Levels of Indoor Allergens in Public Hospitals in Thailand

Supathra Tiewcharoen, M.D., Virach Junnu, M.Sc., Jeerawan Ongrotchanakul, B.Sc., Vanna Mahakittikun, M.Sc.
Department of Parasitology, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok 10700, Thailand.

ABSTRACT

Objective: To determine levels of indoor allergens in five public hospitals in Thailand.
Methods: A total of 90 dust samples were collected from five public hospitals in Bangkok, Thailand, during March 2002 to October 2003. These hospitals provide both adult and pediatric care to over 500 patients daily. Each dust sample was collected at 12.00-13.00 pm during the years 2002-2003. The total amount of dust was weighed and one hundred milligram of fine dust from each sample was extracted. A commercialized two-site monoclonal antibody-based immunoassay (Indoor Biotechnologies, Ltd., Manchester, UK) was used to quantify the levels of Der p1, Der f1, Can f1 and Fel d1.
Results: Fifty-one out of 90 dust samples were positive for indoor allergens. Four common groups of allergens were analyzed and detected; Der p 1 8/90 (8.89%), Der f 1 1/90 (1.11%), Fel d 1 39/90 (43.33%) and Can f 1 3/90 (3.33%)(of total samples). The arithmetic mean and standard deviation were 0.06 μg/g ± 0.26, 0.08 x 10^{-2} μg/g ± 0.001, 0.39 μg/g ± 0.71 and 0.06 μg/g ± 0.30 for Der p 1, Der f 1, Fel d 1 and Can f 1, respectively ($p = 0.004$). Fel d 1, the highest density allergen extracted from dust samples from hospital no. 5 and it showed a statistical difference compared with hospitals no.1,2,3,4 was observed; $p < 0.05$.*
Conclusion: Our findings indicated that cat allergen can be found in a hospital setting where no cat is present.

Keywords: Indoor allergens; Public hospitals; Thailand

Siriraj Med J 2006; 58: 955-958
E-journal: http://www.sirirajmedj.com

Indoor allergens, i.e., allergens derived from house dust mites, cockroaches, dogs and cats, are the main causes of acute asthmatic attacks and allergic diseases, particularly among people who lived in poorly ventilated environment and polluted areas. Increasing asthma morbidity has a major impact on patient's quality of life and also is one of the major public health problems worldwide.[1] Severity of asthma has been found to correlate with allergen exposure and allergen sensitization.[2-4] Thus, levels of allergens in the patient's environment has received much attention and concern in the intervention of the asthmatic morbidity. Many researchers are working on monitoring the levels of the indoor allergens, not only in the patients' homes but also else where, i.e., schools, workplaces, hospitals, and other public places. Example is a quantitative detection of domestic allergens in a British hospital in 1998 from which the data indicated that the levels of dust mite allergen (Der p1) and cockroach allergen (Bla g1), were too low to have any clinical significance to the sensitive asthmatic patients who were waiting in the waiting area of the hospital for their doctors' appointments.[5] The levels of house dust mite allergen were also determined in the public places in New Zealand.[6] In Thailand, several studies have been carried out to investigate and/or measure the indoor allergens especially in the homes of the allergic patients. House dust mite surveys have been carried out in 1995 when dust samples from 630 mattresses were collected from various houses in the central and northern parts of Thailand.[7] The results showed that dust samples from several surveyed houses had significantly high levels of group I allergens. Utilizing a locally produced mite-impermeable membrane to cover mattresses could significantly reduced the amount of the mite allergens.[8] In this study, we determined the amounts of domestic allergens, i.e., allergens from dust mites, cats, dogs, in public hospitals in Bangkok.

MATERIALS AND METHODS

Dust sample collection

A total of 90 dust samples were collected from five public hospitals in Bangkok, Thailand, during March 2002 to October 2003. These hospitals provide both adult and

Correspondence to: Supathra Tiewcharoen
E-mail: sistc@mahidol.ac.th

TABLE 1. The range and significant levels of indoor allergens in hospitals no. 1-5.

Hospitals	Amounts of the indoor allergens in μg per one gram of dust			
	Der p1	Der f1	Fel d1	Can f1
	M=0.06	M=0	M=0.28	M=0.09
No. 1 (n=36)	SD=0.24	SD=0	SD=0.59	SD=0.37
	R=0.17-1.26	R=0	R=0.10-2.67	R=1.21-1.93
	M=0	M=0	M=0.07	M=0
No. 2 (n=12)	SD=0	SD=0	SD=0.19	SD=0
	R=0	R=0	R=0.15-0.64	R=0
	M=0.08	M=0	M=0.29	M=0.07
No. 3 (n=19)	SD=0.04	SD=0	SD=0.65	SD=0.3
	R=0-1.14	R=0	R=0.20-2.60	R=0-1.31
	M=0.02	M=0	M=0.49	M=0
No. 4 (n=7)	SD=0.05	SD=0	SD=0.89	SD=0
	R=0-0.13	R=0	R=0.04-2.45	R=0
	M=0.19	M=0.001	M=0.96**	M=0.08
No. 5 (n=16)	SD=0.5	SD=0.02	SD=0.9	SD=0.3
	R=0.51-1.94	R=0.07	R=0.07-2.99	R=0-1.21
	M=0.06	M=0	M=0.39	M=0.06
Total (n=90)	SD=0.26	SD=0.02	SD=0.71	SD=0.3
	R=0-1.94	R=0.07	R=0.04-2.99	R=0-1.93

Level of significance, p =0.004
M=mean
SD=standard deviation
R=range

pediatric care to over 500 patients daily. Each dust sample from out patient department area was obtained by vacuuming with an ALK dust trap (National 2000 W, through filter paper No. 1). Filters were supported in a plastic dust trap located behind the cleaner attachment. One square meter-area in front of the first row of the chairs on rubber floor where the patients waited for their appointments in the morning clinic was sampled for two min. The total amount of dust was weighed and one hundred milligram of fine dust from each sample was extracted with phosphate buffered saline, pH 7.0 containing 0.1% Tween-20 as described previously.[7] Briefly, the dust sample and the PBS were mixed at a ratio of 1:10 (w/v) on an orbital rotator for two hours at 25°C before being centrifuged at 12,000 x g at 4°C for 20 minutes. Each supernatant was collected and stored in small aliquots at -20°C until analyzed.[4]

A two- site monoclonal antibody- based- ELISA

A commercialized two-site monoclonal antibody-based immunoassay (Indoor Biotechnologies, Ltd., Manchester, UK) was used to quantify the levels of Der p1, Der f1, Can f1 and Fel 1, as previously described.[9-10]

Statistical analysis

Allergen concentrations were log-transformed to normalize their distribution in all samples. The results of the comparison were analyzed using ANOVA. Allergen levels from five public hospitals were compared by using least square difference method.

TABLE 2. Statistical test for comparison of the Fel d1 density in hospitals nos. 1, 2, 3, 4, and 5 was analyzed by the least square difference method.

Hospital no.	P-value
Hospital no 1 and 5	0.001**
Hospital no 2 and 5	0.001**
Hospital no 3 and 5	0.004**
Hospital no 4 and 5	0.12

Level of significant differentce, p < 0.05

RESULTS

Dust samples were collected from the areas in front of the first row of chairs in waiting areas of six outpatient departments, i.e., Obstetrics and Gynecology, Surgery, Pediatrics, Medicine, Oto-Rhino-Laryngology, and Ophthalmology) of the five studied hospitals. A total of 90 samples (36, 12, 19, 7 and 16 samples from hospital nos.1-5, respectively) were collected. Fifty-one dust samples were positive including 8/90 samples (8.89%) for Der p1, 1/90 (1.11%) for Der f1, 39/90 (43.33%) for Fel d1, and 3/90 (3.33%) for Can f1. The ranges and arithmetic means and standard deviation of the amounts of individual allergens are shown in Table 1. Fel d1 allergens from five public hospitals were higher than other allergens. The detail of Fel d1 concentration showed the highest and lowest concentration of Fel d1 (2.987 and 0.64 μg/g of dust). Statistic analysis of Fel d1 allergen by least square difference method showed statistic difference between hospital no. 5 and hospitals no. 1, no. 2 and no.3. ($p < 0.05$)* (Table 2). In addition, Der p1 level in hospital no.5 was different from hospital no.3 even though the value was less than 2ul/gm dust.

DISCUSSION

In this study we measured common environmental allergens from five public hospitals in Thailand. The levels of indoor allergens were less than the threshold levels regarding as risk to acute attacks of asthma in sensitive asthmatic patients, i.e. 10 μg/g for Der p1, 8 μg/g for Fel d1 and 10 μg/g for Can f1. The values of Der p1, Der f1, and Can f1 were significantly different from Fel d1 (p=0.004). A number of different factors that influence the house dust mite population growth are likely to contribute to the low mite allergen levels in hospital dust. All public hospitals that took part in this survey were mechanically ventilated and their floors were mopped everyday without supplementary humidification. There were fewer sources of indoor-produced humidity in the hospitals than domestic households. These environmental factors were not suitable for the survival of a mite's life and growth. Furthermore, factors accounted for the low response of low mite density was the type of floor construction. Previous reports indicated that the type of floor construction and floor covering materials affect to the density of dust mite population. The concentration of Der p1 increased on timber floor construction[12,13]. Furthermore, the floor covering with carpets and rugs also enhanced the level of mite density. In contrast, the floors covered with rubber decreased the level of mite allergens; hence, they are safe for children who are prone to develop asthma.[14] These reasons support the result of our study because all of the public hospital floors were covered with rubber. Several reports of previous studies demon-

strated that low levels of Der f1 could be attributed to the fact that the biological factor that response to dust mites *Dermatophagoides farinae* was not different from *Dermatophagoides pteronyssinus*.[15-16]

It is well-known that cat allergens can be found throughout the environment which corresponds with our findings.[17-18], Since, cat allergen, Fel d1, is predominantly found on cat's skin and it is also contained on skin flakes of a cat, the particles are aerodynamically small and could remain airborne for hours. In addition, cat allergen is not only present in houses in which cats reside but also in schools and public buildings and even in places where there is no cat.[19] The highest level of cat allergen was measured from public hospital no.5 (Table 2), probably as a result of patients transferring allergens into the outpatient area. Recent publications reported that the amount of the Fel d1 allergen in dust from public buildings was probably brought from the clothing of cat owners.[20] Furthermore, cat allergen, unlike the mite allergen, remains airborne in an undisturbed home. The airborne quantity represents less that 0.01% of the allergen contained in the home.[21] Although it is as yet impossible to assess the clinical significance of this finding, there is a possibility that inhalation of such airborne allergens are capable of exacerbating asthma in patients highly allergic to cats.[22] Further research will continue to investigate Fel d1 allergen and other potential asthmatic triggers in all parts of Thailand.

CONCLUSION

An investigation of indoor allergen levels: Der p1, Der f1, Can f1 and Fel 1, were carried out to evaluate the amount of domestic allergens in public hospitals in Thailand. Ninety sets of dust samples were collected from five hospitals at 12.00-13.00 pm before cleaning time, during the years 2002-2003. Fel d1, the highest allergen of the five allergens showed a statistic difference from mite allergens group 1 and dog allergens ($p=0.004$). The comparisons of Fel d1 level between five hospitals were observed. The results showed differentiation of hospital no.5 from no 1, 2, 3 ($p< 0.05$)*. Our findings indicated that cat allergen can be found in hospital settings where no cat is present.

ACKNOWLEDGEMENTS

We are gratefully indebted to Prof. Dr. Wanpen Chaicumpa for her kindness in helping to prepare the manuscript, and Assistant Prof. Dr. Nat Malainual for statistical analysis. We thank Mr. Surasak Suvouttho, Mr. Pisit Chinabut, and Miss Nontiya Monkong for their assistance in dust collection. This work was supported by a research grant from Mahidol University 2002.

REFERENCES

1. Heissenhuber A, Heinrich J, Fahlbusch B, Borte M, Wichman HE, Bolte G. Health impacts of second-hand exposure to cat allergen Fel dI in infants. Allergy 2003; 58: 154-7.
2. Custovic A, Simpson BM, Simpson A, Hallam CL, Morolia H, Walsh D, et al. Current mite, cat and dog allergen exposure, pet ownership, and sensitization to inhalant allergens in adult. J Allergy Clin Immunol 2003; 111: 402-7.
3. Litonjua AA, Sparrow D, Weiss ST, O'Cornnor GT, Long AA, Ohman JL Jr. Sensitization to cat allergen is associated with asthma in older men and predicts new-onset air way hyperresponsiveness. The Normative Aging Study. Am J Respir Crit Care Med 1997; 156: 23-7.
4. Celedon JC, Litonjua AA, Ryan L, Platts-Mills T,Weiss ST,Gold DR. Exposure to cat allergen, maternal history of asthma, and wheezing in the first 5 years of life. Lancet 2002; 360: 781-2.
5. Custovic A, Fletcher A, Pickering CA, Francis HC, Green R, Smith A, et al. Domestic allergens in public places III: house dust mite, cat, dog and cockroach allergens in British hospitals. Clin Exp Allergy 1998; 28: 53-9.
6. Wickens K, Siebers R, Ellis I, Lewis S, Sawyer G, Tohill S, et al. Determinants of house dust mite allergen in house in Wellington, New Zealand. Clin Exp Allergy 1997; 27: 1077-85.
7. Malainual N, Vichyanond P, Phan-Urai P. House dust mite fauna in Thailand. Clin Exp Allergy 1995; 25: 554-60.
8. Vichyanond P, Uthaisangsook S, Ruangruk S, Malainual N. Complete mattress encasing is not superior to partial encasing in the reduction of mite allergen. Allergy 1999; 54: 736-41.
9. Schou C, Hansen GN, Lintner T, Lowenstein H. Assay for the major dog allergen, Can fI. I: investigation of house dust samples and commercial dog extracts. J Allergy Clin Immunol 1991; 88: 847-53.
10. Luczynska CM, Arruda LK, Platts-Mills TA, Miller JD, Lopez M, Chapman MD. A two-site monoclonal antibody ELISA for the quantification of the major *Dermatophagoides* spp. allergens, Der pI and Der fI. J Immunol Methods 1989; 118: 227-35.
11. Chapman MD, Aalberse RC, Brown MJ, Platts-Mills TA. Monoclonal antibodies to the major feline allergen Fel dI. II. Single step affinity purification of Fel dI, N-terminal sequence analysis, and development of a sensitive two-site immunoassay to assess Fel dI exposure. J Immunol 1988; 140: 812-8.
12. Van Strien RT, Verhoeff AP, Brunekreef B, Van Wijnen JH. Mite antigen in house dust relationship with different housing characteristics in The Netherlands. Clin Exp Allergy 1994; 24: 843-53.
13. Martin I. Modifiable indoor domestic environment risk factors for asthma. MPH dissertation. The University of Otago, New Zealand, 1996.
14. Wichens K, MasonK, Fitzharris P, Siebers R,Hearfirld M, Cunningham M, et al. The importance of housing characteristics in determining Der pI levels in carpets in New Zealand homes. Clin Exp Allergy 2001; 31: 827-35.
15. Brandt RL, Arlien LG. Mortality of house dust mites, *Dermatophagoides farinae* and *D. pteronyssinus*, exposed to dehydrating conditions selected pesticides. J Med Entomol 1976; 13: 327-13.
16. Roost HP, Kunzli N, Schindler C, Jarvis D, Chinn S, Perruchoud AP, et al. Role of current and childhood exposure to cat and atopic sensitization. European Community Respiratory Health Survey. J Allergy Clin Immunol 1999; 104: 941-7.
17. Ichikawa K, Iwasaki E, Baba M, Chapman MD. High prevalence of sensitization to cat allergen among Japanese children with asthma, living without cats. Clin Exp Allergy 1999; 29: 754-61.
18. Munir AKM, Einarsson R, Dreborg SKG. Indirect contacts with pets can confound the effect of cleaning procedure for reduction of animal allergen levels in house dust. Pediatr Allergy Immunol 1994; 5: 32-9.
19. Platts-Mills T. Allergen avoidance. J Allergy Clin Immunol 2004; 113: 389-90.
20. Bollinger ME, Eggleston DA, Flanagan E, Wood RA. Cat antigen in homes with and without cats may induce allergic symptoms. J Allergy Clin Immunol 1996; 97: 907-14.
21. Almqvist C, Larsson PH, Egmar AC, Hedren M, Malmberg P, Wickman M. School as a risk environment for children allergic to cats and a site for transfer of cat allergen to homes. J Allergy Clin Immunol 1999; 103: 1012-7.
22. Platts-Mills T, Vaughan J, Squillace S, Woodfolk J, Sporik R. Sensitization, asthma, and a modified Th2 the response in children exposed to cat allergen: a population-based cross-sectional study. Lancet 2001; 357: 752-6.

บทคัดย่อ

ระดับสารก่อภูมิแพ้ในโรงพยาบาลของรัฐในประเทศไทย

สุภัทรา เตียวเจริญ พ.บ., วิรัช จั่นหนู วท.ม., จีรวรรณ องค์โรจนกุล วท.บ., วรรณะ มหากิตติคุณ วท.ม.

ภาควิชาปรสิตวิทยา, คณะแพทยศาสตร์ศิริราชพยาบาล, มหาวิทยาลัยมหิดล, กทม. 10700, ประเทศไทย.

วัตถุประสงค์: ศึกษาระดับ indoor allergen ในโรงพยาบาลของรัฐ 5 แห่งในประเทศไทย

วิธีการ: โดยเก็บจำนวนตัวอย่างฝุ่น 90 ตัวอย่าง ในโรงพยาบาลของรัฐ 5 แห่ง จากบริเวณพื้นที่นั่งผู้ป่วยหน้าห้องตรวจ ระหว่าง ปี 2545-2546 ระหว่างเวลา 12.00-13.00 น. จากนั้นนำฝุ่นทั้งหมดมาตรวจวิเคราะห์โดยวิธี two-site monoclonal antibody enzyme-linked immunosorbent assay

ผลการศึกษา: จากจำนวนตัวอย่างฝุ่น 90 ตัวอย่าง : พบ indoor allergen ในตัวอย่างฝุ่น 51 ตัวอย่าง โดยแยกเป็น Der p1 8 ตัวอย่าง; (8.89%) Der f1 1 ตัวอย่าง (1.11%), Fel d1 39 ตัวอย่าง (43.33%), และ Can f1 3 ตัวอย่าง (3.33%) ระดับค่าเฉลี่ย และความเบี่ยงเบนมาตรฐานของ indoor allergen มีดังนี้ Der p1; 0.06 µg/g, ± 0.26 Der f1; 0.08 x 10-2 µg/g ± 0.001 Fel d1; 0.39 µg/g ± 0.71 Can f1; 0.06 µg/g ± 0.3 เมื่อนำผลการทดลองมาศึกษาวิเคราะห์พบว่า จากตัวอย่างของโรงพยาบาลที่ 5 พบ Fel d1 มีปริมาณสารก่อภูมิแพ้มากที่สุด นอกจากนั้นพบปริมาณของ Fel d1 จำนวนมากเมื่อเปรียบเทียบกับสารก่อภูมิแพ้ชนิด Der p1, Der f1, Can f1 จากการศึกษาความสัมพันธ์ของสารก่อภูมิแพ้ Fel d1 พบความสัมพันธ์ของสารก่อภูมิแพ้ของโรงพยาบาลที่ 5 กับโรงพยาบาลที่ 1, 2, 3

สรุป: พบปริมาณสารก่อภูมิแพ้จากฝุ่น: Der p1, Der f1, Can f1, Fel d1 จากโรงพยาบาลของรัฐบาลอยู่ในระดับต่ำ