IS THE ALLERGEN LEVEL OF HOUSE DUST RELATED TO AGE OF THE HOUSE?

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SUMMARY

House dust mites Dermatophagoides species (Acari: Pyroglyphidae) produce allergens, known for the provocation of asthma and other allergic reactions.

To determine the time needed for the complete colonisation of a new home by house dust mites, dust samples were collected from carpets of houses varying from 2 weeks to 2 years in age. In contrast to the expectation, no relation was found between average levels of the allergens Der pl and Der pll per m² and age of the houses.

However, a positive relation was revealed between the presence of dogs and the number of occupants in the house on one hand and allergen levels on the other hand. Furthermore, carpets in bedrooms appeared to contain more allergens than carpets in living-rooms.

Finally, the age of the mattress was not related to allergen levels of bedroom floors.

INTRODUCTION

Since the work of Voorhorst et al. (1969), it is generally accepted that house dust mites produce allergens. Their faeces are highly allergenic (Tovey et al., 1981) and can provoke asthma and other allergic reactions when inhaled (Wharton, 1976). Especially Dermatophagoides pteronyssinus (Trouessart), D. farinae Hughes and D. microceras Griffiths and Cunnington are known for their allergenic properties (Heymann et al., 1989).

D. pteronyssinus and D. farinae are cosmopolitan species. D. pteronyssinus, more susceptible to desiccation than D. farinae, is extremely common in house dust in Western Europe (Van Bronswijk, 1981). Mite numbers show an annual periodicity, which coincides with the annual humidity cycle in the house (Spieksma, 1967). House dust mite populations are at peak levels in late summer (Blythe, 1976) or autumn when relative humidity is usually highest (Van Bronswijk & Sinha, 1971), and lowest in spring (Blythe, 1976). In Ohio (USA), for example, the average numbers of live mites per gram dust were more than 10 to even more than 25 times higher in late summer than in spring (Artian, 1982). A Dutch study revealed that the allergen level of house dust was on average only 5 times lower in spring than in autumn (Van Leeuwen & Aalberse, 1988). Apparently, decomposition of allergens is a slow process.

The highest numbers of mites are found in places where dust (e.g. skin scales), the food source for house dust mites, accumulates, such as beds, overstuffed furniture...
and carpets (Arlian, 1989). On the other hand, no house dust mites were detected on floors of new houses until human inhabitants had used their home for one week (Van Bronswijk (1974), in The Netherlands) or for one month (Miyamoto & Ouchi (1976), in Japan). Arlian (1982) came across one home (out of 26) without any mites. This house was less than two months old and contained new furnishing and carpeting. So far, no information is available on the length of time needed for complete colonisation of a new home by house dust mites.

The object of the present study is to assess the relation between allergen levels of house dust collected from the carpet and the occupation time of the home. In brand new homes with new carpets a very low allergen level is expected, since there will not be enough food to allow fast mite population growth. Furthermore, an increase in mite numbers with increasing occupation time is expected until the carrying capacity is reached.

MATERIAL AND METHODS

Dust samples
Dust samples were collected in bedrooms and living-rooms in the second half of May 1990. The age of the homes varied from 2 weeks to 2 years. Only rooms with new carpets at the start of occupation were sampled. A total of 114 rooms in 60 different houses in Dronten (Flevoland, The Netherlands) was sampled.

Information on various parameters which might influence mite numbers was obtained by questioning the residents. Questions concerned e.g. the number of occupants and pets in the house, carpet material, age of mattress and the habit of eating in the bedroom.

Samples were taken using a Moulinex® Compact 1250 Vario Electronic vacuum cleaner at 800 Watt. This vacuum cleaner was equipped with a built-in sampling device in a specially constructed hose. The sample was collected in a glass tube with an inner diameter of 4.3 cm, which was covered at one end with a filter cut out of the densest layer of double layer Moulinex® dust bags.

In order to collect one sample, 2 m² of the carpet were vacuum cleaned for 4 minutes. Relative humidity and temperature were recorded at ground level in the sampled room at the time of sampling. After taking one sample, the glass tube with the sample was replaced by a new one. Parts of the vacuum cleaner which had been in contact with the just collected sample were either replaced or cleaned. All samples were taken by the same person.

The tubes containing the samples were stored, for a maximum of two days, in separate plastic bags at 4 °C until the samples were weighed. Part of each sample was stored at -20 °C until, a few weeks later, allergen assessments were done.

Allergen assessments
Measurements of the allergens Der pI and Der pII were done at the Department of Immunochemistry of the Central Laboratory of The Netherlands Blood Transfusion Service. Immunochemical techniques were applied, i.e. two different radio-immuno-assays (RIA's) were used to quantify the respective allergen activity. The antibodies of the RIA applied for determination of Der pI respond quite specifically to group I allergens of D. pteronyssinus, while the antibodies of the second RIA do not distinguish between group II allergens of the three Dermatophagoides species (Van der Zee et al., 1988; Van Leeuwen & Aalberse 1988).

Statistical analysis
Student's t-test and Analysis of Variance were applied on log transformed data to analyse the results.

Some samples were excluded from further (statistical) analysis because both allergen levels were below or above the detection level of the test. In case of one allergen of a sample exceeding a test limit, the results of the other allergen were processed as usual.
RESULTS

No relation was found between allergen levels or dust quantity from the carpet and the age of a house (Figure 1).

![Graph showing dust quantity per m² and allergen levels per m² in relation to time of occupation.]

Figure 1. Average dust quantity per m² (a) and average level of the allergens Der pl and Der pII per m² (b) in relation to the occupation time of the house.

Figure 2a shows the dust quantity per m² in presence or absence of dog or cat in the household. There is no significant difference between households without a dog or cat and households with a cat only. However, the presence of a dog is associated with a higher average dust mass (P < 0.01), both compared to households without a dog or cat and households with a cat. (The three data concerning households with both a cat and a dog were left out of this analysis.)

The average level of both allergens per m² differed significantly (P < 0.01), between households without a dog or cat and those with just a dog (Figure 2b). (Data regarding households with either both a cat and a dog or a cat only were excluded because of too small sample sizes.)

![Graph showing dust quantity per m² and allergen levels per m² in presence or absence of dog or cat.]

Figure 2. (a) Average dust quantity per m² in absence or presence of cat or dog. (b) Average level of the allergens Der pl and Der pII per m² in households without a cat or a dog and those with a dog present.

No significant differences in dust quantity or allergen levels were found between single and double bedrooms. On the other hand both the average dust quantity and average allergen levels were higher (P < 0.01) in bedrooms than in living-rooms (Figure 3).
Figure 3. Average dust quantity per m² (a) and average level of the allergens Der pl and Der pII per m² (b) in single and double bedrooms and in living-rooms.

No significant difference was found between average dust quantities of living-room carpets in houses with one or two occupants and those with three, four or five occupants (Figure 4a). However, there is a trend (P < 0.05) towards a higher average level of Der pl per m² in larger households. As holds for the dust quantities, there is no significant difference between the level of Der pII per m² when the two categories of households were compared (Figure 4b).

Figure 4. Average dust quantity per m² (a) and average level of the allergens Der pl and Der pII per m² (b) in living-rooms of houses in relation to the number of occupants in the house.

No relation was found between the age of the mattress or eating in the bedroom on one hand and dust quantity or allergen levels per m² on the other hand.

DISCUSSION

The results presented here are based on a preliminary analysis of the data. For instance, possible interactions of factors have not yet been studied. Moreover, the possible influence of factors such as temperature and relative humidity (at the moment of sampling) have not yet been taken into consideration. The same applies to, for instance, (approximate) age of the occupant(s). Additionally, it is necessary to check if factors of proven influence, such as the presence of dogs, are evenly
distributed over the classes of occupation time.

In contrast with the expectation, allergen levels and occupation time of the houses were not related (Figure 1). A possible explanation is that allergens in very new homes are mainly brought in, for instance with overstuffed furniture or blankets, and are not produced on the spot. Importation of allergens with blankets is not unlikely since Sesay & Dobson (1972) found blankets to contain even higher mite numbers than mattresses. Another possibility is that carpets themselves serve as a food source. In this case food is, from the very moment of occupation never a limiting factor; mite population increase is possible.

However, more striking are the very low allergen levels, sometimes even lower than the detection level of the tests, in some 'older', i.e. almost two years old houses. To determine the factors involved here might even be more important, since they could provide a key for the prevention of high population levels of house dust mites.

The presence of a dog in households is related to a higher dust quantity as well as higher allergen levels (Figure 2). Of course, this does not necessarily mean that the dog itself is the cause of these differences; presence of a dog might be related to other factors. However, a dog, like human beings, produces skin scales and human skin scales are known to be a good food source for house dust mites (Spieksma, 1967).

Arlian (1982) did not find mite abundance to be correlated with the presence or absence of pets. Hart & Whitehead (1990) came to the same conclusion after analysis of the mite fauna of living-room carpets; no significant relation was found between total Pyroglyphid mite numbers and pets' beds and dining areas or the number of pets in the house. It is not clear if these two authors distinguished between different pets, such as cats and dogs. For example, Figure 2a shows that cats are possibly associated with an opposite effect on the dust quantity compared to that of dogs. Comparison of allergen levels in households with either a cat or a dog could not be made here, because of too small sample sizes in the 'cat groups'. However, it is possible that cats and dogs have opposing effects on dust mite populations.

Dust quantity and allergen levels were higher in bedroom carpets than in carpets of living-rooms (Figure 3). The latter is in accordance with the findings of Blythe (1976) that living-room carpets usually contain fewer mites than those in bedrooms. Blythe assumed that this difference is due to different cleaning routines or the scattering of mites from bedding. Further analysis of the data will indicate if different cleaning routines are a possible explanation in this case. Mulla et al. (1975) concluded that there is a tendency for heavier infestations to occur in bedrooms with more occupants. This cannot be confirmed in the present study, but Mulla et al. sampled bedrooms with up to four occupants, while in the present study the maximum number of occupants was two.

No significant relation was found between household size and dust quantity or Der pII level (P = 0.06, in both cases). However, larger households were associated with a higher Der pI level than smaller households (Figure 4). This is in accordance with the findings of Arlian et al. (1978), who showed that average mite infestations were proportional to the number of members in the household. A likely explanation is that in larger households both more skin scales and moisture are produced. Additionally, more human food might be spilled on the floor, since larger household size usually implies the presence of one or a few (small) children. Furthermore, in larger households there might not only be an increase in the intensity of use, but also
in the duration, since on average more time/day/person is spent at home. If this is true, the effect of household size could even be stronger.

Whether any of the above speculations are supported by the data presented here, will be the subject of further statistical analysis, to be published elsewhere.

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