A study on indoor environment contaminants related to dust mite in dwellings of allergic asthma patients and of healthy subjects

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Summary
This study investigated the pollution of dust mite allergens in the houses of 30 families and their infection to young allergic asthma patients in Shanghai. Medical records, family information, and dust samples were collected from the dwellings of 15 young allergic asthma patients and 15 healthy subjects. Der 1 allergen, which is a common allergen causing allergic asthma, was measured in collected dust samples using the Pharmacia UniCAP System. A significant correlation was found between the number of Der 1 allergens collected from floor surfaces and the number of Der 1 allergens collected from bed surfaces. Some factors influencing Der 1 allergen levels were found in this study. Relative humidity in dwellings was found to be most influential to the allergen levels. The findings suggested that traditional reduction methods for coarse particles, such as opening windows and periodic cleaning of beddings, may be effective in removing dust mite allergens.

Keywords: Dust mite, dust mite allergen, allergic asthma, Der 1, indoor, dwelling

1. Introduction

Allergic diseases, especially asthma, are public health problems worldwide. In most countries, the spread and mortality cases of asthma are continuously increasing. The World Health Organization (WHO) estimated 300 million asthmatic patients around the world, with incidence ranging from 1% to 18%. More than 50% of adult patients and 80% of young patients are sensitive to allergic factors (1,2).

Dust mite allergen is not only a familiar indoor allergen, but is also one of the most important pathogens causing allergic asthma (3-6). Dust mites belong to Acariformes, Acaroidea, Pyroglyphidae, and Pyroglyphidae, including Pyroglyphinae and Dermatophagoidinae. More than 10 genera and 40 species of dust mites exist all over the world. Two of the most important strains are Dermatophagoides pteronyssinus (D.p) and Dermatophagoides farinae (D.f).

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D. pteronyssinus is one of the first advantaged dust mites found in Eurasia, whereas D. farinae is the advantaged dust mite common in America (7,8).

Data reveal that China's cities are seriously polluted by dust mite allergens (9). A research on dust mites in 15 cities in China showed that house dust mites thrive in over 40% of houses in cities, except in high latitude areas, such as Zhangjiakou and Akesu. House dust mites were also found in 67% of houses in Shanghai (10).

Allergic asthma is a disease threatening human health which involves long-term treatment and high costs. Dust mite allergen is one of the most important pathogens causing allergic asthma, which exist in every part of the house. Thus, effectively decreasing indoor dust mite allergen levels can actively contribute to the prevention and treatment of allergic asthma. The objectives of this study are to determine the pollution caused by dust mite allergens in dwellings in Shanghai and to formulate a control method which will reduce indoor air pollution related to dust mite allergens.

2. Materials and Methods

This observational testing and analysis study evaluated indoor air contaminants related to dust mite from 2006
to 2007 in dwellings located in Shanghai. Similar with a related research (11), the present study gathered 15 young allergic asthma patients hospitalized in public pediatric clinics in Shanghai. The parents or legal guardians of eligible child subjects received detailed orientation on the aim of the study. Subjects were selected according to the following criteria: aged 1-16 years old, resident of Shanghai, reported with allergic asthma, income, and house types. Another set of 15 healthy subjects was chosen to participate in the study as control. The healthy subjects were selected based on the same criteria as the allergic asthma patients. Measurements were taken in the living room of each of the subject's dwellings.

A questionnaire survey was also carried out, which focused on medical records, house conditions, and lifestyles. Necessary information was inquired and documented in detail.

The indoor air temperature and relative humidity in each dwelling were measured by a hygrothermograph (THERMO RECORDER RS-11) positioned at the center of the living room. After a waiting time of two minutes, the data were read and recorded.

After measuring air temperature and relative humidity, house dust was collected from the surfaces of living room beds and floors using a paper filter equipped with a hand cleaner (HC-V15, National). The hand cleaner instantly absorbed house dust from the beds and floors. Subsequently, the collected samples of house dust were placed in a paper filter every minute. The samples were labeled and used for the analysis of dust mite allergen levels using the Pharmacia Uni-CAP System. The Pharmacia Uni-CAP System identified the dust mite allergen levels of the dust samples and automatically printed the results.

Results were tabulated and analyzed as μg/g fine dust for the dust mite allergen, Der 1. The levels of the allergen were compared based on geographical location, sampling locations, air temperature, and relative humidity.

The different parameters did not approach a normal distribution, even after log transformation. Non-parametric Mann-Whitney U test was used to evaluate the correlation between the dwellings of allergic asthma patients and those of healthy subjects in different sampling locations.

Correlations between Der 1 levels and temperature and relative humidity were assessed by means of the Spearman correlation coefficient (rho). The limit of significance was 0.05. Statistical analysis was performed with SPSS for Windows.

3. Results and Discussion

A total of 30 dwellings were assessed in this study: 15 dwellings of young allergic asthma patients and 15 dwellings of healthy subjects. Investigations conducted in each dwelling were successfully completed, and results were collected.

Der 1 mite allergens were detected in 100% of the analyzed dust samples (n = 60) collected from the dwellings. In dwellings of young allergic asthma patients, the level of Der 1 on the surfaces of living room beds varied widely from 0.06 μg/g to 21.30 μg/g (geometric mean: 1.74 μg/g). The Der 1 level on bed surfaces was higher than that on the surfaces of living room floors (p < 0.001), which ranged from 0.03 μg/g to 2.09 μg/g (geometric mean: 0.34 μg/g) (Figure 1). In the dwellings of healthy subjects, the level of Der 1 collected from the surfaces of living room beds varied widely from 0.65 μg/g to 69.33 μg/g (geometric mean: 7.14 μg/g), which was higher than the Der 1 level on the surfaces of living room floors (p = 0.045) that ranged from 0.01 μg/g to 22.22 μg/g (geometric mean: 2.05 μg/g) (Figure 1). In comparison, significantly higher levels of Der 1 were found in dwellings of healthy subjects than in dwellings of allergic asthma patients (p < 0.001).

Factors such as medical records of young allergic asthma patients, building structures, and family lifestyles were examined to determine their effects on Der 1 allergen levels; data came from the questionnaire survey. No association was found between the concentration of mite allergens and environmental characteristics, such as type of ventilation, lifestyles, and building structures.

Air temperature in the dwellings of allergic asthma patients ranged from 18.1°C to 21.6°C (mean: 19.9° C), whereas relative humidity ranged from 60% to 75% (mean: 69%). Air temperature in the dwellings of healthy subjects ranged from 19.7°C to 24.2°C (mean: 21.6°C), whereas relative humidity ranged from 41% to 62% (mean: 49.4%). The average air temperature in the patients’ dwellings was lower than that of the healthy subjects’ dwellings. A significant relationship was found between relative humidity and Der 1 levels on bed surfaces in patients’ dwellings (r = 0.577; p = 0.024) (Figure 2), whereas no obvious correlation was found between relative humidity and Der 1 levels on bed surfaces in the dwellings of healthy subjects.

The dwellings of six families who use cleaners reflected higher Der 1 levels compared with those of the nine families who do not use cleaners. A significant relationship between the usage of cleaners and Der 1 levels on bed surfaces in patients’ dwellings (r = 0.577; p = 0.024) (Figure 2), whereas no obvious correlation was found between relative humidity and Der 1 levels on bed surfaces in the dwellings of healthy subjects.

The significantly higher levels of Der 1 in the dwellings of healthy subjects compared with those of allergic asthma patients could be attributed to the attention given to the conditions of their houses. Families of allergic asthma patients apparently spent more time in house cleaning to reduce further exposure of their children to dangerous allergens. Another possible reason

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between ventilation, purification, and relative humidity. Relative humidity decreased sharply after opening windows and normalized quickly as time elapsed. Therefore, opening windows (e.g. once per hour) is effective in reducing indoor relative humidity and dust mite levels.

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