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Prevalence of house dust mites in nursing homes in southwest Ohio

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Dermatophagoides spp house dust mites were found to be prevalent in geriatric nursing homes in southwestern Ohio. Mite density was lower in nursing homes than in private homes in comparable dust-sampling areas and at similar times of the year. Generally, fewer mattresses, floors, and articles of furniture were mite positive in nursing homes by comparison to private homes. Lower institutional mite levels were attributed to frequent linen and mattress cover changes and rigorous cleaning practices, coupled with the lack of a favorable mite environment provided by high ambient temperatures, low relative humidity, tiled or vinyl-covered floors and furniture, and covered or encased mattresses. (*J ALLERGY CLIN IMMUNOL* 77:745-8, 1986.)

The house dust mites, *Dermatophagoides farinae* and *D. pteronyssinus*, have been established as the sources of major allergens for patients sensitive to house dust. These mites are most prevalent in homes in more humid geographic areas where mite density may range from a few to >18,000/gm of dust in specific locations within the home.¹ Within the home mites are more prevalent in carpeted floor areas, fabric-upholstered furniture, and mattresses that are used most frequently, and they are rare or absent in other areas. Although this distribution and dependence on

Abbreviation used

RH: Relative humidity

humans is not clearly understood, when sufficiently high RH exists in the mite microhabitat, presumably, accumulating skin scales that are shed during constant or frequent use of these areas or furniture serve as food to support mite-population development. In homes where RH is not continually or sufficiently high to support mite populations, human use of beds and furniture may provide sufficient moisture to these microhabitats to support significant mite levels, and these locations may become the major foci in the home.¹

Because of these ecologic relationships and the large amount of time institutionalized patients are confined to beds and other furniture, they could potentially provide enough dander and moisture to support large mite populations in these settings. In hospitals, despite the fact that patients are confined primarily to beds, mite prevalence is generally low,²⁻⁷ probably because of the high hygienic standards, plastic mat-

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TABLE I. *Dermatophagoides* spp mite counts from mattresses in nursing homes compared with private homes

Nursing home	Date (mo/yr)	Nursing homes			Private homes*	
		Positive samples/ total sampled	Mean mites/ gm of dust	Mean mites/ gm of dust/ positive sample	Positive samples/ total sampled	Mean mites/ gm of dust/ positive sample
1	10/82	3/3	73	73	6/13	113
	8/83	3/5	43	72	4/5	370
	11/83	2/5	90	225	4/5	70
2	4/83	0/3	0	—	14/17	303
	8/83	3/4	300	400	4/5	370†
3	9/83	3/5	56	93	4/5	370†
	11/83	3/4	15	20	4/5	70†
4	2/84	3/5	16	27	4/5	110

*Corresponding month $\pm$ 1.

†Values given above for same date; therefore they are not figured into means.

tress encasement, and tiled floors.⁸ In some cases it is reported that asthmatic symptoms improved for patients who lived in a hospital or asthmatic center for an extended time where there were few or no mites.⁹⁻¹³ No studies have investigated the mite prevalence in geriatric nursing homes where patients may reside for extended periods. Because these mites are the source of significant allergens,^{14, 15} this information may be important to the confined patients' health. This study investigated house dust mite levels in several geriatric nursing homes in southwest Ohio. Results were compared with mite levels in dust collected from private homes during corresponding months.

MATERIAL AND METHODS

Dust samples were collected from four different nursing homes in Dayton and Cincinnati, Ohio, in October 1982, April 1983, August 1983, September 1983, November 1983, and February 1984. Samples were collected from three sites: the patient's mattress (under the sheet on top of the mattress cover), the tile floor next to the bed, and the patient's chair, if there were one. For comparative purposes, dust samples were also collected from private homes in the same cities during corresponding months. Sampled areas included the same general areas, namely, the mattress, floor beside the bed, and a frequently used chair or couch (usually in the living/family room). The collection and analysis procedures were similar to those reported by Arlian et al.¹ Briefly, 1 m² of surface area was vacuumed for 2 minutes. Dust was collected on a cloth filter that was folded securely with a rubber band to confine the mites and dust. Samples were transported to the laboratory over ice and stored at 4°C and 75% RH until the dust was analyzed (1 to 7 days).

For mite analysis, 0.05 gm aliquots of dust (if it were available) from each sample were suspended in 25 ml of saturated sodium chloride solution that contained detergent,

agitated on a Maxi-Mix (Thermolyne Sybron, Corp., Dubuque, Iowa), rinsed through a sieve (45 μ m pore size), stained with crystal violet, and rinsed with distilled water. The retained material was rinsed into an intergrid Petri dish, and mites were counted by use of a stereoscope from both the water surface and bottom of the dish. Mite counts were extrapolated to mites per gram of dust.

During the study, all the nursing homes continued their daily cleaning procedures, including sheet changes. All but one of the mattresses sampled were encased in plastic. All floors were tile. Patients' chairs were both vinyl and fabric covered.

Usual housecleaning practices were maintained in the private homes during the study. Only one mattress was encased in plastic; all others had either fabric or no covers. Floors were carpeted; chairs and couches, apart from one, were fabric covered.

RESULTS

All nursing homes sampled were positive for house dust mites. Twenty of 34 mattresses, 17 of 36 floor samples, and 12 of 23 chairs sampled during the course of the study were mite positive. Mites were most prevalent in mattresses. The mean density for all mattress samples was 74 ± 96 mites per gram of dust, whereas the mean density for only positive mattress samples was 130 ± 137 mites per gram of dust (Table I). The mean mite density for each sampling time ranged from 0 to 300 mites per gram. All mattresses sampled except one were encased in plastic or a rubberized pad. Mites were least prevalent in floor dust. The mean density for all floor samples was 25 ± 25 mites per gram of dust, and the density ranged from 0 to 73 mites per gram (Table II). The mean mite density for only positive floor samples was

TABLE II. *Dermatophagoides* spp mite counts from tile floors in nursing homes compared with bedroom floors in private homes

Nursing home	Date (mo/yr)	Nursing homes			Private homes*	
		Positive samples/ total sampled	Mean mites/ gm of dust	Mean mites/ gm of dust/ positive sample	Positive samples/ total sampled	Mean mites/ gm of dust/ positive sample
1	10/82	3/4	30	40	10/13	257
	8/83	2/5	8	20	5/5	564
	11/83	2/4	50	100	5/5	264
2	4/83	0/3	0	—	15/17	257
	8/83	1/4	8	33	5/5	564†
3	9/83	3/5	28	50	5/5	564†
	11/83	4/4	73	73	5/5	264†
4	2/84	2/7	6	20	5/5	284

*Corresponding month $\pm$ 1.

†Values given above for same date; therefore they are not figured into means.

48 $\pm$ 29 mites per gram of dust. All sampled floors were tiled.

Mite prevalence in nursing home furniture varied depending on the upholstery type. Twenty-seven percent ($n = 15$) and 100% ($n = 8$) of dust samples obtained from vinyl- and fabric-covered chairs were positive for house dust mites, respectively. Because there is a large difference in the total quantities of dust obtainable when vinyl versus fabric chairs are vacuumed that would bias mite density, only the density of fabric-covered chairs was used for comparative purposes. All fabric-covered chairs sampled were mite positive, and the average density for all samples was 38 $\pm$ 13 mites per gram of recovered dust. Mite prevalence on vinyl-covered chairs was low and ranged from 0 to 1 mite per chair seat.

Generally, the mite levels found in nursing homes were low by comparison to mite prevalence in dust samples obtained from private homes in the same geographic area and at corresponding times of the year. Average mite density in positive mattress samples from private homes (193 $\pm$ 134 mites per gram of dust; $n = 32$) was about 50% higher than in corresponding positive nursing home beds (130 $\pm$ 137 mites per gram of dust; $n = 20$), although this difference was not statistically different ($p > 0.05$) because of the large variation in mite density between samples. Also, a greater percentage of mattresses in private homes was positive for mites than in nursing homes. Fifty-nine percent of the mattresses sampled in nursing homes contained mites, whereas 71% of the mattresses sampled in private homes were mite positive. In private homes mite prevalence was greatest in floor samples. Average mite density in positive floor samples from private homes was significantly

higher ($p < 0.05$) (325 $\pm$ 134 mites per gram of dust; $n = 40$) than in positive samples from nursing homes (48 $\pm$ 29 mites per gram of dust, $n = 17$). Although only 47% of the nursing home floors sampled were positive, 89% of the home floors were positive. Comparable fabric-covered chairs and couches in private homes exhibited significantly higher ($p < 0.05$) mean mite density in positive samples (244 $\pm$ 142 mites per gram of dust; $n = 19$) than in the positive nursing home samples (38 $\pm$ 13 mites per gram of dust; $n = 8$). Seventy-six (19/25) and 100% (8/8) of samples from fabric-covered furniture were positive in the private homes and nursing homes, respectively. Likewise, 27% (4/15) and 100% (1/1) of vinyl furniture were mite positive for nursing and private homes, respectively.

DISCUSSION

This study indicates that *Dermatophagoides* house dust mites are prevalent in geriatric nursing homes in southwestern Ohio. Generally, all the sampled areas in the nursing homes contained low mite densities compared with mite densities found in private homes of this study and those reported by others.^{1,8} Likewise, fewer comparable locations were mite positive in nursing homes than in private homes. Low institutional mite abundance is consistent with reported European studies.^{2-7,9-12} However, mite levels determined for the nursing homes in this study were considerably higher than those reported for hospitals and asthma centers. The clinical significance of the mite densities found in this study cannot be determined, since the threshold household mite levels that trigger the allergic response is unknown.

Frequent linen changes and mattress pad laundering

and rigorous frequent cleaning practices coupled with the lack of a favorable mite environment provided by vinyl floors and covered or encased mattresses are believed to be major factors in lowering institutional mite populations. Plastic mattress covers prevent infestations either by denying the mites access to the mattress or by preventing skin scales from reaching the mattress surface.

Frequent laundering prevents their buildup in linens and bedclothes. Tile floors and vinyl chairs provide no protected microhabitat for accumulation of food and moisture, and cleaning removes most of the residues in these sites. Low mite prevalence has also been reported for similar floors and plastic-encased mattresses in homes in this same survey area.⁸

Higher temperatures may also have contributed to the lower mite counts in the nursing homes studied. Temperatures in nursing homes were approximately 27° to 30° C when these were sampled, probably for the comfort of the inactive patients, whereas private homes were 18° to 25° C. The critical equilibrium humidity of dust mites is influenced by temperature.¹⁶ As temperature increases, the lowest RH at which mites can absorb sufficient water from unsaturated air to compensate for that lost by transpiration also increases. Thus, ambient RH environments that are hydrating for dust mites in homes may be desiccating in nursing homes because of the higher temperature.

Interestingly, although mite density was relatively low in the nursing homes, mattresses contained the highest mean mite density of the three sampled sites. In contrast, mattresses contained the lowest mean density of mites in private homes. The highest mite prevalence in nursing home mattresses, relative to other areas, indicates that this is the most favorable habitat for mite-population development.

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