

EDITORIAL

The importance of domestic allergens in a tropical environment

Asthma and allergic disease are becoming more prevalent in recent years and whilst the exact causes remain largely unknown, increase in allergen exposure has been postulated as one of the important factors. With most human populations retreating and spending more time indoors, increased exposure to indoor allergens, particularly in the domestic setting, has been linked with rise in asthma prevalence and morbidity [1,2].

What are the important domestic allergens in the tropics?

Dust mite

Mites of the Pyroglyphidae family including *Dermatophagoides pteronyssinus*, *Dermatophagoides farinae* and *Euroglyphus maynei* are the main sources of mite allergens in house dust. In the tropical eastern highlands of Papua New Guinea, the incidence of asthma rose from 0.1% to 7.3% in the 1960s and 1970s as a result of blanket introduction to the area, which became heavily infested with house dust mites resulting in significant exposure to mite allergens [3]. In a survey of dust mites in 252 homes of asthmatics in eight different geographic areas with temperate to subtropical climate in the United States, the pyroglyphid mites were present in 80–100% of dust samples [4]. Moreover, in all but 13 homes, dust samples contained more than 100 mites/g, an exposure threshold for mite sensitization to occur. The mite fauna in the tropics is largely similar in that the pyroglyphid mites are found in over 80% of house dust samples [5,6].

In an article by Zhang *et al.* published in this issue, the distribution of indoor allergens in the tropical city of Singapore was neatly presented [7]. In the analysis of dust samples from bedroom, living room, storeroom and kitchen in residential homes, between 76 and 96% of samples were found to have detectable Der p 1 whilst 5–36% of samples contained Der f 1. The relative preference for lower humidity by *D. farinae* could explain the low prevalence of Der f 1 in dust samples. *Blomia tropicalis*, a member of the glycyphagid mites, frequently infests homes in the tropics [5,7–9]. In Singapore, *B. tropicalis* allergens could be detected in 87% of homes and 70% of schools [7] whilst in Cartagena, Columbia, *B. tropicalis* was seen in 96% of floor and mattress dust samples and was even more prevalent than *D. pteronyssinus* [5]. As the level of *B. tropicalis* allergens correlates with absolute humidity, it shows little seasonal

variation due to the perennial high humidity in the tropics [7,10]. It is interesting that in Thailand, *B. tropicalis* is infrequently present in house dust [6]. Although *D. pteronyssinus* is the predominant species in subtropical dwellings, *B. tropicalis* has been detected in high numbers in house dust samples from cities such as Hong Kong [11], New Orleans [4], and San Diego [4] as well.

In a survey of 167 consecutive adult patients with respiratory complaints in Tampa, Florida, 38% had positive skin-prick test to *B. tropicalis* and the prevalence was even higher amongst asthmatics reaching 51% [12]. A quarter of asthmatic children in Argentina also contain specific IgE to *B. tropicalis* detectable by RAST [13]. These findings suggest a possible pathogenic role of *B. tropicalis* in clinical respiratory allergy in the tropics. To date, up to 25 IgE binding proteins in *B. tropicalis* with molecular weights ranging between 11 and 85 kDa have been identified [14] which showed little crossreactivity with allergens of the pyroglyphid mites [14,19]. More recently, the cDNA of a major *B. tropicalis* allergen of 14 kDa was identified and sequenced [15]. Whilst further research in the pathogenic role of *B. tropicalis* in respiratory allergy is much needed, it should be considered an important source of domestic allergens in the tropics.

Cockroach

Cockroach allergens have been associated with inhalant allergy as well as contact sensitivity [16]. Of all the indoor species, the American cockroach (*Periplaneta americana*) and the German cockroach (*Blattella Germanica*) tend to predominate in the United States whereas the Oriental cockroach (*Blattella Orientalis*) is more commonly encountered in the United Kingdom [17]. Cockroach allergen sensitization is high in atopic children living in crowded, multifamily dwellings and low income populations [18], and exposure to Bla g 2 level of ≥ 2 U/g of dust has been proposed as a significant risk factor for asthma exacerbation in sensitized subjects [19]. In subtropical and tropical populations, cockroach sensitization and domestic exposure is high. In Singapore, 53% of homes contain one of the major allergens of the German cockroach, Bla g 1 and the levels are particularly high in bedroom floor, storeroom and kitchen [7]. The prevalence of cockroach sensitivity in unselected Chinese schoolchildren ranges between 25 and 30% and is similar between different populations in South-East Asia [20]. *P. americana* may be the predominant

species in some tropical and subtropical areas and it contains species specific allergens. In Hong Kong, 70–80% of blood samples from asthmatics collected at the time of acute exacerbation contained specific IgE to Per a 1, one of the major allergens of *P. americana* in a recent study [unpublished data].

Animal dander

Domestic cats and dogs are common sources of indoor allergens particularly in temperate areas where pet ownership in residential homes is as high as 50% [21]. The cumulative exposure to animal allergens is related to sensitization [22] but domestic animal allergy can occur in susceptible individuals irrespective of pet ownership at home [21]. In Los Alamos, a high altitude population with dry climate where dust mite and cockroach infestations are uncommon, allergy to domestic animals, particularly cats and dogs, is a significant risk factor for asthma [23]. The major allergen of cat, Fel d 1, and dog, Can f 1, have been associated with respiratory allergy in susceptible individuals and levels of 8 µg Fel d 1/g and 10 µg Can f 1/g were proposed as significant exposure [19, 23]. In Singapore, although only 10% or less of homes have cats or dogs, Fel d 1 and Can f 1 can be found in dust samples in over half of the homes and their levels sometimes exceed the proposed threshold [7]. Domestic animal allergens can be carried on clothings to schools and public places where high levels can be detected [7,21], particularly on upholstered seats [24,25], which are capable of causing sensitization and inducing asthma symptoms [26].

House mould

In areas with a hot and humid climate, visible patches of dampness and mould growth can often be detected on kitchen and bathroom walls. Although exposure to specific mould allergens cannot be quantified immunologically at present, sensitization to house mould has been associated with respiratory allergy. The presence of specific IgE to *Alternaria* was found to confer an increased risk of respiratory arrest in children and young adult with asthma by 200-fold [27]. In a longitudinal study of 981 subjects from birth to 4 years, sensitizations to both *Alternaria* and *Cladosporium* were significantly associated with the development of asthma, rhinitis and eczema [28]. In South-East Asia, 20–50% of asthmatic children in Taiwan and Thailand as well as 10% of adult asthmatics in Hong Kong had positive skin tests to one or more species of *Penicillium*, *Cladosporium*, *Alternaria* and *Aspergillus* spp. [29]. In Hong Kong where a quarter of unselected schoolchildren are sensitized to house mould, the predominant species in residential homes as collected by settled plates are *Cladosporium* sp. (97%), *Penicillium* sp. (37%) and *Aspergillus* sp. (20%) [30].

Could regional difference in the prevalence of asthma and allergic disease be related to difference in domestic allergen exposure?

The ISAAC phase I study is near its completion and preliminary data confirms the wide variations in asthma prevalence between study populations. In the Asia Pacific region, where over 60 000 schoolchildren from mainly tropical and subtropical environments have been surveyed, the prevalence of current wheeze ranges between 4 and 12% with Singapore and Hong Kong, the most westernized cities in the study region, having the highest prevalence rates [31]. Both ISAAC and previous epidemiology studies show significant differences in the prevalence of current wheeze of three- to fourfold between Hong Kong and neighbouring southern Chinese cities such as San Bu [20] and Guangzhou [31]. These cities are only 200 km apart, share virtually identical climatic conditions and inhabited by ethnic Chinese of similar genetic background. One obvious question to ask is if difference in allergen exposure could explain the marked variations in the prevalence of asthma and allergic diseases. In this issue, Zhang *et al.* presented the first comprehensive study on the distribution of domestic allergens in this region in the city of Singapore which will form a useful framework for comparative study of indoor allergens with other populations in the future. Based on data collected in 1992, despite similarly high rates of sensitization to common domestic allergens between Hong Kong and San Bu, the correlation between allergen sensitization, as evidenced by positive skin-prick test, and respiratory allergy could be established for house dust mite only but not for cockroach, domestic animals or house mould [32]. After adjusting for atopic status and other known risk factors for asthma and allergy, the place of residence remained significant suggesting the importance of environmental factors other than allergen sensitization in disease pathogenesis.

In order to determine the relevant environmental factors for asthma and allergy in the region, a pilot study of indoor environment in residential homes in Hong Kong and Guangzhou is currently underway. Preliminary data on 320 dust samples collected from non-selected homes showed little difference in Der p 1, Bla g 1 and Fel d 1 levels in mattress, bedroom floor, lounge room floor and kitchen floors between the two cities [unpublished data]. Indoor exposure to nitrogen dioxide (NO₂) was measured by stationary monitors placed in the bedroom, lounge room and kitchen in each study home over a 1-week period. No difference in NO₂ exposure can be found between the two cities for each collection sites. Although synergism between dust mite allergens and NO₂ on airway hyperresponsiveness has been shown [33], its relevance in the Asia Pacific region remains to be proven.

There is mounting evidence to suggest a causal role of

domestic allergens in respiratory allergy. Avoidance of specific allergens can lead to reduction in asthma symptoms, bronchial hyperresponsiveness and airway inflammation [34]. Nevertheless, at a population level, domestic allergen exposure alone cannot fully explain the rise in the prevalence of asthma and allergy over time and difference in prevalence between population irrespective of geographical locations. Further research into other facets of the modern living environment is very much needed to solve this fascinating puzzle.

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