House dust mites, asthma and skin prick testing in a group of Wairoa school children

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ABSTRACT

A group of Wairoa schoolchildren was examined for the symptoms of asthma using questionnaires, bronchial hyperesponsiveness challenge tests, and atopia by skin prick testing. The homes of a sub-group, which contained an equal number of asthmatics and non-asthmatics, were examined for house dust mites. All 42 homes examined contained *Dermatophagoides pteronyssinus. Glycophagus domesticus, Cheyletus eruditis, Chortoglyphus arcuatus and Forcellinia galleriella* were also present; *D. farinae* was not recorded. There was a strong relationship between positive skin prick tests of house dust mite allergen and the presence of asthma symptoms in individuals. Factors affecting house dust mite prevalence are discussed.

Keywords: House dust mites, New Zealand, asthma, allergy

INTRODUCTION

Cornere (1971) recorded *Dermatophagoides pteronyssinus* (Trouessart) from all of 22 houses examined in Auckland. A second survey involving a range of localities throughout New Zealand found that 99 of 100 houses contained *D. pteronyssinus* (Cornere 1972). No comment was made in these studies on the absence of *D. farinae* Hughes, a common inhabitant of house dust elsewhere in the world, particularly North America. Nor was there reference to other genera and species of mites found periodically in house dust.

Ingham & Ingham (1976) refer to "a few" *D. farinae* being found with *D. pteronyssinus* in a Christchurch study of infant-use sheepskins. From the same locality, Abbot, Cameron & Taylor (1981) recorded *D. pteronyssinus* from all 48 houses examined, with *Euroglyphus maynei* (Cooreman) and several cheyletid species also common. Less frequent were *Goheira fusca* (Oudemans), *Glycophagus domesticus* (De Geer), *Acarus siro* (L.) and other unidentified species. They did not find *D. farinae*, but this study gave the impression of a more thorough approach to species identification.

Given that *D. farinae* is common in other countries and extracts of it are regularly used (along with extracts of *D. pteronyssinus*) in allergy tests, further attempts to confirm its presence in New Zealand are justified. Also, given the seriousness of asthma in New Zealand and the association of this condition with the presence of house dust mites, further basic information on these mites and their distribution should be useful.

A survey by the Wellington School of Medicine of the changes in asthma prevalence in students from Wairoa College, Wairoa, a rural centre in the Hawkes Bay region, provided an opportunity to collect house dust samples from the homes of those surveyed, and link the results with the findings of some of the clinical tests and questionnaires. The survey was conducted in September 1989.

MATERIALS AND METHODS

College students aged between 12-18 years were assessed for atopy and bronchial hyperesponsiveness reaction (BHR) by a team from the Wellington School of Medicine. Assessment was based on the presence/absence of morning cough, response to a video on wheezing and nocturnal coughing, a questionnaire, skin prick testing, and non-specific bronchial responsiveness challenge testing.

Based on responses to the asthma questionaire the houses of 21 asthmatics and 21 non-asthmatics were chosen for a house dust mite survey. A questionnaire sought details of

house structure and site, furnishings (age and material) and housekeeping. Details of the clinical record of the student inhabitant(s) of the house were included in the questionnaire.

A National™ vacuum cleaner with a head modified to accept a paper filter, was used to vacuum dust from the mattress and carpet (or floor and mat) in the bedroom, and a piece of the lounge furniture and adjacent carpet or floor in the living room. One square metre of surface was vacuumed for one minute in each case. Dust samples were deep frozen for later examination in the laboratory where they were weighed, 0.05gm aliquots taken in each case, and mites removed according to the technique established by Woodford *et al.* (1979). Mites were slide-mounted in Hoyer's medium for identification.

RESULTS

The species recorded and percentage of houses infested with each of them are shown in Table 1. *Dermatophagoides pteronyssinus* dominated the fauna at each site, with all houses being infested with this species. *Cheyletus eruditus* (Schrank), *Chortoglyphus arcuatus* (Troupeau) and *Forcellinia galleriella* (Womersley) are all new records from New Zealand house dust.

Responses of the student inhabitants of these houses to allergen skin prick tests using house dust mite extracts are indicated in Table 2. Of the five who had positive skin tests and did not report asthma symptoms, one demonstrated bronchial hyperesponsiveness. One positive BHR failed to react to the skin test. Asthmatics showed significantly more sensitivity to house dust mite skin prick tests ($P<0.01$, X^2 test).

Examination of 0.05g aliquots of house dust gave mites densities for eight houses as in Table 3.

Table 1: Composition of house dust mite fauna.

Species recorded	% of houses (n = 42)
Dermatophagoides pteronyssinus	100
Glycophagus domesticus	58
Cheyletus eruditis	58
Chortoglyphus arcuatus	28
Forcellinia galleriella	3

Table 2: Number of positive responses to one or both mite antigen tests.

Test	Asthmatics	Non-asthmatics	Total
D. pteronyssinus	2	0	2
D. farinae	4	2	6
D. pteronyssinus + *D. farinae*	7	3	10
Total responses	13	5	18
Number examined	21	43	64

Table 3: No. of mites/g of house dust

Source	Mean + Std Dev.	Range
Mattress	1095 + 888	200-3000
Bedroom floor	630 + 417	280-1590
Lounge chair	1997 + 2043	60-6000
Lounge floor	497 + 516	12-1540

DISCUSSION

Composition of the mite fauna and densities

The results are consistent with the earlier study of Abbot *et al.* (1981) in which *D. pteronyssinus* was the dominant species, with glycophagid and cheyletid species occurring frequently in the samples although in smaller numbers. *D. farinae* was absent. It is also noteworthy that *Euroglyphus maynei* (Cooreman), a common inhabitant of house-dust elsewhere was not recorded. *Forcellina galleriella* is a species normally associated with honey bees and is probably a casual addition to the house dust mite fauna. Rural locations, such as Wairoa and its surroundings, can be expected to have a faunal composition of house dust differing in some respects from urban localities. The study confirms *D. pteronyssinus* as New Zealand's predominant house dust mite.

The reason for the very limited presence of *D. farinae* in New Zealand may be a combination of environmental and geographical factors. *Dermatophagoides farinae* and *D. pteronyssinus* are referred to respectively as the American and European house dust mites. Although these names reflect the earlier perceived geographical distribution of each species, they are both widely distributed and may even cohabit in the same house. Both are present in Australia, although *D. pteronyssinus* predominates; *D. farinae* may be the more recent arrival in that country (Green *et al.* 1986).

Although each species has differing temperature and humidity preferences (Arlian *et al*, 1979) these fall within the range offered by Australia and New Zealand. Thus, differing rates of spread, or timing of introduction to Southern Hemisphere countries, as earlier suggested, may be one reason behind the limited records of *D. farinae* in this part of the world.

Arlian (1989) reported that different localities in the United States favoured different mite species, with the more humid, warmer regions favouring *D. pteronyssinus*. Although he thought temperature and humidity factors were important influences on the distribution of each species, the reason for the differences was probably multifactorial. New Zealand houses and climate generally are regarded as being relatively humid. House dust mite species distribution and prevalence need to be evaluated in terms of relative humidity and temperature.

Arlian (1989) noted that seasonal cycles in prevalence tended to occur in cooler, drier localities, with more uniform seasonable prevalence in warmer and wetter ones. It would be useful to have such information in the New Zealand context, as year-round availability of mites at high densities and prevalence might have some bearing on high asthma prevalences.

Establishing meaningful mite density figures is fraught with difficulty, particularly if comparisons are sought with other studies. The figures reported here and elsewhere indicate great variability within and between homes, probably reflecting the variety of substrates examined and household conditions encountered. Also, high standard deviations in sample populations reflect, at least in part, the inadequacies of the vacuum cleaning technique as a reliable estimation of population densities. Housekeeping practices and age of house or furnishings are not believed to be significant (Arlian 1989), but long, loose pile carpets are a better mite habitat than short pile carpets which in turn are better than bare floors. Living room furniture (chairs, cushions etc) provide a better habitat than the floor or carpet beneath, although the reverse can sometimes be true for the relationship between mattresses and bedroom floors (Arlian 1989). The present study indicates higher densities in mattresses and furnishings than on floors. As all houses examined had mites present, factors relating to age and fabric of the house were not able to be correlated with mite presence or absence.

Despite inherent methodological problems that prohibit detailed comparisons with other studies (see above), mite densities recorded here seem high and exceed the benchmark figure of 200 mites/g regarded as being significant for allergy sufferers (Smith *et al.* 1985).

Mites, allergy and asthma

As all houses in the survey contained house dust mites, and *D. pteronyssinus* in particular, no relationship could be established between the presence or absence of mites and the prevalence of asthma in each case. However, a clear relationship exists between the sensitivity to house-dust mite allergens and the presence of asthma.

Curiously, in the light of the species records, the skin tests showed a more frequent response to *D. farinae* than to *D. pteronyssinus*, a result that was also found in Australia by Green *et al.* (1986). These authors thought that the relative strength of the test solutions favoured *D. farinae* but we received no indications that this was the case in the present study. Arlian *et al.* (1987) demonstrated a number of cross-reacting antigens between the two species, and that IgE binding to specific antigens was to some extent, related to the degree of exposure to individual species.

Skin prick tests are not in themselves certain indicators of clinical allergy as indicated by the results here and in other studies where non-allergic individuals showed positive responses to skin tests (Arlian *et al.* 1979). However, positive tests are useful indicators of a probable root cause of allergy or asthma and therefore of benefit to control.

Our results suggest that test extracts of both species should continue to be used, a policy recommended by Smith *et al.* (1985) in the United States who thought that extract from only a single species might not identify all mite allergenic patients.

CONCLUSIONS

The dominance of *D. pteronyssinus* may be a result of environmental conditions favouring this particular species, although geographical distribution factors may also play a role. The same environmental factors may also be responsible for high prevalence and high mite densities in New Zealand homes. Prevalences, densities and seasonal factors need to be established in a wider geographical range of New Zealand houses, and predisposing factors of house structure, furnishing, air conditioning and maintenance examined as to their role in supporting mite populations and airborne allergens.

The results of this study confirm the relationship between house dust mite sensitivity and the prevalence of asthma in New Zealand.

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