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Original Research Article

PATTERN OF ALLERGEN SENSITIZATION BY SKIN PRICK TESTING IN CHILDREN WITH ALLERGIC CONDITIONS: A STUDY FROM A TERTIARY CARE HOSPITAL

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ABSTRACT

Background: Allergens play a major role in the pathogenesis of allergic disorders, particularly asthma and allergic rhinitis. This study aimed to analyze the pattern of allergen sensitization by skin prick testing in various allergic conditions in a referred population from a tertiary care hospital. **Materials and Methods:** This single-center, prospective, observational study was conducted in children below 18 years of age of both sexes, with suspected allergic condition like asthma, allergic rhinitis, atopic dermatitis and others.
Results: A notable male predominance (57%) was observed suggesting that males are either more affected or more likely to seek medical care. Females accounted for 43% of the sample, indicating a lower proportion compared to males. Most subjects with positive skin prick test results were sensitized to either one allergen (33.33%) or two allergens (30%), indicating limited but specific sensitization patterns. Only a small proportion (3.33%) of subjects were sensitized to four allergens, indicating that poly-sensitization is less common. Mites (13%) were the most common allergen, followed by pollen (3.89%), molds (3.33%), animal dander (1.67%), and food allergens (0.16%).
Conclusion: The most prevalent allergic conditions in this region are allergic rhinitis and asthma, with mites being the most common allergens, followed by pollen. These findings emphasize the importance of allergen avoidance and targeted immunotherapy for better disease control.
Keywords: allergic rhinitis, asthma, allergen, mites, pollen.

INTRODUCTION

In both developed and developing countries, the prevalence of allergic disorders has been rising dramatically. Allergens play a major role in the pathogenesis of allergic disorders, particularly asthma and allergic rhinitis. Asthma is a leading cause of chronic illness in childhood and is responsible for a high degree of morbidity and need for hospitalization.[1,2]

Asthma is characterized by airway hyper-reactivity to various stimuli, with reversible airway obstruction that may occur spontaneously or in response to treatment. Allergic rhinitis is an IgE mediated inflammatory condition of the nasal mucosa characterized by pruritis, sneezing, nasal stuffiness and discharge. Both the incidence and morbidity of asthma and allergic rhinitis have increased over the last two decades.[3,4]

According to international guidelines, allergen avoidance is the first-line management strategy for allergic rhinitis and bronchial asthma.[5,6] It may not be completely useful, but it definitely contributes to control of the disease to a large extent. Avoidance of the allergen cannot be achieved without identifying the allergen associated with bronchial asthma and allergic rhinitis for every patient.[5,6] Identification of the allergen to which the patient is sensitized also plays an important role in the management of the

condition in terms of allergic immunotherapy. The present study aimed to analyze the pattern of allergen sensitization using skin prick testing in various allergic conditions in a referred population from a tertiary care hospital.

MATERIALS AND METHODS

This single-center, prospective observational study was conducted after approval from the institutional ethics committee in the Department of Pediatrics at Bombay Hospital Institute of Medical Sciences & Research, Mumbai, India, over two years (July 2016–June 2018).

Children under 18 years of age with clinically suspected allergic conditions such as asthma, allergic rhinitis, and atopic dermatitis were included, provided they consented to participate. Exclusion criteria included patients above 18 years, immunocompromised states (AIDS, TB, cancer), existing skin disorders, severe conditions like uncontrolled asthma, prior anaphylaxis to allergens, and those unable to discontinue asthma medication.

The study was explained in the local language, and written informed consent was obtained from participants and their parents. A detailed history and physical examination were conducted for all participants. Antihistamines, steroids, and other anti-allergic drugs were discontinued one week before the skin prick test, which was performed using allergens, histamine (positive control), and saline (negative control) from MERK ALLERGOSPOT.

A total of 32 allergens were tested, including five mites, nine pollens, eight molds, one animal dander, and ten food allergens, as listed below

List of allergen used in the study.

FOOD	POLLEN	MOULD	MITE	ANIMAL
Peanut	B. Grass	A. Fumigates	D. Farinae	Cat
Salmon fish	T. Grass	A.Alternata	D. Pteronyssinus	
Hen's egg	R. Grass	C. Herbarum	A. Siro	
Cow's milk	L. Quarter	P. Notatum	L. Destructor	
Mutton	Mugwort	F.Moniliforme	T. Putrescentiae	
Chicken	S. Ragweed	H. Halodes		
Orange	K. Blue Grass	R.Nigricans		
Wheat flour	E. Plantain			
Corn flour	R. Pseudoacacia			
Pea				

The procedure was performed as per the MERK ALLERGOSPOT manual, from which standardized allergens, histamine, and saline were procured. All tests were conducted under controlled conditions to ensure consistency and minimize variability.

Each patient was informed about the procedure, including its purpose, steps, and potential outcomes, and informed consent was obtained. Allergen test sites were marked on the volar forearm (or back for smaller patients), maintaining ≥2 cm spacing to prevent false positives. Allergen extracts were applied in a standardized sequence, and the skin was pricked using either a sterile single-head metal lancet per allergen or a multi-prick applicator dipped into allergen wells, both held for at least 1 second.

Test sites were read at 20 minutes, following standard recommendations. Wheal diameters were measured using a millimeter ruler, excluding artifacts. Positive (histamine) and negative controls validated the results. A wheal diameter of ≥3 mm (single-head lancet) or ≥4 mm (multi-prick applicator) was considered positive. Wheal sizes and control results were recorded, and allergen sensitization patterns were analyzed to assess associations with allergic conditions, ensuring accuracy and reproducibility.

Statistical Analysis

Data was entered into Microsoft Excel Worksheet. The Statistical Package for Social Sciences (SPSS Version 25.0) was used for the analysis.

RESULTS

A total of 60 children (mean age: 8.99 ±4.55 years) were analyzed. Most cases (35%) were in the 6–10 years age group, followed by 11–15 years (31.66%). Males constituted 57% of the cohort, suggesting a slight male preponderance. Allergic rhinitis was the most common suspected condition (41.67%), followed by asthma (36.67%), food allergy (10%), and urticaria (8.33%).

Out of 60 patients, 32 patients had history of allergy in the family (53%)

Table 1: Demographic and Clinical characteristics of Subjects

Characteristics	No. of subjects	Percentage
Age group (in years)		
0 to 5 yrs	14	23.33
6 to 10 yrs	21	35.00
11 to 15 yrs	19	31.66
15 yrs to 18years	6	10.00
Mean age (in years)	8.99 ± 4.55	

Male	34	57
Female	26	43
Other		
Positive Family history	32	53.33
Suspected Cases		
Allergic rhinitis	26	41.67
Asthma	23	36.67
Food allergy	06	10
Urticaria	05	8.33

As per table 1 most cases (35%) were in the 6–10 years age group, with a mean age of 9 years. A significant portion (53.33%) reported a positive family history, suggesting a strong genetic predisposition. The mean age of the population is 9 years, with a wide age spread across 0 to 18 years. There is a notable male predominance (57%), suggesting males are either more affected by or more likely to report these conditions. Females accounted for 43% of the sample, indicating a lower proportion compared to males. A significant portion (53.33%) of the subjects reported a positive family history, suggesting a strong genetic or hereditary predisposition to the conditions being studied. Allergic rhinitis was the most commonly suspected condition, affecting 41.67% of subjects, followed by asthma (36.67%). This highlights the prevalence of respiratory-related allergic disorders in the population. Food allergies and urticaria were less frequently observed, with 10 % and 8.33% prevalence, respectively, indicating they are less common in this cohort. The findings suggest a need to focus on early diagnosis and management of allergic rhinitis and asthma in pediatric populations, particularly in those with a positive family history. The strong association with family history underlines the importance of genetic counseling and preventive measures in high-risk families. Awareness programs targeting parents of children in younger age groups could help in early recognition and intervention.

Table 2: Skin prick test results

Characteristics	Total Number of Patients tested	No. of Subjects (Skin Prick Test result – Positive)	Percentage
Skin Prick Test result – Positive	60	43	71.67
No. of allergens			
1	60	20	33.33
2	60	18	30.00
3	60	03	5.00
4	60	02	3.33
Triggering factor			
Dust	60	13	21.66
Damp areas	60	09	15.00
Walking in garden	60	09	15.00
Food	60	06	10.00
Lying on bed	60	04	6.66
Smoke exposure	60	03	5.00

(*Percentages are rounded to two decimal places; total percentage may have minor rounding variations)

A substantial proportion (71.67%) of subjects tested positive for allergens, indicating a high prevalence of sensitization in this population. Most subjects with positive skin prick test results were sensitized to either one allergen (33.33%) or two allergens (30%), suggesting limited but specific sensitivities. Only a small proportion of subjects were sensitized to four allergens (3.33%), indicating poly-sensitization is less common. Dust was the most frequently reported triggering factor, affecting 21.66% of subjects. Both damp areas and walking in gardens were reported equally (15% each), suggesting that environmental exposure plays a significant role. Food allergies were noted in 10% of subjects, whereas indoor triggers such as lying on a bed (6.66%) and smoke exposure (5%) were less common.

Table 3: Distribution of allergens among skin prick test

Allergen	Total number of skin prick tests conducted for allergens	No. of Positive Skin Prick Tests	Percentage (%)
Mites	300	39	13
Pollens	540	21	3.89
Moulds	420	14	3.33
Animal	60	01	1.67
Food	600	01	0.16

Mite 39 (13%) was the most common allergen found followed by pollen 21 (3.89%), moulds 14 (3.33%) and animal (1.67%) and food (0.16%) each respectively.

Table 4: Result of Skin Prick Test with Dust Mite Allergen extract

Mites	Total Number of Patients tested	No. of Patients with Positive Skin Prick Test	Percentage (%)
D. Farinae	60	16	26.67
D. Pteronyssinus	60	13	21.67
A.Siro	60	04	06.67
L. Destructor	60	03	05.00
T. Putrescentiae	60	03	05.00

Among the 60 patients, D. farinae was the most common allergen (26.67%), followed by D. Pteronyssinus (21.67%), A. siro (6.67%), L. destructor (5%), and T. putrescentiae (5%).

Table 5: Result of Skin Prick Test with Pollen Allergen extract

Pollens	Total Number of Patients tested	No. of Patients with Positive Skin Prick Test	Percentage (%)
B. Grass	60	06	10.00
T. Grass	60	04	6.66
S. Ragweed	60	03	5.00
K. Grass	60	03	5.00
Mugwort	60	02	3.33
L. Quarters	60	01	1.66
E. Plantain	60	01	1.66
R. Grass	60	01	1.66
R. Pseudoacacia	60	00	0.00

Total 60 patients were tested out of which, 06 (10%) patients were positive for B. grass, 04 (6.66%) patients were positive for T. grass, 3 (5.00%) patients each were positive for S. ragweed and K. blue grass respectively, 2 (3.33%) patients positive for Mugwort, 1patient (1.66%) each was positive for L. quarter, E. plantain, R, grass respectively, and not a single patient was positive for R. pseudoacacia.

Table 6: Result of Skin Prick Test with Mould Allergen extract

Mould	Total Number of Patients tested	No. of Patients with Positive Skin Prick Test	Percentage (%)
A. Alternata	60	03	5.00
R. Nigricans	60	03	5.00
A. Fumigates	60	02	3.33
P. Notatum	60	02	3.33
C. Herbarum	60	02	3.33
F. Moniliforme	60	01	1.67
H. Halodes	60	01	1.67

Out of 60 patients tested, 3 (5%) patients each were found positive for A. alternata and R. nigricans respectively, 2(3.33%) patients each were found positive for A. fumigates, P. notatum, C.herbarum respectively. 1(1.67%) patient each found positive for F. moniliforme and H.halodes respectively.

Table 7: Result of Skin Prick Test with food and animal dander Allergen extract

Animal and Food	Total Number of Patients tested	No. of Patients with Positive Skin Prick Test	Percentage (%)
Cat	60	01	1.67
Peanut	60	01	1.67
Salmon Fish	60	00	0.00
Mutton	60	00	0.00
Chicken	60	00	0.00
Hens Eggs	60	00	0.00
Orange	60	00	0.00
Pea	60	00	0.00
Wheat Flour	60	00	0.00
Corn Flour	60	00	0.00
Cow's Milk	60	00	0.00

Out of 60 patients tested, 1 (1.67%) patient was positive for cat and peanut respectively. The remaining patients were negative to Salmon fish, mutton, chicken, hen's egg, orange, pea, wheat flour, corn flour, cow's milk.

DISCUSSION

The observation that most cases fell in the 6–10 years range is consistent with studies like Suzan

Alkhteret al,[9] (2017), which highlighted higher susceptibility in early school-age children. The male predominance aligns with studies by Prasad et al.[10] (2009), suggesting hormonal and genetic influences on allergic predisposition. Additionally, the high rate (71.66%) of positive skin prick test results reinforces its reliability as a diagnostic tool, as supported by Gowda et al.[11] (2013).

The mean age of 8.99 ± 4.55 years with cases extending to adolescents reflects the broad age spectrum affected by allergies, consistent with findings by Gowda et al.[11] which reported a rising prevalence of allergic disorders among children and adolescents globally. The male predominance (57%) observed in this study corresponds with results from Prasad R et al.[10], who reported higher rates of allergic conditions in boys, attributing it to differences in hormonal, genetic, and environmental factors. Females constituted 43% of the sample, suggesting that while allergies are less common in girls, they remain significant in prevalence which is similar to the study conducted by Suzan Alkhteret al.[9] in which, mean age group was 8.93±2.93 yrs, including 32 females and 68 males. Age group in the study done by Prasad R. et al.,[10] 12 to 45 years, with male predominance (28 males and 20 females out of 48 patients). In the Study done by Gowda et al.,[11] majority patients were in the age group of 21 to 40 yrs (60.43%) including 56 (40.29 %) males and 83 (59.70%) females.

The finding that 71.67% of subjects tested positive for allergens using the skin prick test aligns with studies like Gowda et al.[11], which documented high sensitization rates in pediatric and adolescent populations, particularly in urban environments where allergen exposure is prevalent. These findings highlight the reliability of skin prick testing (SPT) in diagnosing allergen sensitivities, as also reported by Prasad R et al.[10]. The majority of sensitized subjects showed reactivity to either one (33.33%) or two allergens (30%), indicating limited but specific sensitivities. This trend aligns with findings from Arbat[15] who reported mono-sensitization as more prevalent in younger populations, potentially due to lower cumulative allergen exposure.

The relatively small proportion of poly-sensitized individuals (3.33%) is consistent with research by Soti[13] which showed that poly-sensitization tends to increase with age and prolonged allergen exposure. Study by Prasad et al,[10] showed a very high rate of 60 to 80% co-morbid rate for asthma and allergic rhinitis. The predominance of mite sensitization (D. farinae and D. pteronyssinus) in our study differs from the findings of Sotiet al,[13] where grass pollen was the most common allergen. This variation can likely be attributed to environmental and geographical differences in allergen exposure.

Mumbai, where our study was conducted, has a humid coastal climate with consistently high temperatures and moisture levels throughout the year. These conditions favor the proliferation of dust mites, which thrive in indoor environments such as bedding, upholstery, and carpets, making them a significant allergen in urban households. Studies have demonstrated that dust mite sensitization is more prevalent in humid, densely populated areas with poor ventilation, which aligns with our findings.

In contrast, Sotiet al.'s,[13] study was conducted in regions with more temperate or arid climates, where grass pollen exposure is higher due to abundant vegetation and seasonal fluctuations. In such areas, wind-pollinated plants contribute significantly to airborne allergens, leading to a greater prevalence of pollen sensitization compared to indoor allergens like dust mites.

Among the various mite allergens which were used for skin prick testing in all the subjects, the most common found mite was D. farinae which affected 16 (26.67%) patients out of 60 patients, which was slightly lower than positive results in the study done by Vikas Deep Mishra et al,[14] in whose study 36(60%) patients were affected by D. farinae of 60 patients.

In the study by Arbat et al,[15] D. pteronyssinus 81 (17.8%) was the most common mite, followed by D. farinae 70 (15.4%) and Blomia species 72 (15.8%).

In the present study the major pollen allergies were Bermuda grass 6 (10%) followed by Timothy grass 4 (6.66%), short ragweed 5(3.33%) and Kentucky blue grass5 (3.33%). In contrast to the study done by Vikas Deep Mishra et al,[14] where their major pollen allergens were Ricinus communis (28.33%), and Amaranthus spinosus (28.33%) followed by Parthenium hysterophorous (26.66%), Eucalyptus tereticornis (26.66%), Eucalyptus tereticornis (26.66%), Cynodondactylon (25%), Argimone Mexicana (23.33%), Holoptelea integrifolia (18%).J. S. Matta et al,[16] found that HalopteliaIntergrifolia, ParthearriumHysterophorus and CynodonDactylon were most common.

In present study, among fungi, skin positive reaction was seen in 14 patients and the common fungi were Alternaria alternate (5%) and Rhizopus nigricans (5%) followed by Aspergillus fumigates (3.33%), Penicillium notorum (3.33%) and C. herbarum (3.33%). In the study by Suzan A Alkhater,[9] Alternaria and Aspergillus were more prevalent. In contrast to study conducted by Prasad et al,[10] most common fungal antigens were Aspergillus fumigates followed by Aspergillus flavus, Alternaria alternata, and Fusarium sodani.

CONCLUSION

Allergic rhinitis and asthma are the most prevalent allergic conditions in Mumbai region, with dust mites and pollen as the primary allergens. Given the high sensitization rates, allergen avoidance should be integrated with targeted immunotherapy and environmental control measures to reduce allergic responses. Routine skin prick testing is an essential tool for early identification, targeted intervention,

and long-term management of allergen sensitivities in pediatric patients.

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