



Effect of certain socio-ecological factors on the population density of house dust mites in mattress-dust of asthmatic patients of Calcutta, India

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Abstract

Allergy to house dust mites, particularly to the genus *Dermatophagoides* is a fairly common problem in Calcutta and its adjoining areas since last two decades. Both the common species of the genus *Dermatophagoides* i.e. *D. farinae* and *D. pteronyssinus* are found to be abundant in the dust samples collected from beds of patients suffering from nasobronchial allergic disorders. The presence of these mites in quite a good number in the patients' beds are clinically correlated with the aetiopathology of various allergic manifestations like bronchial asthma. *Dermatophagoides* mites may occupy different niches in the homes of asthmatics and are more common in beds than elsewhere in the house, however, the distribution and abundance of these mites are influenced by some socio-ecological factors. The aim and objective of the present study is to assess the impact of some common socio-ecological management practices like the age of house, age of mattress, type of mattress, frequency of cleaning of the mattress and even the economic status of the patients on the growth, multiplication and finally accumulation of these mites in the patients' surroundings. Proper identification of offending allergens and subsequent reduction of load of these mite allergens from the patient's environment may be helpful for the prophylactic management of these diseases in Calcutta metropolis.

1. Introduction

There has been a spurt in the prevalence and incidence of naso-bronchial allergic disorders in India (Viswanathan, 1972) and the situation being worst in the city of Calcutta since last two decades (Tandon et al., 1988). It is now well documented that the house dust mites particularly the genus *Dermatophagoides* belonging to the family *Dermatophagoidesae* have been incriminated as the most potent allergen in house dust responsible for the precipitation of allergic manifestations among sensitive individuals (Voorhorst et al., 1964; Tripathi and Parikh, 1983; Saha, 1993, 1994). A systematic and comprehensive study to assess the role of house dust mites on bronchial asthma in and around Calcutta metropolis has been carried out by the present authors (Saha et al., 1995a, 1995b; Saha, 1997) during the last

15 years. The study reveals that more than 80% of the asthmatic patients of Calcutta are sensitive to *Dermatophagoides* mites, both *D. pteronyssinus* and *D. farinae* as evidenced from the data of dust analysis, allergy skin test, quantification of total serum IgE level and detection of mite specific IgE antibodies by RAST method. It is also evidenced that mites may exist in different niches in homes and their distribution and rate of abundance are mainly influenced by various socio-ecological factors. Moreover, Saha (1994) further opined that the degree of house dust allergenicity is closely related to the density of mite populations prevalent in patients environment and thus it is reasonable to think that the physical appearance of these mites in higher concentration in the patients environment may remind us to search for an allergic aetiology towards these species of mites. The present study has been designed to assess the influence of

some important socio-ecological factors like the age of houses, the age of mattress used by the patients, type of mattress used, frequency of cleaning of the mattress and the effect of economic status of the patient on the distribution and abundance of house dust mites in homes of asthmatic patients residing in Calcutta metropolis.

2. Materials and methods

Dust samples were collected from the beds of asthmatic patients residing in Calcutta metropolis. All the patients are clinically diagnosed as suffering from bronchial asthma following standard methods mentioned earlier (Saha, 1993). The dust samples were processed following the method of Channa Basavanna et al. (1984). Individual dust sample was thoroughly mixed and sieved in a mechanical sieve-shaker, using a series of sieves with different mesh sizes placed one above the other. Dust collected on sieve with mesh size 75 μ and 45 μ were taken for further processing through flotation technique, using kerosene oil and carbon tetra chloride 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 1000 rpm for two minutes and the supernatants was filtered using filter paper. The sediment left in the centrifuge tube was then mixed with a mixture of kerosene oil and carbon tetra chloride (specific gravity 1.3) and after centrifugation at the same speed and time, decanted on the same filter paper. The same procedure was repeated twice with a mixture of kerosene oil and carbon tetra chloride 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 identified following the classification of Hughes et al. (1976) and Colloff and Spieksma (1992). To fulfill the objective of the present study the samples were categorised in different ways as follows.

3. Results

Effect of age of house on mite densities

To study of the effect of age of house on mite densities, the houses examined were categorised into four

Type of study	Categories of sampling
I. Age of House	Gr. A: 01–10 yrs. old Gr. B: 11–25 yrs. Gr. C: 26–50 yrs. Gr. D: 51 yrs. and above
II. Age of Mattress	Gr. A: Up to 2 yrs. old Gr. B: 2–5 yrs. Gr. C: 6–10 yrs. Gr. D: 11 yrs. and above
III. Type of Mattress	Gr. A: Cotton mattress Gr. B.: Foam mattress
IV. Frequency of Cleaning	Gr. A: Not cleaned even once/month Gr. B: Cleaned once/month Gr. C: Cleaned twice/month Gr. D: Cleaned thrice or more/month
V. Economic Status of Patients	Gr. A: Low income group Gr. B: Middle income group Gr. C: Higher income group

groups: 1–10 yrs. old as Gr. A, 11–25 yrs. as Gr. B, 26–50 yrs. as Gr. C and 51 yrs and above as Gr. D. It was observed that dust samples obtained from Gr. A houses contained the least number of mites per gm of dust in respect to both total mites and *Dermatophagoides* as compared to other groups. The data were subjected to 't' test and the probability values were calculated. It is interesting to note that there is no significant correlation between the population density of mites and the age of houses as shown in Table 1.

Effect of age of mattress on mite densities

Observations in this respect were made by categorising the cotton mattresses into four groups according to their ages as follows. Gr. A (up to 2 yrs. old), Gr. B (2–5 yrs.), Gr. C (6–10 yrs.) and Gr. D (above 10 yrs.). It was observed that density of total as well as *Dermatophagoides* populations were least in case of new mattress (Gr. A) and maximum in older ones (Gr. D) as shown in Table 2. It seems that the mite density is directly proportional to the age of mattresses, although the differences among various groups were not statistically significant.

Effect of type of mattress on mite densities

During the course of present study, a comparison of total mites and *Dermatophagoides* densities among two different types of mattresses namely cotton and foam mattresses used by the patients were made. The

Table 1. Variation in mite densities in asthmatic patients' houses belonging to different age groups.

Type of house	No. surveyed	Total mites/g	<i>Dermatophagoides</i> /g
Gr. A	10	546	358
Gr. B	10	1728	1263
Gr. C	10	1350	803
Gr. D	14	1488	1186

Statistical analysis			
Comparing groups	't' value for total mites	't' value for <i>Dermatophagoides</i>	Remark
A: B	1.3158	1.0828	p > 0.05
B: C	0.3745	0.5992	p > 0.05
B: D	0.2485	0.0903	p > 0.05
A: D	1.1544	1.1932	p > 0.05

Gr. A = 1–10 yrs. old; Gr. B = 11–25 yrs. old; Gr. C = 26–50 yrs. old and Gr. D = 50 yrs. and above.

Table 2. Differences in mite densities (both total and *Dermatophagoides*) in cotton mattresses belonging to different ages.

Type of house	No. surveyed	Total mites/g	<i>Dermatophagoides</i> /g
Gr. A	10	470	391
Gr. B	10	484	343
Gr. C	12	1137	838
Gr. D	14	1628	1189

Statistical analysis			
Comparing groups	't' value for total mites	't' value for <i>Dermatophagoides</i>	Remark
B: C	1.2858	1.0769	P > 0.05
B: D	1.3779	1.2332	p > 0.05
A: D	1.3589	1.2698	p > 0.05
C: D	0.5878	0.5119	p > 0.05
A: C	1.2558	1.1380	p > 0.05

Gr. A = Up to 2 yrs.; Gr. B = 2–5 yrs.; Gr. C = 6–10 yrs. and Gr. D = 10 yrs and above.

study showed that the average number of total mites as well as *Dermatophagoides* were markedly higher in foam mattress in comparison to cotton mattress (Table 3). Statistical analysis showed that the differences were highly significant both for total mites (p < 0.01) and *Dermatophagoides* (p < 0.02).

Effect of frequency of cleaning the mattresses on mite densities

For this study the bed dust samples were collected from different categories of mattresses based on the frequency of their cleaning as follows. Gr. A – not cleaned even once per month; Gr. B – cleaned once

Table 3. Differences in mite density (both total and *Dermatophagoides*) between cotton and foam mattresses used by patients.

Type of mattress	No. surveyed	Total mites/g	<i>Dermatophagoides</i> /g
Gr. A (cotton)	18	654	498
Gr. B (foam)	16	2219	1616

't' value	–	2.8807	2.4822
Remark	–	p < 0.01	p < 0.02

Table 4. Effect of frequency of cleaning on mite densities in bed dust samples collected from patients' houses.

Type	No. surveyed	Total mites/g	<i>Dermatophagoides</i> /g
Gr. A	8	1080	887
Gr. B	18	1863	1402
Gr. C	16	206	110
Gr. D	8	58	41

Statistical analysis			
Comparing groups	't' value for total mites	't' value for <i>Dermatophagoides</i>	Remark
A: C	3.0312 (p < 0.01)	3.7521 (p < 0.01)	Significant
B: C	3.0593 (p < 0.01)	2.9045 (p < 0.01)	Significant
A: B	0.9741 (p > 0.05)	0.7775 (p > 0.05)	Not significant

per month; Gr. C – cleaned twice per month and Gr. D – cleaned thrice or more per month.

The study revealed that the frequency of cleaning has a significant role in reducing the mite population i.e. the more the frequency of cleaning the lesser were the mite densities (Figure 1). It is worth mentioning that the difference in mite densities (both total and *Dermatophagoides*) between Gr. A and C and Gr. B and C were statistically significant (Table 4).

Effect of economic status of patients on mite densities

For this observation dust samples were collected from 50 patients belonging to different economic groups. The study showed that the total mites and *Dermatophagoides* densities were higher in dust samples collected from homes of patients representing middle income group (Gr. B) in comparison to those present in other two categories. The difference, however, was not statistically significant (Table 5).

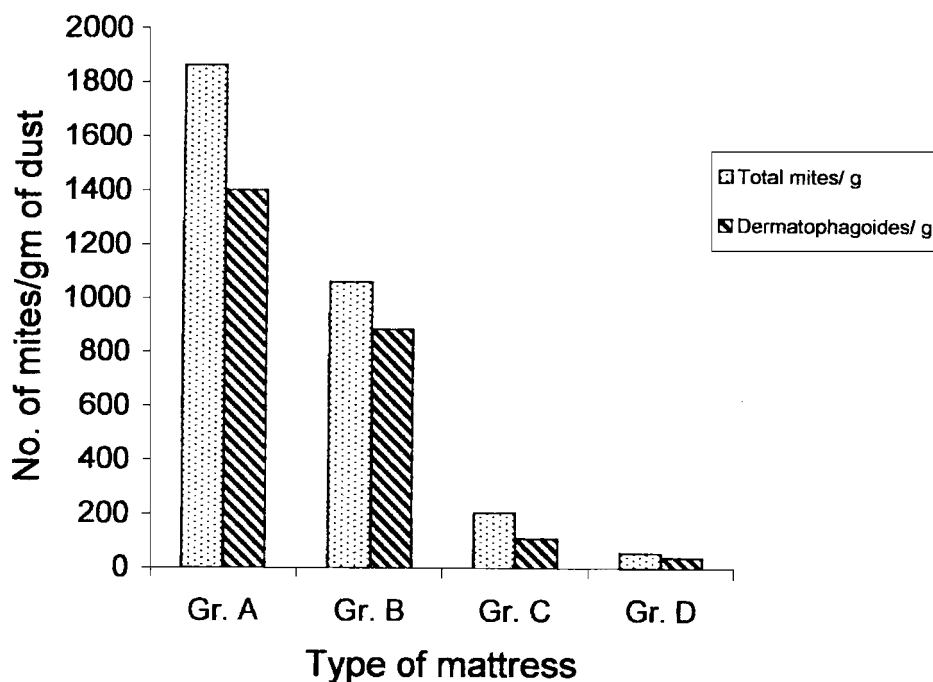


Figure 1. Showing the effect of frequency of cleaning of mattresses on the population density of house dust mite fauna collected from bed dust samples of asthmatic patients.

Table 5. Effect of economic status of patients on density of total mites and *Dermatophagoides* mites in bed dust samples collected from patients' houses.

Study groups	No. surveyed	Total mites/g	<i>Dermatophagoides</i> /g
Gr. A	20	690	521
Gr. B	16	1436	1011
Gr. C	14	1045	798

Statistical analysis			
Comparing groups	't' value for total mites	't' value for <i>Dermatophagoides</i>	Remark
A: B	1.05	0.85	p > 0.05
A: C	0.57	0.57	p > 0.05
B: C	0.62	0.47	p > 0.05

Gr. A = Low Income Group, Gr. B = Middle Income Group, Gr. C = Higher Income Group.

4. Discussion

Population of mites can exist in different niches in a particular house. However, their abundance 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 para-

sitism, inter and intra-specific competition along with sufficient and right type of food are the prime requisite for the successful growth and multiplication of mite population.

The trend of the present study shows that apparently the older houses favour the multiplication of mite population than the newly built houses. However, the differences were not statistically significant. Earlier workers from different parts of the globe (Maunsell et al., 1970; Dixit and Mehta, 1973; Mulla and Medina, 1980; Korsgaard, 1983 and Otani et al., 1984) observed higher mite infestation in older houses as compared to newly built ones. Murton and Madden (1977) was of the opinion that the higher concentration of the mites in older houses is probably due to the presence of ideal microclimatic condition and greater chances of accumulation of more food materials. In contrast Domrow (1970) and Lang and Mulla (1977) found no significant difference in mite density between modern, dry well built houses and old damp houses. On analysis of their data several earlier workers (Sesay and Dobson, 1972; Blythe et al., 1974; Mulla et al., 1975; Ho and Nadchatram, 1984; Tandon et al., 1988) suggested that certain other factors such as age and type of mattress and method and frequency of cleaning have a direct bearing on the mite popula-

tion. In the present study when the data were subjected to statistical analysis it can be safely concluded that the age of house appears to have any significant influence on the mite population as also suggested by Arlian et al. (1983), however, there is a tendency of higher mite accumulation in older houses.

A comparison of mite population among new and old cotton mattresses revealed that older mattresses (more than 10 years old) have higher mite concentration both in respect to total mites and *Dermatophagoides*. The present findings are in corroboration with the earlier observations of Sesay and Dobson (1972), Blythe et al. (1974) and Lang and Mulla (1977). Mulla and Madina (1980). Ho and Nadchatram (1984) also observed higher mite densities in older mattresses in comparison to new ones, however, the difference was not statistically significant in their study. In contrast, Arlian et al. (1983) reported lack of correlation between mite densities and age of mattresses.

To assess the effect of type of mattresses (cotton or foam) on population density of mites, appropriate data were subjected to statistical analysis. The result shows that foam mattresses harbours significantly greater ($p < 0.01$) number of total mites and *Dermatophagoides* ($p < 0.02$) per gram of dust than the cotton mattresses. This might be attributed to seldom cleaning and washing of foam mattresses which results in higher dust accumulation and providing ideal niches for the rapid growth and the multiplication of mites. The present study confirms the earlier observations of Ho and Nadchatram (1984).

It can be presumed that the frequency of cleaning must have some direct bearings on the accumulation or reduction of mite populations in a particular habitat. In the present study also the frequency of cleaning of mattress was observed to have a significant effect on total number of mites per gram of dust and *Dermatophagoides*. It is interesting to note that frequent cleaning reduces mite population as expected. However, on the basis of their observation Ho and Nadchatram (1984) was of the opinion that washing the house should affect the population of mites present on the room floors only more than those in other niches and they claimed that there was similar mite abundance in mattresses cleaned at different frequencies.

Comparison of mite densities in houses of low, middle and higher income group individuals revealed that total mites and *Dermatophagoides* collected from middle income group houses were highest as compared to others. In general, foam mattresses are being widely used by both middle and higher

income group individuals although the mite abundance is much greater among the formers. This may be attributed to the large-scale use of vacuum cleaners by the higher income group people and their overall consciousness about general health and hygiene included in the present study. Bronswijk (1972) also noted higher mite infestations in the house dust samples collected from middle class dwellings. However, Sesay and Dobson (1972) from Scotland and Frankland and El-Hefny (1971) from Egypt recorded that ill-kept homes of poor people were more heavily infested with mites than well-kept ones.

Saha (1994) was of the opinion that the degree of house dust allergenicity is closely related to the density of mite populations prevalent in patients' environment. 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 species of mites. Since, house dust mites particularly the genus *Dermatophagoides* are responsible for the precipitation of attack of bronchial asthma and other nasobronchial allergic disorders, the reduction of load of mites from the patient's environment by adopting some basic bioecological measures might be helpful for the prophylactic management and proper monitoring of these diseases.

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