

The seasonal variation in a population of house dust mites in a North American city

Andrew B. Murray, M.B., F.R.C.P., and Peter Zuk, B.Sc.

Vancouver, B. C., Canada

Mattress dust collected at monthly intervals for 2½ yr was examined for mites. Both Dermatophagoides pteronyssinus and D. farinae were found. There was a significant association between the presence of live mites and the relative humidity (RH): Live mites were seen only when the RH had been ≥50% for at least part of every day during the month of collection. There was a seasonal variation in that live mites were found only in the warmer months and not in the winter. However, the peak in the mite population was consistent neither for month nor for numbers: In 1977 a slight peak in mite numbers occurred in October, while in 1978 the peak was higher and occurred in July. Use of data from previously published studies to predict mite levels may therefore be misleading.

The seasonal variation in numbers of house dust mites is of interest because episodes of house dust-induced asthma are said to occur more frequently in months when mite numbers are highest.^{1, 2}

The season in which mites are present in greatest numbers seems to vary from country to country. A peak has been reported in the late spring in London³; in the summer in Brisbane,⁴ Tokyo,⁵ and Riverside, Calif.⁶; in the autumn in Basel⁷; and in the winter in Honolulu.⁸ There have been two studies in The Netherlands. The highest mite counts were found during the early autumn in Leiden in 1964⁹ and during the late summer in Nijmegen in 1971.¹⁰

While the season and height of the annual peak in mite numbers are known to vary from place to place, no study has continued for the 2-yr period needed to show whether the season and height of the peak remain consistent in one geographical area. We therefore undertook a study to determine when mites are most numerous in Vancouver, and whether the month of greatest prevalence and the numbers counted were the same in two successive years. Since mites need

adequate humidity for survival, we also investigated the association between relative humidity (RH) and the presence of live mites.

METHODS

Mites were counted in the dust collected from mattresses, the principal source of *Dermatophagoides* mites.^{6, 10, 11} Dust was collected from the top surface of an innerspring mattress on a bed in each of three different bedrooms. Bedrooms A and B were on the ground and second floors respectively, of one house. Bedroom C was on the second floor of a house 6 miles away. The bed in room A was used for only 6 wk out of the year while the beds in rooms B and C were occupied every night. Dust was collected from each mattress during the last 2 wk of every month. The method of collecting and examining the dust was a modification of one described by Hughes and Maunsell.³ Briefly, the dust from 1 m² of mattress surface was brushed onto a piece of stiff, black paper. The area sampled was alternately the head and foot of the bed. The dust that was collected was brushed into a bottle of 80% alcohol and later transferred to a Petri dish in the laboratory. Mites were counted under a stereomicroscope and transferred with tweezers to a watch glass. Mites were classed as alive (white and full-bodied) or dead (amber and shrivelled). This process was continued until all the mites were removed from the Petri dish. The mites were cleared in lactic acid, mounted on slides, and examined for positive identification.

In order to find whether the counts were reproducible, two independent observers counted the mites in eight samples of dust. The results were identical in six samples, differed by one mite in one sample, and differed by two mites

From the Department of Paediatrics, University of British Columbia, and Agriculture Canada, Vancouver.

Supported in part by a grant from the B. C. Lung Society.

Received for publication Dec. 14, 1978.

Accepted for publication May 2, 1979.

Reprint requests to: Dr. Andrew B. Murray, Children's Hospital, 250 W. 59th Ave., Vancouver, B. C., Canada, V5X 1X2.

in another. An attempt was also made to determine the reproducibility of the collection method by brushing the dust from the top half of a mattress into one container and that from the lower half into another. The collections were made from three mattresses that were not in the study. The numbers of mites obtained from the two halves of the mattresses were 28 and 22, 0 and 0, and 41 and 32. It is likely that the uneven distribution of the mites on the surface of the mattresses as well as the error of the method were responsible for the differences.

Records of indoor RH and temperature were obtained from hygrothermographs (R. Fuess), which had been calibrated by means of a standardized glass thermometer, and a sling psychrometer (Cenco). A continuous recording was made in room C throughout the study period. Intermittent recordings were made in both rooms A and B for at least a week at a time. Recordings were made in all three rooms in all but 4 mo during the study period. Heating of both houses was by a forced-air heating system thermostatically controlled at 20.5° C in the house with rooms A and B and at 18.3° C in the house containing room C.

A preliminary survey was made from September, 1976, until March, 1977. The study proper was started on April 1, 1977, and ended on March 31, 1979.

Fisher's exact test was used to measure the association between two variables. The result was significant when $p < 0.05$.

RESULTS

All of the mites that were found belonged to the genus *Dermatophagoides*—67% were *D. pteronyssinus* and 33% were *D. farinae*. Live specimens were present in September, October, and November, 1976, during the preliminary study. In the study proper, live mites were present in September and October, 1977, and from April until October, 1978 (Fig. 1). Dead mites were found in one or more samples taken in all months except those taken between April and July, 1977.

In 1977 a small population peak occurred in October. In 1978 the peak was higher and occurred in July (Fig. 1). The mite numbers were unequally distributed not only between the 2 yr but also among the three rooms (Fig. 2). The great majority of mites were found in room A, a small number were found in room B, and very few were found in room C.

There was a significant association between RH and the presence of live mites (Table I). Live mites were found on a mattress only when the RH in the room had been $\geq 50\%$ for at least part of every day during the month of collection. While mites survived a $< 50\%$ RH drop for several hours, as happened on some summer days, they did not survive the more prolonged periods of low RH that occurred during the winter.

Differences in RH and temperature were not great, either between the 2 yr of the study or among the three

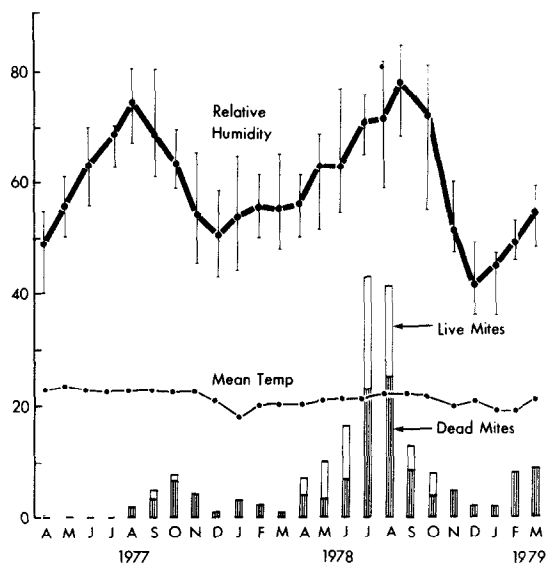


FIG. 1. The average number of live and dead mites collected monthly from 1 m² of mattress surface. The relative humidity (maximum, mean, and minimum) and the mean temperature are those measured in bedroom C.

rooms. RH and temperature were recorded in all three rooms during the months of April, June, August, September, and October in 1977 as well as in 1978. During these months, room A, where the great majority of mites were found, had a mean RH 3% higher and a mean temperature 1° C lower in 1978 than in 1977. In 1978 continuous recordings of RH and temperature were available for all three rooms from April to October, the months when live mites were present. The mean RH was 67% in room A, 66% in room B, and 68% in room C. The mean temperature was 18° C in room A, 17° C in room B, and 21° C in room C.

DISCUSSION

Although there was a seasonal variation, in that live mites were absent in the winter and appeared during the warmer months, the annual peak in mite population was consistent neither for calendar month nor for the number of mites. The 1978 peak occurred 3 mo earlier and was considerably higher than the 1977 peak (Fig. 1). The practice of using data from previously published studies to predict mite levels¹²⁻¹⁵ may therefore be misleading.

There was a significant association between the presence of live mites and an RH of $\geq 50\%$ for at least part of every day (Table I). This is consistent with the known dependence of mites on an adequate RH for survival. When the RH falls below 70%, mites lose water through transpiration and become dehydrated.¹⁶ If they obtain moisture from food, they can make good the water loss and are able to withstand an RH of 60%. When the RH falls to 50%, all *D. farinae* die

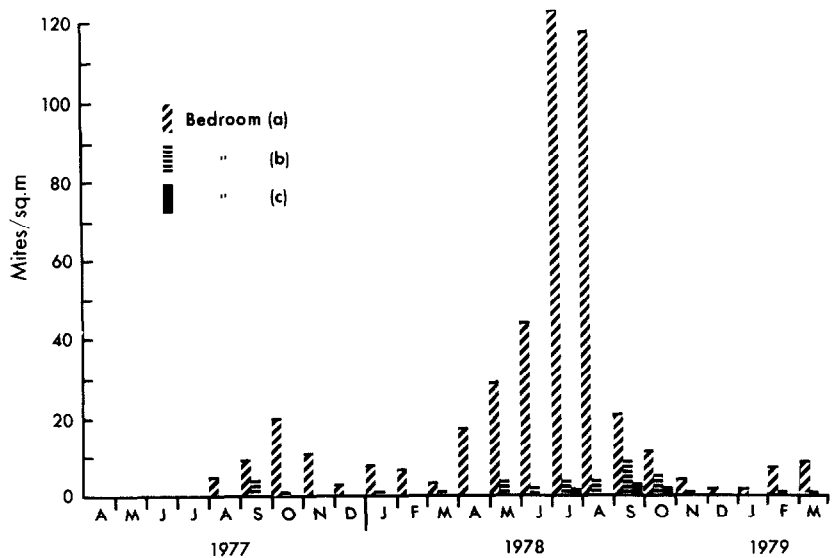


FIG. 2. The monthly total numbers of mites collected in each bedroom from 1 m² of mattress surface.

TABLE I. The relationship between survival of mites and a room with an RH of $\geq 50\%$ for at least part of every day during the month of collection*

RH $\geq 50\%$	Live mites			
	Present		Absent	
	No.	%	No.	%
Yes	16	44.5	20	55.5
No	0	0	29	100

*p < 0.001.

within 11 days¹⁷; *D. pteronyssinus* are even less able to withstand a low RH.¹⁸ The RH in all the rooms that were studied fell below 50% at the onset of cold weather in December, 1976, and in November, 1977 and 1978, when increased heating was needed to maintain a constant indoor temperature. No live mites were found thereafter. In some studies, however, live mites have been found in mattress dust the year-round, though in reduced numbers during the winter when the RH fell below 50%.^{6, 10} The survival of small numbers of mites in those studies may have been because the beds were occupied every night, since the RH in a bed rises when it is occupied.¹⁰ The bed in room A, where the majority of mites were found, was occupied for only 2 wk during the winter. Consequently there were long periods when the mites on the mattress were exposed to an RH below the critical level for their survival.

A difference in RH may have contributed to an earlier and higher peak in mite numbers that was observed in 1978; certainly for *D. pteronyssinus* there

appears to be a close relationship between increasing RH and increasing mite numbers¹⁰. But a difference in RH cannot explain the unequal distribution of mites among the rooms. The RH was much the same in all of them.

The temperature in both houses was thermostatically controlled and was adequate not only for mite survival but also for reproduction. House dust mites can survive freezing temperatures and are able to reproduce at 17° C, albeit rather more slowly than at 25° C.¹⁹ Although temperature variations may have had some effect on the rapidity with which the mites multiplied, it is unlikely that a difference in temperature accounted for the earlier and larger peak in 1978 or for the unequal distribution among rooms: The mean temperature between April and October was lower in 1978 than in 1977, and the mean temperature was highest in the room with the least number of mites, room C.

A separate study is in progress to find whether there is a relationship between mite numbers and mite-induced allergic respiratory symptoms.

We thank Dr. R. A. Forbes, Head, Entomology Section, Agriculture Canada, Vancouver, for advice and for critical reading of our manuscript; Dr. Brenda Morrison and Mr. Ronald Sizto for statistical help; Mr. Cho-Kai Chan for mounting the specimens; and Dr. E. E. Lindquist, Agriculture Canada, Ottawa, for positive identification of the mites.

REFERENCES

1. Van Bronswijk JEMH, Sinha RN: Pyroglyphid mites (*Acari*) and house dust allergy. *J Allergy* 47:31, 1971.
2. Voorhorst R, Spieksma FTM, Varkamp H, Leupen MJ, Lyklema AW: The house dust mite (*D. pteronyssinus*) and the

- allergens it produces. Identity with house dust allergen. *J Allergy* **39**:325, 1967.
3. Hughes MA, Maunsell K: A study of a population of house dust mites in its natural environment. *Clin Allergy* **3**:127, 1973.
 4. Domrow R: Seasonal variation in numbers of the house dust mite in Brisbane. *Med J Aust* **2**:1248, 1970.
 5. Miyamoto J, Ouchi T: Ecological studies of house dust mites. Seasonal changes in mite populations in house dust in Japan. *Jpn J Sanitary Zool* **27**:251, 1976.
 6. Furumizo RT: The biology and ecology of the house dust mite *Dermatophagoides farinae*. Ph.D. dissertation, University of California, Riverside, 1973.
 7. Spieksma FTM, Zuidema P, Leupen MJ: High altitude and house dust mites. *Br Med J* **1**:82, 1971.
 8. Sharp J, Haramoto F: *D. pteronyssinus* and other *Acarina* in house dust in Hawaii. *Proc Hawaiian Entomol Soc* **20**:583, 1970.
 9. Spieksma FTM, Spieksma-Boezeman MIA: The mite fauna of house dust with particular reference to the house dust mite *Dermatophagoides pteronyssinus*. *Acarologia* **9**:226, 1967.
 10. Van Bronswijk JEMH: *Dermatophagoides pteronyssinus* (Troussart, 1897) in mattress and floor dust in a temperate climate. *J Zool Entomol* **10**:63, 1973.
 11. Sesay HR, Dobson RM: Studies on the mite fauna of house dust in Scotland with special reference to that of bedding. *Acarologia* **14**:384, 1972.
 12. Cookson JB, Makoni G: Seasonal asthma and the house dust mite in tropical Africa. *Clin Allergy* **5**:375, 1975.
 13. Pauli G, Bessot JC, Thierry R, Lamensans A: Correlation of skin tests, inhalation tests and specific IgE to house dust and *Dermatophagoides pteronyssinus*. *Clin Allergy* **7**:337, 1977.
 14. Van Niekerk CH, Shore SC, Weinberg EG: The house dust mite and childhood asthma in the Cape peninsula. *S. Afr Med J* **52**:74, 1977.
 15. Warner JO, Price JF: House dust mite sensitivity in childhood asthma. *Arch Dis Child* **53**:710, 1978.
 16. Larson DG: The critical equilibrium activity of adult females of the house dust mite, *Dermatophagoides farinae*. Ph.D. thesis, Hughes, Ohio, 1969.
 17. Brandt RL, Arlian LG: Mortality of house dust mites, *D. farinae* and *D. pteronyssinus*, exposed to dehydrating conditions or selected pesticides. *J Med Entomol* **13**:327, 1976.
 18. Wharton GW: Review article. House dust mites. *J Med Entomol* **12**:557, 1976.
 19. Spieksma FTM: The house dust mite *Dermatophagoides pteronyssinus*, producer of the house dust allergen. Ph.D. thesis, University of Leiden, Netherlands, 1967.

Copyright information

The appearance of a code at the bottom of the first page of an original article in this journal indicates the copyright owner's consent that copies of the article may be made for personal or internal use, or for the personal or internal use of specific clients. This consent is given on the condition, however, that the copier pay the stated per copy fee through the Copyright Clearance Center, Inc., P.O. Box 765, Schenectady, N.Y. 12301, 518-374-4430, for copying beyond that permitted by Sections 107 or 108 of the U.S. Copyright Law. This consent does not extend to other kinds of copying, such as copying for general distribution, for advertising or promotional purposes, for creating new collective works, or for resale.