Common indoor and outdoor aero-allergens in South Africa

Identification of the allergen that is responsible for symptoms is the key to the management of the allergic patient.

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It is important for every practitioner to be familiar with the common allergens in South Africa to be able to make a specific allergy diagnosis in specific patients.

South Africa, because of its wide range of ecological biomes, is home to most of the common indoor and outdoor aero-allergens recognised globally. It also has a number of indigenous grass, tree and insect allergens, which appear to be unique to Africa.

One may be exposed to allergens indoors or outdoors, during everyday life, or via inhalant, ingestant or cutaneous routes, but also in an occupational environment.

Studies from inland towns and cities at higher altitudes showed a significantly lower prevalence of house-dust mite allergy than at the coast.

Aero-allergens in South Africa that are also encountered around the world are listed in Table I. In addition to this wide range of common aero-allergens, South Africans are also exposed to a full range of food allergens, some of which, e.g. perlemoen (*Haliotis midae*) and other seafood allergens, are unique to this region. Some may also be encountered during food processing. This review focuses on the common aero-allergens in South Africa.

Most of the common allergens to inhalants may be diagnosed using commercial allergy skin tests or the ImmunoCAP radioallergosorbent test (RAST), but specific diagnoses of novel or unique allergies previously unrecognised may be performed at specialist allergy centres with facilities for titrated skin-prick testing with fresh extracts, or using Western blotting or the basophil histamine release test in the laboratory.

Unlike in Europe, tree pollen is a relatively uncommon cause of seasonal allergy in South Africa.

House-dust mites

As early as 1958 Ordman identified a group of asthmatics in South Africa who suffered from various forms of upper- and lower-tract allergies and whose condition was always better inland and worse at the coast.[1] In 1971, in his survey of 67 towns in South Africa, he reported that mite numbers were always much lower in towns where the relative humidity consistently dropped below 50%.[2]

Dust samples collected showed that *Dermatophagoides pteronyssinus* was widespread, and at that stage *D. farinae* was also identified in Jeffreys Bay and Louis Trichardt.

In 1977 Van Niekerk *et al.*, using skin-prick testing, found that 65.5% of white and coloured children living in Cape Town were sensitive to house-dust mites.[3]

Studies from inland towns and cities at higher altitudes showed a significantly lower prevalence of house-dust mite allergy than at the coast. In 1991 Mercer and Van Niekerk reported a skin-prick positivity rate of 25.7% in an asthma clinic[4] similar to that of 25%

Table I. Common aero-allergens in South Africa

Indoor		Outdoor		Occupational
Mites	*Dermatophagoides pteronyssinus* *D. farinae* *Blomia tropicalis*	Grass pollens	*Eragrostis curvula* Kikuyu (*Pennisetum clandestinum*) Buffalo (*Stenotaphrum secundatum*)	Platinum salts Locust allergens Latex allergens Spider mites Snake venom (rinkhals) Grains (wheat, barley) Storage mites
Cockroaches	*Blatella germanica* *Periplaneta americana* Oriental cockroach	Tree pollens	Acacia species Mesquite (Prosopis tree) Oak Plane	
Pets	Dogs Cats Hamsters Rabbits Budgies Parrots Canaries	Weed pollens	Asteroidaceae Slangbos (*Stroebe vulgaris*) Compositae Chenopodiaceae English plantain	
		Fungal spores	*Cladosporium* *Aspergillus fumigatus* *Epicoccum* *Alternaria alternata*	

reported from the north-west suburbs of Johannesburg.[5] All available studies among rural black children suggest a low prevalence of house-dust mite allergy in the Eastern Cape. However, in paediatric studies in the Eastern Cape performed by Steinman *et al.*,[6] there was a significant association between specific IgE >0.35 kU/l to house-dust mites and the presence of increased bronchial hyperreactivity.

Fungal spores represent the largest amount of biological material in the atmosphere worldwide.

It would appear from more recent studies that the prevalence of house-dust mite sensitivity has increased. Studies by Luyt and Davis[7] showed a 45% house-dust mite sensitivity by skin-prick testing in urbanised black asthmatic children over the age of 3 years in Soweto. A very recent study by Seedat *et al.*[8] reported that the sensitisation rate to house-dust mites in patients with allergic rhinitis in Bloemfontein is a significant 46% for *D. pteronyssinus* and 44% for *D. farinae* using the ImmunoCAP RAST. A small acaralogical study conducted at the same time by Sinclair *et al.*[9] found house-dust mite in 50% of homes investigated at certain times of the year, and in 30% mites were present consistently.

High levels of house-dust mite sensitivity have been consistently reported from coastal areas, with some of the strongest reactions to house-dust mite being recorded at Swakopmund on the Namibian coastline (C Buys – personal communication).

The relationship between level of exposure, time of exposure, and sensitisation as confirmed by the ImmunoCAP test or skin-prick test and the clinical experience of allergic disease is not simple and may also be influenced by the 'context' of exposure. This includes not only climatic factors or altitude, but also factors such as westernisation, migration and urbanisation.[10]

House-dust mites remain the most important indoor allergen in South Africa. *Blomia tropicalis* sensitivity is being increasingly noted and the extent of the prevalence of sensitivity to *B. tropicalis* needs to be investigated, as this would have implications for the selection of sublingual and subcutaneous house-dust mite vaccines. The major group 1 allergens isolated from *D. pteronyssinus* and *D. farinae* are structurally homologous and have the same molecular weight (24 000 Da). These are cysteine proteases with functional activity. These heat-labile and pH-sensitive allergens are predominantly excreted in mite faeces. The second group of mite allergens, Der p II and Der f II, are heat stable and pH resistant and Der p II has a molecular weight of 14.1 kDa. More than 80% of mite-allergic patients have IgE antibodies to group I and group II allergens; however, more than 30 components have been identified in mite extracts that bind IgE antibodies. There are multiple T-cell epitopes on the group I and group II allergens and T-cell responses to these allergens are therefore complex. The wide heterogeneity of individual immune responses to mites may well influence the individual responses to immunotherapy and may explain why some individuals respond better to immunotherapy than others. Therefore, better results to immunotherapy are achieved when patients have IgE responses to a smaller range of antigens when compared with patients who are polysensitive to a wide range of house-dust mite allergens.

Grass pollens

There are 947 indigenous and 115 naturalised species of grasses in southern Africa, producing an abundance of pollen in the grassland and savanna biomes. There is considerable cross-reactivity between the different grass pollens, so that simple panels can be used for diagnosis. Rye and Bermuda grass (Fig. 1) are the most important allergens. However, in South Africa allergens from the Panicoideae tribe have also been shown to be allergenic, and in the Cape Town area 43% of grass-sensitive individuals also reacted to Kikuyu grass allergens.[11] Up to 80% of South Africans react to Eragrostis and Buffalo grass pollens.[12]

In the Free State maize (*Zea mays*) pollen allergy is a significant problem. Some pollens are abundant, e.g. *Hyparrhenia hirta* (thatch grass), but have not been shown to be particularly allergenic. The spectrum and clinical significance of grass pollen allergies have been reviewed extensively.[13]

Pollen monitoring has been conducted in the Cape for over 20 years by Mrs D Berman at Red Cross Children's Hospital. She is currently employed at the Allergy Diagnostic and Clinical Research Unit, UCT Lung Institute. The grass pollen season starts in September and continues for several months, with defined peaks in October in the Cape province, through to March. On the Highveld the grass pollen season is prolonged and may continue from September to May, behaving more like a 'perennial' allergen.

Interestingly, sensitisation to grass pollen and the development of hayfever and/or seasonal conjunctivitis are more common in urban than rural environments. It has been suggested that cultivation of indigenous grasses for lawns or pasture may stimulate pollen production.[13] Local allergenic grass pollens are illustrated in Fig. 2 (Kikuyu grass) and Fig. 3 (Buffalo grass).

Tree and weed pollens

Unlike in Europe, tree pollen is a relatively uncommon cause of seasonal allergy in

Fig. 1. Bermuda grass (Cynodon dactylon).

Fig. 2. Kikuyu grass (Pennisetum clandestinum).

Fig. 3 Buffalo grass (Stenotaphrum secundatum).

South Africa. However, allergies to 'alien' trees such as oak, plane, cyprus and olive are identified as these trees have short and well-defined flowering times.

The Prosopis tree is highly allergenic. Jacaranda, Eucalyptus, pine and Acacia species appear to have low allergenic potential – allergies to these species are rare. Patients often incorrectly attribute their symptoms to a particular tree, but on testing are found to be allergic to the more common grass pollen allergens rather than to the trees. In a study of South African Olympic athletes in 2000, 15% were found to be sensitised to plane tree pollen.[14]

Weeds and flowers are also uncommon causes of allergic symptoms in southern Africa because many of these pollens are insect borne (entomophilous). Pollens that cause symptoms include the Asteroidaceae (daisy family), *Stroebe vulgaris* (slangbos), Compositae, Chenopodiaceae and the alien English plantain. There are no vaccines available for local floral or weed pollens. Calendars available from local botanical gardens are useful to consult when considering the diagnosis of a floral or weed pollen.

Fungal allergens

Fungal spores represent the largest amount of biological material in the atmosphere worldwide. Important fungal spores in South Africa include *Cladosporium, Alternaria, Aspergillus* and *Epicoccum*. There is significant clustering of specific IgE responses to fungal spores, and a positive ImmunoCAP RAST to *Cladosporium* has been shown in the Western Cape to have an 83% positive predictive index for associated positive IgE responses to *Alternaria alternata* and *Aspergillus fumigatus*.[15] Fungal allergy is a risk factor for more severe asthma and in South Africa is often seen in the polysensitised patient.

Patients with monosensitive fungal allergy are rare; consequently very few patients with fungal allergy would qualify for immunotherapy (e.g. to *Alternaria*). Recently *Curvularia* has been noticed to be produced at higher levels in the Cape (D Berman, UCT Lung Institute). The clinical significance of this needs to be investigated.

Cockroach allergy

Specific IgE responses have been reported to all three of the major cockroach species seen around the world – *Blattella germanica, Periplaneta americana* and the Oriental cockroach. Cockroach sensitivity is also seen in polysensitised allergic patients and monosensitisation to cockroaches is extremely rare in South Africa. Cockroach sensitivity is believed to be a risk factor for more severe asthma in the inner cities (Fig. 4).

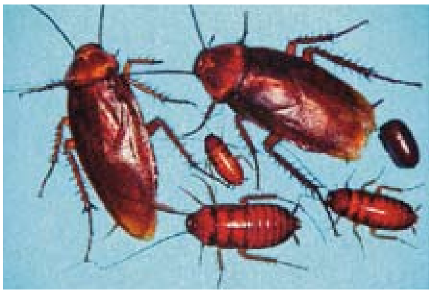

Fig. 4. Cockroaches.

Surprisingly, the rate of cockroach sensitisation appears to be unrelated to the level of cockroach infestation, with similar rates of sensitisation of between 32% and 40% in allergic subjects being found in Durban, Cape Town, Johannesburg and Bloemfontein.[16]

Occupational aero-allergens

- **Latex allergy** is the commonest indoor allergen encountered by health care workers, of whom 5 - 18% have been sensitised to latex in hospitals in the Western Cape. Latex is airborne in the hospital environment, particularly when low-quality starch-powdered gloves are used (Fig. 5). Latex allergies cross-react with several fruit allergens (e.g. avocado, banana, tomato, chestnut and kiwi) and the immune responses in different latex-sensitive individuals are diverse and increased when exposed individuals are already atopic. Latex allergy is widespread in South African hospitals.

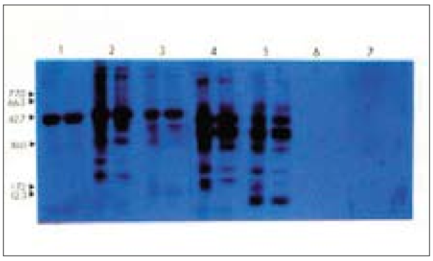

Fig. 5. Latex allergy – IgE responses of 5 different latex patients to latex antigens separated on a Western blot.

- **Locust allergy** (Fig. 6) has been reported in laboratory workers in a university setting when handling locusts in a confined space without proper attention to airflow. IgE responses have been shown to the wings and to the body parts of the locust.

Fig. 6. Locusta migratoria.

- **Platinum salt allergy** is seen in platinum mines and is an important cause of asthma in this occupational setting.

- **Snake venom allergy** has been reported in the occupational setting by snake handlers to the venom of the spitting cobra (rinkhals), resulting in asthma. The allergens important in this setting are the venom phospholipases (Fig. 7).

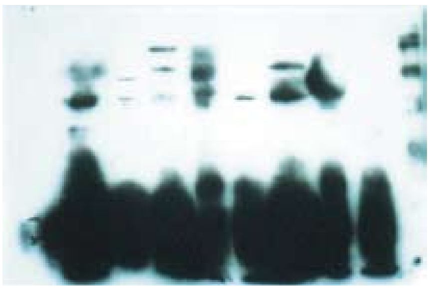

Fig. 7. Western blot of specific IgE responses to different snake venoms shows strong reaction to phospholipases.

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- **Grain workers** are susceptible to sensitisation to wheat allergens, alpha amylase and other grains such as oats and barley in this occupational setting, leading to asthma or rhinoconjunctivitis.

- **Sensitisation to spider mites** *(Tetranychus urticae)* is another unusual allergy in the South African context, originally reported in the Hex River Valley but also found by Seedat *et al.*[8] to be positive in 46% of a rhinitis population in the Free State.

- **Storage mites.** In addition to spider mites patients may also become sensitised to storage mites (e.g. *Lepidoglyphus destructor, Ascaris siro* 1 or *Tyrophagus putrescentiae*) in the grain or agricultural work setting.

- **Other food allergies.** Although foods are not typically aero-allergens, food proteins with allergenic potential may become airborne during food processing, such as boiling (e.g. in the fish canning industry), and result in sensitisation and symptomatic respiratory disease in the workers.

Avoidance of exposure to aero-allergens is difficult indoors and outdoors, but for selected patients with aero-allergen sensitivity immunotherapy may be offered in addition to symptomatic treatment.

Clinical implications of aero-allergen sensitisation

A clinical evaluation for possible aero-allergy requires a knowledge of the patient's regional environment and a detailed history of possible exposure in relation to the timing of symptoms, the season of symptoms and the significance of a positive allergy test result.

Avoidance of exposure to aero-allergens is difficult indoors and outdoors, but for selected patients with aero-allergen sensitivity immunotherapy may be offered in addition to symptomatic treatment. Testing should always be guided by a careful history.

Commercial tests such as the ImmunoCAP and skin prick tests are available for most of the aero-allergies in South Africa, but for some of the indigenous allergens Western blotting or skin testing with 'fresh-extracts' may be required.

References available at www.cmej.org.za

In a nutshell

- It is important for every practitioner to be familiar with the common allergens in South Africa to be able to make a specific allergy diagnosis in specific patients.
- Studies from inland towns and cities at higher altitudes showed a significantly lower prevalence of house-dust mite allergy than at the coast.
- The grass pollen season starts in September and continues for several months, with defined peaks in October in the Cape province, through to March. On the Highveld the grass pollen season is prolonged and may continue from September to May, behaving more like a 'perennial' allergen.
- Unlike in Europe, tree pollen is a relatively uncommon cause of seasonal allergy in South Africa.
- Fungal spores represent the largest amount of biological material in the atmosphere worldwide.
- The rate of cockroach sensitisation appears to be unrelated to the level of cockroach infestation, with similar rates of sensitisation being found in Durban, Cape Town, Johannesburg and Bloemfontein of between 32% and 40% in allergic subjects.
- Avoidance of exposure to aero-allergens is difficult indoors and outdoors, but for selected patients with aero-allergen sensitivity immunotherapy may be offered in addition to symptomatic treatment. Testing should always be guided by a careful history.

Single suture

Eat your way to fewer allergies

We are what we eat. If this also applies to gut bacteria, it could explain higher rates of allergies and other inflammatory diseases in rich nations.

Paolo Lionetti of the University of Florence, Italy, compared the gut bacteria of children in Burkina Faso and Italy. The stools of the African children contained almost three times as many short-chain fatty acids as those of the Italian children. Short-chain fatty acids are generated by bugs associated with diets containing a very high proportion of vegetables and cereals and they also kill harmful gut bacteria such as *Salmonella* and help to protect against inflammation. Allergies are often as a result of excessive inflammatory responses to otherwise harmless agents.

Breastfed infants in both countries had the same gut bacteria profiles, so diet rather than other environmental factors or genes seems to dictate which bacteria colonise the gut. According to Glenn Gibson, University of Reading, UK, this could pave the way for allergy treatments based on gut bacteria.

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