# Airborne pollen and respiratory allergies: Case Study

NHMRC

Allergic diseases cost the Australian economy about $30 billion per year in direct financial costs and lost wellbeing.[1] Pollens are the most widespread allergen source globally. In Australia, grass pollen exposure is a major trigger of seasonal allergic rhinitis (hay fever) and is linked to increases in hospital emergency department visits and admissions for asthma.[2] NHMRC-funded researchers working nationally have helped to reduce the health and socioeconomic burden of pollen-related allergic respiratory diseases by improving the monitoring of airborne pollen and public access to information on local pollen levels.
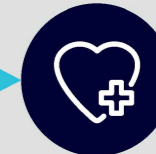
Origin

In 1937, shortly after NHMRC was established, the Council received a letter from Charles Sutherland – an honorary physician at the Asthma Clinic at the Alfred Hospital in Melbourne – which contained suggestions for coordinating work on allergic diseases. Among other things, Sutherland suggested a survey of wind-borne pollens, a national collection of these pollens, and that observations be made on the incidence of pollen in the atmosphere in various localities at various seasons.[3]

A decade later, an NHMRC-funded survey of atmospheric pollen was conducted by researchers from The University of Western Australia. Pollen was counted daily, from July 1948 to December 1949, at 11 collecting stations located around metropolitan Perth. The survey found a close correlation between the amount of atmospheric pollen detected and the number of cases of hay fever observed at local hospitals.[4]

Despite these early beginnings and the high prevalence of allergic rhinitis in Australia,[5] until recently, atmospheric pollen studies were conducted in isolation and limited to monitoring specific cities for narrow time periods. These studies did not use a standardised methodology designed for Australian conditions – since none existed – and nor was the resultant data combined to form a national picture.[6,7]

An **allergy** occurs when a person experiences an immediate inflammatory response to an otherwise harmless substance (e.g. a particular food, pollen, fur, or dust), called an *allergen*, to which their immune system has become hypersensitized. In its most severe form (anaphylaxis), and if not treated immediately, an allergic reaction may be life threatening. Pollen allergies usually cause itchy eyes, sneezing and a runny or blocked nose, and – for some – sleep apnoea, sinusitis and asthma.

Grants and Investment

NHMRC has supported the development of a standardised national pollen monitoring network through the AusPollen grant to Janet Davies, Bircan Erbas, Constance Katelaris, Edward Newbigin, Alfredo Huete, Elizabeth Ebert, Rieks van Klinken, Simon Haberle, Danielle Medek and Paul Beggs.

NHMRC has also provided grants to another researcher involved in this work, Fay Johnston, who established the AirRater pollen and air quality service in Tasmania and the ACT.

Other sources of funding include: Australian Research Council (ARC), Terrestrial Ecosystem Research Network (TERN - a National Collaborative Research Infrastructure Strategy facility), Allergy and Immunology Foundation of Australasia, Victorian Government Department of Health and Human Services, Tasmanian Department of Health, ACT Health, Queensland Health and Sense-T.

Epidemic thunderstorm asthma event

On 21 November 2016, a large number of people in Melbourne experienced breathing problems and asthma attacks. An unprecedented number of emergency calls were made requesting an ambulance (2,332 in 12 hours) and there was a 49 per cent increase in people presenting at public hospital emergency departments (9,909 people presented, 3,270 more than the previous week). There were also nine related deaths.[8]

This event was caused by a severe thunderstorm in the context of high concentrations of aerosolised grass pollen passing with the storm front near ground level over population centres. However, at the time of the event, its cause was uncertain. A review of environmental, meteorological and immunological factors associated with thunderstorm asthma, commissioned by the Victorian Government Department of Health and Human Services and led by Davies, was undertaken by AusPollen Investigators[9] to help inform an Inspector-General for Emergency Management plan aimed at improving future preparedness and response arrangements. The plan recommended implementation of "… a system of standardised pollen and fungal monitoring protocols and sites across Victoria."[10]

Research

As part of a research program looking at atmospheric particles and human health, Haberle, Johnston and colleagues monitored atmospheric pollen loads in Darwin (2004-2005) to generate the first pollen records for Darwin and tropical Australia.[11] A further study of atmospheric pollen loads in relation to public health was undertaken in Hobart, Tasmania (2007–2009).[12]

These – and similar studies in Brisbane (1994-1999), Perth (2006), Sydney (1993-1995), Canberra (2007-2010), and Melbourne (2009-2011) – indicated a need to evaluate current knowledge of airborne pollen and led Davies to convene the Australian Aerobiology Working Group (AAWG) in 2013.

The AAWG was supported by TERN's Australian Centre for Ecological Analysis and Synthesis.[6] Its task was to bring together medical professionals, botanists and climate change modellers – among others – to collate and analyse historical pollen count data and find innovative ways of making this data publicly accessible.[13] The first AAWG study described the diversity of pollen records across Australia and New Zealand.[7]

The group revealed the striking variation in the timing and level of airborne grass pollen between years and cities.[14] This spatial and temporal variability in grass pollen exposures was related to latitude and, notably, secondary grass pollen peaks in summer and autumn extended the duration of pollen exposure nearer the equator.[15]

The group were among the first globally to apply satellite remote sensing to show strong correspondence of grass pollen aerobiology with grass land vegetative indices, to enhance modelling of airborne grass pollen.[16]

These studies provided a framework for targeting grass pollens, some of the most clinically important due to their abundance, allergenic effects and public health impacts.

Collaboration and Results

Supported by NHMRC, in 2016 the AusPollen partnership was formed: led by Queensland University of Technology (QUT), involving eight academic institutes and co-developed with partner organisations; the Australasian Society of Clinical Immunology and Asthma (ASCIA), Asthma Australia, the Bureau of Meteorology, CSIRO, MeteoSwiss (Switzerland), Stallergenes Australia and AirRater.

The goal of the partnership was to implement and evaluate standardized pollen monitoring practices and to extend evidence on Australian aerobiology and its health impacts nationally.

Key outputs of the Partnership included:
- the AusPollen Aerobiology Collaboration Network, with stations in Melbourne, Canberra, Sydney and Brisbane
- the network's Interim Standard and Protocols (ISP) – published as a health professional paper by ASCIA[17] - that outlines minimum requirements and recommended best practice for all pollen monitoring processes
- a standardised terms list of all pollen grains and fungal spores that are counted in Australia by pollen and spore monitoring sites affiliated with the network[18]
- newly established monitoring sites audited against the ISP, and assessment of the proficiency of pollen counters across the network[19]
- the development of websites and mobile device applications (apps) and their use to deliver pollen forecasting information to patients and clinicians[20]
- the first continental scale, Southern Hemisphere standardized aerobiology dataset, to track shifts in the pollen seasons as well as health impacts[21]
- more accurate and evidence-based pollen forecasts, emphasising the importance of pollen monitoring data inputs to valid forecasts[22]
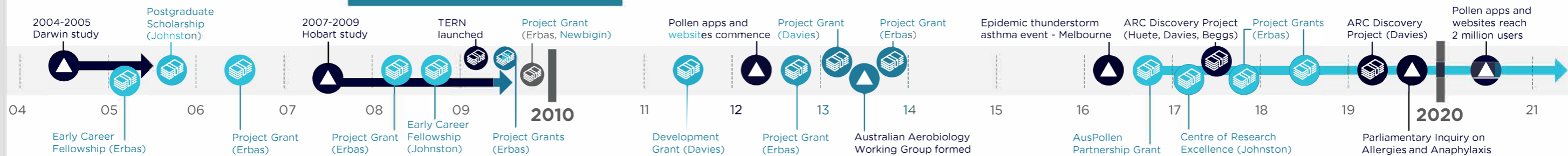- evidence on why and how people use pollen information.[23]

Outcomes and Impact

The pollen-monitoring established by the partnership provides clinicians and respiratory allergy patients across Australia with accurate, up-to-date, standardised and localised information and forecasts on pollen levels. Access to pollen information via the pollen apps and websites increased from less than 1,000 users in 2012 to over 2 million during 2020.

Davies and Katelaris collaborated with ASCIA, National Asthma Council and Asthma Australia to harmonise messages about the risks of pollen allergy in relation to asthma, including thunderstorm asthma. Their research informed a 2019 Federal Parliamentary Inquiry on Allergies and Anaphylaxis and they made multiple contributions to global clinical guidelines, policy, strategy and working parties that have helped to set direction for allergy research and practice internationally.[24]

The AusPollen team played a key role during the 2016 thunderstorm asthma event and its recovery phase. Their research was awarded the European Academy for Allergy and Clinical Immunology Prize in 2016[16] and informed forecast system development for the Bureau of Meteorology Victorian Thunderstorm Asthma Pollen Surveillance project in collaboration with the Department of Health and Human Services. Newbigin and Lampugnani and others worked with the Bureau on the pilot thunderstorm asthma forecasting service that continues to operate in Victoria.

Comparison of AusPollen data with previous records shows that grass pollen exposure in Queensland increased almost three-fold between the 1994-1999 and 2016-2020 monitoring periods. This was associated with climate factors.[26] Ongoing generation and sharing of pollen monitoring data can help inform management of people with allergies and track the effects of climate change on pollen exposure, especially in the context of extreme and La Nina weather.[27]

Timeline

2004-2005 Darwin study
Early Career Fellowship (Erbas)
Postgraduate Scholarship (Johnston)
2007-2009 Hobart study
Project Grant (Erbas)
Project Grant (Erbas)
Early Career Fellowship (Johnston)
TERN launched
Project Grant (Erbas, Newbigin)
Project Grants (Erbas)
Pollen apps and websites commence
Development Grant (Davies)
Project Grant (Davies)
Project Grant (Erbas)
Project Grant (Erbas)
Australian Aerobiology Working Group formed
Epidemic thunderstorm asthma event - Melbourne
AusPollen Partnership Grant
ARC Discovery Project (Huete, Davies, Beggs)
Centre of Research Excellence (Johnston)
Project Grants (Erbas)
ARC Discovery Project (Davies)
Parliamentary Inquiry on Allergies and Anaphylaxis
Pollen apps and websites reach 2 million users

04 | 05 | 06 | 07 | 08 | 09 | **2010** | 11 | **12** | **13** | 14 | 15 | **16** | 17 | 18 | 19 | **2020** | 21

Note: NHMRC grants are dated by their start year.

Prof Janet Davies
Janet Davies completed a PhD in Biology and Environmental Science at Murdoch University. Davies is Associate Dean of Research at QUT and Assistant Director of Research at Queensland's Metro North Health, Australia's largest hospital network.

Prof Bircan Erbas
Bircan Erbas received a Masters degree in statistics and a PhD in biostatistics from The University of Melbourne (UoM) and is a professor at La Trobe University. Erbas is on the editorial board of Respirology and the International Journal of Environmental Research and Public Health.

Prof Constance Katelaris
Constance Katelaris is a Professor of Immunology and Allergy at the University of Western Sydney (UWS), is Head of Department and Senior Staff Specialist at Campbelltown Hospital, is past President of the Australasian Society of Clinical Immunology and Allergy and has monitored pollen in Sydney for many years.

A/Prof Edward Newbigin
Edward Newbigin completed a PhD at ANU. He is an Associate Professor and a plant biologist in the School of BioSciences at UoM and has coordinated the Melbourne pollen count since 1998.

Prof Simon Haberle
Simon Haberle is Director of the School of Culture, History and Language at The Australian National University (ANU) and has coordinated pollen monitoring in Canberra since 2004. Haberle held postdoctoral positions at the Smithsonian Tropical Research Institute (Panama) and the University of Cambridge.

A/Prof Paul Beggs
Paul Beggs is Associate Professor in the School of Natural Sciences at Macquarie University. Beggs won the 2009 Australian Museum Eureka Prize for Medical Research and is Vice President of the International Association for Aerobiology.

D/Prof Alfredo Huete
Alfredo Huete leads the Ecosystem Dynamics Health and Resilience Research Program at University of Technology Sydney (UTS). A geospatial ecologist, Heute has served on space program mission teams and conducted research in the Amazon as well as global drylands.

Dr Danielle Medek
Danielle Medek completed a PhD in plant ecophysiology and a Bachelor of Medicine/Bachelor of Surgery at ANU. Medek was a postdoctoral fellow at ANU and a Ziff Environmental Fellow at Harvard University and is a medical registrar at Queensland Health.

Prof Fay Johnston
Fay Johnston is Professor of Environmental Health at the Menzies Institute for Medical Research at the University of Tasmania (UTas). Johnston is a physician, environmental epidemiologist and a specialist medical advisor for Public Health Services in the Tasmanian Department of Health.

Dr Edwin Lampugnani
Edwin Lampugnani is a Senior Research Fellow in the School of BioScience at UoM. Lampugnani developed the digital frameworks used to deliver pollen information to the community and co-developed a pollen forecast model used by the Victorian thunderstorm asthma forecast service.

Other researchers
- Dr Elizabeth Ebert – Head, Forecast Quality Research, Bureau of Meteorology
- Dr Penelope Jones – Menzies Institute for Medical Research, UTas
- Dr Beth Addison Smith – Allergy Research Group, QUT
- Dr Andelija Milic – Allergy Research Group, QUT
- Dr Jeremy Silver – School of Earth Sciences, Faculty of Science, UoM
- Dr Kathryn Emmerson – Atmospheric Composition and Chemistry group, CSIRO

📖 References

This case study was developed with input from Professor Janet Davies and in partnership with The Australian Pollen Allergen Partnership (AusPollen) team, The University of Tasmania's AirRater team, Asthma Australia, The Bureau of Meteorology and the Australian Society for Clinical Immunology and Allergy.

The information and images from which impact case studies are produced may be obtained from a number of sources including our case study partner, NHMRC's internal records and publicly available materials.

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Data outputs
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https://data.aurin.org.au/dataset/auspollen-canberra-act-6168c4209b7c5111055ffa84-na
https://data.aurin.org.au/dataset/auspollen-parkville-vic-6168c42016eb4e98d9b8cb28-na
https://data.aurin.org.au/dataset/auspollen-campbelltown-nsw-6168c4200e772c4de5849e89-na

Links to other information:
https://auspollen.edu.au/auspollensitesmap/
https://www.allergy.org.au/images/ASCIA_PCC_Pollen_allergy_2020.pdf
https://www.allergy.org.au/patients/allergic-rhinitis-hay-fever-and-sinusitis
https://asthma.org.au/about-asthma/triggers/asthma-and-allergies-2022/
https://www.nationalasthma.org.au/living-with-asthma/resources/health-professionals/information-paper/thunderstorm-asthma
https://www.allergy.org.au/hp/papers/australian-airborne-pollen-and-spore-monitoring-network-interim-standard-and-protocols

🤝 Partners