauna (Spieksma 1967, 1968, Whar-

ton 1976; Lucyzynska 1998). Secondly, the beds provide an undisturbed habitat in comparison to the corresponding bed room floors which are frequently cleaned and mopped (Blythe 1976; Wharton 1976; Mulla and Medino 1980; Chew et al. 1999). Similarly, the comparison of mite densities in mud and concrete house dust samples reveals that the mite densities are higher in the mud houses than in the concrete houses. This study also agrees with the earlier findings of Mumcuoglu et al. (1999) and Macan et al. (2003), who also observed that a correlation exists between the mite numbers and climatic condition in the settlement. According to them the number of mites is higher in the damp environment than dry one. The mud house contains higher mite density than concrete house which may be due to the availability of proper microclimate like relative humidity and temperature for the multiplication of mite species in the former one than the later one (Bronswijk 1973). Beside, the use of the vacuum cleaner for dusting the floor is almost absent in the mud houses. On the other hand, it is frequently used by the inhabitants of the concrete houses. This ensures a stable food supply in the former condition. It has been estimated that a person produces 0.5–1 gm of dead skin/day whilst several thousand of mites are able to survive for months on just 0.25 gm of food (Korsgaard 1998). It would therefore, appear that the house dust mites population size will be primarily influenced by the physical factors like temperature and humidity which are known to affect both the reproduction and development rate of these mites (Arlian et al. 1998).

The variation in the mite density between two types of mattresses has been observed during the course of the present study. Result shows that the foam mattresses harbors a higher number of total mites than the traditional cotton mattresses and the difference is statistically significant ($p<0.0005$). The higher density of mites in the foam mattresses may be due to seldom cleaning of foam mattresses and the availability of proper microclimatic conditions for the rapid multiplication of mites. The present finding agrees well with the earlier work of Abott et al. (1981) and Ho and Nadchatram (1984) who also reported that the foam mattresses contained significantly higher mite population than that in the cotton mattresses.

Saha (1994) was of the opinion that the degree of house dust allergenecity is closely related to the density of mite populations prevalent in patient's environment. Thus the physical appearance of these mites in a higher concentration in the patients' environment may prompt us to search for an allergic aetiology towards these species of mites. Since, house dust mites are responsible for the precipitation of attack of bronchial asthma and other nasobronchial allergic disorders, the reduction of the load of mites from the patients' environment by adopting some bioecological measures might be helpful for the prophylactic management of these diseases.

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