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House Dust Mite Allergen Levels in Chiang Mai Homes

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SUMMARY **The quantitative assays for house dust mite (HDM) allergens provide a valid index of exposure and can be used for risk evaluation. We assessed group I HDM allergen levels in mattress and living room floor dust from 35 Chiang Mai homes and identified factors associated with high allergen levels. One-third of mattress and living room floor dust had group I HDM allergen levels of between 2-10 μg/g. Two-thirds of mattress dust and a small amount of living room floor dust had group I HDM allergen levels of over 10 μg/g. The geometric means of *Der p* I, *Der f* I and total group I allergens in mattress and living room floor dust were 8.61, 2.88, and 15.81 μg/g and 1.61, 0.27 and 2.43 μg/g, respectively. Mattresses made of kapok and rugs kept in the living room were associated with high group I allergen levels.**

Pyroglyphid mites have been found as the most important source of house dust allergens since 1967.[1] A high prevalence of mite allergy among asthmatic patients has been demonstrated and house dust mite (HDM) allergy has been associated with the increasing prevalence of asthma and allergic diseases.[2] Studies from different parts of the world have demonstrated that the mites in house dust were predominantly those of the genus *Dermatophagoides* (*D. pteronyssinus, D. farinae*), except for some tropical countries in which *Blomia tropicalis* was predominant.[3,4] The two major groups of allergens from the genus *Dermatophagoides*, which account for much of the allergenicity include group I (*Der p* I, *Der f* I, and *Der m* I) and group II (*Der p* II, and *Der f* II) allergens.[5,6] HDM allergen concentrations of 2 μg and 10 μg of *Der p* I per gram of dust have been proposed as thresholds of exposure for sensitization and the development of asthma, and acute exacerbation of asthma in mite-allergic individuals, respectively.[2,5] In children at risk for allergic diseases, exposure to a very high level of group I HDM allergens in infancy has been associated with an increased relative risk of developing atopic asthma by the age of 10 years.[7] The quantitative assays for mite allergens provide a valid index of exposure and can be used for risk evaluation. The two previous HDM surveys in Thailand indicated that *D. pteronyssinus* (Dp) was the most common and *D. farinae* (Df) was the second most common species found.[8,9] The first study was a report on mite counts from different provinces in the central and two in northeastern regions of the country.[8] The second one included mite counts and group I HDM allergen in mattresses from central, northern and northeastern regions.[9] However, there was no specific data for Chiang Mai. We, therefore, conducted a group I HDM allergen survey in Chiang Mai, a major city in the north of Thailand. The objectives of the present study were 1) to assess *Der p* I, *Der f* I and total group I allergen levels in dust samples collected from mattresses and living room floors in Chiang Mai homes, and 2) to determine the factors associated with high group I HDM allergen levels. The protocol of this study has been approved by the Research Ethics Committee of

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MATERIALS AND METHODS

Study design

This is a cross-sectional survey of randomly selected houses with 10-year-old children in the Central District of Chiang Mai. This survey was part of a multicenter study led by the Wellington Asthma Research Group on the determinants of dust mite allergen and its relationship to the prevalence of asthma in the Asia-Pacific region.

Selection of the children

Six schools were selected by simple random sampling from a list of all schools enrolling 10-year-old students in the Central District of Chiang Mai. Six children were selected at random from each class of 10-year-olds at each of the six schools. With a written informed consent from a parent or guardian, dust samples were collected from the home of each child on one occasion. A total of 36 homes were sampled. The survey was carried out during the last week of December 1999, which in Chiang Mai is part of the dry winter period.

Dust collection

Dust samples were collected using a standard household vacuum cleaner (Hitachi CV 2800, 1300 watts, Hitachi, Tokyo, Japan), connected to an ALK collection device (ALK Allergologisk Laboratorium A/S, Denmark) with filter paper (Whatman, Maidstone, England). The dust was sampled from the entire upper surface of the child's mattress (for 2 minutes) and the living room floor (2 m^2 for 2 minutes if carpeted, or 1 minute per 1 m^2 if uncarpeted).[5] After sampling, the dust and filter paper were emptied into tinfoil and placed in a labeled self-sealing plastic bag for storage at -20°C until transportation to Wellington, New Zealand. The collecting device was cleaned between each sampling using a cotton ball with methyl alcohol.

Mite allergen analysis

Dust samples were transported in ambient temperature within 72 hours to the Wellington Asthma Research Group, Wellington, New Zealand, for HDM allergen analysis. After removing dust from the filter and sieving (425 μm), the fine dust was extracted with phosphate-buffered saline at room temperature, and *Der p* I and *Der f* I levels were determined in centrifuged supernatants by a two-site monoclonal antibody ELISA[10] (Indoor Biotechnologies, Cardiff, UK). The allergen level was expressed as microgram per gram of dust. For samples where allergen levels were undetectably low, values of 0.01 μg were assigned.

Housing questionnaire

A short questionnaire on housing and bedding characteristics was completed by a parent or guardian of each child.

Statistical analysis

Descriptive analyses of the data were carried out using the SPSS program for Windows (SPSS Inc., Chicago, U.S.A.). Multiple regression analyses were also performed between log-transformed total group I HDM allergen levels, and housing and bedding characteristics.

Table 1 Percentage of dust samples with detectable group I HDM allergens, geometric mean and median of *Der p* I, *Der f* I and total group I allergens. GM = Geometric mean

	Mattresses				Living room floors			
	%	GM (μg/g)	Median (μg/g)	Range (μg/g)	%	GM (μg/g)	Median (μg/g)	Range (μg/g)
***Der p* I**	100	8.61	7.68	0.26-84.44	97.1	1.61	1.62	0.01-18.73
***Der f* I**	94.3	2.88	3.68	0.01-93.73	82.9	0.27	0.41	0.01-3.23
Total group I allergens	100	15.81	13.76	0.73-127.12	100	2.43	2.58	0.25-20.06

RESULTS

Forty-one houses were approached and 36 agreed to participate. Of the 36 houses studied, one appeared to be an orphanage and was excluded from the analysis. During the study period, the lowest and highest relative humidity in Chiang Mai was 20%, and 91%, respectively, with a daily mean ranging from 42% to 62%.

Group I HDM allergen levels

Detectable levels of *Der p* I were found in all dust samples from mattresses and in 97.1% of dust samples from the living room floors, while detectable levels of *Der f* I were found in 94.3% of mattress dust and in 82.9% of the floor dust (Table 1). Mattress dust contained higher levels of *Der p* I and *Der f* I than floor dust, and in both, mattress and floor dust, *Der p* I was higher than *Der f* I. The geometric mean and median of *Der p* I, *Der f* I and total group I allergen in mattress and floor dust are shown in Table 1.

About one-third of the mattress dust had mite allergen levels between 2-10 μg/g, whereas two-thirds of it contained group I allergen more than 10 μg/g (Fig. 1). The highest level of *Der p* I, *Der f* I and total group I allergen in mattress dust was 84.4, 93.73 and 127.12 μg/g, with a geometric mean of 8.61, 2.88, and 15.81 μg/g, respectively (Table 1). None of the mattresses studied had a cover for the prevention of HDM.

About half of the floor dust contained a low level (< 2 μg/g) of group I allergen. One-third had group I allergen levels between 2-10 μg/g and only a small amount had levels higher than 10 μg/g (Fig. 1). The highest level of *Der p* I, *Der f* I and total group I allergen in the floor dust was 18.73, 3.23 and 20.06 μg/g, with a geometric mean of 1.61, 0.27, and 2.43 μg/g, respectively.

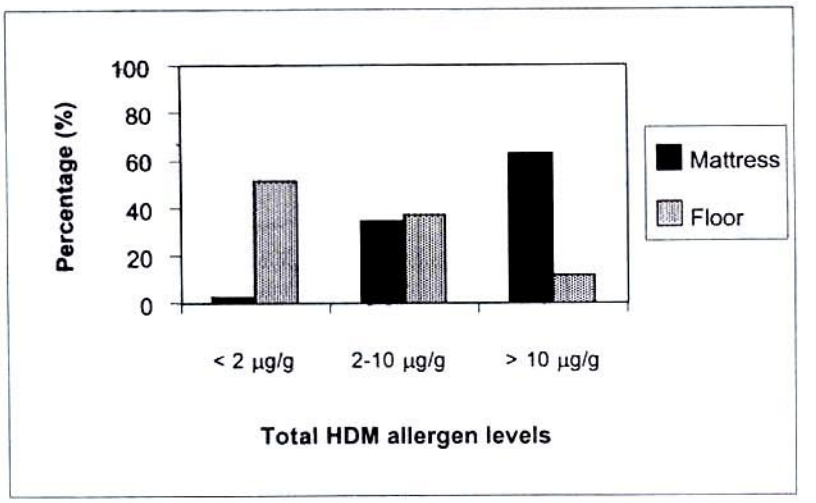

Fig. 1 Percentage of dust samples from mattresses and living room floors with different levels of total group I HDM allergens

Table 2 Association between housing and bedding characteristics and total group I HDM allergen levels in mattress dust

	Standard coefficient beta	*p*-value
Mattress made of kapok	0.497	0.002*
Mattress age	0.093	0.546
Visible dampness	0.087	0.573
Visible mold growth	-0.013	0.936
Family size	-0.036	0.819
House age	-0.015	0.924

* = Statistical significant at $\alpha = 0.05$ (95% CI for beta 0.2, 0.847)

Housing and bedding characteristics at different allergen levels

For mattress dust, the type of mattress, i.e. kapok ($p = 0.002$, beta = 0.497) was the outstanding factor that associated with a higher level of mite allergen, whereas no such association was found with the age of the mattress, family size, number of years the family had lived in that house, or signs of dampness or mold growth in the bedrooms (Table 2).

For living room floor dust, a rug in the living room ($p = 0.005$, beta = 0.438) was the most explicit factor associated with higher levels of mite allergen, whereas no such

association was found with family size, sign of dampness in the living room, or number of people or pets living in the house (Table 3). The presence of mold in the living room was inversely associated with the total group I allergen level ($p = 0.013$, beta = -0.387).

The proportion of the different housing and bedding characteristics in each group of group I allergen levels is shown in Tables 4 and 5.

Table 3 Association between housing characteristics and total group I HDM allergen levels on the living room floors

	Standardized coefficient beta	*p*-value
Rug in living room	0.438	0.005*
Visible mold growth	-0.387	0.013**
Visible dampness	0.113	0.477
Family size	0.025	0.872
House age	0.024	0.872
Pets	0.036	0.823

* = Statistical significant at $\alpha = 0.05$ (95% CI for beta 0.211, 1.111)
** = Statistical significant at $\alpha = 0.05$ (95% CI for beta -0.873, -0.113)

Table 4 Mattress and bedroom characteristics in relation to total group I HDM allergen levels in mattress dust

	Percentage of total samples (n = 35)		
	< 2 μg/g	2-10 μg/g	> 10 μg/g
No. of people living in the house			
1-5	0	20	40
6-10	2.9	14.3	20
> 10	0	0	2.9
Type of mattress			
Rubber	2.9	11.4	11.4
Kapok	0	5.7	25.7
Coconut fiber	0	11.4	14.3
Synthetic material	0	2.9	11.4
Age of mattress			
< 2 years	0	14.3	14.3
3-5 years	2.9	14.3	34.3
6-10 years	0	2.9	14.3
> 10 years	0	2.9	0
Bedroom condition			
Visible dampness	0	2.9	17.1
Visible molds	0	14.3	8.6

Atopic children

Four out of 35 children in this study had atopic diseases. One child had asthma and allergic rhinitis, the other 3 children had allergic rhinitis. The total group I HDM allergen levels in their houses are shown in Table 6.

DISCUSSION

Our study confirmed the results of previous HDM surveys in Thailand that Dp was the most common species found.[8,9] Our previous studies on skin prick test reactions in atopic children and adults in Chiang Mai also showed that Dp was the most important allergen causing sensitization.[11,12]

This study indicated that almost all children in Chiang Mai lived in houses containing mite allergen causing sensitization and two-thirds of them lived with mattress allergen that could cause asthma exacerbation. In contrast, about half of their living rooms contained lower HDM allergen levels than needed for sensitization. It has been documented that mattress dust generally contains a 100-fold higher HDM concentration than that on the corresponding floor, and that the HDM concentration in dust samples from the floor in the bedrooms is higher than that from the living rooms.[13] The mean group I allergen concentration in this study was higher than that reported in the previous study for the northern and

northeastern provinces of Thailand.[9] Our mean *Der p* I concentration in mattresses was about the same as that reported from Hong Kong,[14] but higher than that reported from Taiwan[15] and Singapore.[16]

Among all variables studied, the high group I allergen levels in mattresses were associated with mattresses made of kapok only, and high allergen levels on living room floors were associated with rugs. Most of the living rooms studied had smooth floors and low mite allergen levels. The two floors with the highest (20.06 μg/g) and second highest (17.41 μg/g) mite allergen levels were carpeted with rugs. There has been some evidence that different types of mattresses may contain different levels of HDM. A study in Norway found that the risk of finding mite feces was four times higher in foam compared to spring mattresses.[17] Another study from New Zealand found that *Der p* I levels were significantly higher in beds with kapok or inner sprung mattresses.[18] The reason why HDM allergen levels are higher in dust from carpets is probably due to the fact that HDM cling to carpet fiber tightly and propagate more efficiently in such conditions.

The important environmental factors conducive for mite growth include optimal temperature and humidity, food sources, and adequate textile substratum.[19] Interestingly, the group I allergen level in living room dust was inversely associated with visible molds, which was a good indicator of increased moisture. The effects of molds for mite growth are controversial. They have been thought to make diet more suitable for mites, but in some experiments mold has demonstrated adverse effects on mite growth.[20]

Table 5 Housing characteristics in relation to total group I HDM allergen levels in dust samples from living room floors

	Percentage of total samples (n = 35)		
	< 2 μg/g	2-10 μg/g	> 10 μg/g
No. of people living in the house			
1-5	31.4	22.9	5.7
6-10	17.1	14.3	5.7
>10	2.9	0	0
Rug in living room (Yes)	2.9	2.9	5.7
Age of house			
< 2 years	14.3	2.9	2.9
3-5 years	14.3	2.9	5.7
6-10 years	11.4	20.0	2.9
> 10 years	11.4	11.4	0
Pets (Yes)	34.3	22.9	5.7
Living room condition			
Visible dampness	5.7	5.7	0
Visible molds	17.1	0	0

Table 6 Total group I HDM allergen levels in dust samples from mattresses and living room floors in the homes of 4 atopic children

Child no.	Atopic diseases	Total group I HDM allergen levels (μg/g)	
		Mattress	Living room floor
1	Asthma & allergic rhinitis	25.02	1.54
2	Allergic rhinitis	10.63	3.55
3	Allergic rhinitis	9.35	17.42
4	Allergic rhinitis	83.88	14.24

Other variables, which may directly or indirectly relate to conditions that support the propagation of HDM, such as mattress age, house age, family size and dampness, were not associated with higher group I allergen levels in this study.

All 4 atopic children in this study had high levels of group I HDM allergens in their houses, especially in their mattresses.

The limitation of our study

was the small sample size, which might result in an insignificant association between HDM allergen levels and some variables. Future studies with a larger sample size are needed to identify other factors associated with high HDM allergen levels in Chiang Mai homes, so that mite control measures can be developed for atopic children in that area.

This was the first report of HDM allergen levels in Chiang Mai homes. Our results confirmed that Dp was the most common species in Chiang Mai. Most of the houses studied had a level of mite allergens greater than 2 μg/g in their mattresses, and low mite allergen levels on their living room floors. This indicates that mattresses are the most important source of HDM allergens in Chiang Mai. High group I allergen levels were associated with mattresses made of kapok, as well as with rugs in the living room. The results of our study could lead to further studies in the field of atopic diseases and HDM in Chiang Mai in the future.

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