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Research Article

Desert Allergens: Profiling Pollen and Fungal Sensitivities in Bikaner

Divya Verma*

Department of Botany, Kalindi College (University of Delhi), New Delhi, India.

*Corresponding author: divyaverma@kalindi.du.ac.in

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ABSTRACT

Airborne allergens, such as pollen and fungal spores, are significant triggers of allergic disorders, particularly in arid regions like Bikaner, Rajasthan. This study investigates the allergenic potential of 20 pollen and 5 fungal species in 85 patients with naso-bronchial allergies attending the Asthma Allergy Clinic at S.P. Medical College. Skin test results revealed *Prosopis juliflora*, *Lawsonia inermis*, and *Albizia lebbeck* as the most reactive pollen allergens, while *Alternaria* showed the highest positivity among fungal spores. Seasonal and demographic trends were also analyzed, highlighting peak allergy cases in younger age groups and during specific months. The findings emphasize the importance of understanding regional allergenic profiles to develop targeted diagnostic and treatment strategies. This research provides a foundation for improving allergy management and enhancing the quality of life for affected individuals in arid environments.

Keywords: Airborne Allergens; Naso-Bronchial Allergy; Pollen Sensitivity; Fungal Spores; Skin Test Reactions.

INTRODUCTION

Airborne bio-particles, often referred to as bio-pollutants, represent a significant health concern due to their role in triggering allergic disorders such as bronchial asthma, allergic rhinitis, and atopic dermatitis[1,2]. These bio-pollutants include microorganisms, pollen grains, fungal spores, fungal hyphae, spores of mosses and ferns, insect debris, animal dander, and mites[3–5]. Among these agents, pollen grains and fungal spores have emerged as the most predominant allergens in the atmosphere, necessitating detailed studies on their seasonal and annual variations for effective diagnosis and management of allergic ailments.

Significant research has been conducted to explore the allergenic potential of airborne bio-particles in various regions. Sulemani and Gupta[6] identified key allergens in 200 cases of naso-bronchial allergy in Bikaner, Rajasthan. Menon *et al*.[7] reported Type-I skin reactions to *Aspergillus fumigatus*, correlating strongly with cases of bronchial asthma and allergic aspergillosis. Similarly, Agarwal and Shivpuri [8] identified *Alternaria brassicae* and wheat smut antigen as significant allergens, with positive reactions observed in 8.1% and 1.1% of cases, respectively. Beaumont *et al*. [9] carried out a volumetric aerobiological survey of conidial fungi in the North-East Netherlands and compared aerobiological data and skin tests with mould extracts in an asthmatic population. Gaur *et al*.[10] highlighted the importance of airborne pollen and fungal allergens in asthma, allergic rhinitis in the residents of Narora atomic power plant township, Narora, Uttar Pradesh, India. In Andhra Pradesh, allergens like *Cassia, Ageratum*, and *Ricinus* were reported as dominant by Acharya [11]. Anand *et al*.[12] Further supported these findings, demonstrating high incidences of 3+ and 4+ skin reactions to 17 pollen antigenic extracts. Subsequent studies have advanced the understanding of specific allergenic agents[13–15].

These disorders are particularly pronounced in arid and semi-arid regions, where environmental conditions and allergenic profiles exacerbate susceptibility among populations. The city of Bikaner, located in the arid northwestern region of Rajasthan, India, is characterized by extreme climatic conditions that contribute to a unique spectrum of airborne allergens. Pollen and fungal spores are significant contributors to allergic disorders and warrant detailed investigation. The present study aims to assess the allergenic potential of pollen and fungal spores among patients attending the Asthma Allergy Clinic at S.P. Medical College, Bikaner. The study also explored demographic trends, seasonal variations, and allergen-specific sensitivity patterns among 85 patients with naso-bronchial allergy.

METHODOLOGY

The present study was carried out in the Asthma Allergy Clinic, S.P. Medical College, Bikaner. Bikaner is a city in the northwestern part of Rajasthan, India. It is located in the Thar Desert, making it an arid and sandy region. Bikaner lies approximately between latitude 28.0229° N and longitude 73.3119° E.

Eighty-five patients of naso-bronchial allergy visiting the asthma allergy clinic, S.P. Medical College, Bikaner, were selected for skin test. The consent of each patient was obtained before the skin test. The skin test was performed with 20 pollen allergens and 5 fungal allergens based on their availability and tested allergenicity. These

allergens were procured from All Cure Pharma Pvt Ltd., Bahadurgarh (Haryana). The pollen allergens used for skin test include *Argemone mexicana, Brassica compestris, Cleome gynandra, Azadirachta indica, Acacia nilotica, Albizia lebbeck, Prosopis juliflora, Eucalyptus globulus, Lawsonia inermis, Parthenium hysterophorus, Xanthium strumarium, Salvadora persica, Aerva pseudotomentosa, Amaranthus spinosus, Chenopodium album, Ricinus communis, Morus alba, Cyperus rotundus, Cynodondactylon,* and *Pennisetum typhoides*. In contrast, the fungal spores included were *Mucor, Aspergillus, Alternaria, Cladosporium,* and *Curvularia*. The concentration used for testing was 1:500 and the route of injection was intradermal. The negative control was buffer saline, which was used for the extraction of allergens, and the positive control was histamine acid phosphate reactions diluted with buffered saline to 1:10,000. The response to the skin test was assessed after 20 min according to the criteria adopted by Shivpuri and Agarwal [16]. The skin test results were classified into 5 grades viz. negative when the wheal size is equal to the negative control, 1+ when the wheal size is double the size of negative control; 2+ when the wheal size is 3 to 5 mm greater than the negative control, 3+when the wheal size is 5 to 7 mm greater than the negative control and 4+ when the wheal size is more than 7 mm greater than the negative control. Dr. V.K. Jain, Head and Professor, Department of Chest and Respiratory diseases, S.P. Medical College, Bikaner, did the clinical studies.

RESULTS AND DISCUSSION

85 patients of naso-bronchial allergy (53 male and 32 female) and an age range of 15-65 years were studied. Among these patients, 25 cases were of rhinitis (19 male and 6 female), 20 cases were of bronchial asthma (12 male and 8 female) and 40 cases were of rhinitis with bronchial asthma (22 male and 18 female). The selected patients were categorized into 6 age groups shown in Fig. 1A. The patients of age group 16 to 25 showed the maximum allergy pattern (42.36%), i.e., 11 patients of rhinitis, 10 patients of bronchial asthma and 15 patients of rhinitis with bronchial asthma. Patients belonging to age groups 46 to 55 and 56 to 65 showed the minimum allergy pattern (2.35%). During the study year, month-wise visits of the number of patients are shown in Fig. 1B. The maximum number of naso-bronchial allergy were reported in the month of August (16.47%) and the minimum in the month of December (2.35%).

In the present study, total 1700 skin tests (1069 positive, 631 negative) were performed with 20 pollen allergens in 85 patients, out of which 588 positive tests were found in the case of patients suffering from rhinitis with bronchial asthma, 275 positive tests were found in case of rhinitis only and 206 positive tests were found in case of bronchial asthma (Fig. 2). Bhasale[17] reported clinical investigation on 160 patients of which 142 showed positive response to one or more pollen antigens. Gupta *et al*. [18] investigated the role of pollen allergy in Kanpur, where out of 100 patients, 77 showed positive skin reactions to one or more pollen antigens. Batabyal *et al*. [19] observed the results of skin tests performed on 100 allergic patients, where 68 patients showed significant positive skin reactions.

Out of 85 patients, 5 male and 3 female patients had a totally negative response to all the pollen allergens tested on them. *Prosopis juliflora* showed maximum positivity (80%). It was followed by *Lawsonia inermis* (76.47%), *Albizia lebbeck* and *Salvadora persica*

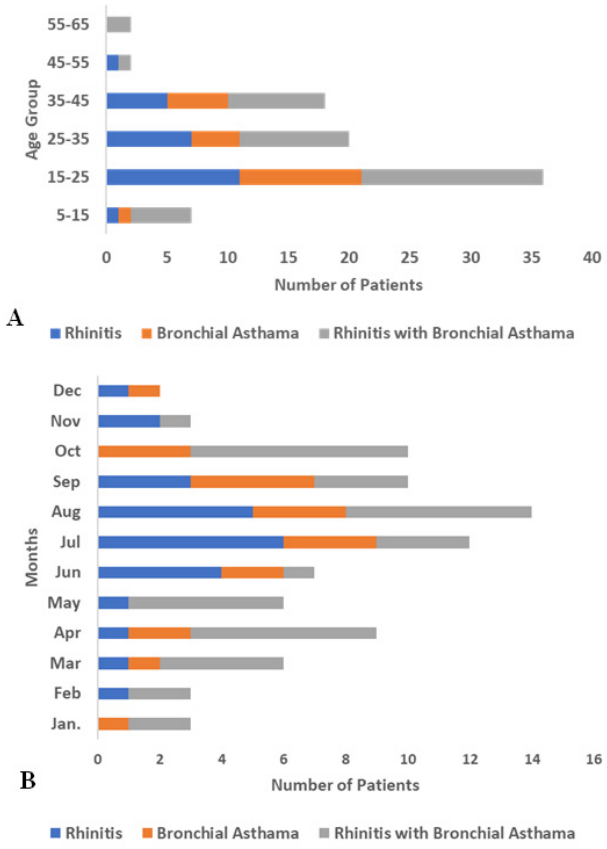

Fig. 1: Distribution of patients of naso-bronchial allergy (A) according to the age groups; (B) during different months.

(72.94%), *Acacia nilotica* (71.46%), *Cleome gynandra* and *Ricinus communis* (69.41%), *Aerva pseudotomentosa*, *Amaranthus spinosus* (67.06%), *Argemone Mexicana* (63.35%), *pennisetumtyphoides* (62.35%), *Brassica campestris* (61.18%), *Azadirachta indica* (60%),*Morus alba* (57.65%), *Xanthium strumarium* (55.29%), *Eucalyptus globulus* (54.12%), *Cyperus rotundus, Cynodondactylon*(52.94%), *Parthenium hysterophorus* (48.24%) and *Chenopodium album* (42.35%) Table 1. *Prosopis juliflora* accounts for 14.84% of total airborne pollen grains in Bikaner amongst arboreal taxa [20]. Vishwe[21] worked with 11 pollen antigens, where *Azadirachta, Amaranthus, Acacia* and *Cynodon* gave high positive skin reactions. Kundu *et al*.[22] performed clinical test of various pollen types, of which *Acacia, Azadirachta*, and grasses were found to be allergenically significant.

It was observed that 1+ and 2+ reactions were found for all the pollen allergens, accounting 13.35 and 43%, respectively of the total tests conducted. Whereas, 3+ reactions were observed in 19 types of pollen allergens, accounting 6.35%, and 4+ reactions were found only in 3 cases, accounting 0.18% of the total tests performed for the pollen allergens (Table 1). Sulemani and Gupta [6] and Ghosh *et al*. [23] have also reported more 2+ reactions. All except *Chenopodium album* showed 3+ reactions and only *Xanthium strumarium*, *Morus alba* and *Pennisetum typhoides* showed 4+ reactions. Shivpuri [24] also found that *Prosopis juliflora* showed 3+ reactions. Anand *et al*[12]carried out intradermal tests in 172 cases of naso-bronchial allergy by using 17 different pollen antigenic extracts with 3+ and 4+ reactions in

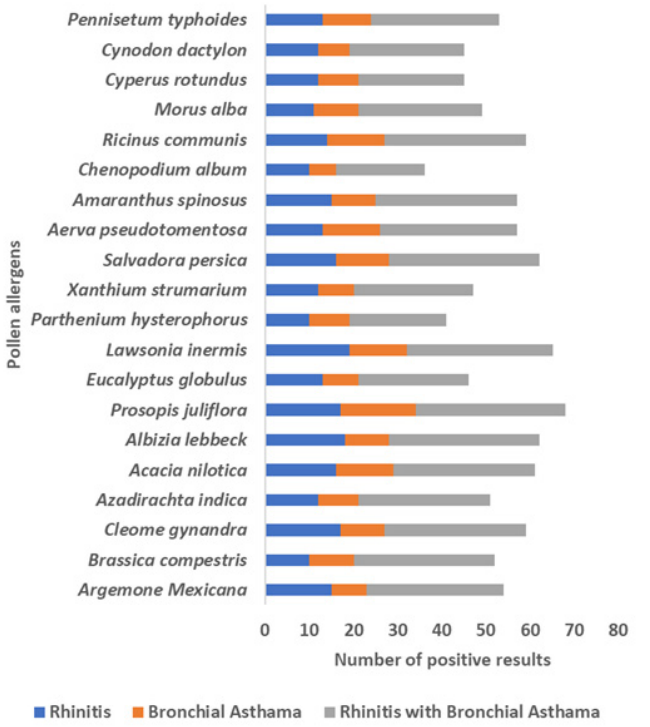

Fig. 2: Results of skin test positivity to variousallergenic pollen grains based onclinical diagnosis

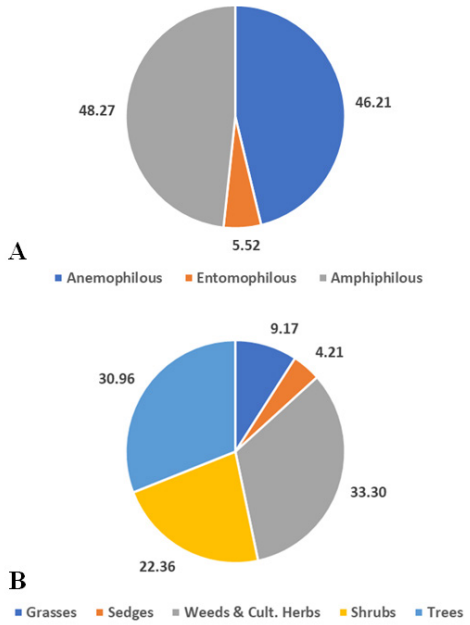

Fig. 3: Percentage distribution of allergenic pollen grains showing positive skin tests in the patients of naso-bronchial allergy (A) based on habit of the plants; (B) based on the mode of pollination

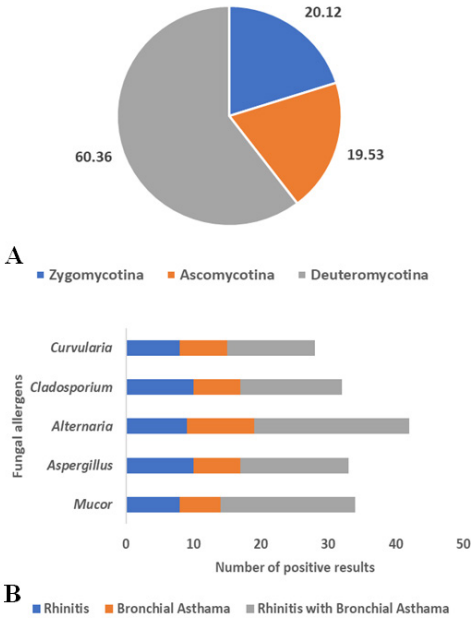

Fig. 4: (A) Percentage distribution of allergenic fungal spores based on taxonomic group showing positive skin tests in the patients of naso-bronchial allergy; (B) Results of skin test positivity to variousallergenic fungal spores based onclinical diagnosis

many cases. Acharya [11] have reported *Salvadora persica* and *Ricinus communis* pollen grains as dominant allergens from Andhra Pradesh.

Out of a total of 1069 positive skin test results, weeds & cultivated herbs pollen grains cause maximum (33.30%) positivity in the patients of naso-bronchial allergy, followed by tree pollen, which showed 30.96% positivity and shrub pollen with 22.36% positivity. Grasses (9.17%) and sedges (4.21%) showed low positivity (Fig. 3A). In light of the results obtained from the present study, it has been observed that amphiphilous pollen grains showed maximum (48.27%) positivity in the patients of naso-bronchial allergy. It is followed by anemophilous mode of pollination, which showed 46.21% positivity. Entomophilous allergenic pollen grains are found to be positive in skin test in only 5.52% cases (Fig. 3B). Although anemophilous pollen grains contributed 56.48% in 2000 and 57.40% in 2001, total pollen grains trapped during the study period, but amphiphilous pollen grains are pollinated by both air and insects, so they can penetrate the surroundings of patients more efficiently. Agasha[25] also reported that entomophilous pollen is present in comparatively insignificant amounts in the air, but these pollens are often highly allergenic.

85 patients of naso-bronchial allergy were skin tested with 5 fungal spore allergens obtained from the species of *Mucor, Aspergillus, Alternaria, Cladosporium* and *Curvularia*. 15 male and 13 female patients had shown totally negative response to all the fungal allergens tested on them. *Alternaria* showed maximum positive (49.41%), followed by *Mucor* (40%). *Aspergillus* (38.82%), *Cladosporium* (37.65%) and *Curvularia* 32.94%. The results of skin reactivity to allergenic fungal spores of selected types in patients are given in Table 2. Bhargava *et.al.*[26] Conducted skin tests applying antigenic extracts from *Alternaria* and found 70% positive results. Similarly, Menon *et al.* [7] observed 76% positivity in the patients of bronchial asthma tested with *Aspergillus spp.* Agarwal and Shivpuri [8] reported only 8.1% positivity in the case of *Alternaria* and *Cladosporium* as the most allergenic fungi in children tested in South Africa[27].

It was noticed that 1+,2+ and 3+ reactions were found in all cases, accounting 10.81%, 22.12% and 6.12%, respectively, of the total tests conducted and 4+ was found only in 3 cases, accounting

Table 1: Skin test reaction to 20 pollens on 85 patients

S. No.	Pollen	Skin test results				No of Patients with (+) ve results	% (+) vity (on 85 Patients)	No of Patients with (-) ve results	% (-) vity (on 85 Patients)
		1+	2+	3+	4+				
1	*Argemone mexicana*	17	33	4	0	54	63.53	31	36.47
2	*Brassica compestris*	11	36	5	0	52	61.18	33	38.82
3	*Cleome gynandra*	7	44	8	0	59	69.41	26	30.59
4	*Azadirachta indica*	9	38	4	0	51	60.00	34	40.00
5	*Acacia nilotica*	12	40	9	0	61	71.76	24	28.24
6	*Albizia lebbeck*	6	51	5	0	62	72.94	23	27.06
7	*Prosopis juliflora*	8	51	9	0	68	80.00	17	20.00
8	*Eucalyptus globulus*	19	24	3	0	46	54.12	39	45.88
9	*Lawsonia inermis*	14	40	11	0	65	76.47	20	23.53
10	*Parthenium hysterophorus*	9	29	3	0	41	48.24	44	51.76
11	*Xanthium strumarium*	12	31	3	1	47	55.29	38	44.71
12	*Salvadora persica*	10	44	8	0	62	72.94	23	27.06
13	*Aerva pseudotomentosa*	10	40	7	0	57	67.06	28	32.94
14	*Amaranthus spinosus*	13	40	4	0	57	67.06	28	32.94
15	*Chenopodium album*	9	27	0	0	36	42.35	49	57.65
16	*Ricinus communis*	16	35	8	0	59	69.41	26	30.59
17	*Morus alba*	14	30	4	1	49	57.65	36	42.35
18	*Cyperus rotundus*	17	27	1	0	45	52.94	40	47.06
19	*Cynodondactylon*	8	33	4	0	45	52.94	40	47.06
20	*Pennisetum typhoides*	6	38	8	1	53	62.35	32	37.65
Total tests		227	731	108	3	1069		631	
Percentage (on 1700 total tests)		13.35	43.00	6.35	0.18	62.88		37.12	

Table 2: Skin test reaction to 5 fungal allergens on 85 patients

S. No.	Pollen	Skin test results				No of Patients with (+)ve results	% (+)vity (on 85 Patients)	No of Patients with (-) ve results	% (-)vity (on 85 Patients)
		1+	2+	3+	4+				
1	*Mucor*	11	17	6	0	34	40.00	51	60.00
2	*Aspergillus*	6	22	4	1	33	38.82	52	61.18
3	*Alternaria*	9	24	8	1	42	49.41	43	50.59
4	*Cladosporium*	11	18	3	0	32	37.65	53	62.35
5	*Curvularia*	9	13	5	1	28	32.94	57	67.06
Total tests		46	94	26	3	169		256	
Percetage (on 425 total tests)		10.82	22.12	6.12	0.71	39.76		60.24	

0.71% shown in Table 2. Deuteromycotina cause maximum (60.35%) positive results in the patients of naso-bronchial allergy, followed by Zygomycotina (20.12%) and Ascomycotnia (19.53%), respectively (Fig. 4A).

In the present study, total 425 skin tests (169 positive and 256 negative) were performed with 5 allergens in 85 patients, out of which 45 positive tests were found in case of rhinitis only, 37 positive tests were found in case of bronchial asthma and 87 positive tests were found in the case of patients suffering from rhinitis with bronchial asthma (Fig. 4B).

CONCLUSION

This study underscores the significant impact of airborne allergens, particularly pollen and fungal spores, on individuals suffering from naso-bronchial allergies in the arid region of Bikaner, Rajasthan. Among the tested allergens, Prosopis juliflora emerged as the most potent, with high positivity rates also observed for Lawsonia inermis, Albizia lebbeck, and Alternaria. These findings not only confirm the allergenic potential of specific species but also highlight the distinct environmental and climatic factors contributing to allergen

prevalence in the region.

The study's detailed insights into age-specific, seasonal, and allergen-specific sensitivities provide a valuable framework for targeted diagnostic and therapeutic approaches. For instance, the peak in allergy cases during certain months suggests the need for heightened awareness and preventive strategies during those times. Moreover, the observed differences in reactions to various allergens emphasize the importance of personalized management plans for affected individuals.

In conclusion, this research contributes to a deeper understanding of allergic disorders in arid climates and serves as a basis for developing region-specific guidelines to mitigate the health burden of airborne allergens. Future studies could expand on these findings by exploring long-term trends and incorporating newer diagnostic methods to enhance patient care.

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CONFLICT OF INTEREST

The authors have no relevant financial or non-financial interests to disclose.

ETHICS STATEMENT

The study was conducted following institutional ethical guidelines, and informed consent was obtained from all participants.

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