

HOUSE DUST MITES AND SKIN TESTS IN DIFFERENT AUSTRALIAN LOCALITIES

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Abstract:

Dermatophagoides mite concentrations in household dust have been measured in three Australian towns with contrasting geographical features, climate, and degree of urbanisation. Mite allergen skin tests on school children living in these areas showed that the prevalence of positive reactions varied with mite concentrations.

In Belmont, *D. farinae* as well as *D. pteronyssinus* were present in some of the dust samples.

Skin test weals were larger in Busselton than in either Wagga Wagga or Belmont.

The importance and practical implications of these findings are discussed. (Aust NZ J Med 1986; 16: 639-643.)

Key words: House dust mite, *Dermatophagoides*, allergen, skin tests, bronchial hyperreactivity, asthma.

It is generally assumed that asthma is related in some way to the atopic state, but the relationship between atopy and asthma is far from clear. Factors which determine the degree of atopy and the specificity of responses in atopic subjects are not known. In particular, the relationship of the density of allergenic mite populations to the intensity of skin reactions and to allergic symptoms remains unclear.¹

House dust mites have been studied in many parts of the world²⁻⁵ and it is known that they favour geographically damper areas.^{6,7} No comparative studies of mite prevalence have been reported in different parts of Australia, where climate varies greatly, and neither have mite numbers been related to mite atopy in different areas. In view of this, mites were studied in three different Australian localities: Belmont, NSW (urban coastal); Busselton, WA (rural coastal); and Wagga Wagga,

NSW (rural inland) during studies of the prevalence of asthma and atopic status of Australian children.

MATERIALS AND METHODS

With prior consent of their parents, samples of children aged eight to nine years living in Belmont and Wagga Wagga, and eight to 15 years living in Busselton, were skin tested with *Dermatophagoides pteronyssinus* and *Dermatophagoides farinae* allergens, and mite densities were determined in dust samples collected from a random sample of approximately 5% of the childrens' houses.

Dust Samples

Approximately 10 g to 20 g amounts of vacuum cleaner dust were collected from a random sample of houses of children attending the studies. The samples were taken over three-week periods in June and October of 1982 in Belmont; in June of 1982

TABLE 1
Mite Counts in Vacuum Cleaner Dust from Three Australian Towns, Belmont, NSW; Wagga Wagga, NSW; and Busselton, WA

Place	Time of Collection	No. of Samples	No. of Samples containing <i>Dermatophagoides</i> *	Mite Count	
				Mean	Range
Belmont	June, Oct. 1982	32	30 (94%)	441	0-26
Wagga	June, Oct. 1982	67	10 (15%)	10	0-1
Busselton	Dec. 1981, May 1983	43	43 (100%)	275	40-15

* $p \leq 0.001$ for significant difference between Busselton and Wagga, Belmont and Wagga.

and October of 1983 in Wagga Wagga; and in December of 1981 and May of 1983 in Busselton. The samples, sealed in small polythene bags, were stored in a freezer to halt further multiplication of the mites or their depletion by predation or disintegration, pending counting of the numbers.

Mite Counts

The dust samples in the polythene bags were mixed thoroughly by shaking and teasing apart any fibrous material. The coarse material was sieved through an s425 stainless steel mesh, and 0.2 g aliquots of the fine dust were further treated and examined microscopically for *Dermatophagoides* mites as described previously.⁸ Dead and living *Dermatophagoides* mites were counted and the concentration was expressed as mites per gram of dust. The mite samples from the three towns were assessed by the same examiner throughout the studies. In addition, since it was noticed that some of the Belmont dust samples contained *D. farinae* as well as *D. pteronyssinus*, five samples from this area were examined in detail and separate counts were made of the two species.

Skin Tests

Skin prick tests using *D. pteronyssinus* (1500 PNU; PNU = protein nitrogen unit) and *D. farinae* 1:50 w/v, 10,000 PNU) in 50% glycerine (Dome/Hollister-Stier, Division of Miles Laboratories, Australia Pty Ltd) were made on randomly selected eight to nine year old primary school children in Belmont and Wagga Wagga and in children aged eight to 15 years in Busselton. The same batches of allergen were used throughout the tests. The skin tests were made on the volar aspect of the forearm using the pin-prick method of Pepys.⁹ Weals of 2 mm x 2 mm diameter or greater were considered positive provided that a saline control solution gave no reaction and that there was a positive reaction to histamine.

Meteorological Data

Records of temperature and relative humidity taken at 3 p.m. daily and averaged over 48 years in

Busselton, 44 years in Wagga Wagga, and 16 years in Belmont were obtained from the Bureau of Meteorology, Sydney, and the mean monthly relative humidities and maximum and minimum temperatures of the three areas were graphed over a period of one year.

Statistics

Chi squared analysis was used to determine the significance of the difference between mite counts in the three towns, the difference in mite atopy, and the significance of the association between weal size and place of residence.

RESULTS

Mite Densities

The results of mite counts are shown in Table 1. Thirty (94%) of the Belmont samples examined contained *Dermatophagoides*.

All Busselton samples contained *Dermatophagoides* but no *D. farinae* were found. The mean mite density of the Belmont samples was roughly one and one-half times that of Busselton, but statistically this was not significant.

Only 15% of the Wagga samples contained *Dermatophagoides*. No *D. farinae* were found. The mite densities in Wagga Wagga were significantly lower than in either Belmont ($p \leq 0.001$) or Busselton ($p \leq 0.001$).

In five Belmont samples selected for more detailed study, *D. farinae* as well as the more commonly seen *D. pteronyssinus* were seen. Differential counting of both species in these five samples showed that three of them also contained *D. pteronyssinus* and none of them contained *D. pteronyssinus* alone (Table 2).

TABLE 2
Five Dust Samples from Belmont, NSW, Examined in Detail for *D. farinae* and *D. pteronyssinus*

Sample	<i>D. farinae</i> /g	<i>D. pteronyssinus</i> /g
1	200	nil
2	440	nil
3	80	40
4	889	1777
5	293	587

TABLE 3
Prevalence (%) of House Dust Mite Atopy in School Children from Belmont, NSW, Busselton, WA, and Wagga Wagga, NSW

	Belmont	Busselton	Wagga
No. of Subjects	718	783	769
% atopic to:			
<i>D. pteronyssinus</i>	20.3	24.1	11.3
<i>D. farinae</i>	25.9	25.1	17.9
<i>D. farinae</i> or <i>D. pteronyssinus</i> *	27.0	28.0	18.9
<i>D. farinae</i> + <i>D. pteronyssinus</i>	18.8	14.2	10.4

* $p \leq 0.001$ for significant difference between Belmont and Wagga, Busselton and Wagga.

Skin Tests

Of the Belmont children, 20.3% had positive skin reactions to *D. pteronyssinus* and 25.9% to *D. farinae* allergen; 27.4% were positive to one or both mite allergens and 18.8% were positive to both (see Table 3).

Of Busselton children, 24.1% were positive to *D. pteronyssinus* and 25.1% were positive to *D. farinae*; 28% were positive to one or both mites and 14.2% were positive to both mites. Of Wagga children, 11.3% were positive to *D. pteronyssinus* and 17.9% were positive to *D. farinae*; 18.9% were positive to one or both mites and 10.4% were positive to both mites.

Skin reactions in Wagga Wagga children were less frequent than in Busselton ($p \leq 0.001$) or Belmont ($p \leq 0.001$) children. The frequency of positive reactions in Busselton was similar to that in Belmont, though the severity of the reactions, as shown by the increased frequency of weal sizes in the 4–6 mm range, was greater ($p \leq 0.001$) in the Busselton children. Weal sizes in Wagga were similar to those in Belmont.

Meteorological Data

The mean monthly relative humidity and maximum and minimum temperatures of the three towns are shown in Figures 1 and 2.

Maximum temperatures in Wagga Wagga were higher than those in either Belmont or Busselton during summer and autumn (November to April) and lower during the winter and spring. The

TABLE 4
Prevalence (%) of Skin Reactions to Mite Allergen (*D. pteronyssinus* or *D. farinae*) in Ascending Categories of Size

	Weal size (mm × mm*)			
	2 × 4	4 × 6	6 × 8	8 × 8
Belmont N = 718	17	6.7	2.4	1.4
Busselton N = 783	12	11.9	3.2	0.9
Wagga Wagga N = 769	12.7	2.9	2.2	1.0

* $p \leq 0.001$ for significant difference between Busselton and Belmont, Busselton and Wagga.

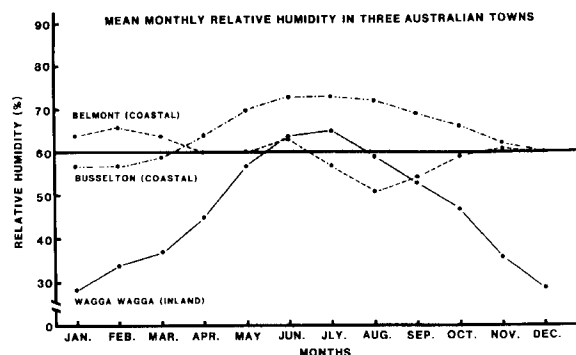


Figure 1: Mean monthly relative humidity in three Australian towns. The horizontal line at 60% indicates the relative humidity below which mites cease to thrive, and die out. Note that the relative humidity in Wagga Wagga is below 60% for most of the year.

minimum temperature in Wagga Wagga was lower than 15°C for ten months of the year (March to December). Busselton maxima were higher than Belmont's all year round, and the minima were lower than Belmont's during the winter (May to September).

Relative humidity in Busselton ranged from 57% in January to 73% in July, and that in Belmont from 51% in August to 66% in February. Humidities in Wagga Wagga were much lower than in Busselton or Belmont and ranged from 29% in January to 65% in July. In general, monthly temperature and humidity changes throughout the year were greatest in Wagga Wagga. The difference between maxima and minima were also greatest in Wagga Wagga.

DISCUSSION

The results show that, at the time of our sampling, the densities of mites per gram of house dust were much lower in the inland town of Wagga Wagga than they were in either of the coastal towns of

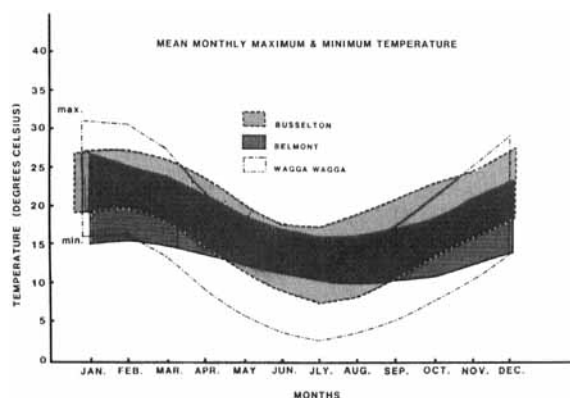


Figure 2: Mean monthly maximum and minimum temperatures in Belmont, NSW; Busselton, WA; and Wagga Wagga, NSW.

Belmont or Busselton. Although dust from Belmont contained a mean count of one and one-half times the number of mites in the Busselton dust samples, the large variations in the number of mites in the samples accounted for the lack of statistical difference in the mite densities found in these two towns.

Meteorological data confirm that both Belmont and Busselton have mild, sea-tempered climates and relative humidities that rarely drop below 60%. Wagga Wagga, in contrast, is drier and hotter in summer and colder in winter. Although mites are not particularly temperature sensitive and can still multiply at 15 °C, it has been shown that at relative humidities below 60% mite communities stop growing and die out.¹⁰⁻¹² The frequent low humidities recorded in Wagga Wagga are probably responsible for the scarcity of house dust mites in that area.

The increased frequency of positive skin tests in Busselton and Belmont over those in Wagga Wagga probably reflects the greater mite densities found in the houses in these two towns. Considering the low mite densities in Wagga Wagga, the skin reactivity to mites, although not as prevalent as in Busselton or Belmont, was surprisingly high. The reason for this is not known. As well as the physical factors of climate and geography, the construction, age, and condition of dwellings, heating, humidification, ventilation, bedding, furnishings, social habits, and life style of the inhabitants could all influence the growth and development of mites in an area.⁵ There may be times when the mite counts are higher than those found in this small survey, possibly during the highly humid winter months. However, the low temperatures of that time do not favour proliferation of mites. In addition, many *Dermatophagoides*-positive subjects in Wagga Wagga have probably had contact with mites in places other than their houses, such as when living away from home or on holidays in other areas. Forty-one per cent of mite-positive children in Wagga had lived away from the area for more than six months. Alternatively, cross reactions between other allergens and mites may possibly explain the relatively high percentage of positive skin reactions to house dust mites in the Wagga Wagga population. Mites are known to give cross reactions with other arthropoda.¹³ The degree of exposure to these allergens is unknown but the possibility to cross reaction of other allergens with *Dermatophagoides* has not been excluded.

The significance of the larger skin weals found in Busselton is not known. A possible explanation is that the mean age of the Busselton children was higher than that in Belmont. The findings of *D.*

farinae as well as *D. pteronyssinus* in Belmont may reflect local conditions there. Other studies in Europe,¹⁴ Sydney,¹⁵ and North America,¹ confirm that the two species can co-exist in the same environment although the ratio of one species to the other may vary greatly. It is noteworthy that there were high numbers of positive skin reactions to *D. farinae* in all three towns, although *D. pteronyssinus* is the predominant mite. This was probably due to the greater concentration of the *D. farinae* skin testing solution as compared to that of *D. pteronyssinus*.

No *D. farinae* were found in Wagga Wagga or Busselton, although its absolute absence in these towns has not been established. *D. farinae* has only recently been reported¹⁵ in Sydney, Australia. Its presence in Belmont at least indicates that the mite is not confined to Sydney. More studies are needed to establish whether *D. farinae* is a recent arrival to this continent and is increasing its domain.

Since other studies have shown that bronchial hyperreactivity may exist independently of atopic status,¹⁶ it is unlikely that allergen exposure is the fundamental factor producing the underlying hyperreactivity of asthma. Allergens can provoke asthmatic symptoms in atopic subjects who have hyperreactive airways and the amount of offending allergen in the environment is therefore important to these atopic subjects. *Dermatophagoides* is such an allergen and, there is some evidence that the degree of bronchial hyperreactivity, once present, is altered by the degree of exposure to allergens. It has been shown¹⁷ that allergen avoidance by asthmatics can result in a reduced bronchial hyperreactivity as well as clinical remission of symptoms, while increased exposure to allergens can produce an increase in bronchial hyperreactivity.^{18,19} A knowledge of areas of high mite occurrence should enable valid choices to be made, at least in the short term, about place of residence, employment, or vacations and permit many to avoid some of the distressing symptoms provoked by mite allergens, and possibly reduce their bronchial hyperreactivity as well.

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BOOK REVIEW

LIFE WITH THE PNEUMOCOCCUS. Notes from the Bedside, Laboratory, and Library. By Robert Austrian. University of Pennsylvania Press, 1985. 168 pp. Recommended retail price US\$25.00 (hardback).

Robert Austrian is Professor and Chairman of the Department of Research Medicine, University of Pennsylvania School of Medicine, and Director of the WHO Collaborating Centre for Reference and Research on Pneumococci at the University of Pennsylvania. The book is a collection of 13 essays concerning the pneumococcus. The essays start with the history of laboratory studies with this organism and the extensive bibliography provides revealing insights into medicine at the turn of the century.

In general the essays are descriptive and narrative in style although one on 'The Current Status of Pneumococcal Vaccines' has a more scientific treatment. I particularly enjoyed the history of pneumococcal vaccines in South Africa entitled 'Of Gold and Pneumococci'. As can be expected the author's personal philosophy is prominent and his essay entitled 'Microbiology and Clinical Medicine — A Personal View' concludes that the welfare of the patient is paramount to the quality of care, teaching, research and laboratory medicine, and is a central tenet to be maintained in an era of rapidly advancing technology and knowledge explosion.

The book has a hard cover, the paper quality is not good, and the limited photographs are black and white only and of average quality. However it is not expensive, being only US\$25.00.

The book can be recommended as entertaining reading for those physicians and microbiologists with a historical and philosophical view but it clearly does not have large audience appeal.

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