

Quantitation of dust mites and allergen in small dust samples

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Exposure to mites and allergen involves multiple variables such as the concentration or quantity of allergen in

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Abbreviation used

Der 2: *Dermatophagoides* group 2 allergen

each reservoir, the activity in the home that renders mite allergens airborne and inhalable, and the time an individual spends in areas with mite allergen. Central to exposure are the amounts of mites and allergen in each of the reservoirs in the home; hence it is critical that the best method of reporting these levels is used so that their relevance to sensitization and provocation of allergy symptoms can be evaluated and mite and mite allergen mitiga-

TABLE I. Total number of mites (live + dead) per gram of dust or per total surface area of the pillow, total weight of pillow dust (in milligrams), and amount of allergen (nanograms of *Dermatophagoides* group 2 allergen [Der 2]) collected from 19 homes in Houston, Tex (subjects 01-19), and from 24 homes in Dayton, Ohio (subjects 21-44)

Subjects	Total mites/g dust			No. of mites	Pillow 1		No. of mites	Pillow 2	
	Couch	Bedroom carpet	Mattress		Dust (mg)	Der 2 (ng)		Dust (mg)	Der 2 (ng)
01	80	300	120	637	1061	176	55	119	6
02	400	720	40	12	596	415	11	556	262
03	140	600	140	738	636	2703	155	141	186
04	620	880	80	13	663	25	11	265	355
05	340	200	80	47	214	133	0	*	ND
06	320	680	1740	50	90	50	236	190	166
07	860	680	1480	1007	950	1859	458	318	572
08	480	260	160	7	335	26	30	190	28
09	20	960	1380	17	118	15	5	120	132
10	200	620	160	22	186	34	87	1088	4960
11	380	400	60	75	207	235	37	116	ND
12	100	1040	140	24	298	5929	24	119	ND
13	140	60	80	5	123	5	12	290	46
14	60	700	120	73	608	186	16	204	83
15	540	660	180	325	451	526	149	437	406
16	220	920	900	22	368	1778	329	350	1361
17	120	620	20	40	286	9	20	203	7
18	140	40	160	69	492	78	216	980	266
19	60	1900	420	0	211	69	124	389	147
21	160	5240	100	1	20	ND	3	30	ND
22	0	20	20	10	20	1	1	20	0
23	20	20	40	2	30	0	NS	NS	NS
24	80	160	0	0	148	10	3	40	ND
25	60	40	120	0	10	ND	NS	NS	NS
26	NS	20	160	71	142	ND	NS	NS	NS
27	140	560	300	9	63	ND	NS	NS	NS
28	940	1000	260	12	40	ND	NS	NS	NS
29	40	160	0	7	83	ND	6	71	ND
30	NS	NS	140	0	41	ND	1	810	0
31	20	40	160	0	134	ND	NS	NS	NS
32	320	60	20	0	30	ND	NS	NS	NS
33	60	180	160	11	40	ND	NS	NS	NS
34	120	40	160	1273	288	992	NS	NS	NS
35	200	NS	20	3	50	23	7	50	5
36	380	120	80	0	50	ND	3	20	ND
37	180	NS	60	0	50	0	NS	NS	NS
38	220	520	480	15	20	ND	NS	NS	NS
39	0	100	100	6	50	ND	NS	NS	NS
40	20	0	NS	2	81	ND	0	71	ND
41	560	NS	500	1	30	ND	NS	NS	NS
42	100	640	NS	13	20	ND	NS	NS	NS
43	900	420	20	1	20	ND	NS	NS	NS
44	40	60	NS	1	40	ND	NS	NS	NS

ND, Der 2 was not determined; NS, no sample was collected.

*Sample weight was not determined.

tion strategies can be used, if necessary. Mite and allergen levels have traditionally been reported as the number of mites or the amount of allergen per gram of dust collected by vacuum sampling of a finite surface area rather than by reporting the total mite or allergen content per sampled area. However, the total quantity of dust collected during sampling of a given surface area is greatly variable, yet it is important for evaluating exposure and identifying whether there is a mite allergen problem. In this

study we investigated the total amount and concentration of mites and allergens on specific surfaces as well as the relationship between mite and allergen levels in various locations within homes.

METHODS

Dust samples were obtained from 19 homes in Houston, Tex, and from 24 homes in Dayton, Ohio, during July and August 1997 (high mite season). In each home dust was collected by vacuuming an

upholstered couch or chair located in the family room and an uncased, regularly used mattress, pillow(s), and carpet next to the bed in the bedroom, as previously reported.¹ The entire surface of the pillows and 1 m² of area of the other sites was vacuumed for 2 minutes to collect the sample.

The number of mites (alive and dead) in a 50-mg aliquot of each sample was determined by our standard method.¹ If <50 mg of dust was recovered, the entire sample was weighed and counted. *Der-matophagoides* group 2 allergen (Der 2) levels in pillow and mattress samples were assayed with use of a commercial ELISA kit (Indoor Biotechnologies, Charlottesville, Va) that recognizes a cross-reactive epitope present on both Der p 2 and Der f 2.

RESULTS

In comparable sites within a home the average densities of mites and allergen were greater in homes in the semitropical climate in Houston compared with the temperate climate in Dayton (Table I). The mean mite density and group 2 allergen concentration in mattresses was higher in Houston (393 mites/g and 1440 ng of Der 2/g) compared with Dayton (139 mites/g and 570 ng of Der 2/g). In both cities most homes (24/36) had mite counts in bedroom carpets > mattresses > pillows. Furthermore, there was no correlation between the mite densities in the various sampling sites ($r^2 < 0.0032$).

The quantity of dust collected by thoroughly vacuuming the pillow surfaces in both Dayton and Houston was very small. The Houston pillows yielded a mean of 378 mg of dust. The mean total number of mites on these pillow surfaces was 136 ± 37 (range = 0 to 1007) with 27 of the 38 pillows (71%) having <100 mites on the entire surface. Only 3 of the 35 pillows tested had >2 μg of Der 2 allergen on the entire surface (mean = 662 ± 228 ng).

Likewise, most pillow samples (27/32) from Dayton homes contained <100 mg of dust (Table I, mean = 82 mg), which was an insufficient quantity to conduct both a mite count and an allergen analysis, so only the mite count was performed. One >10-year-old pillow contained 1273 mites. If this pillow is excluded as an outlier, the mean number of mites recovered from the remaining 31 pillows was 7 ± 2 with a range 0 to 71. Twenty-five of 32 pillows (78%) had fewer than 10 mites on their surfaces and all but this outlier had fewer than 75 mites per pillow surface (Table I).

DISCUSSION

Our results indicate that mite breeding in specific sites in homes is independent of other sites and that dispersal of allergen from site to site does not result in a uniform distribution throughout the home. Therefore the levels of mite and allergen in one location within a home cannot

be used to predict the levels in other areas or to determine occupant exposure to allergens.

Most studies report mite and allergen density (concentration) as the amount per gram of collectable dust, although considerably less than 0.2 g of dust is usually recovered by vacuuming the entire pillow surface.²⁻⁴ The practice of extrapolating and reporting dust mite and allergen concentrations per gram of dust when sampled areas or surfaces yield considerably less than 1 g of dust leads to the reporting of exaggerated mite and allergen levels on surfaces where there are few mites and little allergen. For example, one study² reported averages of 10.85 and 27.58 μg of Der p 1 per gram of dust on pillow surfaces from 2 cohorts of homes. However, the same data analyzed in terms of the actual dust collected per total pillow surface (0.084 and 0.063 g, respectively) resulted in means of 0.91 and 1.74 μg of Der p 1 for the entire surface. Another study³ reported mean concentrations of Der p 1 of 22.28 and 8.24 $\mu\text{g/g}$, whereas the actual micrograms per pillow were 1.0 and 0.13 for synthetic and feather pillows, respectively. In our study, when the concentration was expressed per gram, 24 of 37 Houston pillows exceeded 100 mites per gram, yet only 2 pillows had > 1 g of collectable surface dust. Most had <0.5 g of dust (mean = 378 mg) and <100 mites on the entire surface. The results are even more striking for the Dayton pillows, where the mean number of mites per pillow was only 7 ± 2 (excluding 1 outlier) but extrapolated it was 137 mites per gram. Twenty-five of the 32 pillows had <10 mites on the entire pillow surface.

On the basis of the data presented here and the few data reported in the literature, we are recommending that, as a standard, the actual number of mites and the total quantity of allergen be reported when less than 0.5 g of dust is collected from a sampled surface. For pillow surfaces the total mite number and allergen amount should be reported.

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