

Subtropical Acarien Profile By Topography, Seasons and Change of House Furnishings: 80's Blueprint to the Future

Douglas G. Massey MD, MSc, FACP, FRCPC; Bradley E. Hope MD; and Roy T. Furumizo PhD

Abstract

Background: In Hawai'i, mortality and morbidity from asthma are significant. In the 80's, there had been no local studies of topography folklore. There had been only one report of seasonal variation in house dust mite (HDM) density in Hawai'i, and this showed no significant variation in O'ahu's Manoa Valley, but a definite variation in Waikiki. There were no studies of complete replacement of furnishings.

Objective: In this pilot study, homes in a valley, coastal, and plain sites were investigated for 12 months in 2 homes on O'ahu. A 3rd home was studied prior to and after arrival of furnishings from Denver, Colorado.

Methods: Of the 3 homes, #1 was in Palolo Valley, Honolulu, #2 coastal at Pearl Harbor and #3 on the plain at Mililani. House dust samples were taken from 4-5 sites in 2 rooms every 5 weeks. Sampling and determination of density and species were those of Furumizo.

Results: They were unsupportive of the topography and seasonal variation folklore. Density surged in the 3rd home to >12000 mites/gram of dust within 10-15 weeks with the complete change of low density HDM furnishings. *D. pteronyssinus* (Dp) was dominant in each home year-round. Minor species of mites made up to 1/3 of total mites in 2 homes.

Conclusion: The folklore relating improvement in asthma to geography was not supported. 2 of the 3 homes showed minimal seasonal variation in HDM density. Local mites heavily colonized furniture from high altitude Colorado in a surge within 10-15 weeks.

Introduction

In Hawai'i, mortality and morbidity from asthma is much higher than those in the continental US.¹ This may be due to high levels of HDM, and its major allergic component.² Folklore ascribes this to, among other causes, geography, seasons, and/or furnishings. An earlier study investigated HDM density over an 8 month period and showed seasonal variation in Waikiki, a coastal area, but not in the inland adjoining Manoa Valley.³ Studies have demonstrated a significant seasonal pattern of HDM density in Ohio, Virginia, Australia, and Europe.⁴⁻⁷ Minor mite species commonly occur in Hawai'i as in southern US cities, especially *Euroglyphus maynei* and *Blomia tropicalis*.⁷ HDM density appears to be dependent on relative humidity (RH) and indoor temperature.⁷⁻⁸

The density of acariens in home furnishings in Denver is very low.⁹

In the 70's, host and environmental factors in acute and chronic asthma were investigated by Dr. Benjamin Gordon and Dr. Gisele Fournier-Massey, co-investigators based at the Research Unit, Kua-kini Medical Center, Honolulu. Patients were recruited from door to door surveys and emergency room attendees for asthma. Short and long questionnaires were completed. Simultaneous data collection involved meteorology, air pollution, acariens, fungus and pollens. The study of evidence based etiological factors terminated in 1983.

In 1984-85, a pilot study of 3 factors drawn from local folklore: geographical difference in asthma, seasonal changes, and modification of furnishings is now reported. It guided the research of the following decades.

Methods

Sampling was done from 3 homes on O'ahu occupied by non asthmatics: home #1 in a valley in Honolulu, no air conditioning (AC); home #2 coastal near Pearl Harbor, with AC; and home #3 in Mililani in the central O'ahu plain, without AC and with furnishings that just arrived from Denver, Colorado. Samples were from the living room sofa and carpet, and from bedroom bedding and carpet. With each sampling, temperature and humidity were measured, the latter by a sling psychrometer. Rainfall data was from Federal sources.

The dust collections were performed during the months of March 1984 to March 1985 for houses #1 valley and #2 coastal, and between July, 1984 and March 1985 for home #3 central plain.

The method of Furumizo involved a house dust concentrator, collection of dust, a volumetric washing technique, and the identification and counting of acariens.¹⁰ The house dust concentrator consisted of 4 parts: receptacle cover, sieve insert tube, receptacle tube and a rubber seal. The receptacle cover had a hole large enough to receive the vacuum crevice wand. The sieve tube consisted of a screw cap vial with its bottom replaced by a 44 mesh sieve which trapped dust and mites. The receptacle tube and rubber seal were attached to the hose assembly of a vacuum cleaner. The dust was collected from a 3x3 foot area over 3 minutes. After each sample (1 dust sample per sieve tube) was collected, the sieve insert tube was removed and placed in a 237 ml screw top jar with 40% ethyl alcohol and a coarse wire mesh. This usually occurred immediately, as the dust was not weighed. High ambient humidity in Hawai'i made it difficult to maintain the dust dry long enough to weigh it accurately.

The volumetric washing technique, which was used to quantitatively record the dust and to isolate mites from the house dust samples, involved a washing container, Buchner funnel, and compound microscope. The dust sample in the screw top jar was shaken to remove coarse dust and poured through a standard nest of 4 sieves (#9, 16, 36, and 325 mesh). The sieve insert tube, which retained the dust, was rinsed repeatedly with water and the house dust concentrator was cleaned and dried. The HD from the 4th sieve (325 mesh) was rewashed with aerated tap water to force through any of the finer dust particles and transferred to a graduated cylinder. Tapping occasionally over 24 hours produced maximum settlement and then the volume was recorded in milliliters. The sedimented dust was then transferred to the 88ml plastic screw top vial. The cylinder was washed in 40% alcohol which was added to the vial to give a total volume of approximately 75 ml. With larger amounts of dust or washing alcohol, a 118 ml plastic vial was used.

The counting of the acariens began with pipetting the contents of the vial evenly onto a filter paper in a Buchner funnel with water suction. Intact mites were individually collected by probe from the filter paper and mounted in Hoyers media. After fixation in an incubator at 30 degrees Celsius for at least 2 days, intact mites were counted and identified. Each filter paper and filter was scanned independently by one author and all by Furumizo.

Results

Using HDM density and species as markers of asthma severity, the 3 homes were compared for the effect of geography, seasonal temperature, relative humidity (RH), and rainfall (figure 1), and their furnishings of the living room and bedroom.

Mite Density

Homes: Density ranged from extremes of 1,000 to 12,000 mites/gram with minimal variation over 12 months. The largest variation occurred in home #3 from mid-August to mid-September followed by relative stability (figure 2). This surge was initiated by substituting of furnishings from high altitude.

Furnishings: For the valley home, density varied little from sofa, to carpet to bedding. In coastal home #2, density was the greatest in the bedding (figure 3). In the plain home, the peak density was greatest in the living room carpet, and remained so. The smallest increase was seen in the bedding.

Environment: Temperature correlated positively with density in homes #1 and #2. With decreased temperature, density declined earlier in the bedroom carpet then in the living room carpet, bedding and sofa (figure 4).

RH was positively correlated with increased density in home #2 ($r=0.39$, $p<0.04$). Correlation was largest between RH and density with the living room carpet, the smallest with the sofa. Variation in monthly rainfall had a relatively small affect on density. There was an unexpected reverse correlation of rainfall and density in home #1 and a slightly positive correlation in home #2.

Species

Homes: The prevalent species was always Dp, followed by Euroglyphus sp. in home #1, Df in home #2, and Glycyphagus in home #3. Glycyphagus sp. was the next most abundant in home #1, and then Cheyletus in #2 and #3 (Table 1).

Minor species constituted 32% of HDM in home #1 and 21.5% in home #3, but only 2.5% in #2. One explanation is that home #2 had an AC and, although this did not alter the dominance of Dp, it may have resulted in a greater number of Df, which thrives in drier conditions.

Environment: In the presence of AC, Dp remained the dominant mite but Df was more common than in the other houses.

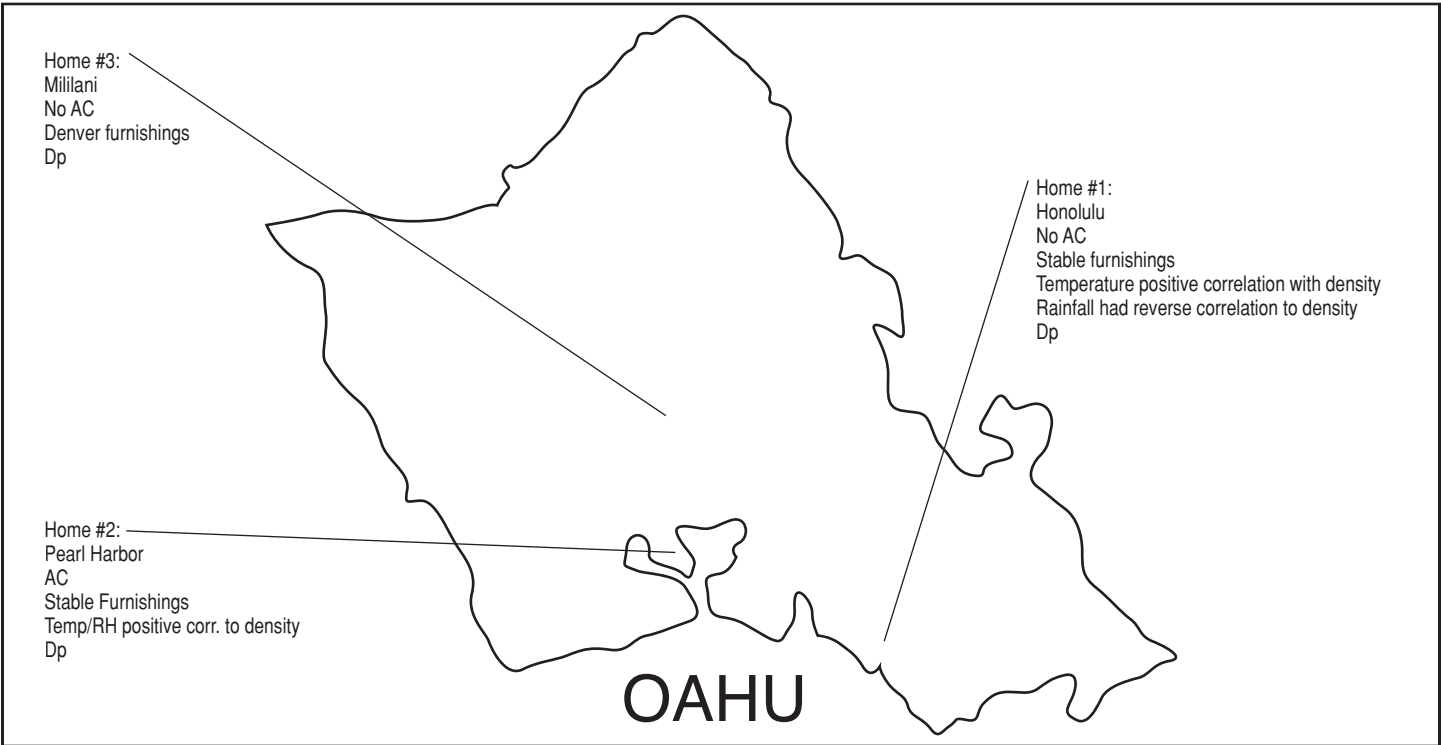


Figure 1.— Location, Environment, and Density Correlation of House Dust Mite from 3 Sampled Homes on O’ahu, Hawai’i from 1984-1985.

Table 1.— Comparison of House Dust Mite Species in 3 Homes on Island of O’ahu			
HDM	Home #1	Home #2	Home #3
Dp	68.0%	92.0%	77.0%
Df	0.5%	3.7 %	1.8 %
Euroglyphus sp.	26.0%	0.3 %	0.2%
Cheyletus sp.	2.8%	3.1%	9.3 %
Glycyphagus sp.	3.2%	0.1%	12.0%

Note: rounded percentages approximate 100%

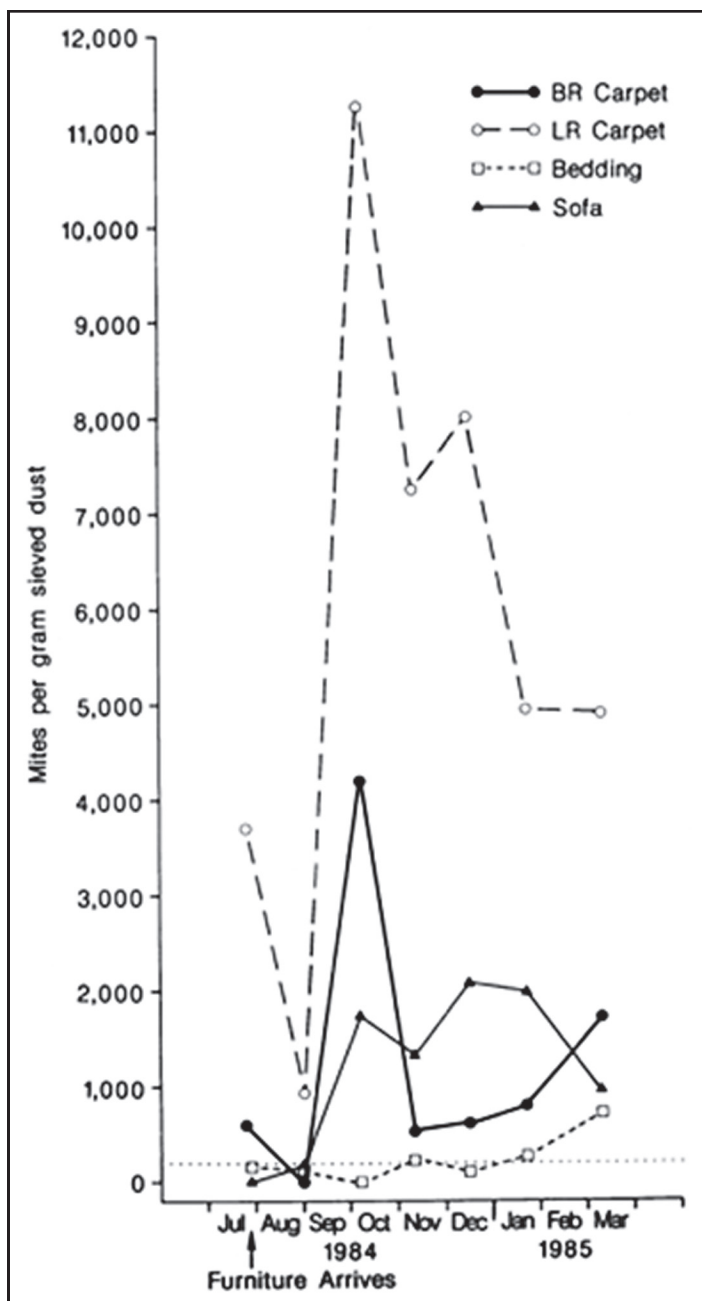


Figure 2.— Mite Density in Home #3

Discussion

Within the confines of acarines as the agency causing asthma in Hawai'i, the common threads in the folklore in Hawai'i have been and still are geography, seasons, and furnishings. The first 2 appear from this pilot study to be narrative fallacies trying to make sense of a jumble of events.

Geography, except perhaps at altitude, does not seem to support the practice of seeking relief from asthma by moving to homes elsewhere whether valley, coastal, or plain.

The lack of a major role of seasonal changes in mite density and species would not likely encourage future research.

In marked contrast, the highly significant effect of replacing complete home furnishings with those from a high altitude area such as Denver showed promise.

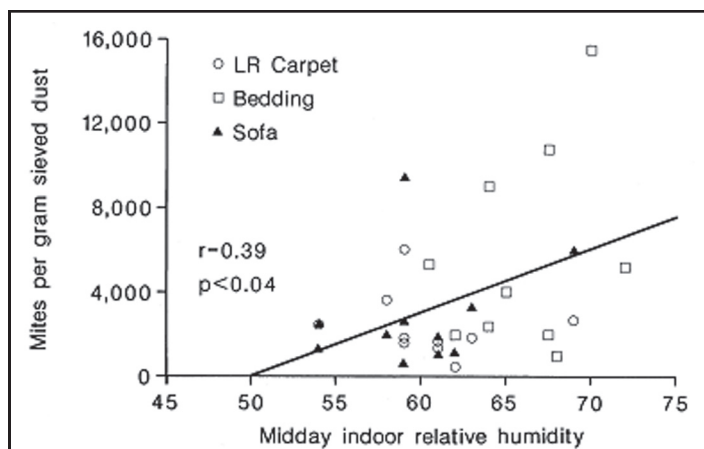


Figure 3.— Mite Density vs. Relative Humidity in Home #2

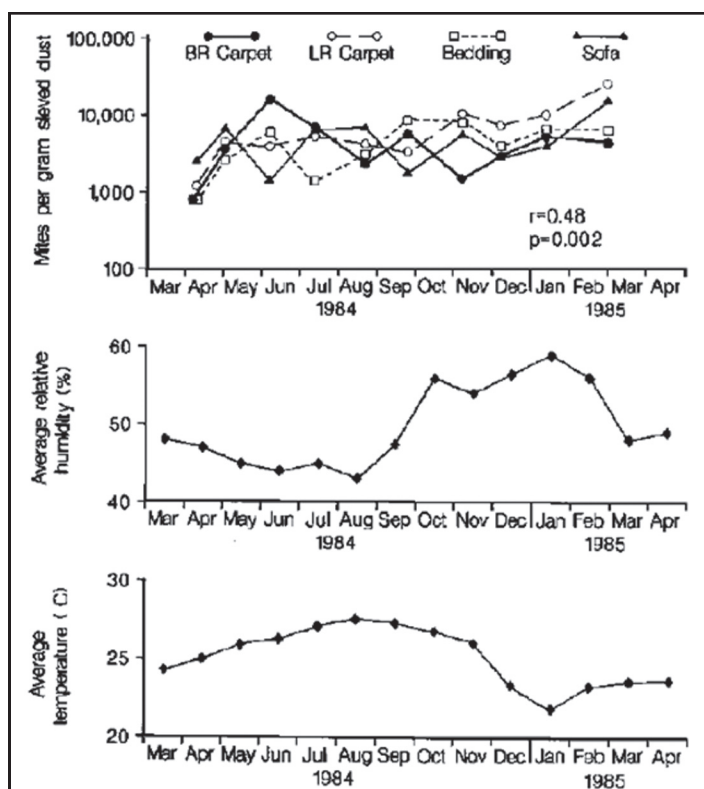


Figure 4.— Mite Density, Humidity, and Temperature in Home #1

Vacuuming is a time honored approach to management of asthma, but as noted by Massey and Massey¹¹, a surge in acarines can accompany it which could induce exacerbation of asthma. The remarkable surge following substitution of low density HDM furnishings in this study supports this possibility. The harmful effects of such management on the environment and patients require clinical study.

Limitations for this paper include: small sample size, Hawai'i's high humidity which did not allow dry dust weights to be measured accurately, and the 3rd house with furnishings from Denver was only studied for 8 months.

Conclusion

This investigation is an overview of some major folklore factors considered to influence asthma in Hawai'i. The authors' subsequent research through the decades has followed these findings.

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Authors' Affiliation:

- Pulmonary Department, Kuakini Medical Center. Professor of Medicine, Department of Medicine, John A. Burns School of Medicine, University of Hawai'i, Honolulu, HI (D.G.M.)
- American Indian Health And Services (AIHS), 4141 State Street, B-4, Santa Barbara, CA (B.E.H.)
- Entomologist 5, Vector Control Branch, Department of Health, State of Hawai'i (R.T.F.; deceased)

Correspondence to:
Douglas G. Massey MD
4523 Aukai Ave, Honolulu, HI 96816
Ph: (808) 737-5145
Fax: (808) 737-1974
Email: massey@lava.net

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