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Household distribution of house dust mite in central Taiwan

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House dust mite (HDM) is a common inhalant allergen which can precipitate atopic disease episodes including asthma and allergic rhinitis. However, the relationship between HDM and asthma in subtropical regions of Asia, which may be affected by differences in climate and environmental variables, has not been widely studied. To assess this relation in the subtropical region of central Taiwan, we collected HDM samples from the houses of eight asthmatic patients as well as four normal subjects over a 1-year period. HDMs were collected by vacuum from the following four areas: living room floor, sofa, the top surface of child's mattress and bedroom floor. The mite concentrations, site distribution, seasonal variation, individual species and correlation with asthmatic attacks were studied. The HDM concentration had a seasonal variation, with the highest concentrations noted from July to November with gradually decrease from December to June. Among the four areas of collection, the highest concentration of mites was found on the child's mattress ($p < 0.05$). *Dermatophagoides pteronyssinus* was the dominant species (77%) and *Dermatophagoides farinae* was the second (13%). Our data showed that: 1. The highest concentrations of HDM occurred during the period from July to November. 2. The child's mattress was the household region with the highest percentage of HDM and thus should be considered of great concern as a likely source of the exacerbation of asthma. 3. *D. pteronyssinus* was the dominant species.

Key words: Asthma, central Taiwan, house dust mite, seasonal variation

Allergens, especially those derived from the house dust mite (HDM) appear not only to fulfil the role of a primary stimulus in the development of asthma but also to act as a trigger for the exacerbation of symptoms [1]. The incidence of asthma in Taiwan, a subtropical area, has been reported as 10.8% [2]. The high temperature and high relative humidity of Taiwan are ideal conditions for HDM growth. Previous HDM distribution studies in Taiwan have focused only in the northern area surrounding Taipei [2,3]. The climate in the central region of Taiwan is warmer than in the northern region (yearly mean temperature, central Taiwan : northern Taiwan = 24.1 : 22.3 °C) and is also drier (yearly mean relative humidity, central Taiwan : northern Taiwan = 75.3% : 86.6%). There is also a lower incidence of asthma in central Taiwan (central Taiwan : northern Taiwan = 6.7% : 10.4%) [4].We had started an education program about control of environmental risk factors to prevent asthma attacks since 10 years ago. However, no studies of household environmental HDM distribution in central Taiwan were reported recently.

In this study, we collected 385 samples from the houses of eight asthmatic children and four normal subjects at intervals of every 2 months from July 1998 to June 1999. The mite concentrations, site distribution, seasonal variation, individual species and their correlation with asthmatic attacks were investigated.

Materials and Methods

Collection of dust samples

Eight HDM-allergic asthma children and four normal children were visited every 2 months for over a 1-year period from July 1998 to June 1999. HDM allergy was demonstrated the CAP system (Pharmacia and Upjohn, AB, Uppsala, Sweden). The sampling area and the time for dust collection, types of vacuum cleaner used and dust-collection devices were all standardized. Samples were collected from four major areas: the living room floor, sofa, the top surface of the child's mattress and bedroom floor following the protocol of Chang [3]. Each area was vacuumed for 1 min over a 1 m^2 surface area. These areas were chosen because children spent

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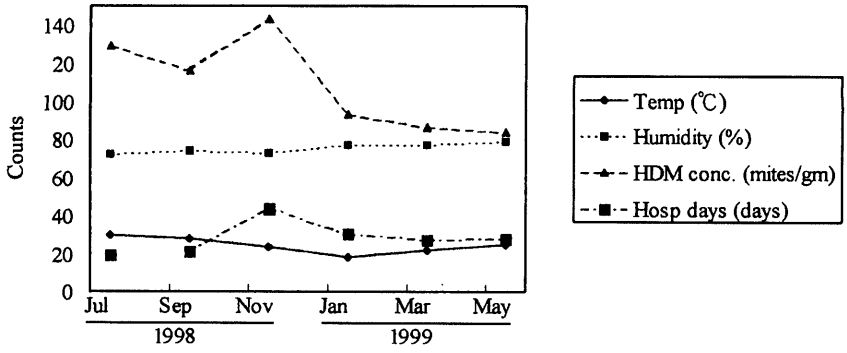

Fig.1. Relation of concentration of HDM, indoor temperature, relative humidity and hospitalization days due to asthma attack.

more time over them. A 1000 watt vacuum cleaner was used (Miele White Pease, Hamburg, Germany). The filter bags were compatible with the machine. After vacuuming, the filter was removed, covered with a plastic lid, placed in a sealable plastic bag and returned to our laboratory. Temperature and relative humidity were measured at the same time. All dust samples were collected by the same person.

Extraction of mites from dust for quantitative analysis

The floating method was used for extracting of mites as previously described [5,6]. Briefly, the net weight of each dust sample was measured. Then, 300 mL of saturated sodium chloride was added to the sample and completely mixed by shaking. After 10 min, the suspension was poured through a 125 mm filter paper (Toyo Roshi Kaisha Ltd, Tokyo, Japan). The mites which were retained on the paper were counted under a Leica GA4 stereomicroscope (25 x). Mite densities were expressed as the number of bugs per gram of dust.

Identification of HDMs

The mites were removed from the filter paper with a fine needle. No more than 10 mites were immersed in Hoyer's mountant (50 mL distilled water, 30 g clear gum arabic crystals, 200 g chloral hydrate and 20 mL glycerin) on a microscope slide and covered with a round coverslip (12-16 mm in diameter, number 0 thickness). The advantage of this mountant is that it cleared the mites effectively, thus eliminating the necessity for a cleansing procedure before mounting the mites. Once the mites were mounted onto slides, the sides were labeled and placed into an oven and left at 45 °C for 7 to 10 days and then were checked under light microscope at 100 x identify species.

Results

The average age of the patients was 8.43 ±3.02 years old. There were three boys and five girls. The average amount of total serum IgE was 1324.3 ±608.1 IU/mL. The average total eosinophil count was 620 ±302.3/mm^3.

A total of 385 dust samples were collected from the houses of the eight asthmatic patients and the four healthy children every 2 months over the 1-year study period. The concentrations of HDM had a wide range (101.49 ±150.19 mites/g of house dust) throughout the year. The concentrations observed were highest in July to November, peaked in November (134.39 ±143.04 mites/g of house dust), and then decreased gradually in subsequent months. There was no significant difference between the concentrations of HDM in samples from the patients and normal groups. The mean indoor temperature during the year was 24.13 ±4.19 °C and

Table 1. The distribution of HDM concentration in various sites of collection in patients with asthma and healthy controls

Sites of collection	Patient group (mites/gm dust)	Control group (mites/gm dust)	*p*
Living room floor	114.4 ±75.4[a]	97.8 ±80.8	NS
Sofa	69.8 ±44.2	74.3 ±72.7	NS
Bedroom floor	110.1 ±55.8	85.4 ±52.8	NS
Child's mattress	140.8 ±30.6	96.7 ±66.2	< 0.05[b]

Abbreviation: NS = nonsignificant
[a]Mean ±SD
[b]Significant

relative humidity 75.33 ±2.73%. The average lowest temperature reading occurred in January (Fig. 1). The incidence of hospitalization due to asthma attack during the study period was also recorded.

The concentrations of mites in the four dust sampling areas are shown in Table 1. The highest concentration was found in the child's mattress (140.8 ±30.8 mites/g of dust) and this concentration was significantly higher in the patient than in the normal groups ($p < 0.05$). No significance between the concentrations of HDM in other sampling areas was found between these two groups (Table 1).

The total number of HDMs examined under the microscope was 125. The classification of species of HDM can be readily identified by examination and comparison of a small number of morphological characteristics namely: 1. the cuticular striation pattern on the dorsum of the female hysterosoma, 2. the structure of the bursa copulatrix and the position of its external opening, 3. the relative lengths of legs III and IV in both sexes, 4. the relative thickness of legs I and II [7]. The major species identified were *Dermatophagoides pteronyssinus* (77%) and *Dermatophagoides farinae* (13%). *Blomian tropicalis* accounted for only 1.8% and up to 8.2% of identified HDMs were not further differentiated.

Discussion

In this study, the highest HDM concentrations were noted during the period from in July to November, although the difference between the average concentrations during these months and during the rest of the year was not significant. Our results are compatible with another study done in Taipei which found the mean mite densities were higher from August to November but did not find a seasonal variation [3]. In a previous study in Der p5, it also did not show a seasonal variation [2]. Another study in Taiwan showed a remarkable seasonal variation of Der p1 level with a peak level occurring in November [8]. In all of these studies, the peak concentration of HDM in samples occurred between late summer and autumn and then decreased in winter, with no seasonal variation except in the study of Der p1. An absence of significant seasonal variation in HDM has also been reported in studies from tropical cities such as Singapore [9] and subtropical cities such as Hong Kong [10]. In a study from eight different geographic areas of the United States, the highest level of HDM was in July [11]. A study done in Australia found that the HDM concentration in the living room was higher in autumn than that in winter or spring and no significant seasonal difference of HDM concentration in the bed and bedroom floor of allergic patients [12]. The seasonal variation in the household environmental distribution of mites in different areas of the world was also to be found different.

Absolute humidity has been reported to be the best single guide for mite growth [2]. However, this factor was not found to have a significant influence in our study. This may have been due to the small variation of humidity (ranged from 72% to 80%) encountered during our study period. The growth rate of mites grow is highest in temperature ranging from 22 °C to 25 °C and relative humidity ranging from 75% to 80% [6]. Thus, room temperature and relative humidity are well suited to mite growth in Taiwan. The relatively steady climate during the study period reflected the small variations in HDM concentrations in our study. With only eight asthmatic patients included in our study, the sample size may not have been large enough to show the seasonal variation or to detect a significant difference in HDM concentration between asthma patients and normal children.

In this study, the rate of hospitalization due to asthma attacks gradually increased during the period from November to March and the HDM concentrations were highest from July to November. However, demonstration of a direct relationship between allergen exposure and disease activity is always difficult because of the influence of a number of possible confounding factors such as viral infection, asthmatic medications, exercise, stress and so on. Short-term heavy allergen exposure may induce early sensitization and onset of symptoms, whereas low levels of allergen exposure may require a longer period of time to induce sensitization [13].

In this study, the highest household environmental level of HDM among the four sampled sites was found in children's mattresses. Children spend at least 6 to 8 h a day in their beds at home. The results clearly imply that in environment control, mattresses are more important than other sites. This is compatible with many previous studies [2,9,10].

Previous studies have found carpet to be a region of relatively high concentration of HDM [9,12]. In this study, none of the families investigated used carpets perhaps due to cultural considerations, personal habits, climate and education. Although asthma patients had higher mean HDM concentrations in all four areas compared to normal subjects, this difference was not significant.

The major species of HDM in this study were *D. pteronyssinus* (77%), *D. farinae* (13%), *B. tropicalis*

1.8 % and undifferentiated species accounted for 8.2% of organisms. While *B. tropicalis* has been reported to be a major species in tropical areas this is not true in subtropical areas [9,10]. In this study, we were able to clearly identify and count the *D. pteronyssinus* from *D. farinae* under light microscope. We did not confirm the species through techniques such as identifying eggs of mites and young mites, and were not able to classify mites with partial loss of body parts (such as a broken leg), resulting in an undifferentiated rate of 8.2%. Further differentiation of species could not be identified by microscopy. At present, there is no consensus on the best way to measure and express HDM level [13, 14]. The combined use of both detecting antibody and floating method to determine HDM concentration may produce more accurate results but also increases the complexity of procedures.

In conclusion, this study suggest that efforts at decreasing the concentration of HDM in the households of patients with asthma should be made on close attention to levels on the child's mattress and that these levels are likely to be particularly high during July to November.

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