

The effect of seasonal and domestic factors on the distribution of *Euroglyphus maynei* in the homes of *Dermatophagoides pteronyssinus* allergic patients

M. J. WALSHAW and C. C. EVANS

Regional Adult Cardiothoracic Unit, Broadgreen Hospital, Liverpool

(Received in original form 15 January 1986 and in revised form 4 July 1986; accepted for publication 14 August 1986)

Summary

A survey of the house dust mite population was carried out in the homes of fifty asthmatic Liverpool individuals with strongly positive skin tests to *Dermatophagoides pteronyssinus*. As expected, *D. pteronyssinus* was the commonest species found. However, *Euroglyphus maynei* made up 37% of the total adult mite count and was the predominant species in 48% of beds examined. There was a good correlation between increasing numbers of *E. maynei* and decreasing social class, but only a weak one with percentage relative humidity. Ionic sodium levels in bed dust were found to correlate with decreasing social class and increasing *E. maynei* levels. In nineteen beds, mites were sampled at 4-monthly intervals for 1 year—this showed a relative decrease in the proportion of *E. maynei* compared with other mites in the autumn, when relative humidity was high. A further twenty beds underwent intensive house dust eradication (including the use of plastic covers) for 1 year—these beds showed a progressive fall in the proportion of *E. maynei* recovered, suggesting that this mite is more vulnerable to anti-house dust mite measures.

Euroglyphus maynei is a common house dust mite and further work needs to be done to assess its antigenic nature and clinical significance.

Introduction

Dermatophagoides pteronyssinus has been shown to be the commonest house dust mite in Europe [1]. However, an unrelated mite, *Euroglyphus maynei*, makes up a significant proportion of the house dust mite count in Scotland [2], the South of England [3-5], and at high altitudes [6], but little is known about its ecological preferences.

The present study was carried out to investigate the distribution of *E. maynei* in homes in a northern city (Liverpool), and to assess domestic and seasonal factors that might influence its prevalence.

Correspondence: Dr M. J. Walshaw, Senior Medical Registrar, Regional Adult Cardiothoracic Unit, Broadgreen Hospital, Thomas Drive, Liverpool L14 3LB, U.K.

Subjects and methods

Patients

Fifty adult asthmatic patients who were highly skin-prick test positive to the house dust mite (*D. pteronyssinus*) formed the study population. Details of their social and domestic circumstances, house age, and the use of central heating were collected. Social class was evaluated using the Registrar General's Classification of Occupations [7].

Mite sampling

Dust was removed from the mattress surface, bedroom floor, and lounge carpet using a standardized vacuum sampling technique that had previously been shown to be reproducible (coefficient of variation of 10% for fourteen paired samples). Briefly, a hand-held vacuum cleaner, modified to accept a paper filter in front of the motor, was used to sample the whole of the mattress surface at a rate of 0.5 m²/min [8]. At the same time, relative humidity was measured using a psychrometer in the bedroom and lounge. The coarse dust samples obtained were sieved through a 1 mm² mesh at 0°C to remove fluff and large particles. The fine dust passing through the mesh was considered to contain the mites—the coarse detritus left above was examined through a stereomicroscope ($\times 30$) to ensure that no fine particles or mites remained. The fine dust was then submitted for mite counting and ionic sodium analysis.

Mite counting

One-hundred milligram aliquots of fine dust were placed in 10-cm petri-dishes and incubated with 10 ml 90% lactic acid and lignin pink dye at 57°C for at least 2 days. All dust samples were processed within 5 h of collection. The dishes were then viewed through a stereomicroscope ($\times 30$) using incident and transillumination, and mites were picked off for counting. Only intact mature mites and larger immature specimens were counted. It was usual to remove all these from a dish, but where large numbers were present only mites in a particular section would be removed. Mite counting had a coefficient of variation of 5%. Mites were mounted in modified Faure's medium for identification of sex, species, and maturity at high magnification using the standard keys [9, 10]. No attempt was made to identify the species of immature specimens. The proportion that *E. maynei* made up of the total mite count from 100 mg of dust was expressed as a percentage, and termed the percentage density of *E. maynei*.

Bed dust ionic sodium analysis

Fifty milligram aliquots of fine dust were dissolved in 12 ml of a stock solution of deionized distilled water containing 15 mmol ionic lithium per litre, using constant agitation at 20°C for 30 min. The resulting solution was then centrifuged at 2 g for 10 min and the supernatant removed. Aliquots of this were passed through a flame photometer (Instrumentation Laboratory IL 243). Those samples that overloaded the range of the machine were diluted down until a reading was obtained. A standard 100 mmol ionic sodium solution was used to check the calibration of the machine every five samples. Preliminary studies revealed this technique to have coefficients of variation for repeatability and reproducibility of 0.5% and 2.5%, respectively.

Table 1. Mite counts in the homes of fifty individuals allergic to *D. pteronyssinus*

Site	Mites/m ² *
Bed	3.07 ± 0.07
Bedroom	2.73 ± 0.10
Lounge	2.00 ± 0.10

* Geometric mean ± s.e.m.

Bed dust eradication techniques

In those beds that underwent dust control, the following techniques were applied.

- (i) A regular, thorough cleaning of the bed base and surround, at least at weekly intervals.
- (ii) The use of plastic mattress and pillow cover, which were damp dusted at least at weekly intervals.
- (iii) A change to non-allergenic bedding, which was washed at least weekly or shaken outside at weekly intervals.

All beds in the study were in regular daily use. Correlation coefficients were calculated by regression analysis using the least squares method.

Results

All patients had initial dust samples collected from their homes during a 5-month winter period (November 1982–March 1983). Repeat sampling in thirty-nine beds (twenty using mite eradication techniques) took place at 4-monthly intervals for 1 year—mean sampling times were January, May and September 1983, and January 1984.

Initial results

The mean mite counts for all sites at the first visit are shown in Table 1. *Euroglyphus maynei* was found to be the predominant mite in 48% of beds sampled, whilst *D. pteronyssinus* was predominant in the remainder. Overall, *E. maynei* made up 37% of all adult bed mites counted initially, and its frequency diminished with increasing distance from the bed—25% on the bedroom floor, and only 18% in the lounge carpet (Fig. 1). This mite was present in forty beds (80%), thirty-eight bedroom floors (76%), and thirty lounge floors (61%). It was absent from all locations in only four houses (8%) of the study group.

At all sites, the female to male sex ratio for both *E. maynei* and *D. pteronyssinus* was noted to be close to unity, varying between 5:4 and 2:1. *Dermatophagoides farinae* occurred rarely, and the only other species found regularly in any numbers was the predatory mite, *Cheyletus* spp. (1–2% of the mite count for all sites). Other non-pyroglyphid mites were rare on the mattress (<1%), but their numbers increased with increasing distance from the bed—3% on the bedroom floor, and 5% in the lounge. A mixture of these mites was encountered, mainly *Glycyphagus* and *Lepidoglyphus* species.

There was no correlation between the numbers of *E. maynei* in the bed and the use of central heating or house age. There was only a weak correlation ($r=0.33$, $P<0.05$)

with relative humidity, whereas *D. pteronyssinus* showed a much stronger relationship ($r=0.51$, $P<0.001$) at the same site. Ionic sodium levels were measured in the beds of forty-seven of the study population. There was a good correlation between the percentage density of *E. maynei* in the bed and decreasing social class ($r=0.64$, $P<0.001$) (Fig. 2), and also between decreasing social class and ionic sodium levels in bed dust ($r=0.43$, $P<0.01$) (Fig. 3). Finally a correlation ($r=0.32$, $P<0.05$) was noted between the percentage density of *E. maynei* and ionic sodium levels in bed dust. There was no relationship between the numbers of *D. pteronyssinus*, social class, or ionic sodium levels in bed dust.

Repeat results

Repeat mean mite counts for the beds in both groups are shown in Table 2. Repeat humidity measurement in the bedrooms of the nineteen patients who did not undertake dust eradication revealed that there was a fall in relative humidity during the spring, and a rise in summer and autumn. The female to male sex ratio for both *D. pteronyssinus* and *E. maynei* at repeat visits was close to unity, varying between 3:2 and 6:7. In the untreated group, *D. pteronyssinus* levels remained steady throughout the study, but the lowest levels of *E. maynei* were found during the autumn (third sampling visit) when non-pyroglyphid species were more prevalent (Fig. 4).

In the treated group, there was an initial large fall in mite numbers for all species. *Dermatophagoides pteronyssinus* levels remained low, whilst *E. maynei* continued to decline (Fig. 4). However, there was some recovery in the numbers of non-pyroglyphid

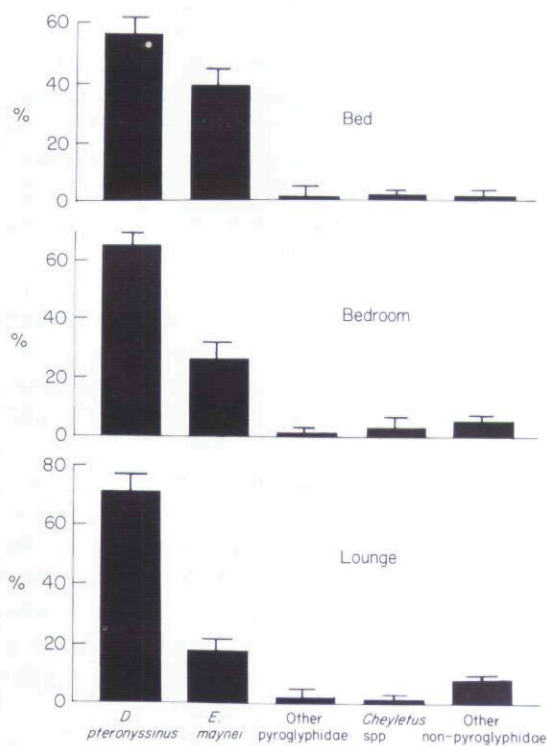


Fig. 1. Species distribution in the homes of fifty *D. pteronyssinus*-sensitive individuals (mean values + s.e.m.).

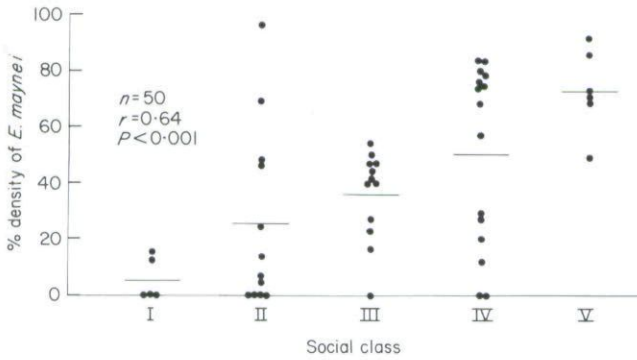


Fig. 2. Relationship between the percentage density of *E. maynei* and social class in the beds of fifty asthmatic individuals.

species at the third sampling visit, but these had fallen away again by the end of the study.

Discussion

This investigation has demonstrated a higher preponderance of *E. maynei* in human dwellings than any other published study. The fact that patients were selected on the basis of a strongly positive skin-prick test to *D. pteronyssinus* makes the discovery of high levels of *E. maynei* even more important. Most British studies have revealed a significant proportion of *E. maynei*, varying from 9% [3] to 33% [11]. In a European survey, Vervloet [6] found an increased prevalence at high altitudes, but overall mite levels were low. Burr [4] has shown high levels of this mite in Cardiff houses, but these numbers were biased by some very heavy infestations and it was the predominant mite in only 32% of mattresses (compared with 48% in this study).

There are probably two reasons why previous studies have failed to demonstrate high levels of *E. maynei*. Firstly, a substrate brushing technique as a means of mite collection is likely to miss most *E. maynei* [11], since they are much smaller than the Dermatophagoidinae—studies based on this method may, therefore, not reflect the

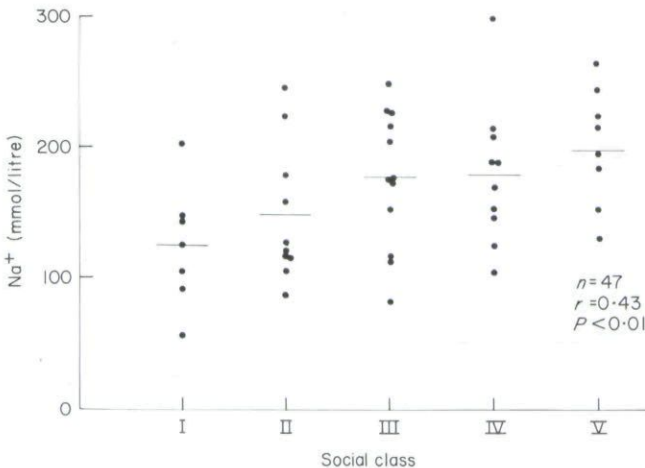


Fig. 3. Relationship between dust sodium level and social class in forty-seven of the study population.

Table 2. Mite counts in twenty treated and nineteen untreated beds from repeat sampling at 4-monthly intervals

	Geometric mean mites/m ²			
	Visit			
	1	2	3	4
Treated (<i>n</i> = 20)	3.22*	0.92	1.00	0.89
Untreated (<i>n</i> = 19)	2.92	2.79	2.68	2.62

* = Untreated.

true level of *E. maynei* in the substrate—however, suction sampling will pick up smaller particles, including these mites. Secondly, an accurate counting technique must be used when assessing these mites, since their small size makes them easy to miss. The male of the species is much smaller than the female [10]—consequently, the sex ratio can be used as a guide to the accuracy of the counting technique [11]. Most previous studies have either failed to sex this mite [3,6], or have found that females greatly outnumber males [2]. In this study, the use of a suction sampling technique and the demonstration of a sex ratio near to unity for *E. maynei* assures the accuracy of the collection and counting techniques.

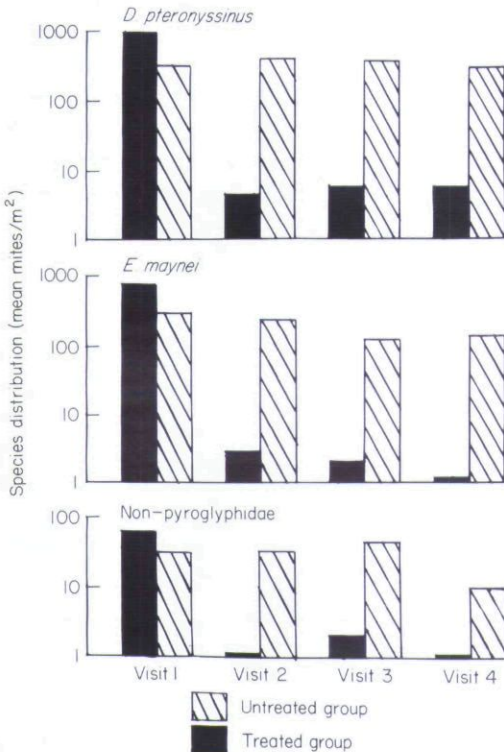


Fig. 4. Species distribution on repeat sampling at 4-monthly intervals in twenty beds that had undergone intensive dust eradication and in nineteen untreated beds.

It has been suggested that *E. maynei* has a lower critical equilibrium activity for water than do most domestic mites [12], allowing it to survive at a lower relative humidity. The fact that *E. maynei* numbers correlated only poorly with the percentage relative humidity at the initial sampling (unlike *D. pteronyssinus*) supports this. Furthermore, the relative fall in *E. maynei* levels at the autumn sampling actually reflects an increase in the levels of non-pyroglyphid mites at this time, perhaps responding to increased humidity when temperatures are still fairly high with a breeding spurt.

This study has shown that *E. maynei* numbers decrease with increasing distance from the bed, confirming the results of Blythe *et al.* [11]. Because of this, it has been suggested that *E. maynei* is dependent upon the bed environment for survival and, since it seems to be less influenced by relative humidity than are other mites, other factors must be important. The marked diminution of *E. maynei* levels in the beds that underwent dust eradication suggests that this mite may well be very susceptible to any alterations in its substrate, supporting the above theory. At the same time, the relatively hostile nature of the treated bed environment was demonstrated by an increased proportion of non-pyroglyphid mites at this site, which are more usually found away from the bed. Overall mite levels in the treated beds were low, in agreement with most other studies that have used plastic mattress covers [13–15].

In the present study, the correlation found between *E. maynei* levels and decreasing social class led to the postulates that individuals in the lower social classes might perspire more (due to increased manual labour), or might wash less (due to lower standards of personal hygiene). If either of these were correct, then increased products of perspiration would be present upon the skin scales deposited in the bed. A major constituent of perspiration is ionic sodium, and this can be measured. The relationship demonstrated between bed dust ionic sodium, decreasing social class, and *E. maynei* numbers in this study is not strong and it is likely that other factors are also important in influencing the survival of *E. maynei*. Burr *et al.* [4] noted the presence of large numbers of *E. maynei* in the beds of enuretic children, and these were attributed to dampness—however, this mite is less influenced by humidity than most and it is possible that its prevalence was due to an increased ionic sodium load (and perhaps other chemicals) from urine in the bedding.

It is well known that *E. maynei* is difficult to culture in the laboratory [16], and when cross-correlating antigenicity between different mites most workers have left it out [16–18]. Voorhorst *et al.* [19] have suggested that there is some antigenic cross-reactivity between *D. pteronyssinus* and *E. maynei*, but the latter appears to produce less antigen. Mumcuoglu [20] has demonstrated that some individuals who are strongly skin-prick test positive for *D. pteronyssinus* can be negative for *E. maynei*, and vice versa. These studies suggest that *E. maynei* produces its own major allergens, and whilst it may share some of these with *D. pteronyssinus*, there is no evidence to indicate that it produces the classical house dust mite antigen (P1) [21].

Euroglyphus maynei is a common European house dust mite, and further work needs to be done to define its antigenic nature and clinical significance.

Acknowledgment

The authors would like to thank the Samuel Crossley Barnes Research Fund, University of Liverpool, for supporting M.J.W. with a Fellowship Award throughout the course of the study.

References

- 1 Blythe ME. Some aspects of the ecological study of the house dust mites. *Br J Dis Chest* 1976; 70:3–31.
- 2 Sesay HR, Dobson RM. Studies on the mite fauna of house dust in Scotland with special reference to that of bedding. *Acarologia* 1972; 14:384–92.
- 3 Rao VRM, Dean BV, Seaton A, Williams DA. A comparison of mite populations in mattress dust from hospital and from private houses in Cardiff, Wales. *Clin Allergy* 1975; 5:209–15.
- 4 Burr ML, Dean BV, Merrett TG, Neale E, St Leger A, Verrier-Jones ER. Effects of anti-mite measures on children with mite-sensitive asthma: a controlled trial. *Thorax* 1980; 35:506–12.
- 5 Carswell F, Robinson DW, Oliver J, Clark J, Robinson P, Wadsworth J. House dust mites in Bristol. *Clin Allergy* 1982; 12:533–45.
- 6 Vervloet D, Penaud A, Razzouk H, Senft M, Arnaud A, Boutin C, Charpin J. Altitude and house dust mites. *J Allergy Clin Immunol* 1982; 69:290–6.
- 7 Classification of Occupations Office of Population Censuses and Surveys. London: HMSO, 1980.
- 8 Walshaw MJ, Evans CC. Allergen avoidance in house dust mite sensitive adult asthma. *Quarterly J Medicine* 1986; New Series 58:199–215.
- 9 van Bronswijk JEMH, Sinha RN. Pyroglyphid mites (Acari) and house dust allergy—a review. *J Allergy* 1971; 47:31–52.
- 10 Hughes AM. The mites of stored food and houses. Technical Bulletin No 9, London: HMSO, 1976.
- 11 Blythe ME, Williams JD, Morrison-Smith J. Distribution of pyroglyphid mites in Birmingham with particular reference to *Euroglyphus maynei*. *Clin Allergy* 1974; 4:25–33.
- 12 Wharton GW. House dust mites—a review article. *J Med Ent* 1976; 12:577–621.
- 13 Sarsfield JK, Gowland G, Toy R, Norman ALE. Mite-sensitive asthma of childhood: trial of avoidance measures. *Arch Dis Child* 1974; 49:716–21.
- 14 Mulla JD, Lang MS. Spatial distribution and abundance of house dust mites, *Dermatophagoides* spp., in houses in Southern California. *Environ Entomol* 1975; 7:121–7.
- 15 Murray AB, Ferguson AC. Dust-free bedrooms in the treatment of asthmatic children with house dust or house dust mite allergy: a controlled trial. *Pediatrics* 1983; 71:418–22.
- 16 Spieksma FThM, Voorhorst R. Comparison of skin reactions to extracts of house dust, mites, and human skin scales. *Acta Allergologica* 1969; 24:124–46.
- 17 Miyamoto T, Oshima S, Mizuno K, Sasa M, Ishizaka T. Cross-antigenicity among six species of dust mites and house dust antigens. *J Allergy* 1969; 44:228–38.
- 18 Morrison-Smith J, Disney ME, Williams JD, Coels ZA. Clinical significance of skin reactions to mite extracts in children with asthma. *BMJ* 1969; ii:723–6.
- 19 Voorhorst R, Spieksma FThM, Varekamp H. House dust atopy and the house dust mite *Dermatophagoides pteronyssinus* (Trouessart 1897). Leiden: Stafleu's Sci Publ Co, 1969.
- 20 Mumcuoglu Y. House dust mites in Switzerland. III. Allergenic properties of the mites. *Acta Allergologica* 1977; 32:333–49.
- 21 Chapman MD, Platts-Mills TAE. Purification and characterisation of the major allergen from *Dermatophagoides pteronyssinus*—antigen P1. *J Immunol* 1980; 125:587–92.

This document is a scanned copy of a printed document. No warranty is given about the accuracy of the copy. Users should refer to the original published version of the material.