

# Higher incidence of *Dermatophagoides pteronyssinus* allergy in children of Taipei city than in children of rural areas

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Received: March 3, 2005 Revised: September 12, 2005 Accepted: December 27, 2005

**Background and Purpose:** House dust mites are the most common cause of sensitization in wheezing children in most parts of the world. The aim of this study was to investigate prevalence of sensitization and the levels of specific immunoglobulin E (IgE) to *Dermatophagoides pteronyssinus* (Der p) in wheezing children in Taipei city and central rural Taiwan.

**Methods:** A total of 3546 children were enrolled in this study. Children were grouped into those living in Taipei city (n = 1340) and those residing in the rural part of central Taiwan (2206). The prevalence of sensitization and level of specific IgE antibody to Der p and cockroach were analyzed by age and geographic area.

**Results:** The results showed significantly higher sensitization rates and mean specific IgE levels to Der p with increasing age of patients in both Taipei city and rural central Taiwan. In addition, children from Taipei city had a significantly higher average sensitization rate of Der p than rural children ( $p < 0.05$ ). The proportion of children sensitized to cockroach increased with age both in Taipei city and central rural Taiwan, but the specific IgE levels to cockroach were not statistically different between the 2 groups ( $p = 0.061$ ).

**Conclusions:** Sensitivity to aeroallergens varies with age and with geographical location (city vs rural) in asthmatic children. Circulating IgE antibodies against Der p were common at all ages. Cockroach allergen is also associated with recurrent wheezing in Taiwan. Avoidance of indoor aeroallergens such as Der p and cockroach allergen should be an important component in plans for the management of recurrent wheezing.

**Key words:** Age factors, cockroaches, *Dermatophagoides pteronyssinus*, immunoglobulin E, rural population, urban population

## Introduction

The prevalence of allergic diseases has increased worldwide, especially in industrialized countries. Dietary change, reduction of average family size, improvements in general living standards, public health and personal hygiene practices may have important roles in the development of allergic disorders [1,2]. The risk of allergic disease can be influenced by genetic background, environmental conditions, or lifestyle

factors. Accumulating evidence indicates mite and cockroach are the sources of the predominant allergens [3]. *Dermatophagoides pteronyssinus* (Der p) is the predominant species of house dust mite in Taiwan, Australia, and Western Europe [4,5]. Allergen exposure related to geographic differences would appear to affect the prevalence of different allergens in children with allergic disease. Although several studies have reported allergen-specific immunoglobulin E (IgE) antibody in various parts of Taiwan [6,7], no large reports exist concerning the prevalence of dust mite allergy in the urban and rural subsistence populations in Taiwan. The aim of this study was to investigate the prevalence of sensitization and the levels of specific IgE

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to Der p in wheezing children in Taipei city and in the rural part of central Taiwan.

## Methods

Children who visited the pediatric allergy clinic of Veterans General Hospital, Taipei and Changhua Christian Hospital between June 2000 and June 2004 for evaluation of recurrent atopic wheezing were included in this study. At the first visit, the area in which the patient resided was recorded. Patients with mild intermittent asthma and those did not reside in Taipei city or central rural Taiwan were excluded. A total of 3546 children were enrolled in this study. The age range was from 6 months to 12 years, with a mean age of  $5.66 \pm 2.80$  years. The diagnosis of recurrent wheezing was defined as 2 or more episodes of wheezing after 3 months of age. Episodes of wheezing during the first 3 months were not included due to the risk of misdiagnosis of disease. Children with recurrent wheezing due to respiratory virus infection with positive respiratory syncytial virus, adenovirus antigen test, elevated C-reactive protein, foreign body aspiration or gastroesophageal reflux were excluded. Venous blood samples were obtained from all children diagnosed as having recurrent wheezing as the wheezing came under control. After clotting at room temperature, the samples were centrifuged, and sera were frozen and stored at  $-20^{\circ}\text{C}$  until analyzed. Specific IgE against house dust mite including Der p, *Dermatophagoides farinae* (Der f) and cockroach were examined by a commercial CAP system (Pharmacia, Uppsala, Sweden). The results were regarded as positive with values of specific IgE  $>0.35\text{kU/L}$ .

The children were divided into 2 groups, those living in Taipei city and those residing in the rural part of central Taiwan. Each group was divided into 5 subgroups according to age. The rate of positive sensitization and level of specific IgE to Der p and cockroach were compared between children under 1.5 years old and each subgroup with children older than 1.5 years in both the city and rural groups. In addition, the mean positive rate and mean level of specific IgE to Der p and cockroach were analyzed between Taipei city and rural central Taiwan to determine whether different geographic areas had different prevalence rates of sensitization.

## Statistical methods

Data were expressed as mean  $\pm$  standard deviation. The positive prevalence rate and level of specific IgE

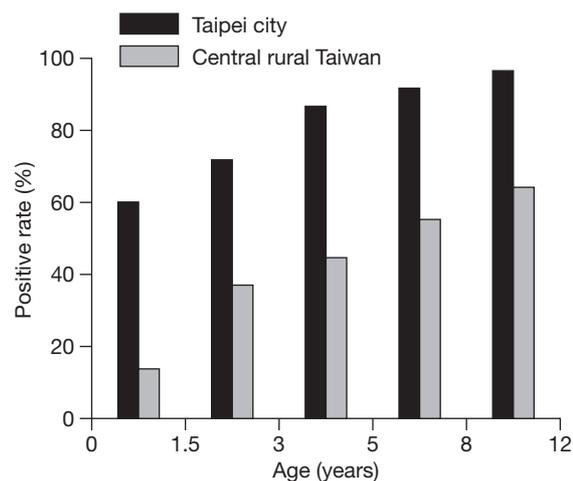
**Table 1.** Distribution by age status of children in Taipei city and those in the rural part of central Taiwan

Age (years)	Taipei city (n = 1340)	Central rural Taiwan (n = 2206)
	No. (% of total)	No. (% of total)
0.5-1.5	60 (4.5)	64 (2.9)
1.5-3	268 (20)	442 (20.03)
3-5	432 (32.24)	643 (29.15)
5-8	392 (29.25)	610 (27.65)
8-12	188 (14.03)	447 (20.26)

antibody to Der p and cockroach were analyzed by age. The difference in sensitization rates to Der p and cockroach between different age groups of children was analyzed by chi-squared test for trend. A univariate general linear model taking into account age and residential region was performed for level of specific IgE to Der p. All statistical analyses were conducted with the Statistical Package for the Social Sciences (SPSS) for Windows (Version 11; SPSS, Chicago, IL, USA).

## Results

Among the 3546 study subjects, 1340 patients were from Taipei city and 2206 patients were from the rural part of central Taiwan. The mean reported age was  $5.38 \pm 2.64$  years in the city group and  $5.84 \pm 2.87$  years in the rural group. The age distributions in the groups are shown in Table 1. Fig. 1 shows the sensitization rates of children who had specific IgE antibodies to Der p according to age and area of residence. The prevalence of circulating

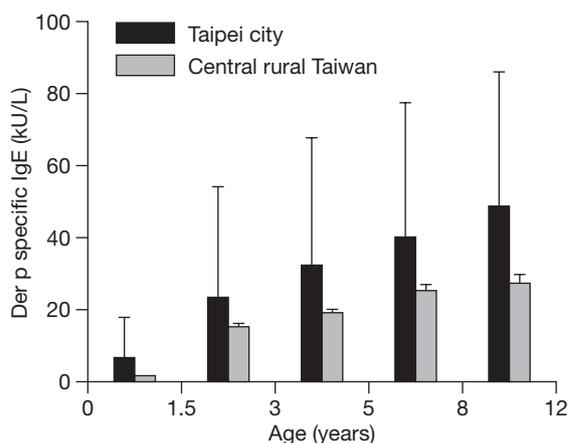


**Fig. 1.** Prevalence of sensitization to *Dermatophagoides pteronyssinus* allergen in wheezing children of Taipei city and the rural part of central Taiwan.

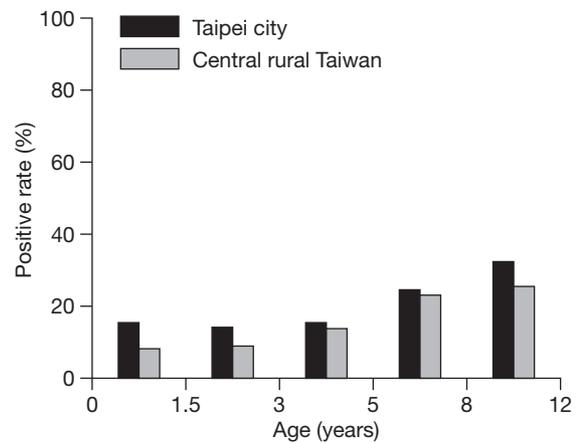
IgE antibodies to Der p increased from 60% at 0.5 to 1.5 years to 71.6% at 1.5 to 3 years, 86.6% at 3 to 5 years, 91.6% at 5 to 8 years and 96.3% at 8 to 12 years in the Taipei city group. For the rural group, the rate of sensitization to Der p was 13.85% in children under 1.5 years, with the highest positive sensitive rate 64.2% in the 8-12 year age group. In both groups, the proportion of patients sensitized to Der p increased with age (chi-squared for trend in Taipei,  $p=0.001$ ; chi-squared for trend in central rural Taiwan,  $p=0.001$ ).

A total of 1121 of 1340 children (83.7%) in the city group had positive test results for specific IgE to Der p compared to 1122 of 2262 in the rural group. Children from Taipei city had a significantly higher average sensitization rate of Der p than rural-residing children ( $p<0.05$ ). Fig. 2 shows the level of specific IgE to Der p. The level of specific IgE in children under 1.5 years in Taipei city and in rural central Taiwan was  $6.33 \pm 16.17$  kU/L and  $1.40 \pm 10.14$  kU/L, respectively. In order to identify the determinants of level of specific IgE levels to Der p, general linear model univariate analysis was performed. Age ( $p=0.001$ ) and residential location ( $p=0.0001$ ) were significant determinants of specific IgE level to Der p. There was a corresponding trend in mean specific IgE levels to Der p across age groups in both Taipei city and rural central Taiwan.

Fig. 3 and Fig. 4 show cockroach sensitivity data. The prevalence of sensitization to cockroach was 19.8% in those from Taipei city and 17.2% in those from rural central Taiwan. The proportion sensitized to cockroach increased with age both in the city and rural areas (chi-squared for trend in Taipei,  $p=0.001$ ; chi-squared for trend in central rural Taiwan,  $p=0.001$ ).



**Fig. 2.** Specific immunoglobulin E (IgE) to *Dermatophagoides pteronyssinus* (Der p) in wheezing children of Taipei city and the rural part of central Taiwan.



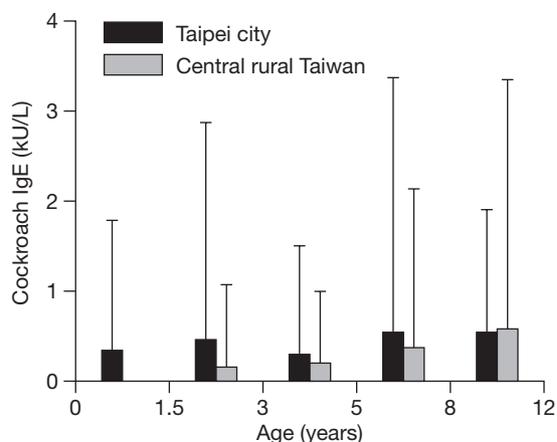
**Fig. 3.** Prevalence of sensitization to cockroach allergen in wheezing children of Taipei city and the rural part of central Taiwan.

The mean level of specific IgE to cockroach was  $0.36 \pm 1.834$  kU/L and  $0.253 \pm 1.478$  kU/L, respectively. There was no statistical difference between Taipei city and rural central Taiwan in sensitization rates ( $p=0.32$ ) and mean specific IgE levels to cockroach ( $p=0.061$ ).

## Discussion

Although allergic disorders are strongly influenced by genetics [8-10], many environmental factors are associated with exacerbation or development of asthma. Recently, the role of indoor environmental risk factors, especially in the home, has been emphasized. Well-documented risk factors in the home include moisture, high dust levels, pest infestation and pets. Der p allergy is a common cause of disease in areas of the world where environmental conditions are favorable for mite growth. Our data confirm earlier reports showing that Der p is also a prevalent allergen in Taiwan.

The sensitization rate and specific IgE level to Der p are significantly different in different age groups both in Taipei city and rural central Taiwan. Repeated exposure may explain the relationship between exposure to allergens and increased antibody formation in sensitized individuals. In the current study, 49.7% of patients in rural central Taiwan were found to be sensitive to Der p. This is a relatively low positive rate when compared with previous reports showing that the positive rate to Der p is about 60 to 80% in rural central Taiwan [11]. The difference in the results might be related to improvement of socioeconomic status and housekeeping standards of the past decade. In addition, there is a marked geographic difference in the prevalence and the level of specific IgE of Der p in Taiwan.



**Fig. 4.** Specific immunoglobulin E (IgE) to cockroach in wheezing children of Taipei city and the rural part of central Taiwan.

Children of Taipei city have had a higher prevalence of sensitization to house dust mite than children living in rural central Taiwan. Several studies suggest that the proportion of children who develop Der p allergy is greater in areas with higher Der p allergy exposure than in areas of lower exposure [12-14]. Regional variation in mite allergen levels depends largely on different levels of relative humidity, temperature, lifestyle, and housing conditions [15-17]. Average daily humidity during the year is higher in Taipei city than in the rural part of central Taiwan. There is strong evidence that elevated indoor humidity levels are associated with increased incidence of mites in the household. There is a higher monthly average of rainy days in Taipei than in rural central Taiwan (range, 12-14 days vs 4-5 days). Taipei city has a climate highly favorable for mite growth, with a monthly mean temperature ranging from 19.3°C in February (winter) to 34°C in July (summer) and high relative humidity ranging from 75% to 93%.

Housing characteristics affect indoor humidity [18,19]. Modern technology applied in building homes and energy-saving features of newer doors and windows results in insufficient natural ventilation and, especially during the winter in Taipei, may provide favorable conditions for mite growth. Bedding, mattresses, blankets and carpet are recognized reservoirs of house dust mites [20]. The western lifestyle and economic development also influence the occurrence of allergic disease. There has been increased use of blankets, upholstered furniture and carpet in Taipei. In addition, people residing in Taipei city spend more time participating in indoor activities such as television viewing and thus have increased exposure to harmful

indoor allergens including Der p. The increasing urban lifestyle in Taipei has reduced microbial stimulation, thus increasing the risk of asthma. It has been suggested that exposure to an agricultural environment causes higher levels of bacterial endotoxin exposure resulting in immune dysregulation from T helper-1/T helper-2 balance [21,22].

Cockroach has been recognized to be associated with asthma since Bernton and Brown were the first to report positive skin test responses to cockroach allergen [23]. Cockroach allergens are found throughout the home, including in beds, furniture, and carpets, although allergen levels are highest in the kitchen. Cockroach has been more significant than dust mite for allergic disorders in inner city areas where overcrowding and poor hygiene is common. Our data confirm earlier reports showing that cockroaches are also an important source of allergens [24].

Sensitization to cockroach allergens is found in 23 to 60% of urban residents with asthma [25]. The relatively low levels of cockroach allergens in our study may reflect improved housekeeping or child care practices in Taiwan. In contrast, our data did not show any difference in the prevalence of sensitization and levels of specific IgE to cockroach between the city and rural areas studied. Increasing evidence shows that the differences in cockroach sensitivity are related to economic conditions and poverty [26].

In conclusion, sensitivity to aeroallergens varies with age and with geographical location (city vs rural) in asthmatic children. Circulating IgE antibodies against Der p were common at all ages. Cockroach allergen is also associated with recurrent wheezing in Taiwan. Avoidance of indoor aeroallergens such as Der p and cockroach allergen should be an important component in plans for the management of recurrent wheezing.

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