

Common Aeroallergens by Skin Prick Test among the Population in Two Different Regions

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Abstract

Objectives: The purpose of this study primarily was to determine and characterise the common allergens found using skin prick test both in Malaysia and the Netherlands.

Study Design: This is retrospective cross-sectional descriptive study which the data was collected from two different hospitals.

Methodology: The study population included patients with history of atopy and / or diagnosed with any forms of allergy, mainly nasal allergy that were referred for skin prick test.

Results: In 284 respondents, the Asians showed significantly ($p < 0.001$) higher percentage of positive response towards most of the subgroups of aeroallergen especially house dust mite (82.4%) as compared to the Europeans (41.2%). More than half (84.3%) of the Asian population had positive test responses to one or more aeroallergens and the highest prevalence was for house dust mite, 69% - 78% (*Dermatophagoides pteronyssinus*, *Dermatophagoides farinae* and *Blomia sp.*) followed by cat fur (40.6%) and *Alternaria sp.* (38.2%). Even the European has higher prevalence of positive response towards house dust mite subgroup (24.7%) in comparison with fungi and epidermals with 3.9% and 8.8% respectively ($p < 0.001$). However, the prevalence for both Bermuda grass and grain pollen (20.9%) in Europe were more or less the same with house dust mite, 21% - 25% (*Dermatophagoides pteronyssinus* and *Dermatophagoides farinae*). The least frequent aeroallergen for both Asia and Europe was dog hair (30.6% and 1.7% respectively).

Conclusions: House dust mites are the most common aeroallergens in the two different regions.

Introduction

Allergy is an immune-mediated hypersensitivity reaction involving specific recognition of a particular allergen and the production of specific immunoglobulins, usually of isotype E (IgE) [1]. This hypersensitivity reaction is often described as type 1 allergic reaction. An allergic reaction of this kind can be manifested in the lungs (allergic asthma), in the eyes and nose (conjunctivitis and allergic rhinitis), or in the skin (atopic eczema). Among those, allergic rhinitis is considered the most common manifestation, furthermore aeroallergens are important contributing factors causing the symptoms in allergic rhinitis [2,3].

Various aeroallergens from animals or plants play an important role in the early development of asthma and allergy [4]. Exposure to aeroallergens increases the risk of sensitisation and the development of allergic respiratory complaints [5]. Many studies have shown that the distribution and pattern of aeroallergen is significantly different in different countries and even in different parts of a country [6,7]. Herbal geography, climate and temperature are responsible for the variations [8]. Among these, climate affects many aspects of allergy and allergen exposure, including the type and frequency of allergens in any particular geographic location, exposure to food and insect allergens, cross-reactivity among allergens, and the prevalence of allergy-related diseases [9-27].

The incidence of allergy is increasing throughout the world with increasing trend of skin prick test positivity [2]. In the latter decades of the twentieth century, there was a rise in the prevalence of allergy, particularly in children, not only in the Netherlands but also in other western countries [28-30]. According to the National Institute of Allergy and Infectious Diseases, as many as 50 million people in the United States suffer from various types of allergies [31]. Of these, 20.3 million have asthma, a chronic lung disease often triggered by allergies.

These allergic conditions affect all ages in all countries, with signs

and symptoms and types of allergens changing according to the ages of the sufferer [2]. In Malaysia, one out of three people is allergic to something and it is expected to affect 50% of Malaysians by the year 2020 [32]. Around 50% of world's teenagers were already suffering from airway allergies such as allergic rhinitis [33]. In addition, a study from the Netherlands done in year 2002 also reported the prevalence of 'nasal allergy' in adults has risen since 1992 [34].

Allergy is one of the common disorders that have major influence on quality of life which also contributes to academic and occupational absenteeism with significant impact on health care expenditure [35-39]. Therefore, it is useful to identify the common allergens that provoke allergic reaction so that prevention from exposure to these allergens can be made to reduce the potential health catastrophe from occurring.

The purpose of this study primarily was to determine and characterise the common allergens found using skin prick test both in Malaysia and the Netherlands. The secondary objective was to compare the allergens between two countries, which were an emerging developing country in Asia like Malaysia and developed country in Europe like the Netherlands; with different economical, lifestyle and climate.

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Methodology

This was a hospital-based retrospective cross-sectional descriptive study that was carried out in University of Malaya Medical Centre (UMMC), Malaysia and University Medical Centre Utrecht (UMCU), in the Netherlands. Both of these centres are the tertiary centre in both countries. The study population included patients with history of atopy and / or diagnosed with any forms of allergy, mainly nasal allergy who were referred for skin prick test. Patients who were on anti-allergic drugs had went through an appropriate wash out period according to the types of drugs taken. Subsequently, the skin prick test was performed by the attending physician excluded those with previous history of severe allergy (anaphylactic shock) or persistent skin disease such as dermatographism, atopic dermatitis and eczema.

Skin Prick Test

It was carried out on the flexor aspect of forearm avoiding the wrist and antecubital fossa. The forearm was coded with a marker pen for the allergens to be tested spacing the tests out at about 3 cm. A drop of the extract was deposited on the indicated position. The skin was then pricked vertically through each drop using a standardised prick test needle (Stallepoint). The extract solution was wiped away with a tissue paper. Result was read after 15 to 20 minutes.

Allergen tested

All patients underwent skin prick test (SPT) with at least 10 common regional allergenic extracts. Eleven and twelve common regional allergen extracts were performed in UMMC and UMCU respectively. These allergens were chosen according to the prevalence of each aeroallergens in each region (Table 1). Histamine and normal saline solution were used as positive and negative controls, respectively. The aeroallergens tested were classified into indoor or outdoor aeroallergens and subdivided four groups as reflected below in Table:

Definition of a positive skin test response

For analysis of the skin prick test data, an allergen-specific skin test response was considered to be positive if there was associated erythema of 3 centrimetre diameter even with or without the presence of wheal. If there were wheals present, the wheals of the allergen extracts were compared with the wheals of the controls of which the positive control was histamine and the negative control was saline. Sensitisation should be considered as positive as soon as the allergen extract's diameter was: superior to negative control (saline) wheal diameter by at least 3mm; and at least equal to half of the positive control (histamine) wheal diameter

The size of the wheal does not indicate the severity of symptoms. The patient was considered to have positive skin prick test towards different subgroup of aeroallergen when there is a positive response to at least one of the aeroallergen in that category. Three patients were excluded from the study because of the positive response to negative control.

Data collection and statistical analysis

Allergy data from April 2007 to September 2009 were obtained from the Department of Otorhinolaryngology in UMMC and UMCU. Collected data included demographics (age, gender, and race) and skin prick test results were entered and analysed using the SPSS version 16.0 software. More than 50% data feather extract was unavailable. Therefore, those were excluded from analysis. Unavailable data for other allergens were treated as a missing data for each case. The chi-square test was used to assess the association between categorical variables and test the univariate association between demographic characteristics and positive skin prick test. The significant level was pre-set at 0.05.

Results

(Table 2) showed the distributions of respondents aged 5 to 84 years by demographic backgrounds and skin prick test (SPT) responses. Of

Asia		Europe	
Aeroallergen tested	Unavailable data, n(%)	Aeroallergen tested	Unavailable data, n(%)
House Dust Mite		House Dust Mite	
<i>Blomia sp.*</i>	15 (14.7)	<i>Dermatophagoides farinae*</i>	0 (0.0)
<i>Dermatophagoides farinae*</i>	0 (0.0)	<i>Dermatophagoides pteronyssinus*</i>	0 (0.0)
<i>Dermatophagoides pteronyssinus*</i>	0 (0.0)		
Fungi		Fungi	
<i>Alternaria sp.†</i>	0 (0.0)	Fungi mix 1*	1 (0.5)
<i>Aspergillus mix*</i>	0 (0.0)	Fungi mix 2†	1 (0.5)
<i>Cladosporium sp.*</i>	0 (0.0)		
<i>Penicillium mix*</i>	0 (0.0)		
Yeast mix†	0 (0.0)		
Pollens		Pollens	
Bermuda grass†	0 (0.0)	Grain pollen†	0 (0.0)
		Bermuda grass†	0 (0.0)
		Weed pollen†	0 (0.0)
		Seasonal tree pollen†	0 (0.0)
		Non-seasonal tree pollen†	1 (0.5)
Epidermals		Epidermals	
Cat fur*	1 (1.0)	Cat fur*	2 (1.1)
Dog hair*	30 (29.4)	Dog hair*	1 (0.5)
		Feather†	116 (63.7)

* indoor aeroallergens
† outdoor aeroallergens

Table 1: Subdivision and classification of aeroallergens tested and the proportions of missing data for each aeroallergen in both regions.

Characteristic	Skin Prick Test (SPT)						p-value
	Total		Positive		Negative		
	n	%	n	%	n	%	
All respondents	284	100.0	161	56.7	123	43.3	
Gender							
Female	141	49.6	78	48.4	63	51.2	0.643
Male	143	50.4	83	51.6	60	48.8	
Age group							
0 to 4	0	0.0	0	0.0	0	0.0	< 0.001
5 to 14	27	9.5	24	14.9	3	2.4	
15 to 24	68	23.9	50	31.1	18	14.6	
25 to 34	55	19.4	30	18.6	25	20.3	
35 to 44	43	15.1	18	11.2	25	20.3	
45 to 54	37	13.0	18	11.2	19	15.4	
55 to 64	35	12.3	15	9.3	20	16.3	
65 to 74	15	5.3	5	3.1	10	8.1	
75 to 84	4	1.4	1	0.6	3	2.4	
Region of residence							
Asia	102	35.9	86	53.4	16	13.0	< 0.001
Europe	182	64.1	75	46.6	107	87.0	

Table 2: Distribution of respondents by background characteristics and skin prick test (SPT) responses in both regions.

the total sample (284 respondents), majority of them were European (64.1%) and only 35.9% were Asian. However, there were fair distributions of respondents in terms of gender with 50.4% of them were male and 49.6% were female. Majority of the respondents were between 15 to 44 years of age with the mean of 36.17 ± 1.044 [S.E] (median 33.07).

About 57% of the total sample have positive skin prick test with the Asian showing higher proportion of positive response (53.4%) as compared to the European (46.6%). Even among Asians (Figure 1), there were higher percentage of respondents with positive response, 84.3% ($p < 0.001$). In contrast, a negative skin prick test (SPT) response was greater among the respondents in Europe with 87.0%. (Table 2) also showed that there were significant difference ($p < 0.001$) in skin prick test response among the different age group with higher positive response among the teenagers and young adults aged 15 to 24 years (31.1% had positive skin prick test). There was no significant difference in skin prick test (SPT) response between both genders.

As shown in (Figure 1), the Asians showed significantly ($p < 0.001$) higher percentage of positive response towards most of the subgroups of aeroallergen especially house dust mite (82.4%) as compared to the Europeans (41.2%). Similar pattern can be observed in the skin prick

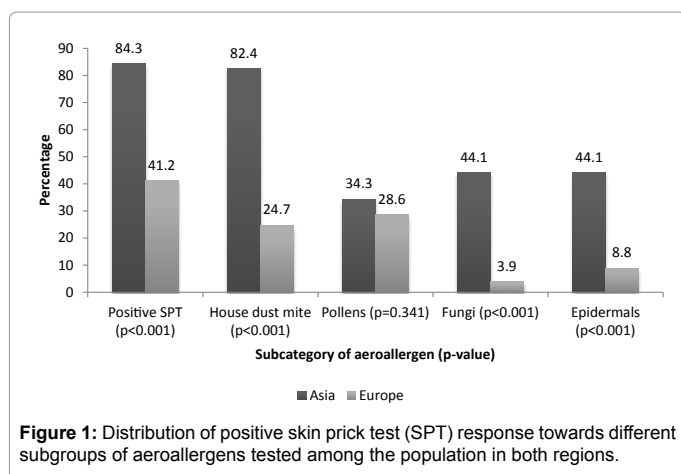


Figure 1: Distribution of positive skin prick test (SPT) response towards different subgroups of aeroallergens tested among the population in both regions.

test (SPT) response to individual aeroallergens as depicted in (Table 3). More than half (84.3%) of the Asian population had positive test responses to one or more aeroallergens and the highest prevalence was for house dust mite, 69% - 78% (*Dermatophagoides pteronyssinus*, *Dermatophagoides farinae* and *Blomia sp.*) followed by cat fur (40.6%) and *Alternaria sp.* (38.2%).

Aeroallergen tested	Positive skin prick test (SPT) responses	
	Asia, n (%)	Europe, n (%)
Indoor aeroallergen		
House Dust Mite		
<i>Blomia sp.</i>	60 (69.0)	-
<i>Dermatophagoides farinae</i>	79 (77.5)	38 (20.9)
<i>Dermatophagoides pteronyssinus</i>	80 (78.4)	45 (24.7)
Epidermals		
Cat fur	41 (40.6)	14 (7.8)
Dog hair	22 (30.6)	3 (1.7)
Fungi / Moulds		
Fungus mix 1	-	5 (2.8)
<i>Aspergillus sp.</i>	38 (37.3)	-
<i>Penicillium mix</i>	37 (36.3)	-
<i>Chladosporium sp.</i>	35 (34.3)	-
At least one indoor aeroallergen	86 (84.3)	50 (27.5)
Outdoor aeroallergen		
Pollens		
Bermuda grass	35 (34.3)	38 (20.9)
Grain pollen	-	38 (20.9)
Weed pollen	-	7 (3.8)
Seasonal tree pollen	-	22 (12.1)
Non-seasonal tree pollen	-	24 (13.3)
Fungi / Moulds		
<i>Alternaria sp.</i>	39 (38.2)	-
Yeast mix	35 (34.3)	-
Fungus mix 2	-	4 (2.2)
At least one outdoor aeroallergen	42 (41.2)	55 (30.2)
At least one indoor or outdoor allergen	86 (84.3)	74 (40.7)

Table 3: Percentages of positive skin prick test (SPT) responses among the population in both regions aged 5 to 84 years.

Even the European has higher prevalence of positive response towards house dust mite subgroup (24.7%) in comparison with fungi and epidermals with 3.9% and 8.8% respectively ($p < 0.001$). However, the prevalence for both Bermuda grass and grain pollen (20.9%) in Europe were more or less the same with house dust mite, 21% - 25% (*Dermatophagoides pteronyssinus* and *Dermatophagoides farinae*). The least frequent aeroallergen for both Asia and Europe was dog hair (30.6% and 1.7% respectively).

A positive to at least one outdoor aeroallergen was slightly more common than a positive test response to at least one indoor aeroallergen in Europe (30.2% vs 27.5%). In comparison with Asia, the reverse pattern was observed whereby a positive test response to at least one indoor aeroallergen was greater than to outdoor aeroallergen (84.3% vs 41.2%). There was insignificant finding in positive skin prick test (SPT) response towards pollens among the population in both regions. (Figure 1)

Discussion

Exposure to allergens is an important triggering factor for the development of allergic sensitization and skin prick test is useful in detecting sensitization to allergen [40-42]. In Asia, it was believed that the prevalence of allergic disease, including food allergy was low [43]. In contrast, this study has shown that majority of Asian with personal history of atopy revealed positive allergic sensitisation to at least one category or subgroup of aeroallergen through skin prick test (SPT) which was consistence with a study from Thailand [44,45].

Negative skin prick response was higher in the Europe although prevalence of nasal allergies appeared to be higher in Western Europe as compared with Eastern Europe and South and Central Asia [46]. However, the result of SPT can varied from 24.9 - 81.6% depending on the diversity of populations tested with regard to the lifestyle, either urban or rural and mobility [47-49].

Aeroallergen is the most common sensitising allergens with variation from area to area with different geo-climate condition [50]. House dust mites (mainly *Dermatophagoides pteronyssinus*) constitute the major sensitising aeroallergen in both Asia and Europe [51,52]. The result was expected for Asia because of the humid climate and moderate temperature in most of the countries [45,51,53]. In a region with four seasons, house dust mites thrive in summer and die during winter. Nevertheless, they will continue thriving even in the coldest of months in a warm and humid house [53].

Although in some countries indoor aeroallergens are the important trigger of nasal allergic symptoms but generally pollens were proven in other study to be the aeroallergens with the highest sensitisation rates among Europeans [54-56]. In this study, pollens were the second most prevalent aeroallergen causing sensitisation in Europe. While the most important pollens causing allergy differ in each geographical area, grass pollen had the highest rate of sensitisation in both regions which was about 35% in Asia and 21% in Europe. The same figure was found in a German study for grass pollen (23.9%) [57,58].

Highest rates of sensitisation to fungi or moulds were found in tropical countries like Singapore and Malaysia, emphasising the role of a climate factor [49-59]. Highest degree of sensitisation to *Alternaria* sp. was found in Asia supporting the findings of other studies [49,60,61]. This study also supported the facts of high prevalence of *Aspergillus* sp. and *Penicillium* sp. in Asia and the low rate of sensitisation to moulds reported across Europe [61,62].

Allergens from cat and dog dander are found in almost every home,

even in the house without resident pets [63]. The sensitisation rate to cat fur was much higher than to dog hair [64,65]. Cats are more likely to cause allergic reactions than dogs because they always lick themselves and spend more time in the house close to humans [52].

Significant association between different age group and positive skin prick test response was also found in this study with higher proportions at age 15 to 44 years with the peaks in the second decade of life among the Asian and the third decade of life among the European supporting the findings in NHANES II and III [61]. Significant correlation between region of residence of the respondents and positive skin prick test response was also observed in this study.

Unfortunately, insignificant correlation between sex and positive skin test responses in this study was proved otherwise in NHANES II and III with higher prevalence of positive skin test responses among male subjects at each decade of life [61]. It is because male subjects have higher levels of serum IgE than female subjects at any give age in the general population, but whether sex influences sensitisation primarily through a genetic or an environmental pathway is controversial [66,67].

Conclusion

There was significant difference in skin prick test (SPT) responses towards different group of aeroallergens in regions with diverse geo-climate. Yet, house dust mites were still the commonest aeroallergen causing allergic sensitisation.

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