ALLERGENS AND ASTHMA IN THE WORKPLACE

Mohamed F Jeebhay, MBChB DOH MPhil (Epi) MPH (OccMed) PhD
Head of Department and Director, School of Public Health and Family Medicine, Health Sciences Faculty, University of Cape Town

Correspondence:
Mohamed Jeebhay, email: Mohamed.Jeebhay@uct.ac.za

My interest in allergies and asthma began as a child when my younger brother was diagnosed with asthma at a very early age, resulting in frequent visits to the doctor. A decade later, I witnessed two contrasting incidents in my job as an intern - one of a young man presenting to the emergency room in status asthmaticus that proved to be fatal, and the other, a young woman who had been successfully resuscitated from an anaphylactic episode. In neither patient was I to discover the actual cause, except surmising that some allergen was at play. Ever since, I have been intrigued by how an allergen, unseen to the naked eye, enters the body through various routes (inhalation, skin or ingestion) and causes a reaction in another part of the body, manifesting in different ways - hives, itchy eyes or a runny nose, tight chest or wheeze, or full-blown, generalised anaphylactic shock. A decade or so later I embarked on a journey of allergen discovery that enabled me to begin to unravel some of these intriguing questions in various South African workplaces.

The first patient I diagnosed with occupational asthma was a joinery worker who had developed the condition after inhaling wood dust from sanding furniture made from an exotic imbuia wood.1 The patient had to be relocated to a less dusty job since his symptoms had not abated even with the use of conventional medical treatment. Early on, this highlighted the importance of prevention of exposure to dusty jobs as being key to reducing the risk of patients with asthma in the workplace.

Later on I worked with my colleague, Andreas Lopata, in investigating allergic reactions among research scientists and technicians handling locusts in a research laboratory at my own academic institution. Asthma was found to be related to sensitisation following inhalation of allergens from the body parts and wing fragments of the African locust, Locusta migratoria. Recommendations were made to provide extraction ventilation to reduce exposure.2

With the increasing incidence of food allergies globally, my later work focussed on investigating inhalant food-related allergic reactions and asthma in occupational environments. I discovered that food handling environments provided an ideal exposure context for studying the relationships between exposure to allergens and the development of asthma. Food allergens were aerosolised during all stages of production - from harvesting, to processing and ultimately the final food product. With the increase in technology, major food allergens were better characterised and techniques to estimate airborne food allergen exposure became increasingly standardised. My studies of various workplace contexts confirmed that large populations of workers begin their working life as healthy individuals, and so the emergence of allergic sensitisation can be readily established as they are followed up over time.

Seafood is a common cause of food allergy among adult consumers worldwide. Seafood processing, especially of crustaceans such as crab, has been shown to be a potent allergen in various North American studies of crab handling. In the past decade, we have also learned that children with seafood allergies related to ingestion can also develop allergic reactions from accidental inhalation of seafood during meal preparation. Understanding the mechanisms, the nature of the allergens and the risk factors that increase the likelihood of such a response, has the potential to benefit both consumers and workers who are exposed to inhalant seafood allergens.

I have worked with my colleague and immunologist, Andreas Lopata, for much of the last decade investigating fish allergens in the context of the South African seafood industry, in which bony fish harvesting predominates. Wide scale epidemiological studies were performed in Saint Helena Bay, the epicentre of fish harvesting and processing in South Africa, in which we found that 15 percent of workers had work-related asthma symptoms. Detailed exposure response studies demonstrated that workers involved in bony fish processing are at increased risk of developing asthma symptoms after inhaling aerosols containing pilchard and anchovy fish antigens. One of the major protein allergens in pilchard, Sardinops Sagax, a parvalbumin found in muscle, was identified and characterised. Further studies are now underway to pinpoint whether the most...
allergenic proteins are found in the skin, muscle or organs of each fish species and the extent to which heating of these proteins through processing changes the nature and allergenicity of these proteins. This African study, the first of its kind, provided important insights to better equip workers and their employers to manage the risks of their working environments. For example, the workers found to be at greatest risk of developing asthma and allergies were those involved in fishmeal production and bagging. Knowing this assisted the seafood industry to take targeted action and implement preventative measures to reduce exposures. A chronology of the 14 scientific communications on this area was the subject of my inaugural address as professor at the University of Cape Town in 2011.3

Other studies of food harvesting industries were conducted in table grape farms of the Western Cape, in which the impact of pesticide exposures on the risk of allergy and asthma associated with spider mite (Tetranychus urticae), also represented one of the first of its kind. The study demonstrated that workers involved with pesticide spraying were at increased risk of developing spidermite allergic rhinitis and asthma symptoms.4 Recently this was taken further by masters’ student, Vuyelwa Ndlovu, demonstrating that pesticide spraying and depressed cholinesterase (a marker of organophosphate exposure) was independently associated with the increased risk of asthma.5 Further work is underway to explore the immunological mechanisms that underlie the development of asthma in this group of workers.

Moving from harvesting to processing of foods - grain and spice mill environments have also illustrated the increased risk of asthma associated with the aerosolisation of...
vegetable products in the food ingredients industry.

Our studies in grain mill workers demonstrated that pest contaminants such as mealworm (Tenebrio molitor) and cockroach (B. orientalis) were associated with increased risk of work-related asthma symptoms.6 The studies in a spice mill led by masters’ student, Anita van der Walt, investigated an epidemic of occupational asthma cases associated with garlic processing, as a result of inadequate and dysfunctional ventilation systems.7 This investigation also showed that garlic processed in powdered, as opposed to its raw form, poses a greater risk of sensitisation in exposed mill workers.

In more recent years we have been focusing more of our efforts on preventing asthma associated with workplace allergens so as to develop interventions that have a more sustainable long term impact. These interventions focus on developing improved legislation and policies to limit exposure; developing workplace control measures such as engineering control measures to reduce dust exposures; establishing medical surveillance programmes to identify high-risk workers at an early stage; and finally modifying work practices through education and training of workers and managers. The most dramatic effect has been our intervention study among supermarket bakery workers led by doctoral student, Roslynn Baatjies. Baseline studies found that 13 percent of supermarket bakery workers had bakers’ asthma due to inhalation of flour dust resulting in allergic sensitisation to wheat or rye allergens.8 Further analysis demonstrated that exposure control strategies in these 31 supermarket bakeries, involved mainly in bread baking, were inadequate in reducing dust exposures to protect the health of bakery workers. We worked with engineers to design a lid for the bakery mixer tub and with media experts to develop an educational video to train bread bakers to modify their work practices. The overall findings demonstrated a substantial reduction (>50%) of exposures in these bakeries, concluding that a multipronged focussed intervention strategy can indeed reduce flour dust and allergen exposures in supermarket bakeries.9

Our work on allergies and asthma have also taken us into the health care setting since population based studies in the north have pointed to agents, other than latex, emerging as important contenders for asthma since the latex epidemic had abated with the introduction of powder free non latex gloves. Studies of dental health care workers, led by doctoral student, Tanusha Singh, demonstrated that work-exacerbated asthma was associated with endotoxin exposure and that old dental unit equipment was a significant predictor of endotoxin levels.10 Recently, there has been a growing trend highlighting the preponderance of cleaning agents in individuals with adult-onset asthma both in domestic and occupational settings. We are currently embarking on identifying the risk factors for work-related asthma associated with the use of cleaning agents in healthcare settings since these agents are commonly used for sterilising instruments, wound cleaning and cleaning work surfaces. This is part of our goal of promoting “green” hospitals.

In conclusion, our studies of work-related allergies and asthma have shown that this entity could be studied from diverse angles, in various interdisciplinary approaches. These include large-scale epidemiological assessments of environmental risk factors; molecular characterisation
of proteins which trigger allergic reactions in working environments; early identification of allergic sensitisation, airway inflammation and asthma through targeted surveillance; and finally evaluating risk reduction strategies for asthma in the workplace using novel home grown interventions.

ACKNOWLEDGEMENTS

Sincere appreciation goes to my family, mentors, collaborators, students, funders, administrative and research support staff of the University of Cape Town for their invaluable support and efforts in making my journey of discovery a reality.

REFERENCES