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PYROGLYPHID MITES, XEROPHILIC FUNGI AND ALLERGENIC ACTIVITY IN DUST FROM HOSPITAL MATTRESSES

by

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Mattresses are a habitat for pyroglyphid mites (2). The most abundant species in Europe, *Dermatophagoides pteronyssinus* (Trouessart 1897), is a source of house-dust allergen (15). By predigesting human dander, xerophilic fungi may favour the development of this mite in the house-dust habitat (3). From the dust of dwelling-houses xerophilic fungi, such as members of the *Aspergillus* (*Eurotium*) *glaucus* group, were frequently isolated (5, 8, 14). In the dust from hospital mattresses only low numbers of pyroglyphid mites were found (4, 9, 10), and the allergen content of this dust was low (4). Xerophilic fungi have not been studied in hospital mattresses.

In this study we will investigate the mite fauna, xerophilic fungal flora and allergen content of dust in hospital mattresses, particularly in relation to composition and age.

MATERIAL AND METHODS

From 24 to 28 June 1975, 31 mattresses from 17 rooms (located on the third and fourth floors) were sampled at the Asthmakrankenhaus der Kamillianer in Mönchengladbach (FRG). Once a week clean sheets were put on the beds. Mattresses used for an uninterrupted period of 1 month by the same patient were treated with a disinfectant (Incidin® Spray, Henkel & Cie GmbH, Düsseldorf, FRG) after his discharge. Most patients occupied their beds only during the night.

The mattresses were classified into three groups:

1. Eleven cotton-horsehair mattresses, which had been in use for 10 years.
2. Seventeen polyester-foam mattresses, which had been in use for 6 months to 5 years.
3. Three polyester-foam mattresses, which had been in use for less than 6 months.

The polyester-foam mattresses were vacuum-cleaned (Hoover type 2907 A) on the upper side only, the cotton-horsehair ones on both sides. The dust samples were stored separately in plastic bags at 10° C in a refrigerator for 4-8 weeks prior to the mite and fungal analyses. At this temperature mites and fungi survive with almost no reproduction (7, 12).

The mite fauna of each mattress was studied by analysing four replicates of 0.2 g of dust with a flotation method (2).

The fungi grown from 15 piles of 1 mg of dust from each mattress were analysed after 1-4 weeks incubation at 25° C and 75 per cent relative humidity, by placing them in closed vessels with a saturated NaCl solution (16). The dusts were put on dried malt extract agar (Oxoid) plates, water content 80-85 per cent w/w.

The polyester-foam mattresses were divided into two groups according to their location, i.e. in rooms with or without equipment to control the allergen content of the air (13). In the former rooms purified air (particles of 2 μ m and bigger were filtered out) was dispersed which had been drawn in from outside at a height of 28 m. The dusts from both these groups of polyester-foam mattresses and those of cotton-horsehair were prepared into extracts for skin testing to determinate the allergenic activity. The extracts, which were prepared according to Frugoni (6), were injected intracutaneously at a dilution rate of 1:100 w/v. The skin reactions were evaluated according to Hansen & Werner (6) in one-, two-, three- or four-plus signs, relative to the negative saline and four-plus histamine reaction injected at a rate of 1:10,000. Forty males and females were tested, all with clinically proved sensitization (by intracutaneous and provocation tests) to house dust and the fungi *Aspergillus fumigatus* Fresenius, *Rhizopus nigricans* Ehrenb. and *Alternaria tenuis* Nees. No sensitization to animal dander, feathers or kapok was observed. The differences were statistically evaluated with the Sign Test (11) at significance level $\alpha=0.05$ by comparing the test individuals with four-plus reactions.

RESULTS

Dust from cotton-horsehair mattresses had a more powdery and darker appearance than dust from polyester-foam ones. No differences were found between the individual dust particles of both types.

If no discrimination is made between the different types,

the mattresses contained Pyroglyphidae (36.6 per cent), *Demodex* spp. (58.2 per cent), Tarsonemini (3.7 per cent) and undetermined specimens (1.5 per cent). The pyroglyphid mites belonged to *Dermatophagoides pteronyssinus* (Trouessart 1897) (36.7 per cent), *Euroglyphus maynei* (Cooreman 1950) (36.7 per cent) and the *D. farinae* group (4.1 per cent) while 22.4 per cent were larvae of *Dermatophagoides* spp. *Demodex* spp. were difficult to observe and the percentage given might be too low*. Pyroglyphid mites were not observed in the polyester-foam mattresses which had been in use for 6 months, or in the cotton-horsehair mattresses, which had been in use much longer (Table 1). This Table also shows that pyroglyphid mites were present in 12 out of the 17 polyester-foam mattresses which had been used for 6 months to 5 years. Their number ranged from 0 to 8 per replicate.

TABLE 1
Numbers of Pyroglyphid Mites in 0.2 g of Dust from Mattresses of Different Types (4 replicates investigated).

Composition	Mattresses		No. with mites	Mites in positive mattresses	
	Time of use (years)	No. tested		Mean number	Variation width
Cotton-horsehair	10	11	0	—	—
Polyester-foam	0.5-5	17	12	1.0	0-8
Polyester-foam	0.5	3	0	—	—

Xerophilic fungi were isolated from one cotton-horsehair mattress and two polyester-foam mattresses (Table 2). The isolations belonged to the genera *Aspergillus* and *Eurotium*. *E. repens* Corda occurred in each of the three positive mattresses.

The sum of all positive reactions (calculated as the sum of all plus signs of the 40 test individuals) to dust extract from

* In one of the replicates extra attention was paid to the occurrence of *Demodex* spp. In this replicate 78.2 per cent of the specimens belonged to this genus.

TABLE 2
Occurrence of Xerophilic Fungi in Different Types of Mattresses
(15 piles of 1 mg of dust from each mattress were incubated
at 75 per cent relative humidity and at 25° C)

Composition	Mattresses			Species of fungi
	Time of use (years)	No. tested	No. with fungi	
Cotton-horsehair	10	11	1	<i>Eurotium repens</i> Corda <i>E. amstelodami</i> Mangin
Polyester-foam	0.5-5	17	2	<i>E. repens</i> *) <i>Aspergillus niger</i> van Tieghem*) <i>A. ustus</i> (Bain.) Thom et Church <i>A. versicolor</i> (Vuill.) Tirab. <i>A. sydowi</i> (Bain. et Sart.) Thom et Church
Polyester-foam	0.5	3	0	

*) Occurring in each positive mattress.

TABLE 3
P-values for the Differences in Allergenic Activity of Dust Extracts
of Different Mattress Groups as Evaluated by Skin Tests on 40 Subjects

Mattress group combinations	<i>n</i>	<i>P</i>
I- II	8	0.008
I-III	7	0.016
II-III	1	-

The test individuals with four-plus reactions are considered and compared by the Sign Test. *n* = number of pairs studied. I: cotton-horsehair mattresses. II: polyester-foam mattresses from rooms with a filtered stream of outside air. III: polyester-foam mattresses from rooms without filtered air.

the cotton-horsehair mattresses was 110. The sums of the positive reactions to dust from the polyester-foam mattresses (as evaluated on the same subjects) from rooms with and without a filtered stream of outside air, were 46 and 67 respectively. Table 3 shows that the differences between the cotton-horsehair mattresses and both polyester-foam groups were significant.

DISCUSSION

According to Sesay & Dobson (10) and Rao et al. (9) hospital mattresses contained low numbers of pyroglyphid mites. The low numbers were probably due to the high standard of hygiene and regular disinfection treatment (10). In spite of the cleaning treatment pyroglyphid mites were present in most of the older polyester-foam mattresses. Possibly the populations had not been eliminated completely by the treatment. Regular re-infestation might also have occurred: the coming and going of patients, and the presence of more than one bed in a room will promote the transport of mites. Although the dust particles from the cotton-horsehair mattresses and the polyester-foam mattresses were essentially the same, the cotton-horsehair mattresses did not contain pyroglyphid mites. The more powdery and darker appearance of the dust in the cotton-horsehair mattresses may be indicative of less suitable abiotic factors for the development of these mites.

Although no pyroglyphid mites were present, the dust of the cotton-horsehair mattresses had the highest allergenic activity. As the 40 test individuals were sensitized to house dust, house-dust allergens might be responsible for this. These allergens can be formed by degradation reactions among house (mattress)-dust constituents. These reactions are promoted by organisms like pyroglyphid mites, but can also occur in their absence (1).

Xerophilic fungi were isolated from only three mattresses. The low number may be due to the cleaning procedures, as was stated for the pyroglyphid mites. According to Davies (5) and Mallea (8) members of the *A. glaucus* group, particularly

E. repens, were the most abundant. Members of this group may stimulate the production of house-dust allergens. Bronswijk & Sinha (3) found that human dander, which is pre-digested by these fungi, is a better substrate for the development of *D. pteronyssinus* than untreated human dander.

SUMMARY

Dust from mattresses of different composition and age was analysed for mites, xerophilic fungi and allergenic activity.

The mites of the genus *Demodex* were the most abundant (58.2 per cent). Also pyroglyphid mites occurred commonly (36.6 per cent). Pyroglyphid mites were present in small numbers (mean: 1 specimen/0.2 g of dust) in 12 out of the 17 older polyester-foam mattresses. The 11 cotton-horsehair mattresses and the newly used polyester-foam mattresses (three tested) were without them. The dust from the cotton-horsehair mattresses had a significantly higher allergenic activity than from those of polyester-foam.

Xerophilic fungi were isolated in three out of 31 mattresses. The species isolated belonged to the genus *Aspergillus* and *Eurotium*. *E. repens* occurred most frequently.

Disinfection of mattresses was suggested to have a negative influence on the occurrence of mites and fungi.

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