

The importance of mites in house dust sensitivity in Barbadian asthmatics

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Summary

House dust sensitivity is a common precipitating cause of naso-respiratory allergy in Barbados. A high degree of correlation between skin tests to house dust and to mite extracts was found. The pyroglyphid species *Dermatophagoides pteronyssinus* occurred in high densities in samples of mattress and bedroom dust. Twenty-two other species of mites were identified in the dust samples and in certain cases some of these species were more abundant than *D. pter.* Skin tests were positive in a high proportion of dust sensitive asthmatics tested with extracts prepared from five species of mite in addition to *D. pter.* and *D. farinae*. There appears to be a relationship between the density of *D. pter.* in mattress dust and allergy to house dust.

Introduction

A study of asthma in Barbados (Pearson, 1973) has shown that house dust is the commonest recognized allergen responsible for the precipitation of naso-respiratory symptoms. Of 143 patients investigated, 50% gave a clinical history of attacks caused by contact with house dust confirmed by positive skin tests to house dust extracts. A total of 64% gave positive skin reactions to dust independently of the clinical history.

It is now generally accepted that allergy to house dust is caused mainly by mites, chiefly *Dermatophagoides* spp., which occur, often in abundance, on the surface of mattresses or in the dust present in the living-rooms and bedrooms (Voorhorst *et al.*, 1964, 1967; Maunsell, Wraith & Cunnington, 1968; Morrow Brown & Filer, 1968; Spieksma & Voorhorst, 1969). *D. pteronyssinus*, a saprophyte living on desquamated human skin scales, is regarded, at least in Europe, as the most important of these species. McAllen, Assem & Maunsell (1970) have shown that a high proportion of patients with positive skin reactions to *D. pter.* developed symptoms of naso-respiratory allergy in response to provocation tests.

Method

Skin tests were carried out by the modified prick test method with two proprietary

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house dust preparations and with 1% extracts of *D. pter.*, *D. farinae* and *Glyciphagus domesticus*. Weaker extracts of *Suidasia medanensis* (0.1%), *Chortoglyphus* sp. (0.01%), *Glyciphagus* sp. (0.01%) and *Cheyletus* sp. (0.01%) were used for testing a smaller number of patients by the intradermal route. The mite extracts were kindly prepared by the late Dr Kate Maunsell. Extracts of *D. pter.* were prepared by the method described by McAllen *et al.* (1970), and of other mites as described by Maunsell *et al.* (1968). Proprietary extracts of *D. pter.* and *D. farinae* (1%) were also used. Reactions giving a weal of 2 mm or more were considered to be positive.

Patients were supplied with small plastic containers and asked to collect dust samples from two sources, (i) from the surface of their mattresses by gently brushing dust from the latter directly into the container and (ii) from the bedroom floor by normal collection with a dust-pan and brush. Twenty-three samples of mattress dust and twenty-five samples of bedroom dust were collected in this way; two patients, having said they were unable to collect mattress dust, brought samples only of bedroom dust. Examination of samples under a dissecting microscope showed that the dust contained, in addition to human skin scales, large quantities of sand and coral dust, fibres of animal, vegetable and synthetic origin, insect remains and termite pellets and that mites were often present in large numbers.

The samples were sent by air, or in some cases by messenger, to one of us (A.M.C.) in England, who made a detailed examination and identified and counted the various species of mites. The estimated mite density per gram of dust was calculated from the number/weight ratio determined for each sample present, using the technique of Maunsell *et al.* (1968).

Statistical analysis was carried out using a chi-squared test for Table 1. Other tables were dealt with according to the methods outlined in 'Tables for use with binomial samples etc.' (Mainland, Herrera & Sutcliffe, 1956).

Clinical

Table 1 shows the relationship between the clinical history of dust sensitivity and skin sensitivity to house dust extract. The evidence shows clearly that of those patients with a history of sensitivity to house dust and who claimed that naso-respiratory symptoms developed while making beds or during the sweeping of a room—electric vacuum cleaners are uncommon in Barbadian houses—the proportion who gave positive skin reactions to house dust extract was much greater than in those who gave no such history. The difference is statistically significant at the 1% level.

In Table 2 it is apparent that a very high percentage of patients giving positive reactions to house dust extract also react to extracts of *D. pter.* and *D. farinae*, whereas only a small number of those with negative reactions to house dust do so.

Table 1. Relationship between the clinical history of dust allergy and skin sensitivity

	No. of patients	Positive skin reactions to house dust extract	Per cent
History of sensitivity to house dust	91	71	79
No history of sensitivity to house dust	52	21	42

Difference significant at 1% level ($P < 0.01$).

A control group of fifty-two patients between the ages of 14 and 60 years attending the Medical Outpatients Department of the Queen Elizabeth Hospital for non-allergic conditions also gave few reactions. Two patients in the control group who reacted to house dust and both mite extracts, stated that bed-making and dusting caused sneezing and nose running. Here again, the differences in skin sensitivity to *D. pter.* and *D. farinae* between patients who reacted positively to house dust extracts (Group i), and those who reacted negatively (Group ii), or were in the control group (Group iii), are statistically significant at the 1% level.

Table 2. Relationship between skin reactions to house dust extracts and extracts of *D. pteronyssinus* and *D. farinae*

	No. of patients	Positive skin reactions to:	
		<i>D. pter.</i>	<i>D. farinae</i>
Group i (patients with positive reactions to dust extract)	92	74 (80%)	85 (92%)
Group ii (patients with negative reactions to dust extract)	51	5 (10%)	8 (16%)
Group iii (control patients attending for treatment of non-allergic conditions)	52	3 (6%)	5 (10%)

Differences significant at 1% level ($P < 0.01$).

Table 3 shows the different species of mites identified in twenty-three samples of mattress dust and twenty-five samples of bedroom dust; the estimated mean density and the range of the densities are also shown. It will be seen that twenty-three species of mite were identified, and that *D. pter.* occurred as the major species in both mattress and bedroom dust, often reaching very high density levels in the former. In one sample of mattress dust *Blomia species* (1) predominated; *Cheyletus* spp. were also present in moderate numbers in a high proportion of cases.

In bedroom dust the estimated mite density was considerably less although the total quantity of dust was far greater. As in mattress dust *D. pter.*, *Blomia* sp. and *Cheyletus* spp. were usually present. *Suidasia medianensis* was seen in six samples and at times reached high levels. In six samples *Blomia* sp. out-numbered *D. pter.* and in two of these the density exceeded 1000 mites per gram. *Tyrophagus putus centiae* predominated in one sample. It is of interest that *D. farinae* was found only in two samples and then in small quantities, contrasting with the findings of Frankland & El-Hefny (1971) in Egypt. Table 4 shows the frequency of occurrence and relative abundance of the varieties of mites encountered.

As will be seen in Table 5, a high proportion of reactions were also obtained in dust sensitive patients tested to extracts of *Suidasia*, *Cheyletus* sp., *Chortoglyphus* and *Glyciphagus* sp. Those with negative reactions to dust gave few or no reactions to these mite extracts, but the numbers are too few to be statistically assessed.

Table 6 shows the relationship between the estimated density of *D. pter.* in mattress dust and skin reactions to house dust extracts and extracts of *D. pter.* Although the numbers are small there is a trend in favour of allergy to both extracts in patients with a high density of mites on their mattresses.

Table 3. The mite fauna of Barbadian house dust

Species	Mattress dust (23 samples)			Bedroom dust (25 samples)		
	No. of times present	Estimated mean density (mites) per g	Range	No. of times present	Estimated mean density (mites) per g	Range
Pyroglyphidae						
<i>D. pteronyssinus</i>	23	2943	83-12723	25	255	23-1745
<i>D. farinae</i>	1	19	—	1	4	—
Acaridae						
<i>Acarus siro</i>	1	529	—	0	—	—
<i>Tyrophagus putrescentiae</i>	1	111	—	2	137	2-183
<i>Suidasia medianensis</i>	5	12	1-122	6	110	2-558
<i>Aleuroglyphus</i> sp.	0	—	—	1	1	—
<i>Analgidae</i> sp.	1	10	—	0	—	—
Glyciphagidae						
<i>Blomia</i> sp.	16	279	7-2240	22	152	2-1097
<i>Glyciphagus</i> sp.	0	—	—	2	13	2-35
<i>Carpoglyphus</i> sp.	2	16	3-333	0	—	—
<i>Xenoryetes</i> sp.	2	28	9-44	1	18	—
<i>Labidophorinae</i> sp.	1	28	—	0	—	—
<i>Oribatei</i> sp.	0	—	—	2	16	1-20
Cheyletidae						
<i>Cheyletus</i> sp.	19	119	4-670	19	21	1-115
<i>Cheyletia</i> sp.	1	10	—	0	—	—
<i>Cheyletidae</i> sp.	1	14	—	0	—	—
Tarsonemidae						
<i>Tarsonemus</i> sp.	4	70	14-163	4	31	2-61
Bdellidae						
<i>Bdella</i> sp.	1	2	—	0	—	—
Tenuipalpidae sp.						
Prostigmata (unidentified)	0	—	—	1	0.5	—
Uropodidae						
<i>Leiodinychus</i> sp.	0	—	—	1	3	—
Phytoseiidae						
<i>Typhlodromus</i> sp.	0	—	—	1	6	—
Dermanyssidae sp.	0	—	—	2	1	—
<i>Ixodidae</i> (ticks)	1	250	—	1	8	—

Table 4. The mite fauna of Barbadian house dust frequency of occurrence and relative abundance of species

Species	% Frequency of occurrence	% Proportion of total mite population present
(a) Mattress dust	$\left(\frac{N}{23} \times 100\right)$	$\left(\frac{N}{16359} \times 100\right)$
<i>D. pteronyssinus</i>	100	87.7
<i>Blomia</i> sp.	69.5	8.0
<i>Cheyletus</i> sp. and other	87	3.7
<i>Cheyletidae</i>		
All other species	—	0.6
	$\left(\frac{N}{25} \times 100\right)$	$\left(\frac{N}{8726} \times 100\right)$
(b) Bedroom dust		
<i>D. pteronyssinus</i>	100	51.5
<i>Blomia</i> sp.	88	35.4
<i>Suidesia</i> sp.	24	3.5
<i>Cheyletus</i> sp.	76	2.1
<i>Tarsonemus</i> sp.	20	1.7
<i>Tyrophagus</i> sp.	8	4.2
All other species	—	1.6

Discussion

Contact with house dust is recognized by a high proportion of Barbadian asthmatics as a precipitating cause of asthma and rhinitis. Moreover, it was the only allergen recognized in fifty-eight of ninety-two patients giving positive skin reactions to it. Skin tests with commercially prepared house dust extracts and extracts of *D. pter.* and *D. farinae* prepared both commercially and privately, the latter by the late Dr Kate Maunsell, show a high correlation with a history of clinical sensitivity and with each other. House dust and hence mite allergy appears to be by far the most common precipitating cause of asthma in Barbados.

Examination of dust samples obtained from the surface of mattresses and bedroom floors show not only high counts of *D. pter.* but the presence of twenty-two other species of mites, some of which (*Blomia* sp., *Cheyletus* sp. and *Suidasia medanensis*) were found frequently and sometimes achieved high densities. Oshima (1970) recorded the presence of forty-one species of mites in samples of house dust from Japan and Taiwan. Cunningham (1967) reported the occurrence of at least twenty-two species in British house dust while Spielsma & Spielsma-Boezeman (1967) listed representatives from fifteen genera, families or higher groups found in Dutch house dust.

Barbadian houses are most commonly small single-storey wooden structures containing two to four rooms and are supported on either coral or concrete blocks about a foot above the ground. These provide a damp course, a necessary attribute because many houses are situated on low-lying ground near the sea or elsewhere; more modern houses are constructed of concrete. The older houses have wooden roof tiles but the majority have corrugated iron roofing. The relative humidity is moderately

Table 5. Skin sensitivity to five mite extracts

	<i>Suidasia</i>		<i>Cheyletus</i>		<i>Chortoglyphus</i>		<i>Glyciphagus d.</i>		<i>Glyciphagidae</i>	
	No. tested	+ve react.	No. tested	+ve react.	No. tested	+ve react.	No. tested	+ve react.	No. tested	+ve react.
Dust +ve patients	22	16 (70%)	9	5 (55%)	11	6 (55%)	62	15 (24%)	11	8 (73%)
Dust -ve Patients	10	3 (30%)	2	0 (—)	3	0 (—)	38	2 (5%)	3	0 (—)

Table 6. Relationship between density of *D. pter.* in mattress dust and sensitivity to dust and *D. pter.* extracts

	No. tested	Clinically sensitive to house dust	Positive skin tests to:	
			House dust ext.	<i>D. pter.</i> ext.
Estimated density of <i>D. pter.</i> over 1000/g	13	11 (84%)	13 (100%)	12 (92%)
Estimated density of <i>D. pter.</i> under 1000/g	9	3 (33%)	4 (45%)	4 (45%)

high, varying throughout the year between 64 and 74%, with temperatures ranging from 21 to 32°C. The average number of people living in each house was calculated to be 3.9 in 1970 (Commonwealth Caribbean population census, 1970, Barbados). The conditions are, therefore, especially suitable for the growth of many mite species, particularly *D. pter.* Both temperature and relative humidity are at peak levels between September and January. It is, therefore, at this time of year that the mites are likely to reach their maximum rate of increase, a factor which may at least partly account for the increased number of admissions of patients with severe asthma at this time of the year (Pearson, 1973). A similar conclusion as to the relationships between relative humidity, hospital admissions, and mite sensitivity are reported by Buchanan & Jones (1972) in Zambia.

A high proportion of dust sensitive asthmatics gave positive skin reactions to *D. pter.* and *D. farinae*. The high counts of *D. pter.* in almost every sample of mattress and to a less extent bedroom dust leaves little doubt that this species is the most important cause of asthma in Barbados as it is in Europe. Patients with an estimated count of over 1000 *D. pter.* per gram in mattress dust gave a higher proportion of skin reactions to house dust and *D. pter.* extracts than those with less than 1000 mites per gram, but although the numbers are too small to be statistically significant the trend confirms the importance of this mite as a cause of allergic sensitivity.

The high number of reactions obtained with *D. farinae* which was found in small numbers in only two samples, one of mattress and one of bedroom dust, can only be explained by cross reactivity with *D. pter.* This mechanism probably also explains the reactions given by *Glyciphagus* sp. which was present in two samples and by *Suidasia medanensis* which although it occurred in eleven samples gave a higher proportion of positive reactions than would be expected. Whether specific sensitivity to individual species or crossed sensitivity is responsible for the high skin sensitivity, it is reasonable to suggest that mites other than *D. pter.* are probably an additional cause of symptoms (Bernecker, 1970; Miyamoto *et al.*, 1969).

Instructions were given to patients and the parents of asthmatic children to keep their rooms as free from dust as possible and to expose their mattresses to the sun for at least half an hour twice weekly. This manoeuvre appeared to effect an improvement in some cases. In others the use of simple bronchodilators with or without the inhalation of sodium cromoglycate was effective.

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