

A comparison of mite populations in mattress dust from hospital and from private houses in Cardiff, Wales

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Summary

Fifty mattress dust samples from private houses were examined—all were mite infested. *Dermatophagoides pteronyssinus* occurred in all samples and accounted for 81% of all mites.

In thirty-two paired samples the total mite population of bedroom floor dust was only 10% of that found in the corresponding mattress dust. *D. pteronyssinus* was the dominant species in both and the population of this mite amounted to 7.5% of that found in the mattress dust.

An analysis of mattress dust from 100 hospital beds showed that ninety-four mattresses were mite free; the other six contained only seven mites, all *D. pteronyssinus*.

It is suggested that frequent changing and washing of bed linen and brushing and cleaning of mattresses were the main factors in preventing mite infestation in the Cardiff hospitals.

Introduction

House dust allergy is an important cause of allergic asthma and rhinitis all over the world. Skin tests and nasal and bronchial challenge tests have clearly established that pyroglyphid mites are chiefly responsible for house dust allergy (Voorhost, Spieksma-Boezeman & Spieksma, 1964; Pepys, Chan & Hargreave, 1968; McAllen, Assem and Maunsell, 1970). In asthmatic children mite sensitivity, as indicated by skin tests, has been shown to occur in 80% of those tested (Morrison Smith *et al.*, 1969; Sarsfield, 1974).

Studies on the mite fauna of house dust in Holland (Spieksma & Spieksma-Boezeman, 1967; Spieksma, 1967) and in the U.K. (Cunnington, 1967; Sesay & Dobson, 1972; Blythe, Williams and Morrison Smith, 1974) have revealed that pyroglyphid mites occur in large numbers in private houses and are particularly numerous in mattress dust. It is clear from these studies that *Dermatophagoides pteronyssinus* (Trouessart, 1897) is the most abundant house dust mite in the U.K. and probably in most European countries.

In contrast to house dust fauna, the mite fauna of hospitals has been infrequently studied. Voorhorst, Spieksma & Varekamp (1969) found 'ward dust' from their hospital a less potent source of mite allergen than 'house dust' from the homes of their patients. Cunningham & Gregory (1968) found no mites in the dust collected from the air of a London hospital ward during bed-making. Sessay & Dobson (1972) found low mite populations in hospital beds in Scotland, and Sarsfield (1974) also found no mites in ward mattresses in a Leeds hospital.

This paper reports the results of a series of investigations started in 1969 to determine the prevalence of mites in dust from hospital and private mattresses in active use in Cardiff and the surrounding district. Concomitantly, dust from bedroom floors of the houses included in this study was analysed for mites for comparison with the corresponding mattress dust.

Materials and Methods

Scope of investigations

Samples of dust were collected from 100 hospital mattresses in the Cardiff district. At St David's Hospital, sixty-three mattresses were sampled; eighteen from an acute medical ward, twenty-two from a dermatological ward and twenty-three from a geriatric ward. At Llandough Hospital, samples were taken from twenty-nine mattresses of an acute paediatric ward. At Rookwood Hospital, four mattresses from a subacute medical ward and at Sully Hospital another four from a paediatric ward were examined.

A parallel survey of the mite fauna of fifty private mattresses in regular use in the Cardiff area was conducted. Forty-four mattresses belonged to asthmatic patients attending the Asthma Clinic at Cardiff and six belonged to non-asthmatic subjects. Thirty-two of the fifty subjects also provided dust samples from the corresponding bedroom floors collected on the same occasion as the mattress dust.

Technique of sampling

Detailed verbal and printed instructions were given to each individual participating in the survey and the standard technique of sampling was also explained. A clean, hard, dry brush was used for brushing the surface of the mattress, the areas under the buttons and along the piping receiving special attention. The dust was brushed onto a smooth, clean piece of paper and then transferred into a plastic bag provided for the purpose. The bag was sealed ensuring an air pocket remained inside and was then returned to the Asthma Research Unit for analysis.

All the sampling in hospitals was done by one of us (B.V.D.). A toothbrush was used for collecting samples and to avoid contamination a separate new brush was used for each mattress. The walls of all the wards were examined for dampness with a Protometer. Most of the sampling was done between 8.15 a.m. and 9.55 a.m. and the temperature and humidity operating at the time were recorded. Most of the samples (68%) were taken in July, August and September. Full details were obtained from each ward sister about the type of mattress in use, whether 'old' or 'new', the type of cover or absence of an enclosing cover, the frequency with which the sheets, pillow cases and the cotton cellular blankets were changed and laundered: also the frequency with which the covers were brushed or carbolized and the mattresses were brushed and aired was ascertained.

Examination of samples

A modification of the method described by Maunsell, Wraith & Cunnington (1968) was used for detection and isolation of mites. It involved a simple flotation technique (Solomon, 1962) to extract the mites from the dust. On receipt at the laboratory each sample was weighed and the dust then poured into a 100 ml wide mouthed conical glass flask filled to the brim with dichloromethane. The solvent was then filtered under reduced pressure through a Buchner funnel fitted with a circular disc of black filter paper 11 cm in diameter. The disc was removed, dried in an oven at 50°C for at least 24 hr and then examined under a stereo-microscope for mites. Those found were removed from the filter paper with a fine needle and mounted on microscope slides using Swann's modification of Berlese's medium. After further drying and hardening of the mountant at approximately 50°C the slides were examined under a binocular microscope and the mites identified and counted.

Results

Mites were found in all fifty samples of mattress dust from homes in the Cardiff area. Mean densities, i.e. estimated numbers/gram of dust, were calculated from the no./wt ratio of each sample and the results summarized in Table 1. Densities varied widely between samples from three to 12,922 mites/gram of dust with a mean of 1464. *D. pteronyssinus* occurred in all fifty samples and showed a similar wide variation in number with densities ranging from three to 7000 mites/gram with a mean of 1180. *D. pteronyssinus* was the predominant species present and formed 81% of all mites recovered. Two other pyroglyphid species were also present, *Dermatophagoides farinae* which occurred in very small numbers in a single sample and *Euroglyphus maynei* which was found in thirteen samples and accounted for a further 9% of the total mite population. Non-pyroglyphid mites, *Cheyletus* sp. (5%), *Glycyphagus* sp. (1.6%), *Tyrophagus* sp. (1%) and damaged and unidentifiable specimens made up the remainder.

In the thirty-two paired samples from mattresses and corresponding bedroom floors, densities were higher in mattress dust than in floor dust with the exception of

Table 1. Summary of results in fifty samples of mattress dust from private houses. Mean weights of dust per sample = 0.0767 g

Species	Mean density/g	Proportion of total mite population (%)
<i>D. pteronyssinus</i>	1180	81
<i>D. farinae</i>	2	
<i>Euroglyphus maynei</i>	131	9
<i>Cheyletus</i> sp.	75	5
<i>Glycyphagus</i> sp.	23	1.6
<i>Tyrophagus</i> sp.	1	
Damaged	51	3.5
Unidentified	1	
Total	1464	100

Table 2. Summary of findings in thirty-two pairs of mattress and floor dusts sampled from same rooms

	Mattress dust	Bedroom dust	Bedroom dust results as % of mattress dust results
Mean weight of samples	0.0735	0.1478	201
Range	0.004–0.65 g	0.001–0.74 g	
Mean density of <i>D. pteronyssinus</i> /g	789	59	7.5
All species mean density/g	884	90	10

Table 3. Bedding at the hospitals

Type of bedding	No. tested	No. of mattresses with mites	Percentage with mites
(a) Mattresses:			
rubber or foam	49	3	6
spring	51	3	6
Total of all types	100	6	6
(b) Enclosing cover used:			
rubber or plastic	67	5	7.4
cotton	14	—	—
none	19	1	5.3
Total of all types	100	6	6

Table 4. Linen changing routine of various wards investigated (average times)

Type of linen	Types of ward				
	Paediatric (days)	Acute medical (days)	Geriatric (days)	Dermatology (days)	Subacute medical (days)
Sheets and pillow cases	1–2	2–3	At least daily	At least daily	1–3
Cotton cellular blankets laundered	3	14–21	7	14–21	35
Mattress covers washed, carbolized or brushed	3	14	7–14	14	35

two homes where the reverse was true. A summary of these findings is given in Table 2. *D. pteronyssinus* occurred less frequently and abundantly in floor dust than in mattress dust and accounted for only 66% of the total mite population as opposed to 90% in mattress dust. *E. maynei* was also much less frequent and less numerous. Non-pyroglyphid mites, *Cheyletus* sp. (5%), *Glycyphagus* sp. (5%), *Tarsonemus* sp. (1%) and damaged and unidentifiable specimens (22%) formed a considerably higher proportion of the population in floor dust than in mattress dust.

Of the 100 hospital mattress dust samples analysed, ninety-four were mite free and the remaining six contained only seven mites, all *D. pteronyssinus*. Table 3 shows the type of bedding used in the hospitals investigated and the number of mattresses which contained mites. The mite densities per gram of dust for these six mattresses ranged from thirteen to 500. Linen changing routine of various wards was investigated and the details summarized in Table 4. The temperature at the time of sampling ranged between 20.5°C and 23.5°C and the relative humidity varied between 53% and 64%.

Discussion

Our results show most striking differences in mite densities between hospital and private mattresses. An overwhelming number of hospital mattresses (94%) had no mites whereas all fifty mattresses from homes were mite infested. Cunningham & Gregory (1968) analysed the dust collected from the air of a London hospital ward during bed-making and found no mites which accords with our finding. On the other hand, they found mites in all six samples of bedroom air collected during bed-making in both the homes they investigated. Sesay & Dobson (1972) investigated an unspecified number of hospital beds in Scotland and found low mite populations (62/g). Sarsfield (1974) found no mites in fifteen samples of dust collected from hospital ward mattresses in Leeds. Therefore, it would appear that mite infestation of mattresses in the types of hospital investigated is a rare phenomenon.

There were high densities of mites in our mattress dust samples from houses in which *D. pteronyssinus* was the dominant species in both mattress and floor dust samples. These findings are similar to those of other workers (Spieksma, 1967; Maunsell *et al.*, 1968; Sesay & Dobson, 1972). Maunsell *et al.* (1968) found that mattress dust contained 100 times more mites than living room dust. In our paired samples the mite density in respect of total mites was ten times lower in the bedroom dust than in the mattress dust.

Although the relative absence of mites in hospital mattresses can be credited to several factors, we consider the high standard of hygiene in these hospitals as the single most important factor militating against mite growth. It is evident from Table 4 that in the hospitals investigated bed linen was kept rigorously clean and frequently changed: sheets and pillow cases were changed every 1–3 days, cotton cellular blankets were laundered every 3–21 days and mattress covers were washed or carbolized or brushed frequently. We did not examine the bedrooms when the dust samples were taken nor did we enquire regarding the hygiene in homes included in this study. But it is highly unlikely that cleaning and washing of mattresses and bedclothes was as thorough or as frequent as in the hospitals.

That hygiene plays a very important role in reducing mite numbers is supported by the work of Sesay & Dobson (1972). These workers have shown that houses with low standards of hygiene have higher total mite populations than houses with good hygiene. They also made comparisons of mite densities in dusts from various layers

of bedclothes—the superficial, intermediate and lower layers and from pillows. The highest densities of mites occurred in the intermediate layers. Since mites are killed by heat during washing it is logical to expect a drastic reduction in mite numbers in private beds if the hospital routine of frequent washing and changing of bedclothes and pillow cases were to be followed.

Sarsfield *et al.* (1974) conducted a trial of avoidance measures aimed at reducing exposure of asthmatic children to mite allergen and concluded that the single most important step in preventing exposure to mites was the covering of the mattress with a plastic cover although they also recommended rigorous hygiene of the bed and its surroundings as well. In our survey, such factors as the type of mattress used, whether or not the mattress was encased in a rubber or plastic cover or none at all appeared to have no effect on whether or not mites were present. Our findings suggest that strict hygienic measures in respect of bed clothes and the mattress can, for all practical purposes, prevent the growth of mites on mattresses irrespective of the cover used. A leading article in the *British Medical Journal* (1971) recommended regular vacuum cleaning and washing with special attention to the bedding as a means of reducing exposure to house dust allergen. Hughes & Maunsell (1973) also found that vacuum cleaning and brushing of the mattress reduced the numbers of live and dead mites.

As regards the source of the few mites in hospitals, it is almost certain that they are brought in from outside on certain clothes and other items such as toys. We have examined three dressing gowns, three coats and slippers in regular use and found mites in every one of them ranging from ten to 980 mites/l gram of dust. We have also isolated mites from all five fluffy toys brought from homes. Others have reported similar findings (Sesay & Dobson, 1972; Sarsfield, 1974). In contrast, only one of the three toys on hospital wards contained a small number of mites (13/g). The mites we found on hospital mattresses may well have been brought into hospital on clothes and toys but owing to the high standards of hygiene and possibly to a small extent to low atmospheric relative humidity levels and the absence of damp walls, they failed to thrive.

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