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ESTABLISHMENT OF RELATIONSHIP BETWEEN ALLERGY AND ASTHMA – A PEDIATRIC PATIENT

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ABSTRACT : This retrospective study examines the relationship between allergen exposure and the development of asthma in pediatric patients. Conducted at Sai Allergy and Asthma Clinic, Pune, the study included 200 children who were assessed through structured allergy questionnaires and Skin Prick Tests (SPT) to determine sensitivities to various allergens, such as pollens, fungi, molds, animal and bird dander, plant allergens, and indoor allergens like dust mites and cockroach allergens. The majority of patients (60% male, 40% female) were within the age range of 6–12 years, with moderate allergic reactions being the most common. Typical asthma symptoms included nasal itching, sneezing, chronic cough, blocked nose, shortness of breath, and chest tightness. A significant rate of sensitization was noted for Corn, Bermuda Grass, *Penicillium notatum, Blomia sp.* , and pigeon-related allergens, with numerous patients reacting to both indoor and outdoor allergens. The results underscore a significant link between allergen sensitization and asthma symptoms, highlighting the necessity for early diagnosis and strategic management approaches to avert the advancement of allergic conditions into chronic asthma in children.

Keywords - Pediatric asthma, Allergen sensitization, Skin prick test

1.INTRODUCTION

Childhood asthma is a chronic, non-communicable inflammatory disorder of the airways that predominantly affects children and poses a significant public health concern worldwide. It is characterized by episodic symptoms including wheezing, coughing, shortness of breath, and chest tightness, which vary in intensity and frequency and are often triggered by a wide range of environmental and genetic factors. Globally, asthma affects millions of children and is a major cause of emergency visits, hospitalizations, missed school days, and impaired quality of life. The pathogenesis of asthma is multifactorial, involving genetic predisposition, immune system dysregulation, and environmental exposures such as allergens (dust mites, pollen, mold, pet dander), respiratory infections, tobacco smoke, indoor and outdoor air pollutants, cold weather, exercise, and stress. Children with a family history of asthma, eczema, or allergic rhinitis are particularly vulnerable. Immunologically, asthma is associated with an overactive Th2 immune response leading to elevated levels of immunoglobulin E (IgE), activation of mast cells, eosinophils, and the release of inflammatory mediators like histamine and leukotrienes, resulting in airway hyperresponsiveness, bronchoconstriction, mucosal edema, and mucus hypersecretion. Chronic inflammation can cause structural remodeling of the airways, further complicating the disease. Diagnosis in children requires a thorough medical history, physical examination, and supportive tests such as spirometry, peak expiratory flow rate (PEFR), fractional exhaled nitric oxide (FeNO), and skin prick testing to detect allergen sensitization. Management aims at long-term control through patient and caregiver education, trigger avoidance, use of inhaled corticosteroids, leukotriene modifiers, bronchodilators, and, in some cases, immunotherapy. Personalized asthma action plans, regular follow-up, and school-based asthma awareness programs play a crucial role in minimizing exacerbations and promoting adherence to treatment. In addition, comorbid conditions such as allergic rhinitis, gastroesophageal reflux, and obesity must be addressed for effective disease control. Despite advancements in therapy and understanding of the disease, childhood asthma continues to be underdiagnosed and poorly managed in many low- and middle-income countries, where limited access to healthcare, lack of awareness, and socioeconomic disparities prevail. Strengthening early detection strategies, promoting research on asthma biomarkers, and fostering multidisciplinary care are essential steps toward improving clinical outcomes and enhancing the overall well-being of children suffering from this lifelong respiratory illness.

2. LITERATURE SURVEY

Several studies have explored the multifactorial nature of asthma, particularly in children, with a focus on genetic, environmental, immunological, and microbial influences. Akdis and Akdis (2012) investigated allergen-specific immunotherapy (AIT) and its role in inducing long-term tolerance in allergic asthma patients, highlighting the immunomodulatory shift from a Th2 to a regulatory T-cell profile. Huang and Boushey (2015) reviewed the emerging significance of the microbiome, emphasizing how microbial communities in the gut and respiratory tract influence immune responses and asthma development. Weinmayr et al.

(2009) examined the impact of nutrition and environmental exposures, concluding that dietary patterns and pollutants can modulate immune function and contribute to asthma risk. Agache and Akdis (2019) evaluated the efficacy and safety of biologics in severe allergic asthma, discussing currently approved therapies and potential advancements in targeted treatments. Yang et al. (2011) explored genetic and epigenetic mechanisms in asthma, underlining the complex interaction between genetic predisposition and environmental exposures. Searing and Leung (2010) discussed the role of vitamin D in immune regulation, presenting evidence for its potential benefit in the prevention and treatment of allergic diseases including asthma. Tarlo and Lemiere (2014) focused on occupational asthma, detailing how workplace allergens induce sensitization and emphasizing preventive strategies. Holt and Strickland (2010) examined innate immunity in childhood asthma, proposing that early-life exposures shape immune responses and influence long-term asthma risk. Holgate (2012) addressed targeted treatment strategies for severe asthma, particularly biologics, and emphasized the need for personalized therapies based on disease mechanisms. Finally, Guarnieri and Balmes (2014) assessed the effects of air pollution on allergic asthma, presenting epidemiological and mechanistic evidence that pollutants exacerbate asthma symptoms and contribute to increased disease prevalence. Collectively, these findings underscore the complex interplay between genetic, environmental, and immunological factors in asthma pathogenesis and support the development of personalized and preventive strategies, particularly for pediatric populations.

3. METHODOLOGY

3.1 Study Design

This study followed a retrospective design, utilizing previously recorded clinical data to evaluate the association between allergen sensitization and asthma symptoms in pediatric patients.

3.2 Study Setting

The study was conducted at Sai Allergy and Asthma Clinic, Pune, where data from pediatric patients visiting the clinic with allergic complaints was reviewed.

3.3 Participants

A total of 200 pediatric patients (children and adolescents) were included in the study. These participants had documented symptoms suggestive of allergic disorders. Basic demographic information, including age and gender, was also collected for analysis.

3.4 Data Collection Methods

Data collection was carried out using two primary tools:

3.4.1 Patient Allergy Questionnaire

A structured questionnaire was administered to gather detailed information about the patients' allergy-related symptoms, exposure history, and overall clinical presentation. This provided insight into the pattern and severity of allergic responses as experienced by the patients.

3.4.2 Skin Prick Test (SPT)

The Skin Prick Test, a standardized diagnostic tool, was performed on all participants to identify specific allergen sensitivities. A small amount of allergen extract was applied to the skin (typically on the forearm), followed by a light prick. The development of a wheal and flare reaction indicated sensitization to that particular allergen.

3.5 Allergens Tested

A comprehensive panel of region-specific aeroallergens was used for testing, which included:

- **Pollens:** Bermuda Grass, Parthenium, Cyperus rotundus
- **Fungi/Molds:** Alternaria tenuis, Penicillium notatum, Rhizopus nigricans, Fusarium moniliforme
- **Animal/Bird Allergens:** Cat epithelia, Dog epithelia, Pigeon droppings/feathers
- **Plant Allergens:** Eucalyptus spp, Acacia arabica, Prosopis juliflora
- **Other Allergens:** House dust mites (Blomia sp), Cockroach allergens

3.6 Data Analysis

The collected data from the questionnaires and SPT results were analyzed to:

- Identify common symptom patterns and potential allergen exposures.
- Determine the prevalence and severity of sensitization to specific allergens.
- Establish a clinical correlation between the SPT-confirmed allergen sensitivities and the symptoms of allergy and asthma reported by the patients.

4. **RESULT ANALYSIS**

4.1GENDER

The gender distribution among the patients surveyed indicates that 60% were male and 40% were female, with a total of 200 individuals participating in the Asthma Allergy Study.

Table no 4.1 Gender of Patients

Gender	No of Patients
Male	120
Female	80
Total	200

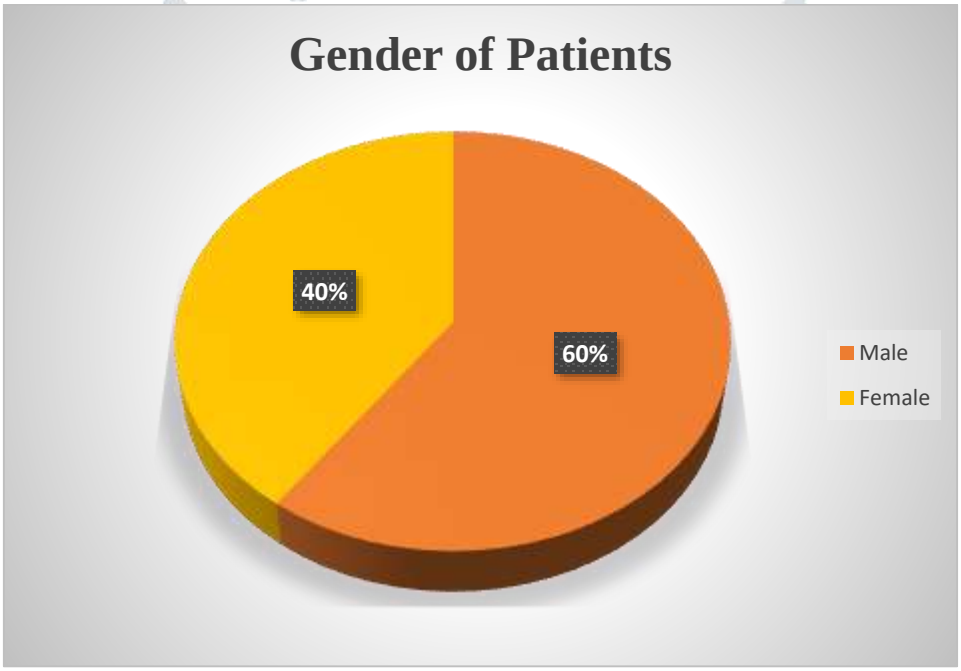


Fig No 4.1 Gender of patient's

4.2 AGE GROUP

The data provided offers insight into the distribution of patients across different age groups. Among the four specified age brackets, the largest cohort appears to be children aged 6 to 12 years, with 84 patients. Following closely behind are children aged 3 to 6 years, accounting for 79 patients. Meanwhile, there are 24 patients in the youngest age group of 1 to 3 years. Conversely, the smallest group consists of patients above the age of 12, numbering only 11 individuals. This distribution suggests a concentration of patients in the pediatric age range, particularly between 3 to 12 years, which may have implications for healthcare planning, resource allocation, and targeted interventions.

Table no 4.2 Age Group

Age Group	Number of Patients
1-3yrs	24
3-6yrs	79
6-12yrs	84
above 12	11

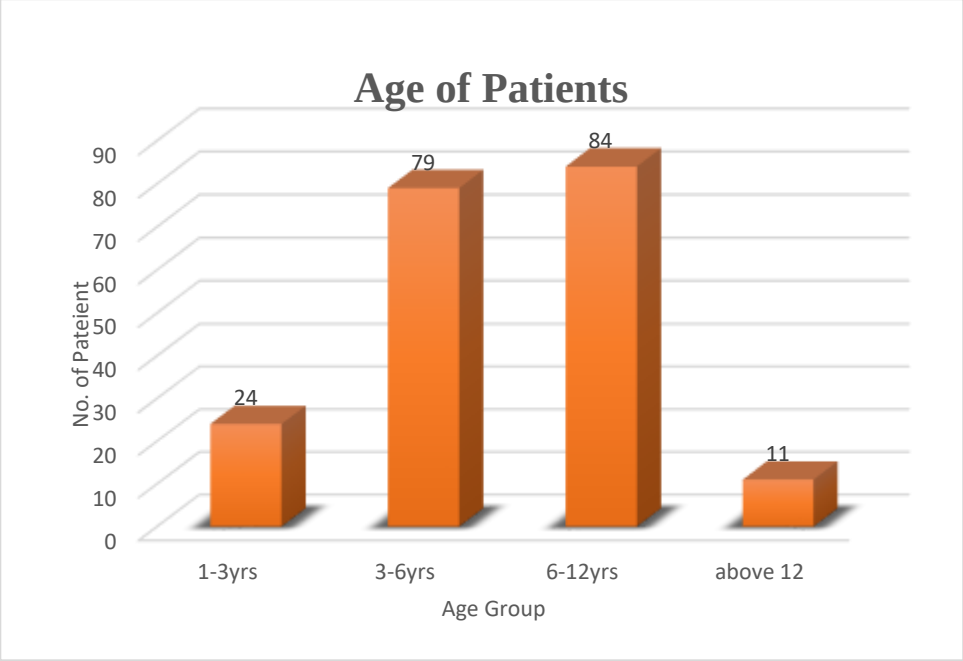


Fig No 4.2 Age of patients

4.3 Allergy Severity

The data shows that moderate allergies are the most common, with 134 patients affected, followed by severe allergies with 36 cases. Mild allergies, affecting 30 patients, are the least prevalent. Understanding these distributions helps healthcare professionals prioritize care and allocate resources effectively to manage allergies across different severity levels.

Table no. 4.3 Allery Severity

Allergy Severity	Number of patients
Mild	30

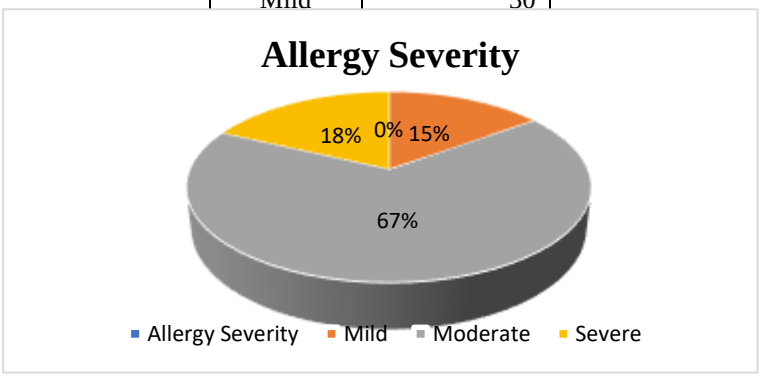


Fig No 4.3 Allergy Severity

4.4 Types of Symptoms

The data reveals varying combinations of symptoms experienced by patients. The most common combination includes nasal itching, runny nose, blocked nose, shortness of breath, and chest tightness, affecting 129 patients. Another group of 41

patients presents a broader range of symptoms, including sneezing and chronic cough. Additionally, 30 patients experience nasal itching, sneezing, and chronic cough. Understanding these patterns helps healthcare professionals tailor treatments effectively to address specific symptom clusters and improve patient care.

Table no 4.4 Types of Symptoms

Type of Symptoms	No of patients
Nasal itching,Sneezing ,Chronic Cough	30
Nasal itching,Runny nose,Blocked nose,Shortness of Breath,chest tightness	129
Nasal itching,Runny nose,Blocked nose, Snezzing ,Chronic Cough,Shortness of Breath,chest tightness	41

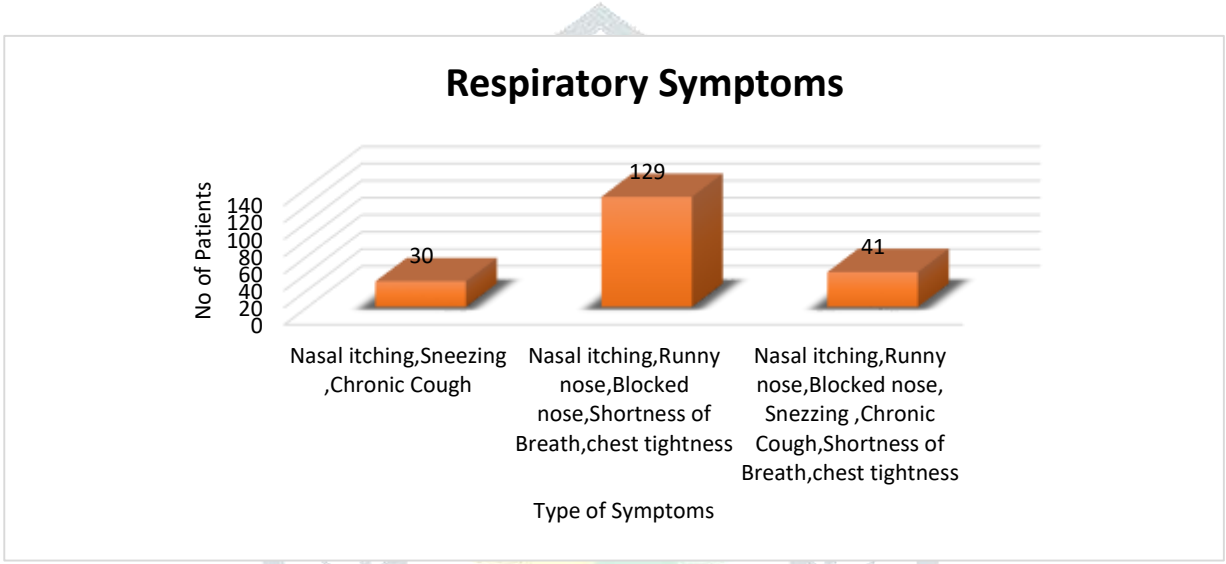


Fig No 4.4 Types of Symptoms

4.5 Nature of Allergens

The data provides insight into the nature of allergens triggering allergic reactions among patients. A notable portion of patients, 115 individuals, experience reactions to both indoor and outdoor allergens, indicating a broad range of sensitivities across environments. Additionally, 45 patients are affected by indoor allergens, while 40 patients react to outdoor allergens exclusively. Understanding these patterns helps healthcare professionals tailor interventions, such as allergen avoidance strategies or immunotherapy, to effectively manage symptoms and improve patient well-being.

Table no. 4.5 Nature of Allergens

Nature of Allergens	No of patients
Indoor	45
Outdoor	40
Both	115

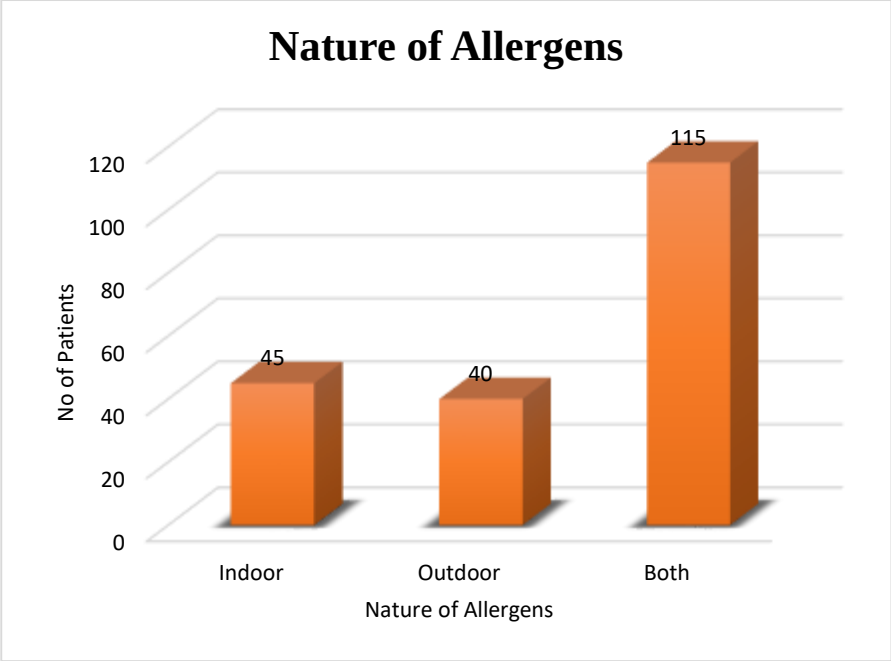


Fig No 4.5 Nature of Allergens

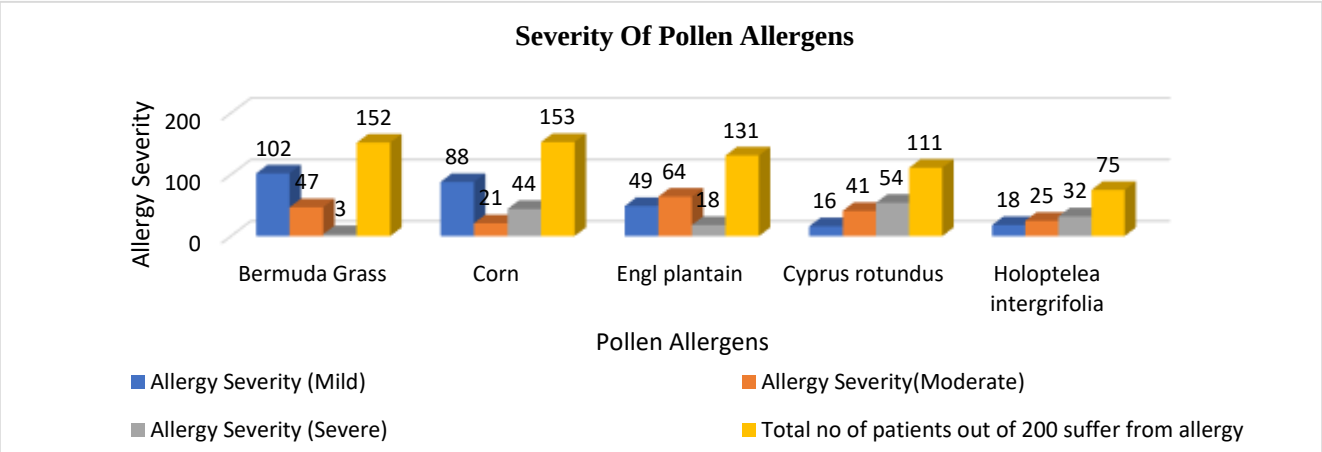
4.6 POLLEN ALLERGENS

The data provides a comprehensive overview of allergy prevalence and severity across various pollen allergens. Among the 200 patients surveyed, Bermuda Grass and Corn allergies appear most prevalent, affecting 152 and 153 patients respectively, while Holoptelea Integrifolia shows the least prevalence with 75 affected patients. Severity varies across allergens, with Corn exhibiting the highest number of severe cases (44 patients) and Bermuda Grass having the lowest (3 patients).

Table no .4.6 Pollen Allergens

Pollen Allergens	Bermuda Grass	Corn	Engl plantain	C. rotundus	H. intergrifolia
Allergy Severity (Mild)	102	88	49	16	18
Allergy Severity(Moderate)	47	21	64	41	25
Allergy Severity (Severe)	3	44	18	54	32
Total no of patients out of 200 suffer from allergy	152	153	131	111	75

Fig No 4.6 Severity of pollen Allergens



4.7 FUNGI ALLERGENS

The data presents allergy severity and prevalence for various fungi allergens among 200 surveyed patients. Penicillium notatum emerges as the most prevalent allergen, affecting 152 patients, followed closely by Aspergillus flavus with 108 affected individuals. Alternaria tenuis shows the lowest prevalence, with 114 patients affected. Severity varies across allergens, with Penicillium notatum and Candida albicans exhibiting the highest number of severe cases (59 and 30 patients respectively), while Yeast shows the lowest severe cases (1 patient).

Table no.4.7 Fungi Allergens

Fungi Allergens	B.Cinerea	P.notatum	A tenuis	F.Moniliforme	Tricodermasp	C.albicans	A. flavus	Yeast
Allergy Severity (Mild)	55	61	26	32	15	23	48	20
Allergy Severity(Moderate)	20	76	46	33	39	59	30	47
Allergy Severity (Severe)	30	15	42	46	25	1	30	22
Total no of patients out of 200 suffer from allergy	105	152	114	111	79	83	108	89

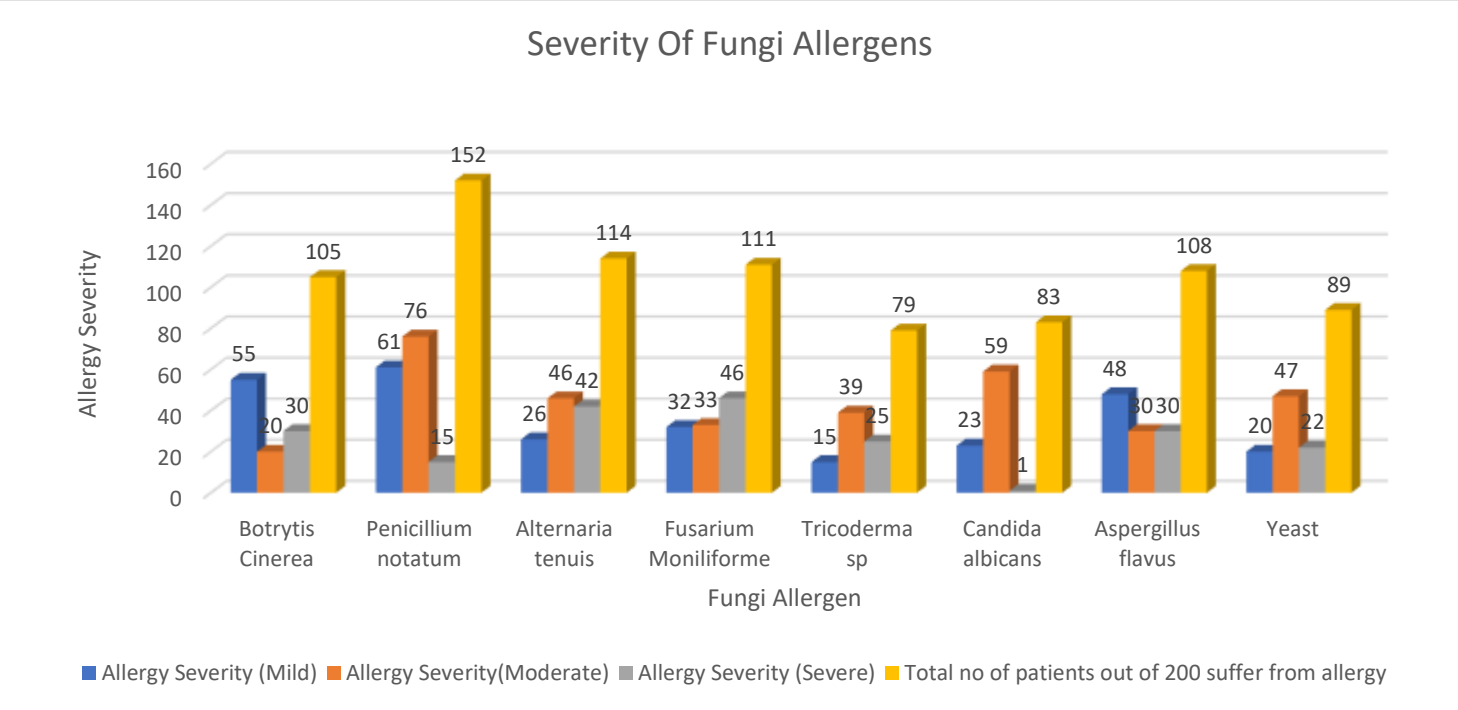


Fig No 4.7 Serverity of Fungi Allergens

4.8 MOLD ALLERGENS

Out of 200 patients: Helminthosporium Halodes caused allergies in 87 patients, with 41 experiencing mild symptoms, 23 moderate, and 23 severe. Rhizopus higricans caused allergies in 101 patients, with 31 mild, 19 moderate, and 51 severe.

Table no. 4.8 Mold Allergens

Mold Allergens	H.Halodes	R. higricans
Allergy Severity (Mild)	41	31
Allergy Severity(Moderate)	23	19
Allergy Severity (Severe)	23	51
Total no of patients out of 200 suffer from allergy	87	101

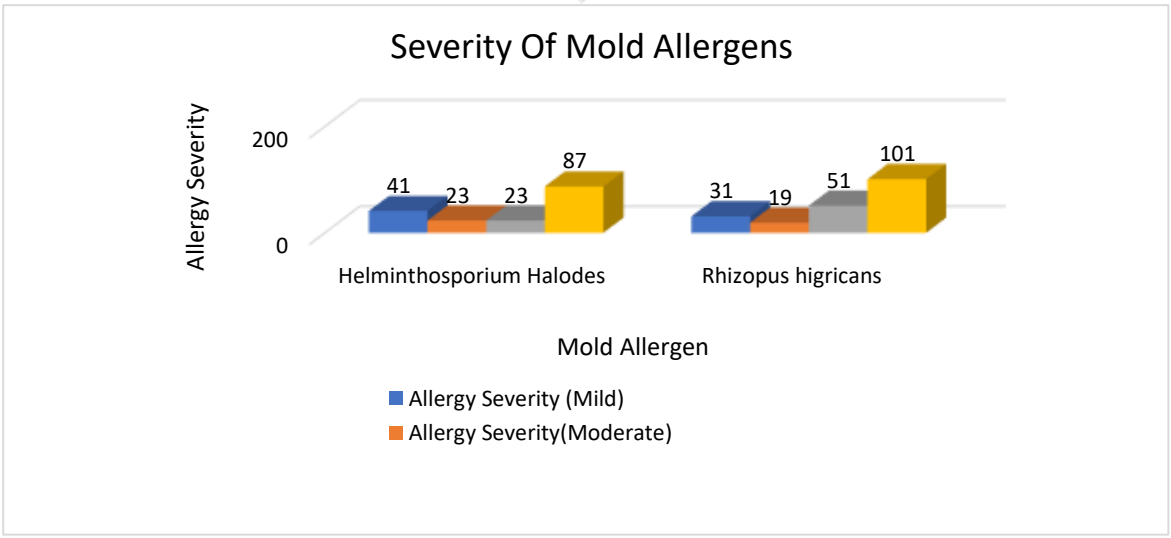


Fig No 4.8 Severity of Mold Allergens

4.9 ANIMAL AND BIRDS ALLERGENS

Among the 200 patients surveyed:

Cat epithelia caused allergies in 102 patients, with 16 experiencing mild symptoms, 16 moderate, and 70 severe.

Tyrophagus putrescentiae, a mite found in stored products, caused allergies in 106 patients, with 21 mild, 74 moderate, and 11 severe cases. Dog epithelia led to allergies in 80 patients, with 24 mild, 44 moderate, and 12 severe cases. Pigeon droppings caused allergies in 123 patients, with 66 mild, 38 moderate, and 19 severe cases. Pigeon feathers led to allergies in 118 patients, with 37 mild, 60 moderate, and 21 severe cases.Blomia sp, a dust mite species, caused allergies in 122 patients, with 42 mild, 36 moderate, and 44 severe cases. Cockroach allergens led to allergies in 104 patients, with 29 mild, 31 moderate, and 44severe cases. This data underscores the varied allergenic impact of different animal and bird allergens,with some causing more severe reactions than others. Pigeon-related allergens, in particular, appear to affect a significant number of patients across all severity levels.

Table no. 4.9 Animal And Birds Allergens

Animal And Birds Allergens	Cat epithelia	T. putrescentiae	Dog epithelia	Pigeon dropping	Pigeon ferther	Blomia sp—	Cockroarth
Allergy Severity (Mild)	16	21	24	66	37	42	29
Allergy Severity(Moderate)	16	74	44	38	60	36	31
Allergy Severity (Severe)	70	11	12	19	21	44	44
Total no of patients out of 200 suffer from allergy	102	106	80	123	118	122	104

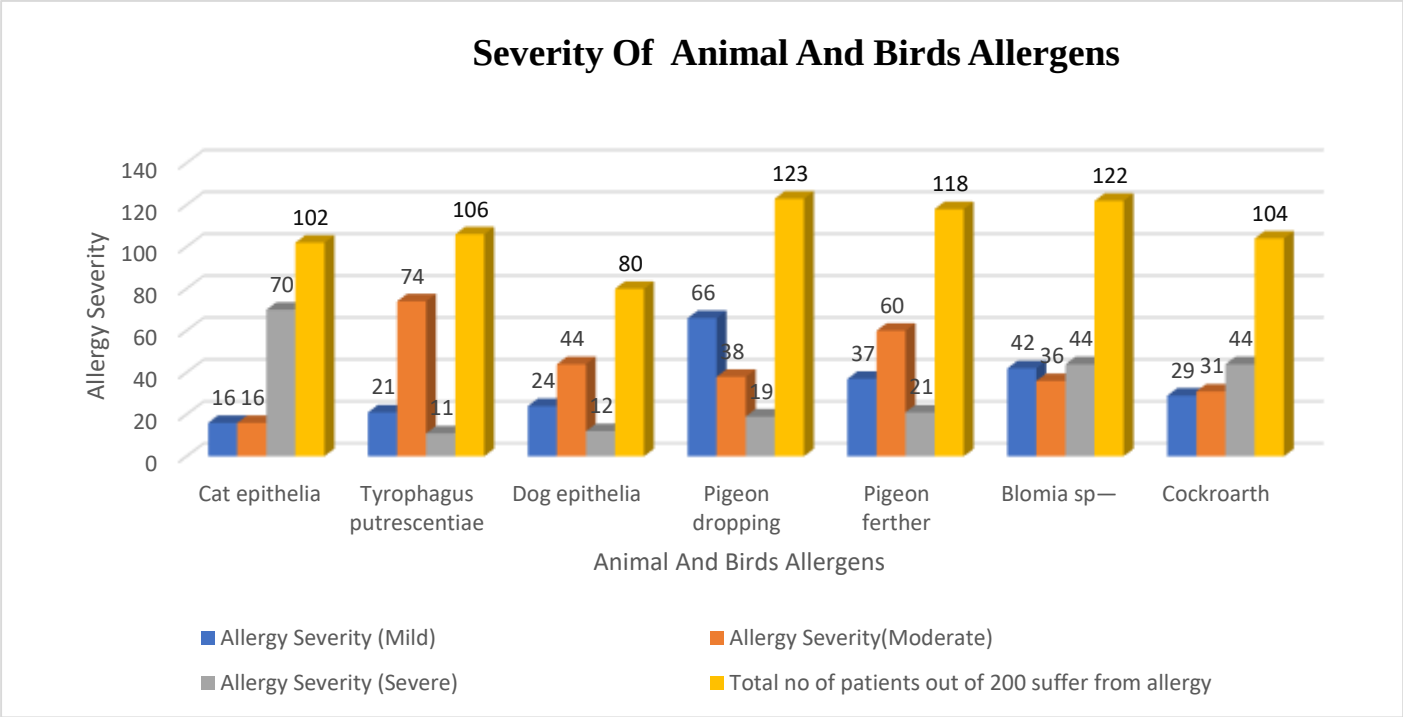


Fig No 4.9 Severity Of Animal And Birds Allergens

4.10 Plant Allergens

The provided data presents a detailed analysis of plant allergens and the severity of associated allergies among a cohort of 200 patients. Among the allergens listed in the first table, Acacia Arabica emerges as the most prevalent allergen, affecting 70 patients, with a distribution of 10 cases of mild severity, 60 cases of moderate severity, and 29 cases of severe severity. Argemone Mexicana follows closely, impacting 59 patients, with 30 cases of mild, 29 cases of moderate, and 43 cases of severe allergies. Eucalyptus spp affects 48 patients, showing a considerable range in severity with 36 cases of mild, 12 cases of moderate, and 38 cases of severe allergies. Interestingly, while Magnifera indica affects a similar number of patients as Eucalyptus spp (51 patients), its severity distribution leans more towards the mild and moderate end, with 34 cases of mild, 17 cases of moderate, and 18 cases of severe allergies. In the second table, Chenopodium albim stands out as the most prevalent allergen, impacting 102 patients, with a distribution of 84 cases of mild, 18 cases of moderate, and 13 cases of severe allergies. These findings provide a nuanced understanding of the prevalence and severity of plant allergens in the surveyed population, emphasizing the need for tailored management strategies to address the diverse spectrum of allergic responses.

Table no. 4.10Plant Allergens

Plant Allergens	P. roxburghii	Eucalyptus spp	Acacia Arabica	A. Mexicana	P. Juliflora	M. indica	A. indica
Allergy Severity (Mild)	18	36	10	30	31	34	28
Allergy Severity(Moderate)	41	12	60	29	12	17	21
Allergy Severity (Severe)	30	38	29	43	16	18	13
Total no of patients out of 200 suffer from allergy	59	48	70	59	43	51	49

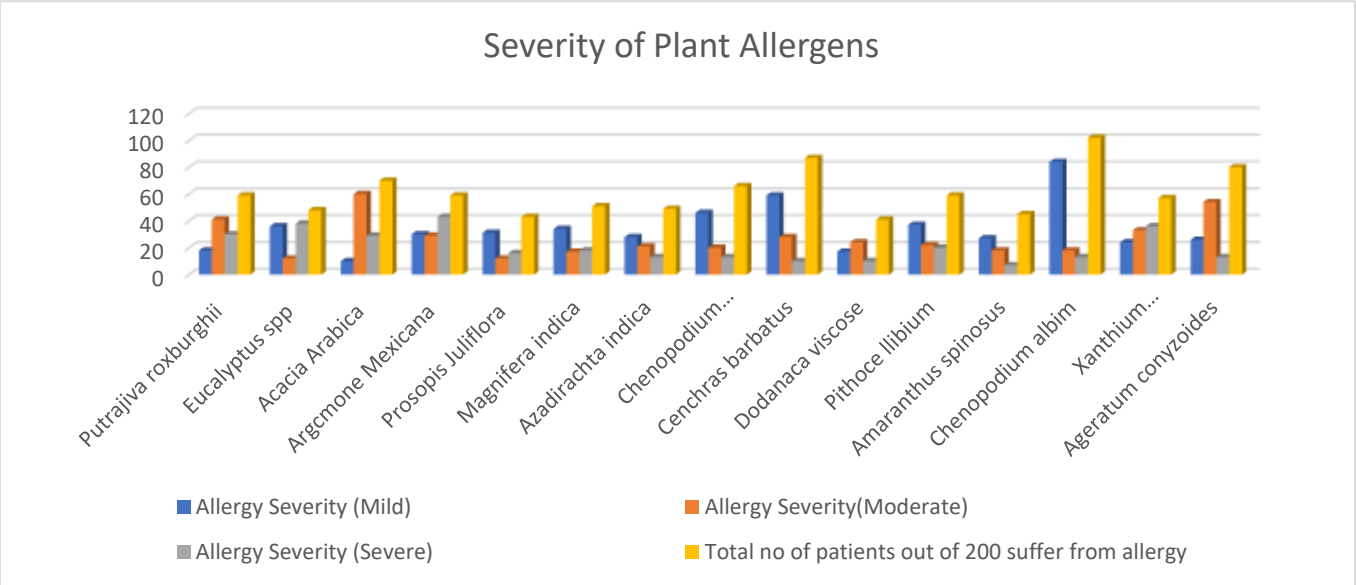


Fig No 4.10 Severity of Plant Allergens

5. DISCUSSION

Asthma is defined as an obstructive disease of the pulmonary airways resulting from spasm of airway muscle, increased mucus secretion, and inflammation**.** Childhood asthma is a chronic respiratory condition characterized by inflammation and hyperresponsiveness of the airways, resulting in symptoms such as wheezing, coughing, shortness of breath, and chest tightness. This debilitating condition has seen a significant rise in prevalence over the past few decades, with a concerning increase in morbidity and mortality rates, particularly in urban areas and minority populations. Despite its prevalence, childhood asthma remains underdiagnosed and undertreated, posing a substantial burden on affected individuals and healthcare systems alike.The pathophysiology of childhood asthma is complex and heterogeneous, involving various host-environment interactions occurring at different scales. Allergic sensitization is a common pathway, with exposure to allergens leading to the production of immunoglobulin E (IgE) antibodies and subsequent airway inflammation. Type I hypersensitivity reactions further exacerbate the inflammatory response, resulting in bronchoconstriction and airflow obstruction. Airway hyperresponsiveness, a hallmark of asthma, makes the airways more reactive to various stimuli, leading to asthma symptoms.Respiratory allergies, particularly allergen exposure, play a significant role in triggering and exacerbating childhood asthma. Common allergens like dust mites, pet dander, pollen, mold spores, and cockroach droppings can induce immune-mediated responses and airway inflammation in susceptible individuals. Understanding the correlation between allergy and asthma is crucial for effective management, which often involves allergen avoidance measures, pharmacotherapy, and allergen immunotherapy.The causes of childhood asthma are multifactorial, involving intricate interactions between genetic predisposition and environmental factors. Common triggers include allergens like dust mites, pet dander, pollen, mold spores, respiratory infections, air pollutants, and certain lifestyle factors. Genetic predisposition plays a significant role, with children having a family history of asthma or allergic conditions being at a higher risk. Environmental exposures, such as exposure to tobacco smoke during pregnancy or early childhood, also contribute to asthma development in children.From literature survey it was observed that the exposure to various allergens responsible for onset of respiratory allergy which can further progress into asthma if remained undignosied. The proper allergy diagnosis and management is necessary to prevent development of asthma in children.The retrospective study conducted on 250 patients atSai Allergy and Asthma Clinic, Pune. The patients allergy questionnaire were studied to find out respiratory allergy symptoms, asthma symptoms. The patients allergen exposure were examined by using allergy history. The variety of allergens were included in the study like certain pollen, dust mites, mold and fungi etc. The allergy severity were assessed using SPT result.The study involved various allergens like pollen, mold and fungi, Animal and Birds Allergens and Plant Allergens. Total 200 patients were included in study. (Male:120, Female:80). From study it was observed that……more prone to develop allergy. The asthma symptoms include Nasal itching, Runny nose, Blocked nose, Sneezing, Chronic Cough, Shortness of Breath, chest tightness. Most of the study participants showed almost all of the asthma symptoms along with allergy exposure, which can be responsible for severe respiratory allergy.Most of study participating showed respiratory allergy symptoms along with asthma confirmation. Allergy severity were examined by using SPT result. Almost of all the participants were allergic to different allergens.In case of pollen allergens most of the patients were suffering from cyprus roundas pollen allergy. Almost all of the patients showed severe to moderate allergy to all of the pollen allergens.In fungi allergens study most of the patients were suffering from Fusarium Moniliform, followed by the Alternaria tenuis. Some of other shows mild and moderate allergy to fungi allergens.The two primary allergens associated with mold are Rhizopus higricans and Helminthosporium Halode, which cause mild to severe allergies, respectively.And in animal and birds allergens in this study we got know about cat epithelia allergen got more severe allergy and others have mild to moderate allergens. In case of plants allergens most of patients suffering from Eucalyptus spp plant allergy. Almost all of patients showed mild to severe allergy to of the plant allergy.

6. Conclusion

The study aimed to investigate the correlation between exposure to allergens and the onset of asthma in paediatric patients.Various allergens were tested in these patients, who exhibited mild to moderate severity of allergic reactions.The findings from this study indicate that early exposure to allergens can lead to significant health issues, including the development of asthma.This emphasizes the importance of early and accurate allergy diagnosis.By identifying and managing allergies at a young age, respiratory conditions in children can be significantly improved, potentially preventing the progression to more serious complications such as asthma.Early intervention and tailored treatment plans based on specific allergen sensitivities are crucial for enhancing the overall respiratory health and quality of life in paediatric patients.

7. Refferences

1. Environment Health Prospect 107(supply 31:421429 (1999). http.//ehpnetl.niehs.nih.gov/docs/1999/suppl-3/421-429clark/abstract.html
2. Serebrisky D, Wiznia A. Paediatric asthma: a global epidemic. Ann Glob Health. 2019;85(1):1–6. doi:10.5334/aogh.2411 2. Masoli M, Fabian D, Holt S, Beasley R. The global burden of asthma: executive summary of the GINA Dissemination Committee Report. Allergy. 2004;59(5):469–478. doi:10.1111/j.13989995.2004.00526.x 3. von Hertzen LHT, Haahtela T. Disconnection of man and the 334–344. doi:10.1016/j.jaci.2005.11.013
3. Anderson GP. Endotyping asthma: New insights into key pathogenic mechanisms in a complex, heterogeneous disease. Lancet. 2008;372(9643):1107-19.
4. Bateman ED et al. Global strategy for asthma management and prevention: GINA executive summary. Eur Respir J. 2008;31(1):143-78.
5. Asher I, Pearce N. Global burden of asthma among children. Int J Tuberc Lung Dis. 2014;18(11):1269-78
6. Trivedi M, Denton E. Asthma in Children and Adults-What Are the Differences and What Can They Tell us About Asthma? Front Pediatr. 2019;7:256.
7. Mazi A, Madani F, Alsulami E, Almutari A, Alamri R, Jahhaf J, et al. Uncontrolled Asthma Among Children and Its Association With Parents' Asthma Knowledge and Other Socioeconomic and Environmental Factors. Cureus. 2023;15(2):e35240.
8. Corlateanu A, Stratan I, Covantev S, Botnaru V, Corlateanu O, Siafakas N. Asthma and stroke: a narrative review. Asthma Res Pract. 2021;7(1):3.
9. Dharmage SC, Perret JL, Custovic A. Epidemiology of Asthma in Children and Adults. Front Pediatr. 2019;7:246.
10. Gupta A, Bhat G, Pianosi P. What is New in the Management of Childhood Asthma? Indian J Pediatr. 2018;85(9):773-81.
11. Martin J, Townshend J, Brodlie M. Diagnosis and management of asthma in children. BMJ Paediatr Open. 2022;6(1).
12. Darveaux J, Busse WW. Biologics in asthma--the next step toward personalized treatment. J Allergy Clin Immunol Pract. 2015;3(2):152-60.
13. McCracken JL, Tripple JW, Calhoun WJ. Biologic therapy in the management of asthma. Curr Opin Allergy Clin Immunol. 2016;16(4):375-82.
14. Louisias M, Ramadan A, Naja AS, Phipatanakul W. The Effects of the Environment on Asthma Disease Activity. Immunol Allergy Clin North Am. 2019;39(2):163-75.
15. Tiotiu AI, Novakova P, Nedeva D, Chong-Neto HJ, Novakova S, Steiropoulos P, et al. Impact of Air Pollution on Asthma Outcomes.
16. Int J Environ Res Public Health. 2020;17(17)12. Rehman N, Morais-Almeida M, Wu AC. Asthma Across Childhood: Improving Adherence to Asthma Management from Early Childhood to Adolescence. J Allergy Clin Immunol Pract. 2020;8(6):1802-7. Magarey, R. D., Botrytis cinerea: causal agent of grey mould disease. Fungicides Resistance Action Committee (FRAC), 2004
17. Fleming, A. (1929). On the antibacterial action of cultures of a penicillium, with special reference to their use in the isolation of B. influenzae. British Journal of Experimental Pathology, 10(3), 226-236.
18. Simmons, E. G. (2007). Alternaria: An Identification Manual. CBS Fungal Biodiversity Centre.
19. Desjardins, A. E. (2006). Fusarium Mycotoxins: Chemistry, Genetics, and Biology. American Phytopathological Society (APS Press).

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20. Harman, G. E., Howell, C. R., Viterbo, A., Chet, I., & Lorito, M. (2004). Trichoderma species—opportunistic, avirulent plant symbionts. Nature Reviews Microbiology, 2(1), 43-56.
21. Mayer, F. L., Wilson, D., & Hube, B. (2013). Candida albicans pathogenicity mechanisms. Virulence, 4(2), 119-128.
22. Bennett, J. W., & Klich, M. (2003). Mycotoxins. Clinical Microbiology Reviews, 16(3), 497-516.
23. Abd-Elsalam, K.A., 2010. Rhizopus nigricans. In Reference Module in Food Science (pp. 1-3). Elsevier
24. Gelain, M.E., Marques, M.C., Cárnio, E.C. et al. Morphological study of the cat tongue epithelium. Anat Sci Int 84, 180–185 (2009).
25. Arlian, L. G., Morgan, M. S., & Neal, J. S. (2002). Dust-Mite Allergens and Asthma: A Worldwide Problem. Journal of Allergy and Clinical Immunology, 110(1), S21-S28.
26. Goffeau, A., Barrell, B. G., Bussey, H., Davis, R. W., Dujon, B., Feldmann, H., ... & Urrestarazu, L. A. (1996). Life with 6000 genes. Science, 274(5287), 546-567.

27. Duveiller, E., Brar, D. S., & Singh, R. P. (2007). Resistance in Barley to Spot Blotch Caused by Cochliobolus sativus. Journal of Phytopathology, 155(10), 563-571
28. Singh, A., & Kumar, S. (2017). Putranjiva roxburghii: an overview. Journal of Medicinal Plants Studies, 5(6), 135-139.
29. Brooker, M. I. H., & Kleinig, D. A. (2006). Field Guide to Eucalypts: Volume 1: South-eastern Australia. Bloomsbury Publishing.
30. Gupta, V.K., Shukla, R., Kaul, V.K. et al. Pharmacological potential of Acacia arabica. Pharm Biol 50, 425–437 (2012).
31. Vashist, H., Gupta, N., Mishra, S.K. et al. Chemical constituents, traditional and medicinal uses of Argemone mexicana Linn. Pharmacogn Rev 4, 180–187 (2010).
32. Pasiecznik, N.M., Felker, P., Harris, P.J.C. et al. The Prosopis juliflora – Prosopis pallida complex: a monograph. HDRA, Coventry, UK (2001).
33. Mukherjee, S.K. & Litz, R.E. (2009). Introduction: Botany and Importance. In: The Mango: Botany, Production and Uses. Ed. by Litz, R.E. CAB International, Wallingford, UK. pp. 1-18.

34. Biswas, K., Chattopadhyay, I., Banerjee, R. K., & Bandyopadhyay, U. (2002). Biological activities and medicinal properties of neem (Azadirachta indica). Current science, 82(11), 1336-1345.

35. Khan, I. A., et al. "Chenopodium murale Linn. A review of ethnobotanical and pharmacological aspects." Pharmacognosy reviews 3.5 (2009): 392.
36. Dogan, Y., & Demirci, M. (2017). An invasive alien species: Cenchrus setaceus (Forssk.) Morrone, comb. & Hieron. (Poaceae). Journal of Biological and Environmental Sciences, 11(31), 247-258.

37. There may not be specific references available for Dodonaea viscosa pollen allergies, as research on this topic may be limited. However, consulting general literature on pollen allergies and cross-reactivity with related plant species in the Sapindaceae family could provide valuable insights.

38. Flora of North America Editorial Committee. (1993+). Flora of North America North of Mexico. Retrieved from http://www.efloras.org/flora_page.aspx?flora_id=1

39. Gupta, M. M., Verma, R. K., & Singh, A. K. (2012). Amaranthus spinosus: a review on traditional uses, phytochemistry, and pharmacological properties. Pharmacognosy reviews, 6(11), 56–60.
40. Pereira, F. O., Silva, F. C., & Lima, T. A. (2018). Chemical constituents and biological activities of Chenopodium album L. Natural Product Research, 32(24), 2915–2923.
41. Oliveira, M. V., Almeida, E. R., Ramos, E. M., & Ramos, A. C. (2019). Xanthium strumarium L. (Asteraceae): ethnomedical uses, phytochemistry, and bioactivity. Phytochemistry Reviews, 18(4), 1023–1041. https://doi.org/10.1007/s11101-019-09632-x
42. da Silva, J. K. R., Câmara, C. A. G., & da Silva, E. M. S. (2018). Ageratum conyzoides L.: A Review on Its Phytochemical and Pharmacological Profiles. Medicines, 5(4), 121. https://doi.org/10.3390/medicines5040121

43. Burks, A. W., Tang, M., Sicherer, S., Muraro, A., Eigenmann, P. A., Ebisawa, M., ... & Sampson, H. A. (2012). ICON: food allergy. Journal of Allergy and Clinical Immunology, 129(4), 906-920.
44. Busse, W. W., & Lemanske Jr, R. F. (2001). Asthma. New England Journal of Medicine, 344(5), 350-362.
45. Peters, M. C., Mekonnen, Z. K., Yuan, S., Bhakta, N. R., Woodruff, P. G., & Fahy, J. V. (2014). Measures of gene expression in sputum cells can identify TH2-high and TH2-low subtypes of asthma. Journal of Allergy and Clinical Immunology, 133(2), 388-394.
46. Liu, A. H., Zeiger, R., Sorkness, C., Mahr, T., Ostrom, N., Burgess, S., ... & Manjunath, R. (2019). Development and cross-sectional validation of the Childhood Asthma Control Test. Journal of Allergy and Clinical Immunology, 133(6), 870-877.

47. D'Amato, G., Vitale, C., Lanza, M., Molino, A., D'Amato, M., & Cecchi, L. (2015). Climate change, air pollution, and allergic respiratory diseases: an update. Current opinion in allergy and clinical immunology, 15(5), 443-448.