

ALLERGEN SENSITISATION OF PATIENTS WITH ALLERGIC RHINITIS AT A PRIVATE EAR, NOSE AND THROAT PRACTICE IN THE NORTHERN CAPE

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ABSTRACT

Introduction: Allergic rhinitis occurs as a result of an IgE-mediated hypersensitivity response in the nose. There are no reported data from patients with allergic rhinitis from the Northern Cape to guide the panel of aeroallergens used for allergy testing. The aim of the study was to describe the aeroallergen sensitivity profile of patients diagnosed with allergic rhinitis at a private ear, nose and throat practice in the Northern Cape.

Methods: This was a retrospective descriptive study of patients diagnosed with allergic rhinitis who underwent testing for aeroallergen sensitisation by skin-prick testing or detection of allergen-specific IgE over a six-year period at a private ear, nose and throat practice in the Northern Cape.

Results: Grass pollens were the most common sensitising allergen, with 84.6% of patients tested being sensitised to one or more grass pollen. Of the patients tested, sensitisation to weed pollens was present in 46.4%, to tree pollens in 27.6%, to moulds in 48.6% and to dust mites in 41.0%.

Conclusion: Knowledge of the allergen sensitisations of patients with allergic respiratory diseases, together with pollen calendars can assist with allergen avoidance by these patients. Further studies are required to determine sensitisation to prevalent airborne pollens identified by pollen monitoring.

Keywords: allergen sensitisation, allergic rhinitis, Northern Cape

INTRODUCTION

Allergic rhinitis (AR) occurs as a result of an IgE-mediated hypersensitivity response in the nose.¹ It causes symptoms including congestion, anterior or posterior rhinorrhoea, pruritus and sneezing, and affects quality of life adversely.¹⁻³ The prevalence of AR in South Africa is more than 30%.² The diagnosis of IgE-mediated allergy is made using skin-prick tests (SPTs) or by the detection of allergen-specific IgE in the blood (ImmunoCAP).¹

The Northern Cape is the largest, but least-populated province of South Africa. There are no reported data from patients with allergic rhinitis from the Northern Cape to guide the panel of aeroallergens used for allergy testing. A recent study on allergic

sensitisation in South Africa did not report regional data for the Northern Cape.⁴

The aim of the study was to describe the aeroallergen sensitivity profile of patients diagnosed with AR at a private ear, nose and throat (ENT) practice in the Northern Cape.

METHODS

This was a retrospective descriptive study that reviewed the medical records of patients who were diagnosed with AR from 1 November 2013 to 31 October 2019 at the private ENT practice of Dr W Hoek in the Northern Cape. The practice is located in Kimberley with a secondary practice in Upington.

Patients were identified by searching the Vericlim electronic database software used for billing in the practice for the ICD-10 code for AR (J30.4). The clinical records of those patients where the diagnosis was confirmed by SPTs or specific-IgE testing (ImmunoCAP) for aeroallergens were reviewed and data regarding the patients' demographics, presenting symptoms and allergy test results were recorded on a data form. For ImmunoCAP results, a result greater than 0.35 IU/L was considered positive. For SPTs, a reaction with a wheal at least 3 mm greater than the negative control was considered positive. Coded data were entered into a Microsoft Excel spreadsheet and analysed using SAS version 9.4. Descriptive statistics, namely, frequencies and percentages for categorical variables and medians and interquartile ranges (IQR) for numerical variables, were calculated.

The study was approved by the Health Sciences Research Ethics Committee of the University of the Free State (UFS-HSD2019/2134/2611).

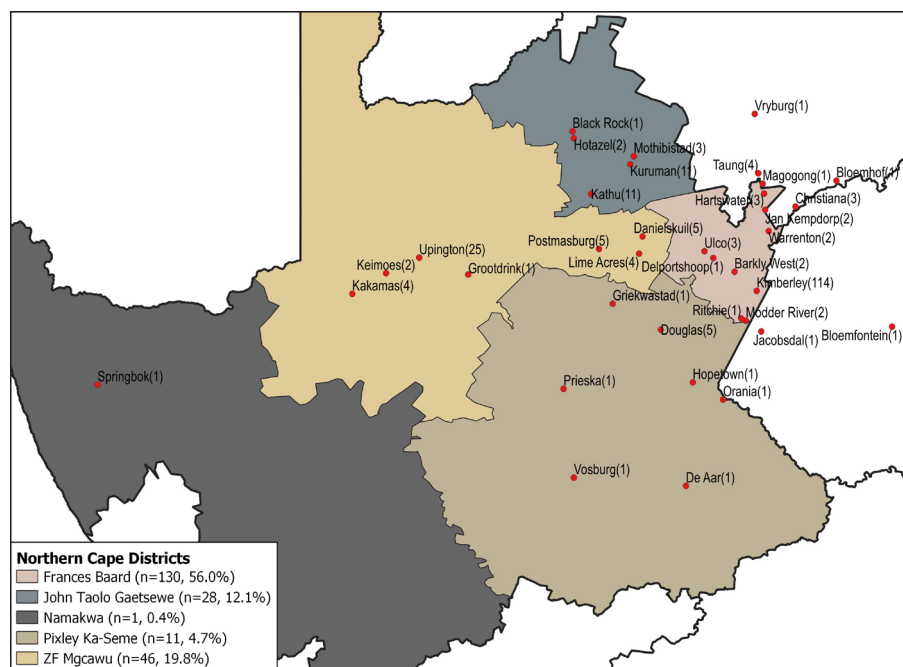


Figure 1: Towns of residence of patients and districts of the Northern Cape
Number of patients indicated in brackets

Not shown: Cape Town (1), Mahikeng (1), Potchefstroom (1), Pretoria (1)

TABLE I: PRESENTING SYMPTOMS (n = 232)	
SYMPTOM	(%) (n)
Nasal obstruction	85.3 (198)
Rhinorrhoea	49.1 (114)
Sneezing	31.9 (74)
Itching	34.1 (79)
Conjunctivitis	12.1 (28)
Post-nasal drip	34.1 (79)
Headache	4.7 (11)
Recurrent sinusitis	3.0 (7)
Recurrent otitis media	7.3 (17)
Hearing loss	2.6 (6)
Epistaxis	15.6 (37)
Hyposmia	5.2 (12)
Itching ears	0.4 (1)
Chronic cough	3.5 (8)
Snoring	12.9 (30)
Sore throat	5.2 (12)
Eustachian tube dysfunction	2.6 (6)
Halitosis	1.3 (3)
Mouth breathing	2.2 (5)
Otorrhoea	4.3 (1)
Itching throat	3.0 (7)
Globus sensation	1.7 (4)
Complicated sinusitis	1.3 (3)
Hoarseness	1.7 (4)

RESULTS

Of the 613 patients with a clinical diagnosis of AR, 232 patients underwent allergy testing by SPT or ImmunoCAP. All these patients had positive results on allergy testing. The patients comprised 121 (52.2%) males and 111 (47.8%) females with a median age of 16.7 years (range 3.2–66.4 years, IQR 9.1–33.0).

The main presenting symptom was nasal obstruction, followed by rhinorrhoea, sneezing, itching and a post nasal drip (see Table I). Asthma was present in 16.8% (38/226) of patients and 3.7% (8/217) had eczema. Twenty-two (9.5%) patients were farm residents. Most patients (216; 93.1%) resided in the Northern Cape, whereas some patients resided in the North West (12; 5.2%), Free State (2; 0.9%), Gauteng (1; 0.4%) and the Western Cape (1; 0.4%). Patients from the Northern Cape resided mainly in the Frances Baard district (see Figure 1), with almost half of the patients (114; 49.1%) residing in Kimberley.

A Phadiatop was performed on 153 patients and was positive in all cases. Of these patients, ImmunoCAP tests were performed on 147 (95.5%) and SPTs on three (1.9%), whereas four (2.6%) did not undergo further testing.

Grass pollens were the most common allergen to which patients were sensitised on SPTs (see Table II). Sensitisation to at least one grass pollen was present in 77.6% (59/76) of patients, 38.9% (28/72) of patients were sensitised to moulds and 21.2% (14/66) had sensitisation to one or more tree pollen. Maize pollen sensitisation was present in 58.3% (28/48) of patients tested, with 25 (83.3%) of these patients also being sensitised to one or more grass pollen.

TABLE II: SKIN-PRICK TEST RESULTS

ALLERGEN	(%) (n)
Grass mix Mainly 5-grass mix – Orchard grass (<i>Dactylis glomerata</i>), Meadow fescue (<i>Festuca pratensis</i>), Rye grass (<i>Lolium perenne</i>), Timothy grass (<i>Phleum pratense</i>), Kentucky bluegrass (<i>Poa pratensis</i>). Some patients were tested with a 6-grass mix – Meadow soft grass (<i>Holcus lanatus</i>), orchard grass, meadow fescue, rye grass, timothy grass, Kentucky bluegrass	59.5 (44/74)
Bermuda grass (<i>Cynodon dactylon</i>) pollen	75.0 (53/72)
Rye grass (<i>Lolium perenne</i>) pollen	100 (11/11)
Timothy grass (<i>Phleum pratense</i>) pollen	100 (1/1)
Maize (<i>Zea mays</i>) pollen	58.3 (28/48)
Tree pollen mix (birch, ash pollen, live oak, false acacia)	13.6 (3/22)
Olive (<i>Olea europaea</i>) pollen	23.9 (11/46)
Plane tree (<i>Platanus acerifolia</i>) pollen	29.3 (12/41)
Mesquite (<i>Prosopis juliflora</i>) pollen	0 (0/3)
Plantain (<i>Plantago lanceolata</i>) pollen	41.7 (20/48)
Weed mix	100 (3/3)
Dog dander	32.3 (22/68)
Cat dander	23.2 (16/69)
Feather mix	9.1 (5/55)
Mite mix (<i>D farinae</i> and <i>D pteronyssinus</i>)	37.0 (17/46)
Cockroach mix	28.8 (19/66)
Mould mix (<i>Alternaria</i> , <i>Aspergillus</i> , <i>Cladosporium</i> , <i>Penicillium</i>)	100 (1/1)
<i>Alternaria alternata</i>	35.8 (24/67)
<i>Aspergillus fumigatus</i>	13.1 (8/61)
<i>Cladosporium herbatum</i>	9.1 (2/22)

ImmunoCAP testing also showed that grass pollens were the aeroallergen to which patients were most commonly sensitised (see Table III). Sensitisation to at least one grass was present in 88.1% (133/151) of patients tested and to dust mites in 42.3% (63/149). Most (32, 84.2%) patients who were sensitised to *Blomia tropicalis* were also sensitised to *Dermatophagoides pteronyssinus*.

When combining the results of SPTs and ImmunoCAP testing, grass pollens were the most common allergen to which patients were sensitised, with 84.6% (192/227) of patients tested being sensitised to one or more grass pollen. Bermuda grass sensitisation was present in 83.3% (184/221) of patients tested and rye grass sensitisation in 86.6% (136/157). Sensitisation to one or more tree pollen was present in 27.6% (21/76); 31.5% (17/54) tested were sensitised to olive pollen. Almost half the patients tested were sensitised to one or more weed pollen (46.4%, 26/56) or mould allergen (48.6%, 108/222). Dust-mite sensitisation was present in 41.0% (80/195) of patients.

DISCUSSION

In this study of 232 patients with AR over a six-year period, grass pollens were found to be the most common sensitising allergen, similar to other South African studies.^{3–7} High grass pollen levels are present in Kimberley in summer.⁸

In keeping with other studies, nasal obstruction was the main presenting symptom.⁵ Patients also presented with secondary

effects of nasal obstruction such as snoring (12.9%), epistaxis (15.6%), hyposmia (5.2%) and sore throat (5.2%).

Sensitisation to *Zea mays* pollen was present in 58.3% of patients tested. Maize is mostly produced under irrigation in the Northern Cape, mainly in the Pixley ka Seme and Frances Baard districts.⁹ Maize pollen has been found to be a common sensitising allergen in the Free State, Gauteng, Mpumalanga and North West provinces.^{4,5} It has been hypothesised that grass pollen cross-sensitisation may play a role in the high level of maize-pollen sensitisation.⁴

Although sensitisation to tree pollens was not prominent, sensitisation to olive pollen was present in more than 30% of patients tested. Sensitisation to pollen of the London plane tree, used as an ornamental and shade tree, was present in 29.3% of patients tested. The under-representation of tree pollens in current testing panels has been highlighted.¹⁰ Tree-pollen sensitisation requires further investigation.

The Northern Cape is one of the major pecan nut-producing areas in South Africa.⁹ The pecan tree (*Carya illinoensis*) is a wind-pollinated tree and the pollen is considered highly allergenic.¹¹ Mesquite tree (*Prosopis*), an invasive species, has been identified as a major threat in the Northern Cape.¹² The pollen has been identified in the Kimberley pollen trap and is also highly allergenic.¹³ Olive tree (*Olea africana*), white mulberry

TABLE III: IMMUNOCAP TESTS FOR AEROALLERGENS

ALLERGEN	(%) (n)
Bermuda grass (<i>Cynodon dactylon</i>) pollen	87.9 (131/149)
Rye grass (<i>Lolium perenne</i>) pollen	85.6 (125/146)
Timothy grass (<i>Phleum pratense</i>) pollen	33.3 (1/3)
Grass pollen mix (<i>Cynodon dactylon</i> , <i>Lolium perenne</i> , <i>Phleum pratense</i> , <i>Poa pratensis</i> , <i>Sorghum halepense</i> , <i>Paspalum notatum</i>)	100 (3/3)
Tree pollen mix (<i>Quercus alba</i> , <i>Ulmus americana</i> , <i>Platanus acerifolia</i> , <i>Salix caprea</i> , <i>Populus deltoids</i>)	0 (0/1)
Tree pollen mix (<i>Olea europaea</i> , <i>Salix caprea</i> , <i>Pinus strobus</i> , <i>Eucalyptus</i> spp, <i>Acacia longifolia</i> , <i>Melaleuca leucadendron</i>)	50 (1/2)
Olive (<i>Olea europaea</i>) pollen	75 (6/8)
Mesquite (<i>Prosopis juliflora</i>) pollen	100 (2/2)
Plantain (<i>Plantago lanceolata</i>) pollen	100 (1/1)
Goosefoot (<i>Chenopodium album</i>) pollen	100 (1/1)
Alfalfa (<i>Medicago sativa</i>) pollen	100 (3/3)
Weed pollen mix (<i>Chrysanthemum leucanthemum</i> , <i>Taraxacum vulgare</i> , <i>Plantago lanceolata</i> , <i>Chenopodium album</i> , <i>Solidago virgaurea</i>)	0 (0/2)
<i>Dermatophagoides pteronyssinus</i>	38.3 (57/149)
<i>Blomia tropicalis</i>	26.2 (38/145)
German cockroach (<i>Blatella germanica</i>)	40.0 (2/5)
<i>Aspergillus fumigatus</i>	36.4 (52/143)
<i>Alternaria alternata</i>	49.0 (72/147)
<i>Cladosporium herbarum</i>	26.2 (38/145)
Mould mix (<i>Penicillium chrysogenum</i> , <i>Cladosporium herbarum</i> , <i>Aspergillus fumigatus</i> , <i>Alternaria alternata</i>)	100 (1/1)
Mould mix 4 (<i>Aspergillus fumigatus</i> , <i>Aspergillus niger</i> , <i>Aspergillus terreus</i> , <i>Aspergillus flavus</i>)	33.3 (1/3)
Dog dander	53.0 (80/151)
Cat dander	45.6 (68/149)
Feather mix (goose, chicken, duck and turkey feathers)	0 (0/3)
Horse dander	100 (3/3)
Cow dander	100 (3/3)
Sheep epithelium	100 (3/3)

(*Morus*) and karee (*Searsia*) pollen have also been identified as potential allergens in the Northern Cape.⁸

Weed-pollen sensitisation was present in more than 45% of patients. Weed pollens are generally not regarded as common allergens in South Africa,¹⁴ but require further investigation. Goosefoot (*Chenopodiaceae*) and *Asteraceae* have been identified as possible aeroallergens.⁸ Ragweed (*Ambrosia*) is an invasive plant that originated in North America.¹⁵ The pollen is highly allergenic and has been identified in the pollen trap in Kimberley. Studies to determine whether patients are sensitised to this aeroallergen are required.

Mould spores were identified as the second most common allergen in the Northern Cape, with the levels of sensitisation being higher than that found in the Free State.^{5,16} Further studies are required to understand the role of the environment on fungal spore release and their role in aeroallergies. It is possible that the extreme weather conditions and the widespread use of humidifiers and air-conditioners in certain populations might play a role with the increased mould-allergy sensitisation patterns.

The rate of sensitisation to *Dermatophagoides* was similar to that found in other inland regions of South Africa, but the rate of sensitisation to *B tropicalis* was higher than that found in previous studies, but not as high as that found in coastal areas.^{7,17} The hot, dry climate of the Northern Cape is unfavourable to dust mites. It has previously been suggested that dust-mite sensitisation may have had occurred at the coast.⁷

AR was predominantly confirmed during the study period by ImmunoCAP testing, performed on 64% of patients. Although SPTs are more cost-effective than the ImmunoCAP, it is not always possible to perform these tests in office. There are multiple reasons for this. Some medical aids do not reimburse the clinician for the tests, and the allergen extracts in a test kit can easily expire in a general ENT practice that is not dedicated to allergy patients. Referring a patient to a laboratory for skin prick testing also has its pitfalls as the test is operator-dependent. As SPTs are influenced by antihistamines, corticosteroids and other drugs, it is not always possible to perform SPTs on the day of the initial consultation. Patients in the Northern Cape often travel long distances for consultations and it is often not possible for

them to return for testing. Data from private laboratories showed that allergy testing was performed using SPTs in the minority of patients.^{4,18}

Allergen avoidance plays an important role in the management of allergic respiratory conditions.¹ Although it is not possible to avoid pollens and outdoor fungal spores completely, measures can be taken to reduce exposure in the outdoor environment and reduce the amount of allergen entering indoors in order to improve disease control (see Table IV).¹⁹ These measures require knowledge of patients' allergen sensitisation and the levels of pollens and fungal spores. The South African Pollen Network (SAPNET) measures the daily pollen count in a number of cities, including Kimberley, and reports these weekly on the website at <http://www.pollencount.co.za>.⁸

TABLE IV: ENVIRONMENTAL CONTROL MEASURES FOR OUTDOOR ALLERGENS¹⁹

- Avoid outdoor activities during peak pollen and mould times.
- Keep doors and windows closed and use air-conditioning.
- Change clothing when returning home.
- Wash pets and keep them out of the bedroom.
- Mould-sensitive patients should avoid contact with decomposing leaves, grasses and grains and avoid camping or walking in forests.

As this was a retrospective review of aeroallergen sensitisation in a group of patients at a private ENT practice mainly from the Frances Baard district where the main practice is located, they might not be representative of the wider population of the Northern Cape. More than half of the patients resided in the

Frances Baard district, but only 32.5% of the Northern Cape population resides in this area.²⁰ Only one-third of the patients diagnosed clinically with AR had the allergy confirmed with SPT or ImmunoCAP testing. This was mainly because patients who were referred for testing did not have the tests performed, usually because of the costs. Not all patients were tested for the same allergens, with sensitisation to some allergens being tested in only a few patients. Allergy testing was, to some extent, guided by the clinical history and patients were tested for sensitisation to allergens to which they were suspected to be allergic. The rate of sensitisation of atopic patients in general to the specific allergens may therefore not be as high as that found in this study.

CONCLUSION

Grass pollens were the predominant aeroallergens to which patients were sensitised, but there were high levels of sensitisation to weed pollens and moulds indicating that these allergens should be included in the allergen-testing panel for patients in the Northern Cape. Knowledge of the allergen sensitisations of patients with allergic respiratory diseases together with pollen calendars and the monitoring of pollen and mould-spore counts can assist with allergen avoidance by patients as they can take steps such as avoiding outdoor activities and keeping doors and windows closed during peak pollen and mould periods. Further studies are required to determine sensitisation to prevalent airborne pollens identified by pollen monitoring.

DECLARATION OF CONFLICTS OF INTEREST

The authors declare no conflict of interest.

This article has been peer reviewed.

REFERENCES

- Bousquet J, Van Cauwenberge P, Khaltaev N. Allergic rhinitis and its impact on asthma. *J Allergy Clin Immunol* 2001;108:S147-334. <https://doi.org/10.1067/mai.2001.118891>.
- Seedat RY, Sujee M, Ismail W, Vallybhai NY, et al. Allergic rhinitis in medical students at the University of the Free State. *S Afr Fam Prac* 2018;60:121-125. <https://doi.org/10.1080/20786190.2018.1437869>.
- Hoek W. Seasonal allergic rhinitis triggered by pollen in the Northern Cape. *Curr Allergy Clin Immunol* 2020;33:83-89.
- Van Rooyen C, Van den Berg S, Becker PJ, Green RJ. Allergic sensitisation in South Africa: Exploring regional variation in sensitisation. *S Afr Med J* 2020;110:686-690.
- Seedat RY, Rautenbach J, Steenkamp G, et al. Allergen sensitivities of patients with allergic rhinitis presenting to the ENT clinic at Universitas Academic Hospital. *Curr Allergy Clin Immunol* 2006;19:130-132.
- Mercer MJ, Van der Linde GP, Joubert G. Rhinitis (allergic and nonallergic) in an atopic pediatric referral population in the grasslands of inland South Africa. *Ann Allergy Asthma Immunol* 2002;89:503-512. [https://doi.org/10.1016/S1081-1206\(10\)62089-3](https://doi.org/10.1016/S1081-1206(10)62089-3).
- Seedat RY, Claassen J, Claassen AJ, Joubert G. Mite and cockroach sensitisation in patients with allergic rhinitis in the Free State. *S Afr Med J* 2010;100:160-163. <https://doi.org/10.7196/SAMJ.3669>.
- Berman D, Peter JG, Green RJ. A new South African pollen network (SAPNET). *Curr Allergy Clin Immunol* 2020;33:74-82.
- Statistics South Africa. Census of commercial agriculture 2017. Pretoria: Statistics South Africa; 2020. Report No.: 11-02-01 (2017).
- Green RJ, Hockman M, Friedman R, et al. Chronic rhinitis in South Africa – more than just allergy! *S Afr Med J* 2020;110:594-598.
- Rachmiel M, Verleger H, Waisel Y, et al. The importance of the pecan tree pollen in allergic manifestations. *Clin Exp Allergy* 1996;26:323-329.
- Shackleton RT, Le Maitre DC, Van Wilgen BW, Richardson DM. Towards a national strategy to optimise the management of a widespread invasive tree (*Prosopis* species; mesquite) in South Africa. *Ecosyst Serv* 2017;27:242-252. <https://doi.org/10.1016/j.ecoser.2016.11.022>.
- Hussain MI, Shackleton RT, El-Keblawy A, Del Mar Trigo Pérez M, González L. Invasive mesquite (*Prosopis juliflora*), an allergy and health challenge. *Plants* 2020;9:141. <https://doi.org/10.3390/plants9020141>.
- Potter PC. Common indoor and outdoor aero-allergens in South Africa. *CME* 2010;28:426-432.
- Chen K-W, Marusciac L, Tamas PT, Valenta R, Panaitescu C. Ragweed pollen allergy: Burden, characteristics, and management of an imported allergen source in Europe. *Int Arch Allergy Immunol* 2018;176:163-180. <https://doi.org/10.1159/000487997>.
- Borstlap CW, Joubert G, Seedat RY. A pilot study of fungal sensitisation in patients with allergic rhinitis at the ear, nose and throat clinic at Universitas Academic Hospital. *Curr Allergy Clin Immunol* 2014;27:314-316.
- Jeevarathnum AC, Van Niekerk A, Green R, Becker P, Masekela R. Prevalence of *Blomia tropicalis* allergy in two regions of South Africa. *S Afr Med J* 2015;105:567. <https://doi.org/10.7196/SAMJnew.7786>.
- Green RJ, Hockman M, Friedman R, et al. Allergic rhinitis in South Africa: 2012 guidelines. *S Afr Med J* 2012;102:693. <https://doi.org/10.7196/SAMJ.5810>.
- Seedat RY. Environmental control of outdoor allergens. *Curr Allergy Clin Immunol* 2019;32:12-14.
- Statistics South Africa. Provincial profile: Northern Cape. Pretoria: Statistics South Africa; 2018. Report No.: 03-01-14.