ASSOCIATION OF POLYSENSITISATION WITH SEVERITY AMONG ADULTS WITH ALLERGIC RHINITIS

A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE RULE AND REGULATIONS FOR MS BRANCH – IV (OTORHINOLARYNGOLOGY) EXAMINATION OF THE TAMIL NADU DR. MGR MEDICAL UNIVERSITY,

TO BE HELD IN MAY 2022

DEPARTMENT OF OTORHINOLARYNGOLOGY

CHRISTIAN MEDICAL COLLEGE VELLORE

CERTIFICATE

This is to certify that the dissertation 'ASSOCIATION OF POLYSENSITISATION WITH SEVERITY AMONG ADULTS WITH ALLERGIC RHINITIS' is a bonafide original work of Dr. Shilpa Susan Mathew, submitted in partial fulfillment of the rules and regulations for the MS Branch IV, Otorhinolaryngology examination of The Tamil Nadu Dr. M.G.R Medical University to be held in May 2022.

Dr. Rupa Vedantam MS, DLO

Professor of ENT

Department of ENT unit 3

Christian Medical College Hospital

Vellore - 632004

DEPARTMENT OF OTORHINOLARYNGOLOGY

CHRISTIAN MEDICAL COLLEGE VELLORE

CERTIFICATE

This is to certify that the dissertation 'ASSOCIATION OF POLYSENSITISATION WITH SEVERITY AMONG ADULTS WITH ALLERGIC RHINITIS' is a bonafide original work of Dr. Shilpa Susan Mathew, submitted in partial fulfillment of the rules and regulations for the MS Branch IV, Otorhinolaryngology examination of The Tamil Nadu Dr. M.G.R Medical University to be held in May 2022.

Dr. Anna B. Pulimood

Principal

Christian Medical College

Vellore - 632002

Dr. Ajoy Mathew Varghese

Professor & Head

Department of ENT

Christian Medical College

Vellore - 632004

DEPARTMENT OF OTORHINOLARYNGOLOGY

CHRISTIAN MEDICAL COLLEGE VELLORE

DECLARATION

I, Shilpa Susan Mathew, do hereby declare that the dissertation titled "ASSOCIATION OF POLYSENSITISATION WITH SEVERITY AMONG ADULTS WITH ALLERGIC RHINITIS" submitted towards partial fulfilment of the requirements of the Tamil Nadu Dr. M.G.R. Medical University for the MS Branch IV, Otorhinolaryngology examination to be conducted in May 2022, is the bona fide work done by me, and due acknowledgements have been made in text to all materials.

Shilpa Susan Mathew

PG Registrar,

Registration Number 221914358

MS ENT

Deparment of Otorhinolaryngology

Christian Medical College,

Vellore - 632004

CERTIFICATE – II

This is to certify that this dissertation work titled "ASSOCIATION OF POLYSENSITISATION WITH SEVERITY AMONG ADULTS WITH ALLERGIC RHINITIS" of the candidate Dr. Shilpa Susan Mathew with Registration Number 221914358 for the award of MS degree in the branch of MS Branch IV, Otorhinolaryngology. I personally verified the urkund.com website for the purpose of Plagiarism Check. I found that the uploaded thesis file contains from introduction to conclusion pages and result shows 1% percentage of plagiarism in the dissertation.

Guide & Supervisor sign with Seal.

ACKNOWLEDGEMENTS

I would like to express my deepest and sincere gratitude to my teacher and guide Dr.Rupa Vedantam for her invaluable mentorship, hours of patient instruction and meticulous guidance in doing this study. She has been a helping hand in every step of the completion of this thesis.

I am also indebted to the biostatistician, Mr. Bijesh, for his help with the data analysis.

I would also like to express my sincere thanks to all the patients who were part of this study. And finally, thanks to all my colleagues and friends for their support and help in doing the study.

I would like to thank God for his unparalleled grace and guidance. I thank my family whose support was invaluable in the completion of this dissertation.

Shilpa Susan Mathew

CONTENTS

ABSTRACT

ASSOCIATION OF POLYSENSITISATION WITH SEVERITY AMONG ADULTS WITH ALLERGIC RHINITIS

BACKGROUND:

Allergic rhinitis is a common otorhinolaryngological condition and is characterized by at least one or more of the following clinical symptoms based on the 'ARIA' (Allergic Rhinitis and its Impact on Asthma) classification: watery nasal discharge, sneezing, intermittent nasal obstruction, epiphora and itching. The 'ARIA' classification subdivides allergic rhinitis into 'intermittent' and 'persistent' and on the basis of severity of illness and its impact on daily activities into 'mild' and 'moderate/severe'.

Currently, the percutaneous skin prick test or skin allergy test is considered the gold standard for the diagnosis of allergic rhinitis. Skin allergy test determines if a patient's symptoms are caused by immediate hypersensitivity to allergens. Each allergen tested induces specific IgE that binds to mast cells. Mast cells on degranulation cause the localized skin response in a positive skin test. Polysensitivity indicates a positive response to 3 or more allergens tested.

OBJECTIVE:

The aim of this retrospective study is to determine if there is any correlation between the severity of allergic rhinitis (as determined by standard ARIA criteria) and polysensitisation (as determined by the result of skin allergy testing) among adult patients diagnosed with allergic rhinitis who were evaluated at our Rhinology clinic.

MATERIALS AND METHODS:

Hospital records of all patients of age 18 and older, with a clinical diagnosis of allergic rhinitis were included in the study sample. Grading of severity of allergic rhinitis was done in accordance with the ARIA criteria. Other information regarding demography, exacerbating factors for allergic rhinitis, food allergy, family history of allergy and history of specific allergies was also be collected. The reactivity to each allergen that was part of the 'common allergen panel' and additional allergens tested as per patient requests will be tabulated in an excel spreadsheet. A diameter of more 3mm or more was considered a 'positive' response for each allergen tested. The data collected was used to correlate the number of patients that are polysensitive (i.e those that test positive for 2 or more allergens) and the severity of their illness.

RESULTS:

A total of 320 patients were recruited to the study. The majority (223 patients,69.6%) of those with allergic rhinitis were less than 35 years of age. There were 200 (62.5%) males and 120 (37.5%) females. A total of 190 of the 320 patients (59.4%) resided in an urban locality while 130 (40.6%) resided in a rural area. A little over ¾ of patients (76.8%; 246 patients) complained of nasal block, 83.4% of rhinorrhoea and 274(85.6%) of sneezing. A positive family history was reported by only 25.3% of patients with allergic rhinitis. The maximum triggers for allergy occurred indoors at home or at work in 65.7%. The vast majority (89%) of patients were symptomatic at the beginning of the day. All patients reported seasonal exacerbation of allergic symptoms with varying intensities, with maximum (39.4%) in winter/rainy season. Household chemicals as their trigger for allergic rhinitis in 49%. The most common inhaled allergens for which patients tested positive were dust mites,

D.pteronyssinus and D.farinae. House dust (29.4%) and cockroach (23.8%) were the next most common allergens, indicating a greater preponderance of indoor allergen triggers. The commonest food allergen was lemon (35.3%). Bronchial asthma and allergic dermatitis were seen in 46 (14.4%) and 49 (15.3%) of the 320 patients respectively. A combination of both bronchial asthma and dermatitis was seen in 7 individuals.

A total of 182 patients (56.9%) had intermittent symptoms and 138 (43.1%) of them had persistent symptoms. Mild disease was reported in 152 patients (47.5%) while168 patients; 52.5%) had moderate-severe disease. In this cohort, more patients (188 patients, 58.8%) were polysensitive than monosensitive (132 patients, 41.2%). A comparison of patients with monosensitisation with those with polysensitisation in terms of 6 clinical parameters revealed that the presence of nasal block, seasonal exacerbation and greater severity of disease was more frequently observed in polysensitive individuals on univariate analysis. Multivariate analysis of risk factors, however, showed that only nasal block (p=0.04) and moderate-severe allergic rhinitis (p=0.000) were associated with polysensitisation. Thus, a patient with nasal block was 1.8 times more likely to be polysensitive than monosensitive. Similarly, a patient with moderate/severe allergic rhinitis was 3.7 times more likely to be polysensitive than monosensitive.

CONCLUSIONS

Allergic rhinitis is a common problem in India affecting young adults and is chiefly associated with indoor allergens. Polysensitisation is associated with increased severity of the disease. These findings have important implications in clinical practice.

Keywords: allergic rhinitis, sensitization, ARIA, skin allergy test, polysensitivity

INTRODUCTION

Allergic rhinitis is an Immunoglobulin E (IgE)-mediated inflammation of the nasal mucosa following exposure to an allergen. It is a common otorhinolaryngological condition and is characterized by at least one or more of the following clinical symptoms such as watery nasal discharge, sneezing, intermittent nasal obstruction, epiphora and itching. The prevalence of the disease in India is reportedly 11% among adults and despite the gradually increasing incidence over the last few years, data regarding health seeking behaviour in allergic rhinitis patients is limited. Allergic rhinitis is a growing challenge because of the economic burden, impact on quality of life and presence of other comorbid conditions like allergic dermatitis and bronchial asthma.

Clinical assessment of allergic rhinitis is required to categorise the disease into mild or severe and intermittent or persistent types. The diagnosis of allergic rhinitis is based on both clinical features as well as a positive skin allergy test. Skin allergy test is considered the gold standard for the diagnosis of allergic rhinitis. This test enables the clinician to determine the exact allergens that the patient is hypersensitive to. When a standard set of allergens are administered, some patients are sensitive to a number of allergens and this condition is referred to as polysensitivity. Other patients who are administered the same set of allergens are occasionally found to be sensitive to only a single allergen. This is refrred to as monosensitivity.The relationship between mono/polysensitivity and the severity of allergic rhinitis has not been extensively studied. While it may appear reasonable to assume that patients with monosensitivity or paucisensitivity have less severe disease, in practice a wide variation in clinical presentation is seen. The present research is aimed at determining the

distribution of sensitivity to common allergens among Indian patients with different types of allergic rhinitis. We also aim to study the association between polysensitivity and severity of allergic rhinitis in the same cohort.

REVIEW OF LITERATURE

Allergic rhinitis is an immunoglobulin E (IgE)-mediated inflammation of the nasal mucosa following exposure to an allergen(1). Symptoms typically commence with exposure to nasal allergens such as pollens, molds, animal dander, and dust mites(2).This common otorhinolaryngological condition is characterized by at least one or more of the following clinical symptoms based on the 'ARIA' (Allergic Rhinitis and its Impact on Asthma) classification: watery nasal discharge, sneezing, intermittent nasal obstruction, epiphora and itching(3). Severity of these symptoms and presence of subsequent comorbid illnesses associated with allergic rhinitis like allergic dermatitis and bronchial asthma can vary from individual to individual.

DEVELOPMENT OF THE ARIA GUIDELINES

History

Prior to 1999, allergic rhinitis was classified as being either perennial, seasonal or occupational. However, the overlap between the two categories made use of this classification difficult, particularly in patients with perennial allergic rhinitis which was also seasonal. Several deliberations on the problems of the existing classification ensued and the World Health Organisation (WHO) conducted a workshop on "Allergic Rhinitis and its Impact on Asthma" (ARIA) by experts at Geneva in 1999. Guidelines formulated at this convention regarding classification, diagnosis and treatment were published in 2001 and these were known as the ARIA guidelines which are now accepted worldwide. Updates were made and subsequently published in the following years in 4 phases(4).

PRESENT ARIA CLASSIFICATION (Table 1)

A new classification of allergic rhinitis on the basis of duration and severity of symptoms was described in the ARIA (Allergic Rhinitis and Its Impact on Asthma) update in 2001. Bousquet et al subdivided allergic rhinitis into ‘intermittent’ and ‘persistent’ along with a grading of its severity and impact on quality of life into mild and moderate/severe(5). According to this classification,

1. “Intermittent” means that the symptoms are present: • Less than 4 days a week, • Or for less than 4 weeks.
2. “Persistent” means that the symptoms are present: • More than 4 days a week, • And for more than 4 weeks.
3. “Mild” means that none of the following items are present: • Sleep disturbance, • Impairment of daily activities, leisure and/or sport, • Impairment of school or work, • Troublesome symptoms.
4. “Moderate-severe” means that one or more of the following items are present: • Sleep disturbance, • Impairment of daily activities, leisure and/or sport, • Impairment of school or work, • Troublesome symptoms.

Table 1

Classification based on severity also made it easier to propose a stepwise approach to management of allergic rhinitis. The earlier subdivisions of allergic rhinitis were based on time of exposure to allergen and cause of allergy, viz., seasonal, perennial and occupational. Outdoor allergens such as pollen or mold trigger the seasonal variant of allergic rhinitis whereas indoor allergens are associated with perennial allergic rhinitis. Several studies reported that this classification was redundant and that its use was not practical in all circumstances as 80% of the cases of allergic rhinitis reportedly were of mixed type and hence the 'seasonal' and 'perennial' definitions were ineffective(6). The International Consensus statement on Allergy and Rhinology: Allergic Rhinitis (ICAR:AR) is an evidence- based document produced by an international team of experts in 2018 to update rhinologists on the currents concepts regarding classification, diagnosis, evaluation and treatment of allergic rhinitis(7).

UPDATES IN GUIDELINES

Phase 1: In the 2008 data, attention was given to the association between rhinitis and asthma, its prevention and treatment (1).

Phase 2: In 2010 using the Grading of Recommendation, Assessment, Development and Evaluation (GRADE) approach, an advanced evidence-based evaluation and recommendation methodology for guidelines, this was revised. Recommendations were described for prevention and specific management of allergic diseases along with their sociated risks and benefits. Clinicians were encouraged to use these guidelines in routine practice(8).

Phase 3: The focus was on emerging technologies that could be used by individuals in the management of allergic rhinitis and asthma(9).

Phase 4: This phase in 2019 intended to increase self-medication and decision making in rhinitis and asthma multimorbidity, along with a attempt at decreasing global inequalities in health care(10).

PREVALENCE OF ALLERGIC RHINITIS

Allergic rhinitis, despite being a globally prevalent disease, remains under -treated and under reported even when its manifestations are severe and persistent(11). Allergic rhinitis is reported to have a global prevalence of 10% to 40% and these figures continue to ascend with urbanization, changes in lifestyle and exposure to environmental pollutants(12).

The prevalence of the disease in India is reportedly 11% among adults(4). Very few studies have evaluated the prevalence of allergic rhinitis among both Indian adults and children. Inadequate data and poor documentation on allergic rhinitis from around the world led to generation of the 'International Study of Asthma and Allergies in Children'(ISAAC), that studied extensively global prevalence of asthma, rhino-conjunctivitis, and allergic eczema in children(13). Aims of the study also included assessment of the upcoming trends in prevalence, disease severity and factors affecting these allergic diseases(14). This analysis took place in 3 distinct phases. The ISAAC study stated that, in terms of the prevalence of rhino-conjunctivitis, India ranked 75th among 97 countries in the 13-14 year age group and 53rd among 61 countries in the 6-7 year age groups, respectively(15). Systematic international comparison of the prevalence of asthma and other allergic disorders has helped to understand the worldwide prevalence figures better. One of the most conclusive studies done in India to assess prevalence and associated features of allergic rhinitis is 'ISAAC phase 3'. The symptoms of allergic rhinitis and its associated features were evaluated using a

validated ISAAC questionnaire. Analysis and comparison of several centers across India was possible. It showed marked differences probably owing to regional variations in climate, flora, soil, air pollution levels, lifestyle, diet and genetic variability(16).

PATHOPHYSIOLOGY OF ALLERGIC RHINITIS (Fig.1)

Allergic rhinitis is an IgE mediated type1 hypersensitivity reaction to small amounts of aeroallergens and comprises of initial sensitization followed by early and late phase responses. The manifestations include characteristic symptoms such as sneezing, rhinorrhoea, itching and nasal congestion. The cellular responses ,that occur as part of the late phase, trigger systemic inflammation and are noted to cause the comorbid conditions associated with allergic rhinitis(5,17).

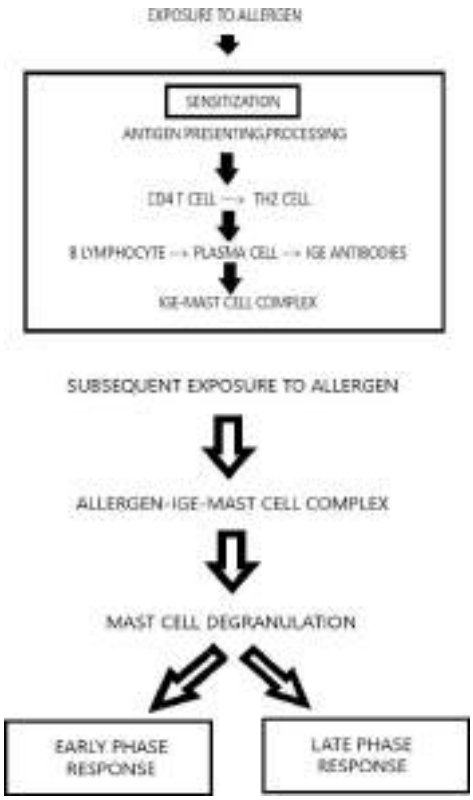


Fig.1 BASIC PATHOPHYSIOLOGY OF ALLERGIC RHINITIS

Sensitization (Fig.2)

When allergens are exposed to nasal mucosa, antigen presenting cells such as dendritic cells receive, internalize and process the allergen. Simultaneously, the mucosal epithelial cells secrete a number of inflammatory mediators like chemokines, cytokines, eicosanoids, endopeptidases, matrix metalloproteinases and thymic stromal lymphopoietin which enhance the process of sensitization. The dendritic cells then migrate to the lymphoid organ and then present these antigen peptides on the major histocompatibility complex(MHC) class II molecule on the cell surface of naïve T cells. The MHC class II and antigen complex behave as T-cell receptors on naive CD4+ cells and enable these cells to differentiate to allergen specific Th2 cells (Fig.1). CD28, CD80 and CD86 also provide the stimulus for conversion of naïve T cells to TH2 cells. This conversion leads to the release of IL4, IL 5 and IL 13. These cytokines stimulate B lmphocytes to transform into plasma cells which produce IgE antibody.

Subsequently, IgE stays bound to the FcER1 sites on the surface of mast cells and basophils, leaving its allergen specific receptor site (Fab)available for future interaction with allergen. Other cells which have receptors for allergen specific IgE include Langerhans cells and activated monocytes. This process is called sensitization and successive exposures to allergens trigger a series of physiological events that lead to manifestation of symptoms of allergic rhinitis(2,18).

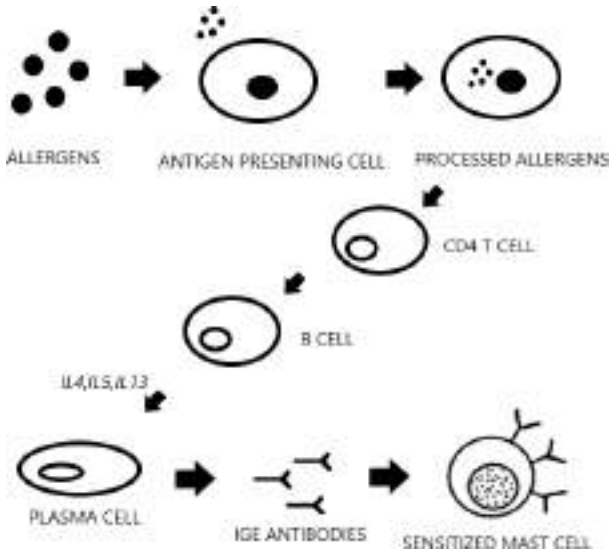


Fig.2 MECHANISM OF SENSITIZATION

Early phase response (Fig.3)

With re-exposure to the allergen in sensitized individuals, the recognition of the antigen takes place at the FcER1 receptors and this triggers degranulation of mast cells, present in large numbers in the nasal mucosa. Mast cell degranulation releases preformed histamine and other mediators, thereby causing immediate response within few minutes of exposure. Besides histamine, the other inflammatory mediators generated by mast cells include prostaglandin D2, thromboxane and sulfidopeptidyl leukotrienes.

In response to the release of these substances, vascular permeability increases, producing mucosal edema causing nasal congestion and rhinorrhea, typical of allergic rhinitis. Sensory nerve endings of trigeminal nerve are stimulated by these substances causing sneezing(2,19).

Late phase response (Fig.4)

As evidenced by previously published data, mediators derived from T lymphocytes, IgE induced mast cells and basophils are responsible for the late phase of allergic rhinitis(18–20). The late phase response occurs approximately 4-6 hours following the early phase response.

A wide spectrum of substances are released by these cells including leukotrienes, kinins and histamine which cause the persistent symptoms in the late phase response. The release of cytokines IL-4 and IL-13 from mast cells is significant in increasing the expression of vascular cell adhesion molecules (VCAM-1) in the endothelial cells. This will promote influx of eosinophils, T lymphocytes and basophils into the nasal mucosa(23–25). This influx is further sustained by other cytokines such as cells RANTES, eotaxin, MCP-4 and Thymus- and activation Regulated chemokine (TARC), produced by epithelial cells, which function as chemoattractants for eosinophils, basophils and T lymphocytes(26–28). Recent studies have shown that mast cells orchestrate the upregulation of these cytokines in the nasal epithelial cells causing prolongation of the late phase response(29). Inflammation caused by the late phase response causes persistence of sneezing, rhinorrhoea, nasal congestion and airway hyper responsiveness(19).

The coexistence of allergic rhinitis and asthma has been reported by several studies from around the world(30,31). Despite this being a well-established entity, there is a dearth in literature from India with regard to the same. In a study by Jaggi et al, it was noted that there was a high prevalence of underlying allergic rhinitis among patients with asthma. These numbers were particularly high in Southern India(32).

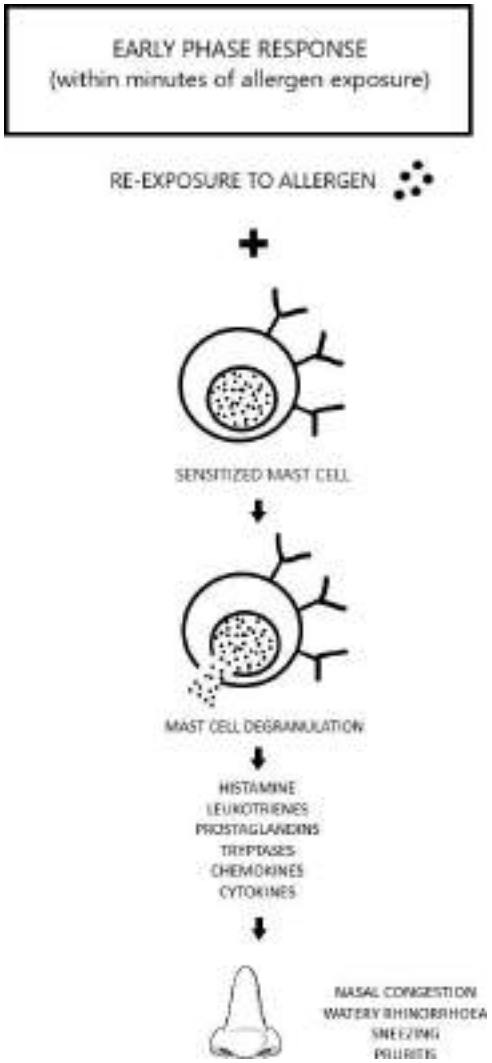


Fig.3 EARLY PHASE RESPONSE

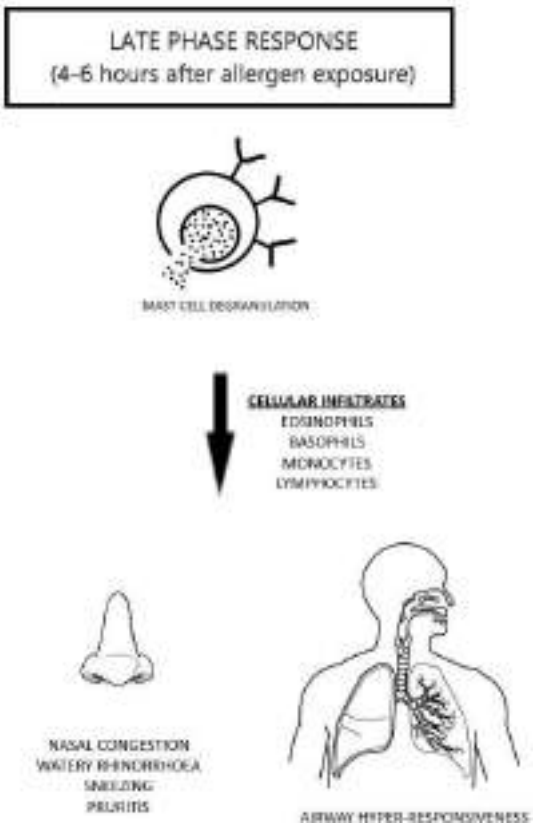


Fig.4 LATE PHASE RESPONSE

RISK FACTORS

Several risk factors for allergic rhinitis have been studied in different parts of the world to assess their association with the disease. While some of these factors may be non modifiable, there are others that play a critical role in putting a person at risk for allergic rhinitis(33).There are a number of individual elements that have been assessed as potential risk factors of allergic rhinitis. Common risk factors include age, gender, race, education, geographical location, occupation, smoking and consumption of alcohol. High stress among adults is reported significant in the occurrence of allergic rhinitis(34). Better education translates to greater exposure to an indoor working environment, exposing the individual to several indoor allergens(33). Socioeconomic risk factors contributing to allergic rhinitis

include family size, socioeconomic status, type of housing and exposure to firewood or gas for cooking(35).Household exposure to fumes and smoke is inevitable especially in parts of the country that continue to use firewood for cooking. While cooking fumes have been found to be a substantial risk factor, passive exposure to smoke and use of mosquito coils or incense were reportedly insignificant(36). The effects of smoking, both primary and secondary, are linked to the presence of allergic rhinitis(37). Exposure to traffic fumes has been shown to be a risk factor for allergic rhinitis(38)

HYGIENE HYPOTHESIS

The 'hygiene hypothesis' states that increased contact between adult members of the family and older children, leads to a protective effect on the development of allergic rhinitis(39). Conversely, those individuals who are of a higher socioeconomic status may have reduced exposure to infective agents and are, therefore, more prone to allergic rhinitis. One of the first published studies on the associations of allergies with family size and birth order was by Strachan in 1989(40). Allergic diseases were reportedly lower among the younger children in large families due to possible 'unhygienic contact' with older siblings or acquired prenatally from a mother infected by contact with her older children(41).

Matheson et al reported that a synergistic exposure of siblings and childhood viral infections before 2 years of age lowered the overall risk of allergic rhinitis. This combined exposure was linked to reduced disease manifestations before 7 years of age when compared to the same after the age of 7 years(42). The hygiene hypothesis is based on the imbalance between the two types of cells which is said to be the basis of several diseases. With more exposure to childhood infections, Th1 cell type differentiation predominates while children

that lack this exposure have more Th2 cells, further leading to the development of allergies(43)Contradiction of the hygiene hypothesis and limited understanding of the relevant immunology provide scope for further research in this field(42,44).

DIAGNOSIS OF ALLERGIC RHINITIS

The diagnosis of allergic rhinitis is dependent on both clinical and laboratory assessment. The levels of evidence for diagnosis in available publications is understandably poor (level D in most studies) because there is an overlap with similar types of rhinitis. Several patients tend to to have a combination of different kinds of rhinitis too. Despite affecting both the young and old, data regarding disease load and risk factors especially in a community setting in India is limited. In large populations, a major challenge in determining prevalence is the difficulty in administering laboratory tests. Epidemiological studies which are community –based tend to rely on clinical features to establish a diagnosis.

HISTORY:

Complete and adequate clinical history is the cornerstone in the diagnosis of any illness. Likewise, in a patient with features suggestive of allergic rhinitis, history eliciting all constituitional symptoms, frequency, severity and response to prior treatment needs to be documented. Following the patient's account of his or her symptoms, the clinician needs to enquire further by structured questions(5). Apart from classical symptoms such as watery nasal discharge, sneezing, intermittent nasal obstruction, epiphora and itching,(3) other common symptoms to be asked for include loss of smell, snoring, post nasal drip or chronic cough and features of sinusitis, asthma and conjunctivitis. Broadly speaking, those with

allergic symptoms are classified into "sneezers and runners" and "blockers". Hence, it is always necessary to ask the patient what his or her main symptom is so that the appropriate treatment can be begun. Due importance should also be given to assessment of the patient's quality of life in terms of work or school, leisure activities and quality of sleep. Potential allergens and exposure at home or work that induce symptoms should be noted. Prior attempts at allergen avoidance and response to previous treatments need to be documented. A complete history, clinical examination and limited number of skin tests will enable a clinician to confirm or exclude most allergic etiologies(5). Current ICAR-AR recommendations include initiation of therapy based on a thorough history and reserving laboratory testing if reponse to therapy is inadequate(7).

Validated quality of life (QoL)instruments. The use of validated QoL instruments has been uniformly shown with level A evidence to be useful in providing a baseline assessment of the degree and type of allergic rhinitis as well as providing data to compare response to therapy(45–47).

Examination:

In all patients with allergic symptoms, a nasal examination and anterior rhinoscopy are warranted. This is followed by a rigid nasal endoscopic examination. However, the routine performance of nasal endoscopy is not recommended(7).

Specific findings in allergic rhinitis on rigid nasal endoscopy include:

- Pale nasal mucosa
- Bilateral edema and bluish discolouration of inferior turbinates, as well as cobblestone or mulberry appearance of the inferior turbinates.

- Micropolyps or edema over the mucosa in the region of the middle meatus.

These findings are marked during an allergic exacerbation of symptoms. When there is absent exposure, nasal mucosa may appear normal. The primary role of rigid nasal endoscopy in patients with allergic rhinitis is the exclusion of associated conditions like sinusitis, deviated nasal septum or polyposis.

Diagnostic tests:

The clinical interpretation of allergic rhinitis must be correlated with diagnosis based on tests. The key determinant in diagnosing allergic diseases is in vivo or in vitro detection of IgE antibodies. There are guidelines set to standardize allergen extracts used in these tests(5).

Skin tests that elicit immediate hypersensitivity reactions are diagnostic in allergic conditions. IgE-mediated 'wheal and flare' response of the skin is corroboratory evidence for diagnosis of specific allergen.

Serum total IgE and serum specific IgE are not diagnostic of allergic rhinitis but only indicates the allergic or non-allergic nature of the patient.

Nasal challenge tests are useful techniques in research. They can be used specifically in the diagnosis of occupational rhinitis but most often not practical for use in clinical practice.

Routine nasal swabbing reportedly have limited role in diagnosis of allergic rhinitis(5).

Radiology. Routine radiology is not recommended for patients with allergic rhinitis and is performed only in patients with suspected sinusitis or polyposis. In this study, xray of the sinuses (Caldwell or Waters' view) was performed to assess the presence/absence of any associated sinusitis. Positive sinus radiography was defined as ≥ 1 abnormal finding of plain

film paranasal sinus (haziness, opacity, air-fluid level and mucosal thickening ≥ 5 mm). The criteria for diagnosis of CRS were a history of ≥ 2 nasal symptoms and either positive nasal endoscopy and/or positive sinus radiography.CT scanning of the paranasal sinuses, osteomeatal complex (OMC) view was performed in those patients with suspected rhinosinusitis with structural anomalies like concha bullosa, Haller's cells, paradoxical middle turbinate etc. as these abnormalities are best seen on CT scanning. Lund Mackay scoring was done and a score of five or more was strongly predictive of CRS.

TYPE OF TEST	LEVEL OF EVIDENCE	RECOMMENDATION(5)	INTERPRETATION
SPT	B	Recommended	Should be done for all hospital based patients(5)
Skin intradermal testing	C	Not recommended	If high suspicion for allergy exists in patient with a negative SPT result(48)
In vitro testing Serum total IgE	C	Not recommended	IgE in the serum does not always correlate with severity of disease(5)
In vitro testing Serum allergen specific IgE	C	Not recommended	Presence or absence of specific serum IgE does not correlate with severity of disease
Nasal IgE	I	Not recommended	Concept of local allergic reaction in the nose without systemic IgE release is not supported(49)
Basophil activation test	I	Not recommended	Can be used to monitor those on immunomodulator drugs, better understand mechanism of allergy(50)
Nasal cytology	I	Not recommended	Study of mucosal cellular patterns(51)
Nasal provocation test	I	Not recommended	Not relevant for daily clinical practice and diagnosis(52)
Nasal histology	I	Not recommended	Study morphological changes associated with disease(51)

Table 2. Laboratory tests for assessment of allergic rhinitis

SKIN ALLERGY TESTING

Skin testing determines if a patient's symptoms are caused by immediate hypersensitivity to allergens. There is level B evidence on its utility in the diagnosis of allergic rhinitis. Each allergen tested induces specific IgE that binds to mast cells. Mast cells on degranulation cause the localized skin response in a positive skin test.

The types of skin testing available for use in medical practice include

I. Percutaneous (prick or puncture)
II. Intracutaneous (intradermal) tests.

Skin allergy test, otherwise known as the percutaneous skin prick test is considered the gold standard for the diagnosis of allergic rhinitis(53–55). This test was first described by Lewis and Grant in 1924. The test provides evidence that there is allergic hypersensitization. Contraindications for this test include in patients with urticaria or eczema, particularly in the areas that SAT may be administered to. Neurological disorders and infectious pathologies such as leprosy are reported to give false negative test results(56).

Skin-prick testing:

a. Pre-test requirements including what drugs to avoid: A detailed history is collected on the allergic manifestations of the patient and severity is determined. Details on underlying skin diseases, history of asthma or anaphylaxis is elicited prior to administration of SAT. The test is not done if the patient is on any of the drugs that suppress the skin response(Table 3) and it is advised to stop the following medication prior to SAT(5).

DRUG	DEGREE OF EFFECT ON SAT	DURATION
Astemizole	++++	30-60 days
Azelastine oral	++++	3-10 days
Cetirizine	++++	3-10 days
Chlorpheniramine	++	1-3 days
Clemastine	+++	1-10 days
Ebastine	++++	3-10 days
Fexofenadine	++++	3-10 days
Hydroxyzine	++++	1-10 days
Ketotifen	++++	3-10 days
loratadine	++++	3-10 days
Mequitazine	++++	3-10 days
Mizolastine	++++	3-10 days
Oxatomide	++++	3-10 days
Terfenadine*	++++	3-10 days
Imipramines	++++	>10 days

Table 3 Drugs that suppress skin allergen test response

b. Locations on body where testing may be done ideally is the volar aspect of the arm(Fig.5), about 2 – 3 cm from the wrist and the antecubital fossae or on the back(54)

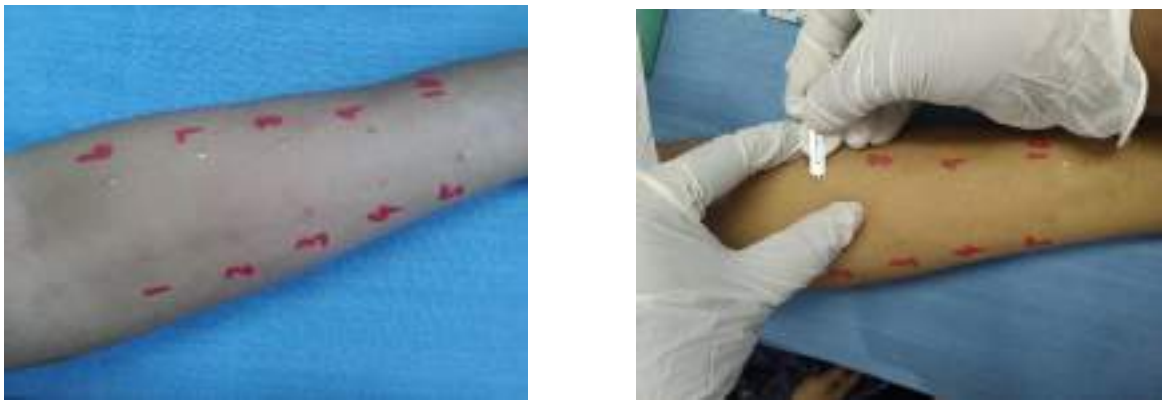


Fig.5 (a)SPT on volar aspect of forearm (b)Lancet used to prick through drop of allergen extract

c. Positive and negative controls: Negative (saline) and positive (e.g. 9% histamine hydrochloride solution) controls are required in SPTs to make any interpretation possible. The purpose of the negative control is to exclude dermographism, which when present can make interpretation of the test difficult. A positive histamine control ensures that the subsequent allergen exudates are administered correctly. It also excludes a negative skin response due to drugs that have a suppressant effect on SAT response(56).
d. Procedure: A small drop of allergen extract or control fluid is placed over the forearm or back of the patient. Following this step, a sharp device such as a hypodermic needle or lancet (Fig.6) is used to puncture the skin through the drop causing it to just penetrate into the skin. Skin prick tests should be 2 cm apart(5)

Fig.6 Disposable lancet

e. Timing of reading response: all tests, including the histamine and negative control test results are read 15–20 minutes following application.

f. Interpretation of results:

   To begin with, the positive and negative controls should be measured. The wheal and erythema have been used to assess the positivity of the skin test. Wheal diameters of 3 mm or greater are considered positive in SPTs. It is considered that small wheals under 3 mm of diameter are not significant in clinical studies (57).

   Dermographism could result in false-positive skin tests. False-negative results could be due to poor or loss of potency of allergen extracts, SAP response suppressant medication, improper techniques and other host factors such as diseases altering the skin response and limited local IgE production.

g. Patient after-care: Following interpretation of the skin response, it is mandatory to monitor the patients for upto thirty minutes(58).

Intradermal testing:

Indication: Intradermal skin test is significant as a second-line tool in cases of suspected allergies including allergic rhinitis, where a negative skin prick test is obtained(59)

A minimal dose of the allergen is injected between the epidermal and dermal tissue. The injectants used in this test are dilutions of the allergen extracts utilized in the skin prick test(60).The local reaction is assessed at the end of 15 minutes in a manner similar to that of the skin prick test.

A skin prick test has a much better diagnostic sensitivity and specificity in comparison to an intradermal skin test , despite multiple factors that influence the accuracy of both tests such as clinical skill, instrument used to puncture, complexion of skin, local reactivity on the day of testing, potency and stability of reagents(61).

Adverse reaction to skin allergen test:

The skin allergy test is a safe and reliable test for the diagnosis of allergic rhinitis and is routinely administered to patients with suspected allergic rhinitis. A rare complication for this test is anaphylaxis. The rate of systemic reactions associated with skin allergy testing is <0.1% (62). The clinical manifestations of a systemic reaction to skin testing are mostly respiratory and dermatologic. Therefore, monitoring of patients who have been administered skin allergen tests is mandatory for upto thirty minutes after the procedure(58). Resuscitation equipment is available in the Treatment Room of ENT outpatient department which is just adjacent to the location of the Rhinology lab where the test is done. Till date, we have had no patient who developed anaphylaxis after the test.

ALLERGENS USED FOR SKIN ALLERGY TEST

Definition: Allergens are those substances that can elicit an IgE response when exposed to most humans. Extracts of common allergens seen in nature are used for diagnostic tests such as the skin allergy test(63).

“Allergen vaccine” is the term used to refer to the biological products such as allergen extracts administered to patients for diagnosis, prevention and treatment of allergic diseases(64,65).

Composition of an allergen: Allergen extracts, mostly composed of an active protein fraction, trigger responses that are allergen specific. They may also contain glycoproteins and polysaccharides. Non-allergenic components may be mixed with the allergen depending on its source.

Choice of allergen:

Allergens used for testing are based on specific clinical history, allergen exposure pattern (seasonal vs perennial), distribution of specific allergens in the patient’s environment, presence of food allergies, occupation, home environment, presence of pets and hobbies.Biological response to each allergen extract used in clinical tests should be consistent(63). This makes it crucial to determine the quality, potency and reliability of extracts. Hence, standardization is mandatory (65,66).

Sources of allergen:

a) Natural allergens

Allergens are usually obtained from natural sources by a process of aqueous extraction. Hence, they need to be as free from impurity as possible to be effective. The

preservative used (usually glycerin) as well as storage conditions (usually at 2-8 degrees in a refrigerator) can also affect the efficacy of an allergen.

b) Synthesized or recombinant allergens are highly purified extracts of allergenic proteins which are manufactured in some countries.
c) Allergoids are highly purified allergen extracts which have high immunogenicity but limited allergenic activity. They are produced by chemically treating allergens. They are more often used for desensitization that skin allergen testing.

Types of allergens:

Common types of allergens are broadly categorized into the following (67) :

i. Pollen
ii. Fungi
iii. Insects
iv. Mites
v. Food

POLLEN:

The sources of pollen are dried and crushed flower heads. Flowers from different flowering seasons and sites must be compiled to achieve a broad-gauged primary sample. Samples with pollen content of 90% or greater and other floral components less than 10% are accepted for antigen extraction process(67).

FUNGI:

To begin with, the fungal inoculum should be procured from culture banks like Indian Agriculture Research Institute, Delhi; Institute of Microbial Technology, Chandigarh and National Chemical Laboratory, Pune. Molds are cultured under optimum conditions and resultant surface growth is utilized for antigen extract production(67).

INSECTS:

The source of inhaled allergen is the whole body of the insect, whereas contact allergen with insect can be caused by any form of insect debris such as feces or secretions. Killed insects are utilized for the purpose of allergen extraction(67).

MITES:

Commonest indoor allergens in India are Dermatophilosis pteronyssinus and Dermatophilosis farinae. Extracts are obtained from whole mite culture(67).

FOOD:

Proteins such as pulses are stored in saline buffers. In case of fresh diary products, fruits and vegetables direct prick to prick transmission of allergen is preferred. But this direct prick to prick technique is not practical in a clinical setting. Standardization of this method is not possible as availability of fruits and vegetables vary according to season. Products such as milk and eggs should be administered at a fixed dilution for comparable results on SAT(67,68).

ALLERGEN TEST PANELS

Optimized panels have been developed for Europe and Asia but no such standardized panel is available in India(69,70). The study by Dey et al from India selected thirty-four aeroallergens on the basis of their aerial dominance and availability and it reported the

maximum sensitization to house mite dust (Fig. 7). Further studies are required in this area to evolve a minimum allergen standardized panel that can be used for diagnostic purposes(71).

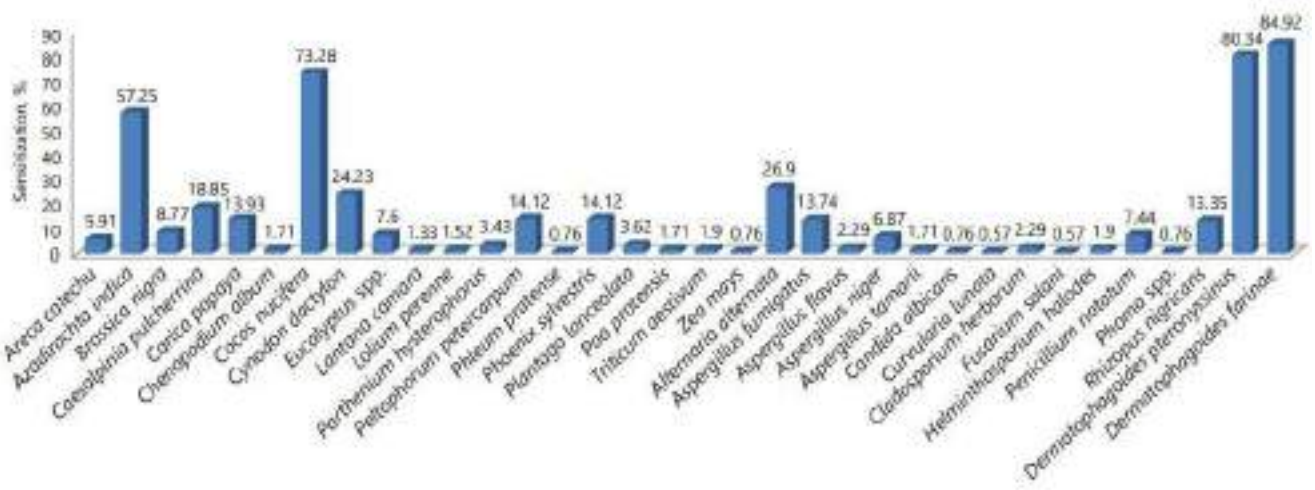


Fig.7 Overall sensitization of allergens tested (71)

STANDARDISATION OF ALLERGEN PANEL

Larsen et al describes in detail the preparation of in-house references(IHR) for each source of allergen(63). Each manufacturer in Europe develops IHR In Europe, each laboratory and manufacturer establishes an in-house reference (IHR) preparation for each source material. The IHR must be thoroughly characterized by in vitro methods as a basis for equilibration of subsequent batches, and the biological activity of the IHR should be determined by in vivo methods in humans. The IHR eliminates the need for in vivo methods in batch-to-batch standardization, which can be performed by comparing new batches to the IHR using in vitro methods exclusively(63).

In a study done by Hansen et al, standardization of allergens was done according to guidelines from the Nordic Council of Medicine(68). Extraction and purification of food allergens were done such that adequate allergen consistency was maintained in each batch. Every batch was standardized against a laboratory reference in terms of protein content,

allergen concentration and allergic response. The processed extract is then dissolved in carbonate buffer medium and its diluent administered in a skin prick test. Histamine dihydrochloride 10 mg/ml was used as positive control and diluent (50% glycerol, saline and buffers) as negative control(68).Unlike the Nordic Committee, the American Academy of Allergy, Asthma and Immunology states that allergen extracts of common food items should be chosen on the basis of biological standardization(presence of IgE in serum) using skin prick test(72).

Standardization is necessary to control variation and ensure consistency and reproducibility for the safety and efficacy of specific allergy disease management. Batch-to-batch standardization is performed by comparison of new batches to established standards assessing complexity, major allergen content, and IgE binding(63).

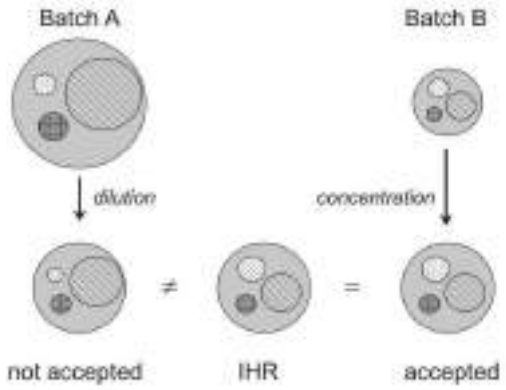


Fig.8 Standardization of allergen extracts (63)

SENSITISATION ON SKIN ALLERGY TESTS

The European Academy of Allergy and Clinical Immunology's Immunotherapy Task Force, defines an allergen as "a protein or glycoprotein capable of binding immunoglobulin E (IgE)(73). Sensitization is that physiological response of the body to such a protein that it is exposed to. This response is confirmed by skin allergy tests or serum specific IgE

assays(74). Patients who manifest symptoms may be clinically allergic to one or more allergens. The type of sensitization is of prime significance in understanding and managing allergic diseases.

According to Migueres et al (74), “polysensitization” implies “more than one sensitization”, i.e greater than one positive response on skin allergy test. However, a study by de Jong et al(75) used the term “paucisensitization” to describe 2 to 4 sensitizations and “polysensitization” to describe 5 or more sensitizations. Although this description is very comprehensive, only few patients will have a positive response to 5 or more allergens on skin allergy tests. Hence, the two types of sensitization patterns for clinical practice are described by the broad terms, “monosensitization” and “polysensitization”(74)**.** Polysensitization can further be classified into cross-reactivity/cross-sensitization and co-sensitization(74).

Definition of terminology used commonly with respect to sensitization patterns:

- Monosensitization: Sensitization to a single allergen as confirmed by skin allergen test or serum IgE assay.
- Polysensitization: Sensitization to two or more allergens as confirmed by skin allergen test or serum IgE assay.
- Cross-sensitization: This is the phenomenon in which IgE antibodies are initially raised against a particular allergen and subsequently binds to a similar protein in another allergen.
- Co-sensitization: The simultaneous presence of multiple IgEs arise against structurally unrelated allergen groups.

Author/Year of study	Prevalence of monosensitization	Prevalence of polysensitization
Bousquet/2010	16.2% to 19.6%	12.8% to 25.3%
Ciprandi/2011	25.7%	74.3%
Migueres/2014	26.4%	76.3%
Katotomichelakis/2016	40.3%	59.7%
Kumar/2021	44.44%	55.5%

Table 4. Prevalence of sensitization among adults and children

According to the European Community Respiratory Health Survey(ECRHS) conducted among a target populaton of 11,355 , 19.4% were monosensitized and 12.8% to 25.3% were polysensitized and 67.8% were non sensitized(76). Ciprandi et al, who conducted the POLISMAIL study that studied the characteristics of polysensitised patients, reported that among adults, 25.7% were monosensitized and 74.3% were polysensitized(77). Similarly, in a study by Migueres et al, 26.4% were sensitized to one allergen and 76.3% were polysensitized(74). In India, among 183 patients with allergic rhinitis, 44.44% were sensitized to single allergen, while 40.40% and 15.15% of patients were sensitized to 2–5 allergens and >5 allergens, respectively(78).

In a study done among children, aged 6 to 17 years, 231 of the 675 children showed positive sensitization on skin allergy tests. Of these, 40.3% were monosensitized and 59.7% were polysensitized(79). 87 of the 231 children(37.6%) that were sensitized were documented to have a positive family history of atopy(79). The study also stated that total IgE level and allergen sensitization were poorly correlated. Although levels of total IgE were higher in the polysensitized group when compared with the monosensitized group this was stated as statistically insignificant(80).

Table 5. Patterns of sensitization:

Author/Year of study	Number of patients	Objective	Study conclusion (with respect to sensitization and severity of disease) :
Cirillo/2005	185	Association between Asthma Quality of Life Questionnaire and sensitization, evaluated by skin prick testing	Significant
Ciprandi/2008	418	Sensitization patterns, severity of disease and quality of life using Juniper's RQLQ questionnaire	Not significant
Burbach/2009	3034	Correlation between sensitization and allergic disease	Significant
Ciprandi/2011	2415	Features of mono- and poly-sensitized subjects.	Significant
Aburuz/2011	538	Pattern of skin prick test reactivity to various aeroallergens	Significant
De Bot/2013	784	Sensitization patterns in children and associations, gender and clinical symptoms of allergic rhinitis	Not significant
Fiocchi/2015	267	Sensitization patterns in children with common allergic symptoms without an allergy diagnosis	Not significant
Kumar/2020	183	Association between total serum IgE level and skin prick test in Indian patients with allergic rhinitis	Significant

Sensitization is determined by the results of skin allergen tests using common aeroallergen extracts(77,81). Published literature reports contrasting findings on the significance of polysensitization and allergic rhinitis(82,83).

The POLISMAIL study by Ciprandi et al(82), evaluated patients diagnosed with allergic rhinitis who also had associated asthma. The diagnosis of allergic rhinitis was made based on history (categorized based on ARIA guidelines), nasal symptoms and a positive skin allergy test. Similarly, asthma in the same patients was classified based on GINA criteria. Their relation with quality of life was assessed using Juniper's RQLQ questionnaire. This study reported that polysensitization was not a prerequisite for asthma as a comorbid condition and had no association with severity of rhinitis or asthma. Fiocchi et al(84) stated that polysensitivity did not imply an increased severity of disease. Despite the absence of allergic rhino-conjunctivitis, family history for allergies could predispose to an early sensitization in children. These patients could be counselled and monitored with regard to disease development. De Bot et al(85) concluded that severity of clinical symptoms did not differ between polysensitized and monosensitized children, but symptoms were significantly lower in non-sensitized children.

On the contrary, the Global Asthma and Allergy European Network (GA^2LEN) study stated that presence of allergic rhinitis and sensitization patterns observed on skin allergy tests are clinically significant(83). It was interesting to note that patients acquire sensitization over time and with subsequent exposure(74,77). Very often, children who are reported to be monosensitive, become polysensitive later in life and these changes are statistically significant(86). Similar to the GA^2LEN study, a cross sectional study done among a large number of patients with allergic rhinitis by Ciprandi et al(77), found that severity of disease

was greater in patients with polysensitivity. The study also stated that sensitivity pattern was independent of duration of symptoms(77). There are other studies too that report a positive association between number and nature of allergen status affecting an individual and the severity of allergic rhinitis(84,87).

Polysensitivity is also reportedly associated with a worse quality of life(88). While the male to female ratio among monosensitized patients was 1:1, the polysensitized group had a 2:1 ratio of the same(80). The average number of positive antigens according to the skin allergy test was 5.0±0.5 in the polysensitized group, and the commonest allergen was the house dust mite, followed by *Alternaria* and cockroach(80). Treatment decisions for allergic rhinitis should be made on the basis of a detailed clinical history and skin allergy testing.

Since polysensitization is seen to be associated with asthma and family history of atopy, accurate interpretation of skin allergy tests is essential irrespective of the disease manifestation. Through our study, we would also like to assess the relationship of sensitization patterns and severity of disease. Knowledge of sensitivity pattern enables us to optimize treatment for each patient. Information at the conclusion of the study can be used to formulate concise population specific guidelines for further investigation, disease modification or need for immunotherapy in monosensitized and polysensitized patients with allergic rhinitis.

METHODOLOGY

STUDY DESIGN:

This was a hospital- based, retrospective, cross-sectional observational study that was conducted at Christian Medical College,Vellore, a tertiary care center in South India. The clinical records of adult patients evaluated at the Rhinology clinic, with a clinical diagnosis of allergic rhinitis and a positive skin prick test, were accessed to note clinical features and skin allergy test results.

INCLUSION CRITERIA:

Adults 18 years and older with clinical diagnosis of allergic rhinitis with a positive skin allergen test.

EXCLUSION CRITERIA:

i. Patients without skin allergy testing result

ii. Patients with a negative skin allergen test result

Calculation of sample size

In order to calculate a sample size with sufficient power to detect a difference between the polysensitised and monosensitised groups, we performed sample size calculation using the following formula:

Formula

$H_0: P_1 = P_2$, $H_a: P_1 \neq P_2$

$$n = \frac{\left\{ Z_{1-\frac{\alpha}{2}} \sqrt{2\bar{P}(1-\bar{P})} + Z_{1-\beta} \sqrt{P_1(1-P_1) + P_2(1-P_2)} \right\}^2}{(P_1 - P_2)^2}$$

Where,

$$\bar{P} = \frac{P_1 + P_2}{2}$$

P_1 : Proportion in the first group

P_2 : Proportion in the second group

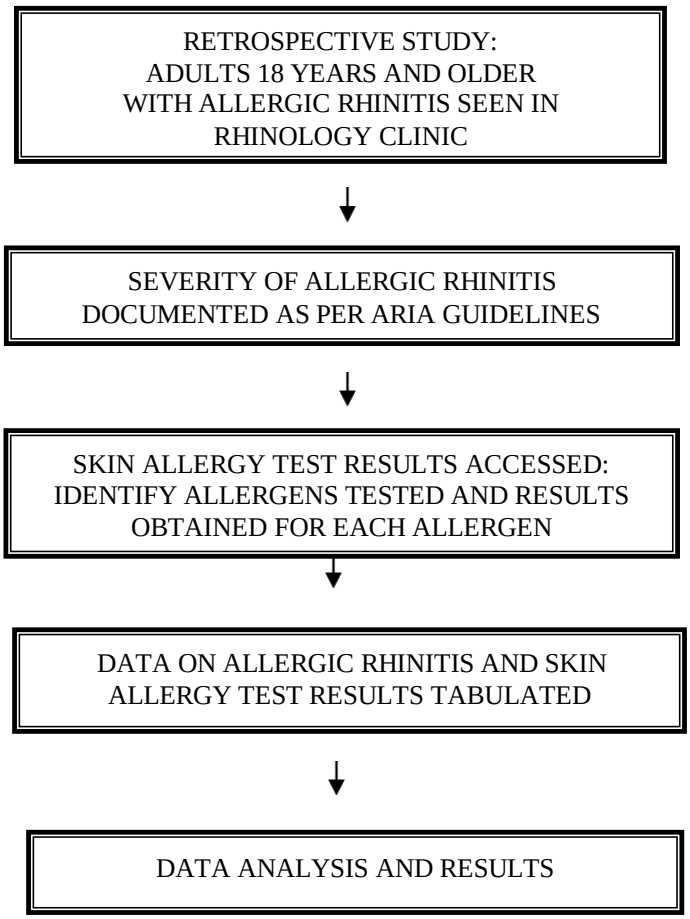
α : Significance level

$1-\beta$: Power

Two Proportion - Hypothesis Testing - Large Proportion - Equal Allocation			
Proportion in group I	0.8	0.8	**0.7**
Proportion in group II	0.86	0.7	**0.84**
Estimated risk difference	-6.00E-02	0.1	**-0.14**
Power (1- beta) %	80	80	**81**
Alpha error (%)	5	5	**5**
1 or 2 sided	2	2	**2**
Required sample size for each arm	614	293	**145**

Based on the Pilot study on 36 patients, the proportion of polysensitivity in the mild disease and moderate-severe disease group was 12/15 = 80 (95% CI: 51% – 95%) and 18/21=86% (95% CI: 63% - 96%) respectively. The sample size calculation was based on the difference of 14% (mild= 47% and modrate-severe= 84%) having 80% power to detect an estimated difference between two groups using a two-sided hypothesis test and a critical level of significance of 5%. A total sample size of around 300 participants (150 in each group) was required.

DETAILED DIAGRAMMATIC ALGORITHM OF DATA COLLECTION OF THE STUDY



INSTITUTIONAL REVIEW BOARD APPROVAL:

Approval was obtained from the institutional review board and ethics committee for the conduct of this study. (IRB No.13642).

RESULTS

Demography

A total of 320 patients were recruited to the study. All patients were confirmed to have allergic rhinitis based on a positive skin allergy test.

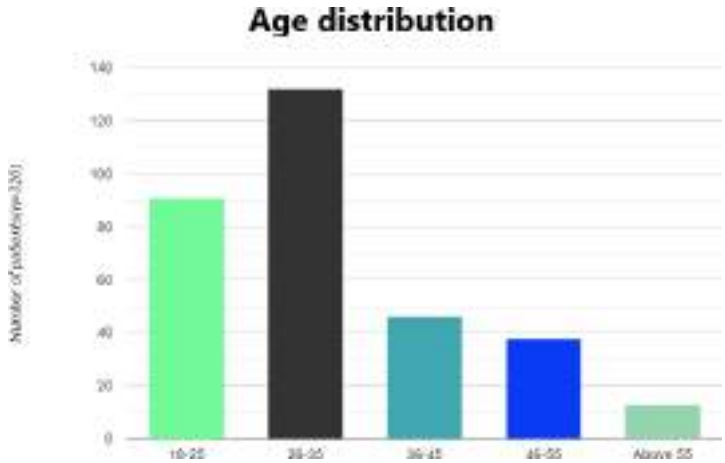


Fig.9 Age distribution in cohort

Category	**Number of patients**	**Percentage**
18-25 years	91	28.4%
26-35 years	132	41.3%
36-45 years	46	14.4%
46-55 years	38	11.9%
>55 years	13	4.0%

Table 8. Number of patients in each age category

As per the inclusion criteria, all patients aged 18 and above were included in the study. The majority (223 patients,69.6%) of those with allergic rhinitis were less than 35 years of age. Only 13 patients (4.0%) were above 55 years of age. Our data shows that the

disease manifestation is maximum among the younger population who are between the ages of 18 and 35 years (69.6%), following which there is sharp fall in prevalence.

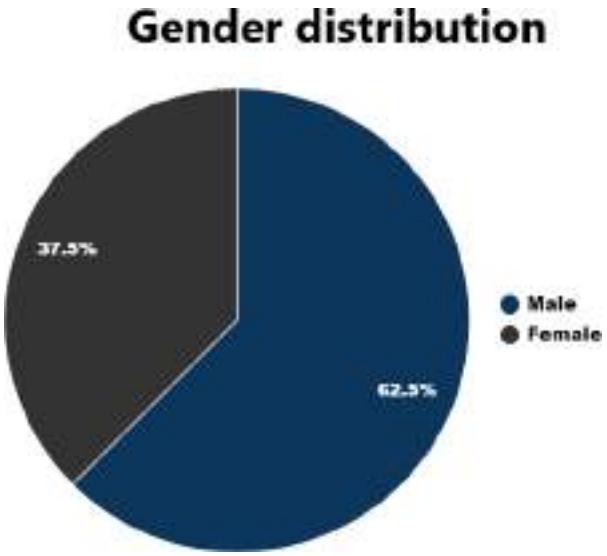


Fig. 10 Gender distribution in cohort (n=320)

Category	Number of patients (n=320)	Number of male patients in each category(n=200)	Number of female patients in each category(n=120)
18-25 years	91(28.4%)	63(69.2%)	28(30.8%)
26-35 years	132(41.3%)	85(64.4%)	47(35.6%)
36-45 years	46(14.4%)	27(58.7%)	19(41.3%)
46-55 years	38(11.9%)	19(50.0%)	19(50.0%)
>55 years	13(4.0%)	6(46.2%)	7(53.8%)

Table 9. Gender distribution in each age category

Of the 320 patients enrolled in the study, there were 200 (62.5%) males and 120 (37.5%) females. The larger number of male patients reflects the greater utilisation of male patients of medical care for all ENT complaints at our hospital and may not be reflective of a greater prevalence of allergic rhinitis among male patients in general. Among both male and

female patients, most patients (41.3%) with allergic symptoms were aged between 26 to 35 years.

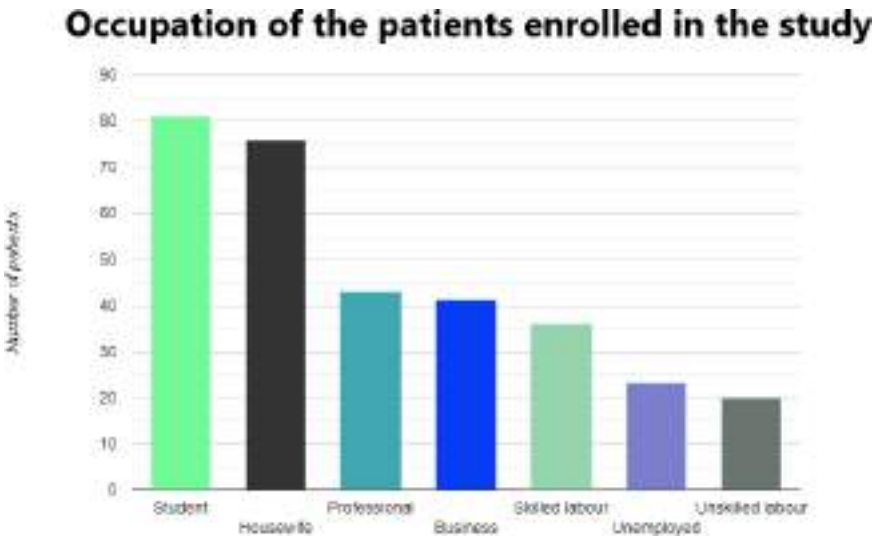


Fig.11 Occupation of patients enrolled in the study

Occupation	Number of patients	Percentage
Student	81	25.3%
Housewife	76	23.8%
Professional	43	13.4%
Business	41	12.8%
Skilled labour	36	11.3%
Unemployed	23	7.2%
Unskilled labour	20	6.2%

Table 10. Occupational distribution in the cohort

Analysis of the occupational distribution among the study participants shows that most patients with symptoms were students (81 patients; 25.3%) or housewives (76 patients, 23.8%) indicating that the allergen triggers that the patients were exposed to were located indoors. This data also indicated that 13.4% (43 patients) were professionals, 12.8% (41

patients) were pursuing business and 11.3% (36 patients) were skilled labourers. The disease was also reported among 23 patients who were unemployed (7.2%) and 20 unskilled labourers(6.2%).

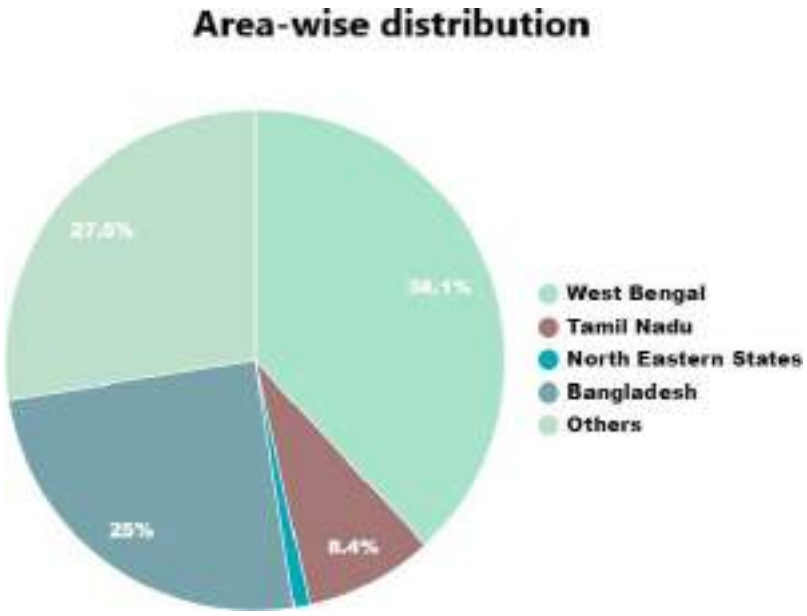


Fig.12 Area-wise distribution

Area	Number of patients	Percentage
West Bengal	122	38.1%
Tamil Nadu	27	8.4%
North Eastern states	3	0.9%
Bangladesh	80	25.0%
Others	88	27.5%

Table 11. Area-wise distribution in the cohort

Most patients with allergic rhinitis enrolled into the study were from West Bengal (122 patients; 38.1%) and Bangladesh (80 patients; 25%). Only 27 of the 320 patients (8.4%) belonged to Tamil Nadu. This breakdown reflects the pattern of distribution of patients in our

outpatient section and not any geographical increase or decrease in the prevalence of the disease in specific states.

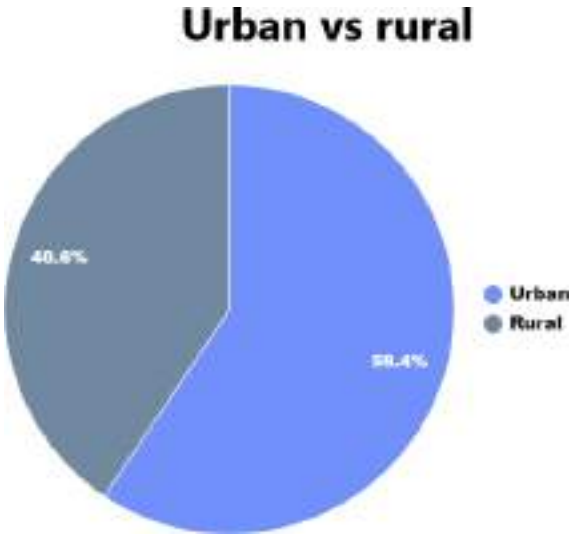


Fig.13 Urban and rural distribution in cohort(n=320)

Locality	Number of patients	Percentage
Urban	190	59.4%
Rural	130	40.6%

Table 12. Urban and rural distribution in cohort

A total of 190 of the 320 patients (59.4%) resided in an urban locality while 130 (40.6%) resided in a rural area. As most of our patients were from outside Tamil Nadu, this pattern is consistent with a higher number of urban patients (who are more likely to travel for healthcare) coming from these areas.

Symptoms of allergic rhinitis

Patients with allergic rhinitis presented to us with symptoms of nasal obstruction, watery rhinorrhoea, sneezing , epiphora and itching of eyes. In many patients , one of these symptoms was the primary symptom, while the others were either present to a lesser extent or not at all.

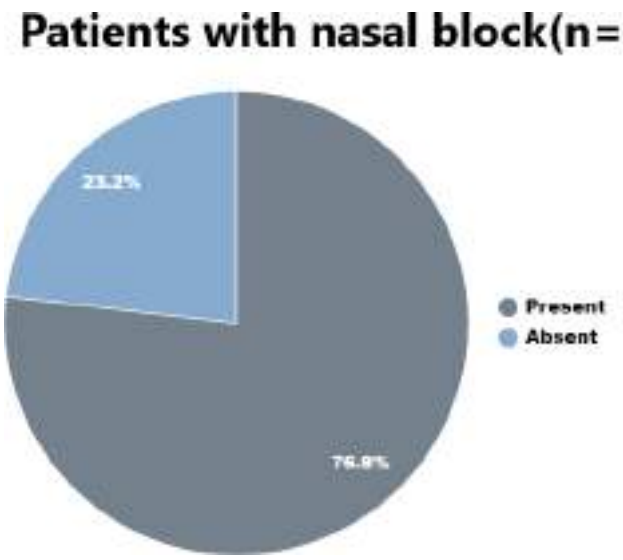


Fig.14 Patients with nasal block as primary symptom

Patients with nasal block	Number of patients	Percentage
Present	246	76.8%
Absent	74	23.2%

Table 13. Number of patients with nasal block as primary symptom

A little over ¾ of patients (76.8%; 246 patients) complained of nasal block as one of their primary symptoms showing that nasal obstruction is a common problem in patients with allergic rhinitis.

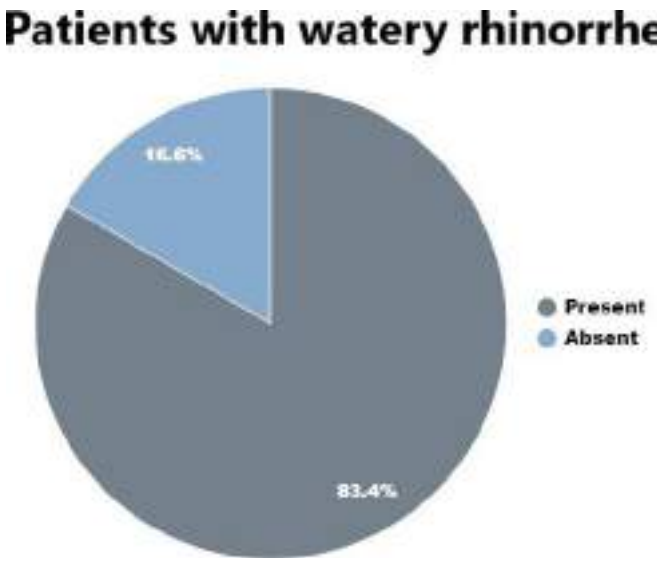


Fig.15 Patients with watery rhinorrhoea as one of the primary symptoms

Patients with rhinorrhoea	Number of patients	Percentage
Present	267	83.4%
Absent	53	16.6%

Table 14.Number of patients with watery rhinorrhoea as primary symptom

A total of 267 of the 320 patients (83.4%) complained of watery rhinorrhea as one of their primary symptoms. Rhinorrhoea was described as being clear, mucoid or watery and usually accompanied other nasal symptoms.

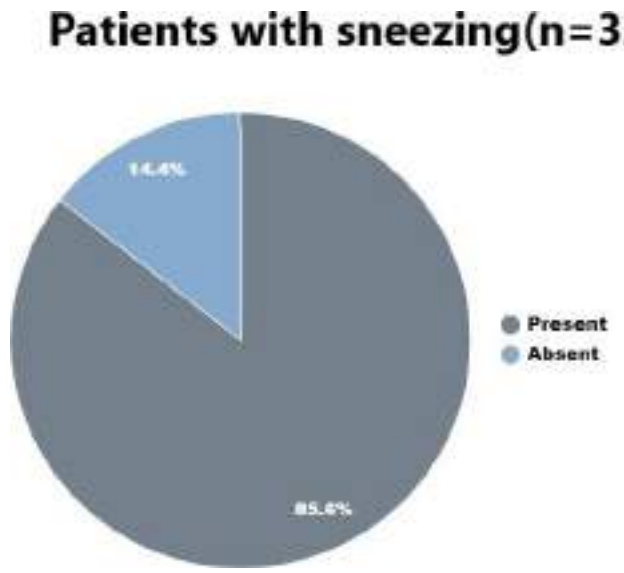


Fig.16 Patients with sneezing as one of the primary symptoms

Patients with sneezing	Number of patients	Percentage
Present	274	85.6%
Absent	46	14.4%

Table 15. Number of patients with sneezing as primary symptom

Among 320 patients, 274(85.6%) complained of sneezing as one of their primary symptoms. Sneezing was, in fact, the most common primary symptom in this cohort of patients with intermittent or persistent allergic rhinitis.

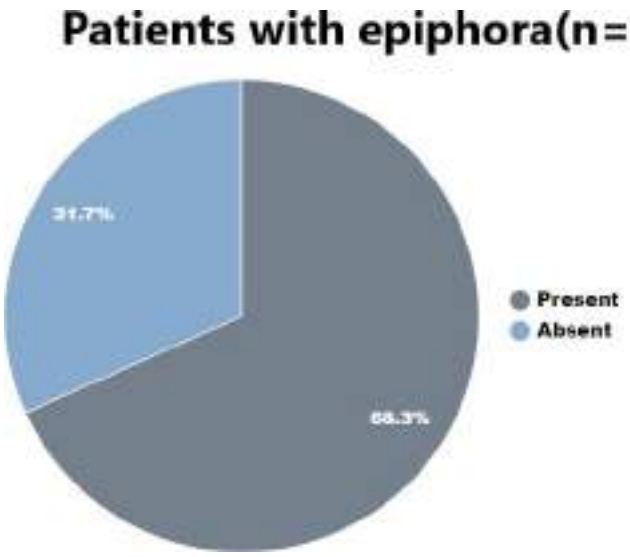


Fig.17 Patients with epiphora as one of the primary symptoms

Patients with epiphora	Number of patients	Percentage
Present	219	68.3%
Absent	101	31.7%

Table 16. Number of patients with epiphora as primary symptom

A total of 219 patients(68.3%) had a history of watering from eyes/epiphora associated with features of allergic rhinitis. This was usually accompanied by itching of eyes.

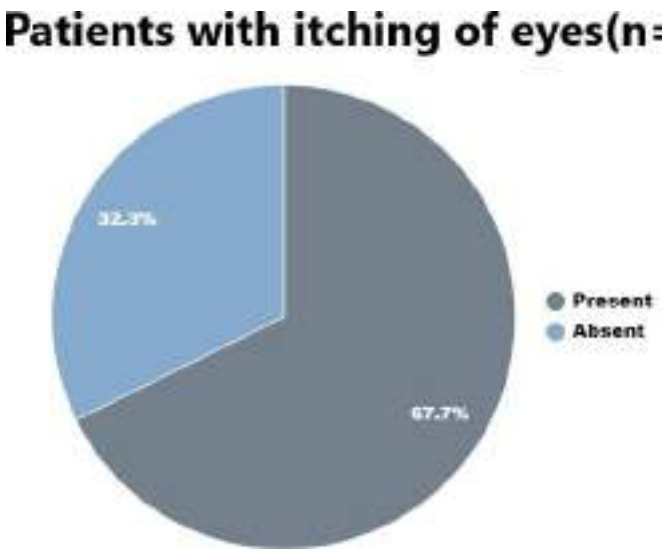


Fig.18 Patients with itching of eyes as one of the primary symptoms

Patients with itching of eyes	**Number of patients**	**Percentage**
Present	217	67.7%
Absent	103	32.3%

Table 17. Number of patients with itching of eyes as primary symptom

A total of 217 patients(67.7%) complained of itching of eyes associated with exposure to allergic triggers. This symptom was usually associated with epiphora.

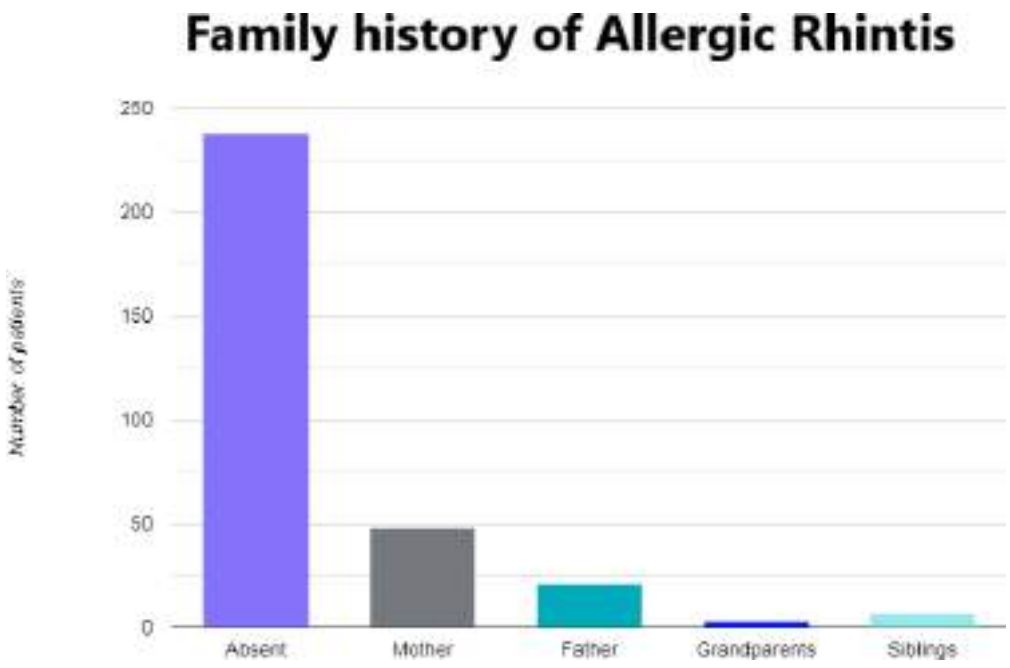


Fig.19 Family history of allergic rhinitis

Positive family history	Number of patients	Percentage
Mother	48	60%
Father	21	26.3%
Grandparents	4	5.0%
Siblings	7	8.7%

Table 18. Distribution of patients with positive family history (n=80)

A positive family history was reported by only 25.3% of patients with allergic rhinitis. In our study, the majority of patients (239 patients; 74.7%) had no family history of allergic rhinitis. This data was missing for 1 patient. Among those 80 patients with a positive family history, 48 patients (60%) had a history of allergic rhinitis in the mother and 21(26.3%) had a similar history in the father. Less commonly, allergic rhinitis was seen in the grandparents (4patients; 5%) and siblings (7 patients; 8.7%) respectively.

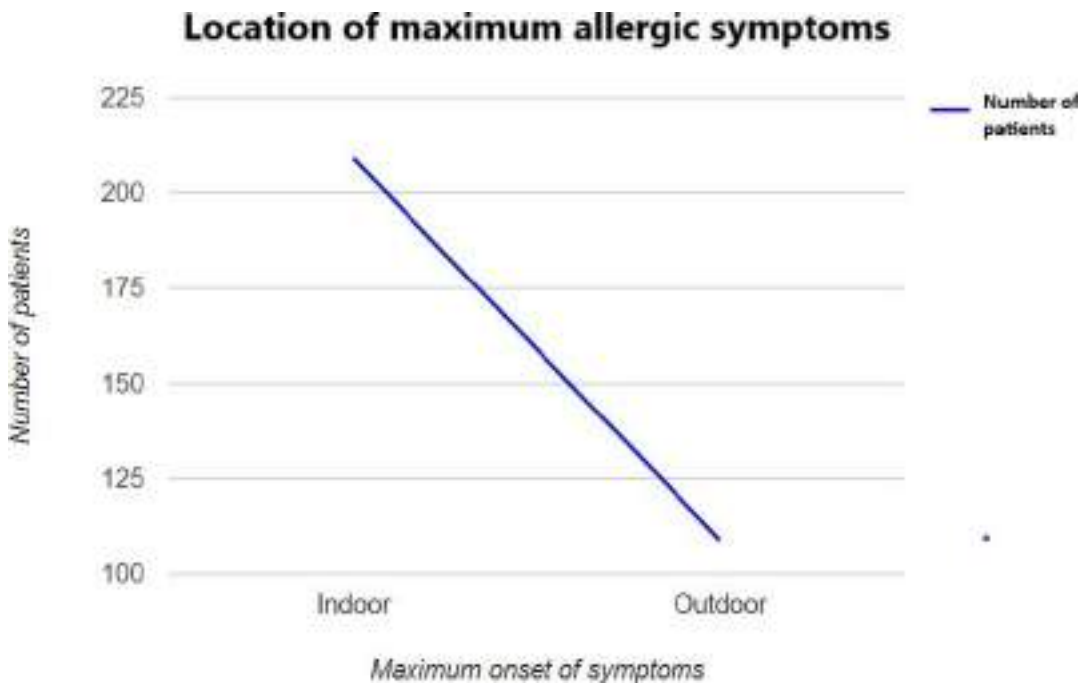


Fig.20 Location of maximum allergic symptoms

Location	Number of patients	Percentage
Indoors	209	65.7%
Outdoors	109	34.3%

Table 19. Location of maximum allergic symptoms

Among the 318 patients for whom data was available, 209 patients(65.7%) reported that maximum onset of symptoms occurred while indoors. This shows that the maximum triggers for allergy occurs indoors at home or at work (13 patients worked indoors). In 109 patients (34.3%), symptoms presented when outdoors, with one patient alone whose work was chiefly outdoors getting symptoms at work. Data was missing for 2 patients.

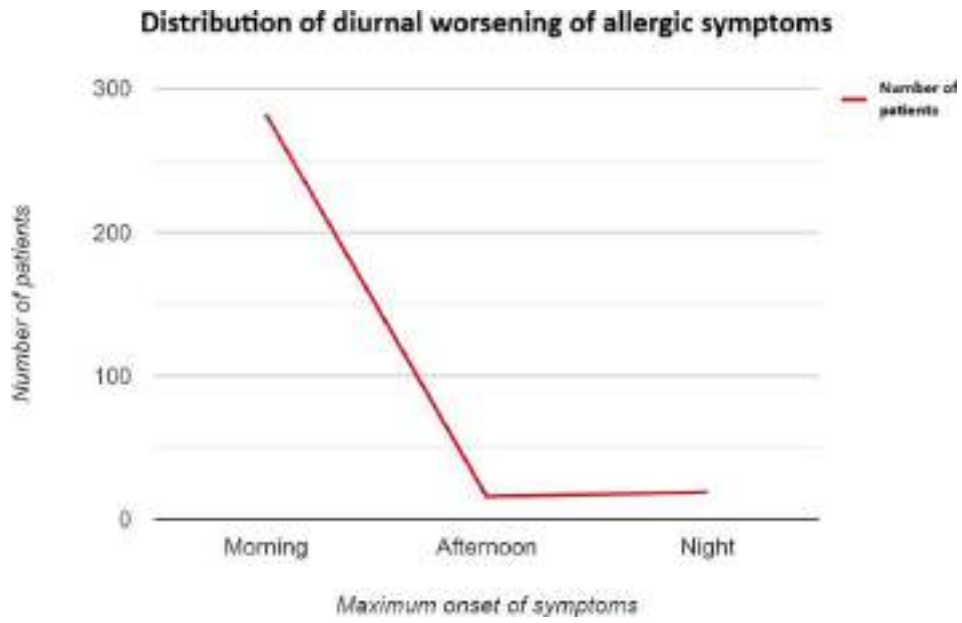


Fig.21 Diurnal worsening of allergic symptoms

Diurnal variation	Number of patients	Percentage
Morning	282	89.0%
Afternoon	16	5.0%
Night	19	6.0%

Table 20. Diurnal worsening of allergic symptoms

We analysed the timing of maximum symptoms during the day in these patients. Of the 317 patients for whom data was available 89% of patients i.e 282 patients reported that 'onset of worst symptoms in a day' occurred in the mornings. Comparatively fewer patients had symptoms in the afternoon and night (16 patients; 5% and 19 patients; 6% respectively). Three patients did not comment on this aspect of their symptoms. The vast majority of patients appear to be affected when the day begins, rather than later in the course of the day. This predilection of timing of maximum symptoms appears to be linked to the fact that the majority of symptoms occur indoors and at home, rather than at work. Even among those 14 patients whose symptoms occurred at work alone, 13 of 14 patients (92.9%) worked indoors.

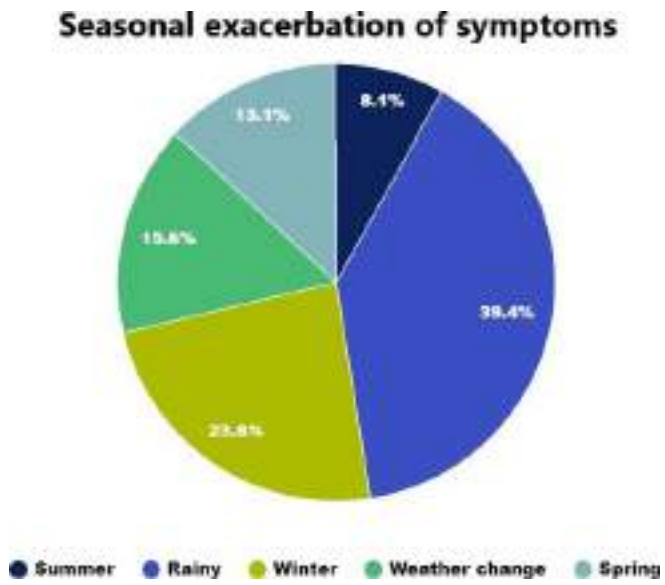


Fig.22 Seasonal exacerbation of symptoms

Seasonal exacerbation	Number of patients	Percentage
Summer	26	8.1%
Rainy	126	39.4%
Winter	76	23.8%
Weather change	50	15.6%
Spring	42	13.1%

Table 21. Number of patients with nasal block as primary symptom

All patients reported seasonal exacerbation of allergic symptoms with varying intensities. 126 patients (39.4%) had symptoms that worsened in the rainy season. Other patients reported exacerbation of symptoms in winter(76 patients; 23.8%). Some patients reported that allergic symptoms appeared during change in weather (50 patients; 15.6%). It is possible that some of these patients either had associated vasomotor rhinopathy or that a sudden exposure to allergens (eg. a dust storm or heavy breeze carrying pollen allergens) occurred. Overall, winter and rainy season were the chief seasons that provoked allergic

symptoms. Spring (42 patients; 13.1%) and summer (26 patients; 8.1%) were not associated with much allergy in this cohort.

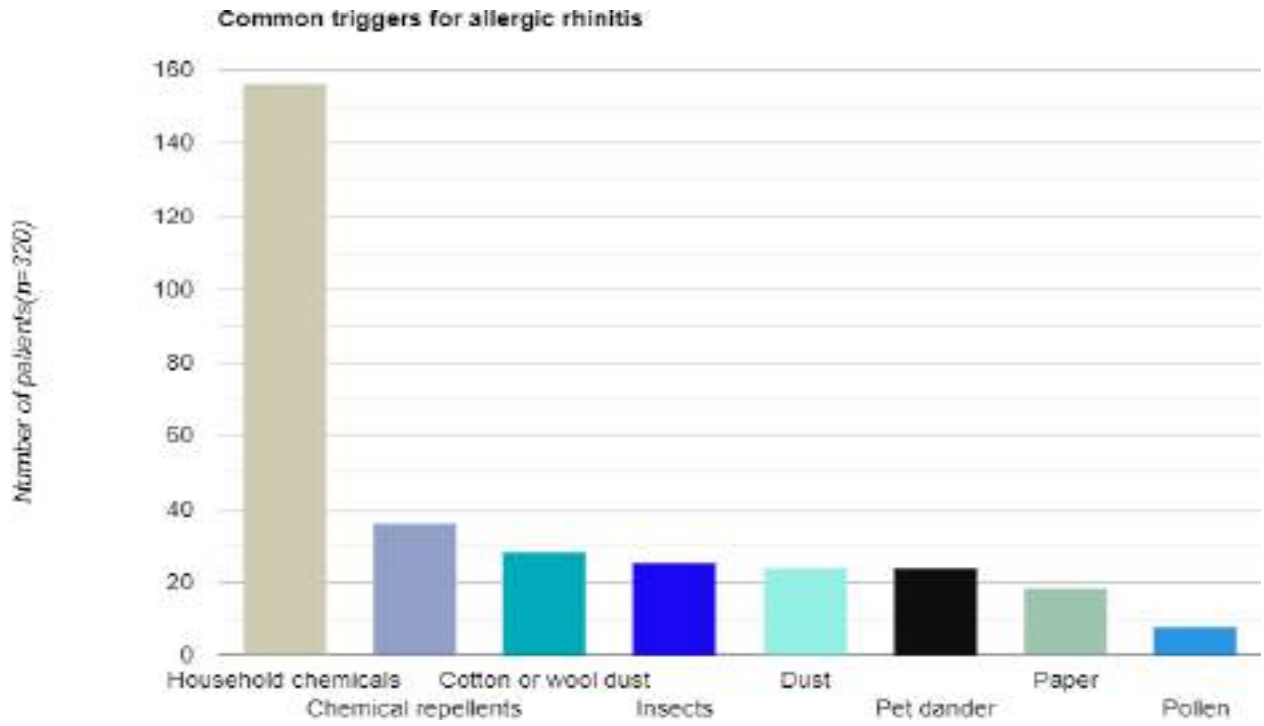


Fig.23 Common triggers for allergic rhinitis

Patients were each asked to document their commonest triggers for allergic rhinitis. The three commonest triggers were household chemicals, chemical repellents and cotton/wool dust. Of the 319 patients for whom data was available, almost half of them (156 patients; 49%) reported household chemicals as their trigger for allergic rhinitis. This included substances such as detergents, commonly used spices such as turmeric, coriander powder, black pepper, red chilli powder, asafoetida, garam masala and other spice mixtures containing preservatives and colorants. This category also included agarbatti (incense sticks), bleaching powder used for cleaning and slaked lime powder used for white washing walls.

Chemical repellents such as pyrethrin dust, mosquito coils and other pesticides such as boric acid powder were reported by 36 patients (11.3%). 28 patients (8.8%) reported allergic manifestation with exposure to cotton or wool dust. All of these triggers are largely used indoors and this finding is consistent with the other finding we noted which was that most patients are symptomatic indoors rather than outdoors. A summary of common allergens that triggered symptoms in our cohort are as follows:

ALLERGEN	NUMBER OF PATIENTS(n=319)	PERCENTAGE
Household chemicals	156	49%
Chemical repellents	36	11.3%
Cotton/wool dust	28	8.8%
Insects	25	7.8%
Dust	24	7.5%
Pet dander	24	7.5%
Paper	18	5.6%
Pollen	8	2.5%

Table 22. Number of patients with various allergen triggers

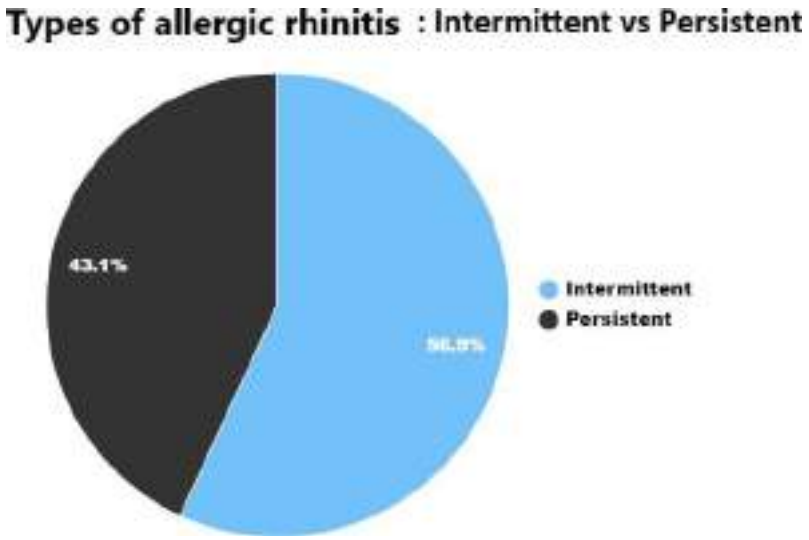


Fig.24 Types of allergic rhinitis: Intermittent vs Persistent

Type of allergic rhinitis	Number of patients	Percentage
Intermittent	182	56.9%
Persistent	138	43.1%

Table 23. Distribution of types of allergic rhinitis

According to ARIA criteria, 'intermittent' is the term used to define symptoms of allergic rhinitis present for less than 4 days a week or for less than 4 weeks. The term 'persistent' means that symptoms are present for more that 4 days a week and more than 4 weeks. Of the 320 patients enrolled in the study,182 patients (56.9%) had intermittent symptoms and 138 (43.1%) of them had persistent symptoms.

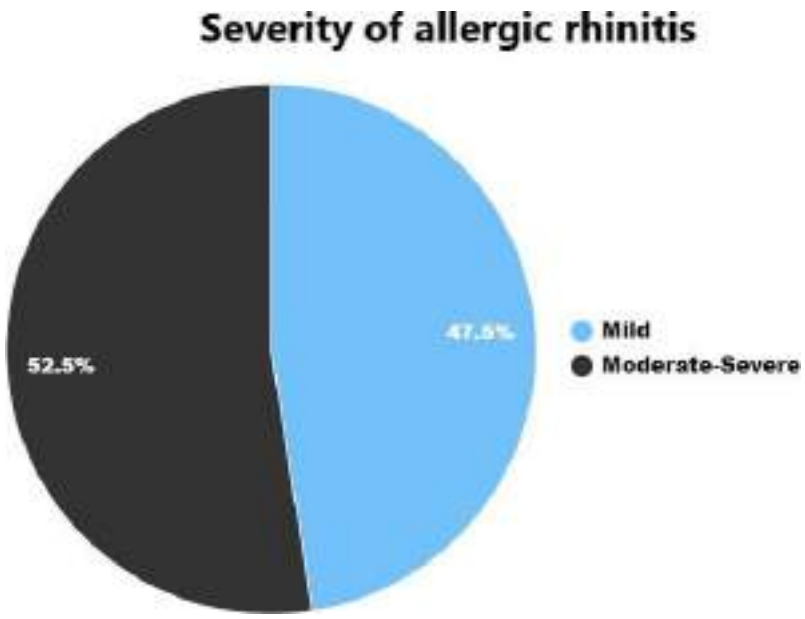


Fig.25 Severity of allergic rhinitis

Severity of disease	Number of patients	Percentage
Mild	152	47.5%
Moderate-severe	168	52.5%

Table 24. Distribution of severity of allergic rhinitis

According to ARIA criteria, allergic rhinitis is described as ‘mild’ when patients have no impairment in sleep and are able to perform normal activities (including work or school). Mild disease was reported in 152 patients (47.5%). A greater number of patients (168 patients; 52.5%) had moderate-severe disease which means that their symptoms were troublesome. This suggests that patients who had moderate-severe disease were more likely to seek medical advice than those with mild disease or did not respond to existing therapy, if it had been started.

Type of allergic rhinitis	Number of patients with mild disease(n=152)	Number of patients with moderate-severe disease(n=168)
Intermittent(n=182)	112(35%)	70(21.9%)
Persistent(n=138)	40(12.5%)	98(30.6%)

Table 25. Distribution of intermittent and persistent allergic rhinitis according to severity (n=320)

Overall, moderate/severe disease was more prevalent (52.5%) than mild (47.5%) disease. Of 152 patients (47.5%) with mild disease, 112 patients (35%) of the cohort had intermittent, mild allergic rhinitis while 70 patients, (21.9%) had intermittent, moderate/severe disease. Among those 168 patients (52.5%) with persistent disease, 98 patients (30.6%) had allergic rhinitis that was moderate/severe. Only 40 patients had persistent allergic rhinitis which was mild in severity.

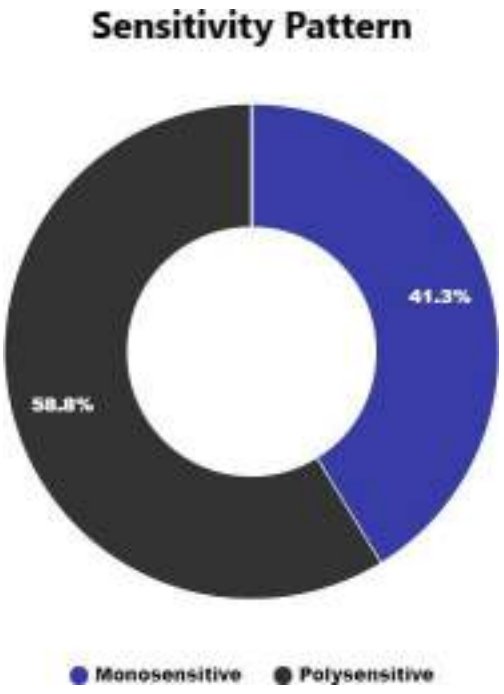


Fig.26 Sensitivity pattern on allergen skin tests

Sensitivity pattern	Number of patients	Percentage
Monosensitive	132	41.2%
Polysensitive	188	58.8%

Table 26. Sensitivity patterns among patients on allergen skin tests

In this cohort, more patients (188 patients, 58.8%) were polysensitive than monosensitive (132 patients, 41.2%). A polysensitive result on allergen skin test implies that more than one positive response was obtained on allergen skin test.

Types of allergens

Fig.27 Classification of allergens

Inhalant allergen on skin test	Number of patients positive	Number of patients negative
Dustmite- D.pteronyssinus	**190(59.4%)**	130(40.6%)
Dust mite- D.farinae	**181(56.6%)**	139(43.4%)
House dust	94(29.4%)	226(70.6%)
Cockroach	76(23.8%)	244(76.2%)
Cotton dust	47(14.7%)	273(85.3%)
Parthenium hysterophorus	33(10.3%)	287(89.7%)

Cat dander	29(9%)	291(91%)
Wheat dust	16(5%)	304(95%)

Table 27. Types of allergens administered on AST, sensitivity

The most common inhaled allergens for which patients tested positive were dust mites, D.pteronyssinus and D.farinae. Of these, a slightly greater number (59.4%) tested positive for D.pteronyssinus than D.farinae (56.6%). House dust (29.4%) and cockroach (23.8%) were the next most common allergens, indicating a greater preponderance of indoor allergen triggers. Parthenium (10.3%), an outdoor allergen, was, therefore, less commonly seen as a trigger.

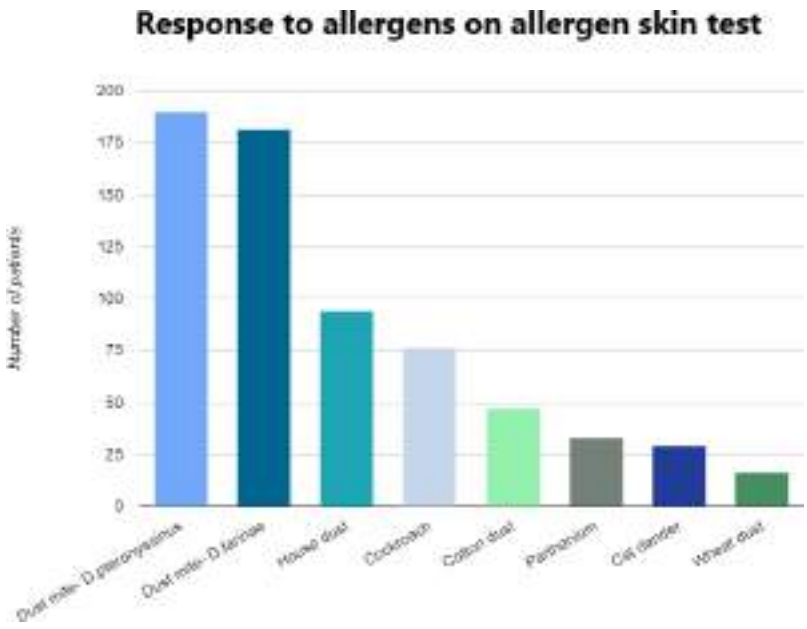


Fig.28 Types of inhaled allergens administered on allergen skin test

Additional allergen test	Number of patients tested	Number of patients positive
Prawn	50	16(32%)
Crab	40	8(20%)
Beef	14	0
Egg	13	0
Curd	17	3(17.6%)
Brinjal	106	14(13.2%)
Banana	39	5(12.8%)
Guava	21	1(4.8%)
Lemon	17	6(35.3%)

Table 28. Commonest food allergens tested

Food allergen testing was performed on select patients who complained of food allergy when this was enquired into. Table 12 indicates the commonest food allergens tested among patients enrolled. These were tested in addition to the 8 extracts in the common allergen panel. The commonest food allergen was lemon (35.3%). Despite 106 of the 320 patients (33%) reporting allergic symptoms with consumption of brinjal, only 14(13.2%) had a positive response to the same on allergen skin test. A positive skin allergen test was commonly seen with sea food particularly prawn and crab. Surprisingly, no patient had a positive test to either beef or egg.

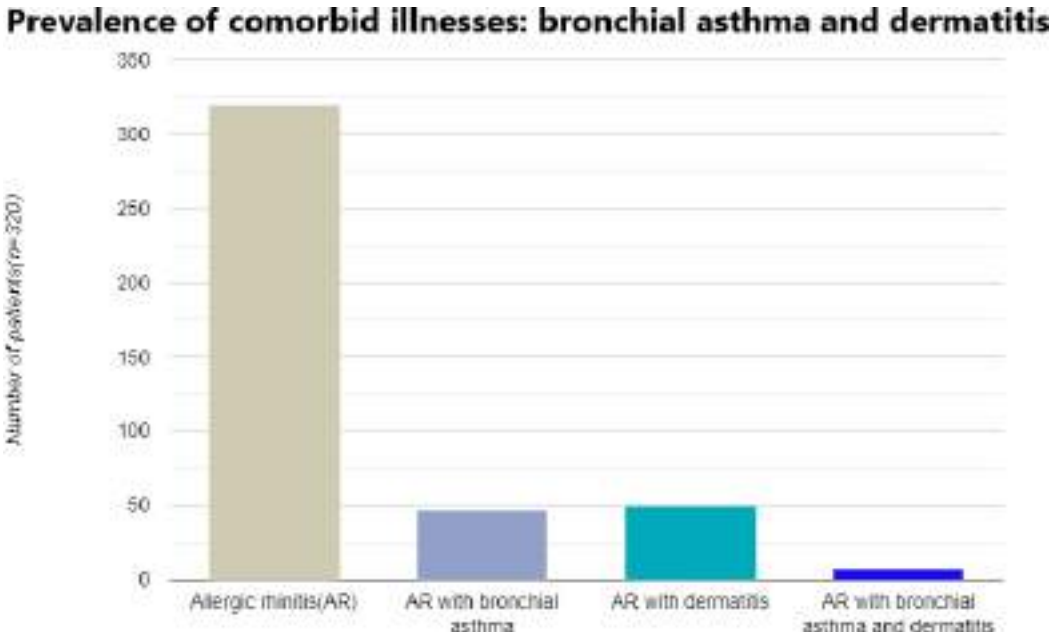


Fig.29 Prevalence of bronchial asthma and dermatitis associated with allergic rhinitis

Among the study population with allergic rhinitis, the prevalence of bronchial asthma and dermatitis was determined. Features suggestive of bronchial asthma and allergic dermatitis were seen in 46 (14.4%) and 49 (15.3%) of the 320 patients respectively. A combination of both bronchial asthma and dermatitis was seen in 7 individuals. At least of the two comorbid illnesses i.e bronchial asthma and dermatitis were seen among 88 (27.5%) of the 320 patients.

Comparison of monosensitive and polysensitive patients in terms of various parameters

In order to see if there were differences between monosensitive and polysensitive patients, we compared the two groups in terms of common variables, viz. age, sex, location triggering symptoms, occupation, type of allergen exposed to at home, nasal symptoms like nasal block, nasal discharge and sneezing, ocular symptoms like epiphora and itching of

eyes, seasonal triggers,diurnal variation in symptoms, severity, seasonal exacerbation and association with bronchial asthma and allergic dermatitis. The results of this analysis were as follows:

a) Age wise comparison of those with monosensitivity vs polysensitivity

	Monosensitivity(n=132)	Polysensitivity(n=188)	
18-25 years(91)	39(29.5%)	52(27.7%)	
26-35 years(132)	50(37.9%)	82(43.6%)	p=0.829
36-45 years (46)	20(15.2%)	26(13.8%)	
46-55 years(38)	16(12.1%)	22(11.7%)	
>55 years(13)	7(5.3%)	6(3.2%)	

Table 29

Most patients with allergic rhinitis were aged less than 35 years (223 patients; 69.6%). There appeared to be an almost equal percentage of patients in both the monosensitive and polysensitive groups in all age groups, with the greatest difference (5%) in the 26-35 years age group. This difference was not statistically significant, however (p=0.829).

b) Gender wise comparison of those with monosensitivity vs polysensitivity

	Monosensitivity(n=132)	Polysensitivity(n=188)	
Male	87(65.9%)	113(60.1%)	p=0.34
Female	45(34.1%)	75(39.9%)	

Table 30

Among males, 5.8% more men were found to be monosensitive (65.9%) than polysensitive (60.1%). In contrast, among females, 5.8% more women were polysensitive (39.9%) than monosensitive (34.1%). However, no significant difference was found between monosensitivity and polysensitivity when the genders were compared(p=0.34).

c) Comparison of those with monosensitivity vs polysensitivity as per state of origin

	Monosensitivity(n=132)	Polysensitivity(n=188)	
West Bengal	51(38.6%)	71(37.8%)	p=0.8
Tamil Nadu	14(10.6%)	13(6.9%)	
North Eastern States	1(0.8%)	2(1.1%)	
Bangladesh	31(23.5%)	49(26.1%)	
Others	35(26.5%)	53(28.2%)	

Table 31

More patients appeared to be polysensitive than monosensitive among patients who came from all the states except West Bengal and Tamil Nadu. Even in these 2 states, the difference between the 2 groups was minimal. Overall, there appeared to be no significant difference between patients who were monosensitive versus polysensitive based on their state of origin, even though these states were geographically several hundred kilometres apart (p=0.8).

d) Comparison of those with monosensitivity vs polysensitivity as per urban or rural place of residence

	Monosensitivity(n=132)	Polysensitivity(n=188)	
Urban	81(61.4%)	109(58.0%)	p=0.54
Rural	51(38.6%)	79(42.0%)	

Table 32

Among patients from urban areas, more were likely to be monosensitive (61.4%) than polysensitive (58%). In contrast, among patients who came from rural areas, more patients were polysensitive than monosensitive. Yet, no significant difference was found between monosensitivity and polysensitivity despite their locality of residence(P=0.54).

e) Comparison of those with monosensitivity vs polysensitivity as per occupation

	Monosensitivity(n=132)	Polysensitivity(n=188)	
Housewife	27(20.5%)	49(26.0%)	p=0.26
Unemployed	11(8.3%)	12(6.4%)	
Student	34(25.7%)	47(25.0%)	
Unskilled workers	5(3.8%)	15(8.0%)	
Skilled workers	21(15.9%)	15(8.0%)	
Professional	19(14.4%)	24(12.8%)	
Business	15(11.4%)	26(13.8%)	

Table 33

In the monosensitive group 25.7% were students, 20.5% were students and 15.9% were skilled workers. In the polysensitive group 26% were housewives, 25% were students and 13.8% were those pursuing business. Most patients in both monosensitive and polysensitive categories belonged to occupations that spent more time indoors. Using the

Pearson Chi-square test, no difference was found in monosensitivity and polysensitivity among the various occupations(P=0.26).

f) Comparison of those with monosensitivity vs polysensitivity as per type of allergen exposed to at home

	Monosensitivity(n=132)	Polysensitivity(n=188)	
Household chemicals	56(42.4%)	100(53.5%)	p=0.22
Chemical repellants	14(10.6%)	22(11.8%)	
Cotton/wool	10(7.6%)	18(9.6%)	
Paper	11(8.3%)	7(3.7%)	
Dust	13(9.8%)	11(5.9%)	
Pet dander	10(7.6%)	14(7.5%)	
Insects	14(10.6%)	11(5.9%)	
Pollen	4(3.0%)	4(2.1%)	

Table 34

In both the monosensitive and polysensitive groups, a large majority (42.4% and 53.5% respectively) reported household chemicals as their trigger for allergic rhinitis. This included substances such as detergents, commonly used spices mixtures containing preservatives and colorants, bleaching powder used for cleaning and slaked lime powder used for white washing walls.

In the monosensitive group, the next common triggers were chemical repellants and insecticides (10.6% each). Among those that were polysensitive, the second and third common triggers were chemical repellants (11.8%) and cotton/wool (9.6%).

All of these triggers are largely used indoors and this finding is consistent with the other finding we noted which was that most patients are symptomatic indoors rather than outdoors.Using the Pearson Chi-square test, we found no difference between patients with monosensitivity and polysensitivity in terms of the allergen triggers reported (p=0.22).

g) Relationship between nasal block and polysensitivity versus monosensitivity in patients with AR (n=320)

	Monosensitivity(n=132)	Polysensitivity(n=188)	
Nasal block present	93(70.5%)	153(81.4%)	p=0.02
Nasal block absent	39(29.5%)	35(18.6%)	

Table 35

A large majority (81.4%) of patients that tested polysensitive had nasal block as a primary symptom and 18.6% did not. Among those that tested monosensitive, only 70.5% of patients had nasal block in comparison.

Pearson Chi-square test was used to compare the presence or absence of nasal block in patients with monosensitivity and polysensitivity and the results were significant(p=0.02). Thus, a patient who was polysensitive was more likely to have nasal block as a symptom than a patient who was monosensitive.

h) Relationship between nasal discharge and polysensitivity versus monosensitivity in patients with AR (n=320)

	Monosensitivity(n=132)	Polysensitivity(n=188)	
Nasal discharge present	104(78.8%)	162(86.2%)	p=0.08
Nasal discharge absent	28(21.2%)	26(13.8%)	

Table 36

Among patients with polysensitivity, 86.2% of them had nasal discharge as a primary symptom whereas 13.8% did not complain of the same. In the monosensitive group only 78.8% of patients reported similar complaints of nasal discharge, in comparison.

However, comparing data on the presence or absence of nasal discharge in patients with monosensitivity and polysensitivity, the results were not significant(p=0.08).

i) Relationship between sneezing and polysensitivity versus monosensitivity in patients with AR (n=320)

	Monosensitivity(n=132)	Polysensitivity(n=188)	
Sneezing present	110(83.3%)	164(87.2%)	p=0.3
Sneezing absent	22(16.7%)	24(12.8%)	

Table 37

Among patients with polysensitivity, 87.2% of them had sneezing as a primary symptom whereas 12.8% did not complain of the same. In the monosensitive group 83.3% of patients reported of nasal discharge and 16.7% did not have sneezing as one of their symptoms. Pearson Chi-square test was used to compare the presence or absence of sneezing in patients with monosensitivity and polysensitivity. The results were not significant(p=0.3). Thus sneezing per se did not distinguish polysensitive from monosensitive patients.

j) Relationship between epiphora and polysensitivity versus monosensitivity in patients with AR (n=320)

	Monosensitivity(n=132)	Polysensitivity(n=188)	
Epiphora present	85(64.4%)	133(70.7%)	p=0.2
Epiphora absent	47(35.6%)	55(29.3%)	

Table 38

Epiphora was a primary symptom in 70.7% of patients with polysensitivity and absent in 29.3% of the patients. In the monosensitivity group, epiphora was present among 64.4% and 35.6% had no such symptom associated with allergic rhinitis. Pearson Chi-square test was used to compare the presence or absence of epiphora in patients with monosensitivity and polysensitivity. The results were not significant(p=0.2). Thus, despite the considerably greater prevalence of epiphora among polysensitive individuals, no difference was evident between the groups.

k) Relationship between itching of eyes/skin and polysensitivity versus monosensitivity in patients with AR (n=320)

	Monosensitivity(n=132)	Polysensitivity(n=188)	
Itching skin/eyes present	82(62.1%)	134(71.3%)	p=0.08
Itching skin/eyes absent	50(37.9%)	54(28.7%)	

Table 39

Majority (71.3%) of patients that tested polysensitive had itching of skin and eyes as a primary symptom and 28.7% did not. Among those that tested monosensitive, 62.1% of patients had similar complaints and 37.9% did not.Data on the presence or absence of itching of skin/eyes in patients with monosensitivity and polysensitivity was compared.The results were not significant(p=0.08).

l) Relationship between seasonal exacerbation and polysensitivity versus monosensitivity in patients with AR (n=320)

	Monosensitivity(n=132)	Polysensitivity(n=188)	
Summer	11(8.3%)	15(8.0%)	
Rainy	52(39.4%)	73(38.8%)	

Winter	39(29.5%)	38(20.2%)	
Weather change	11(8.3%)	39(20.7%)	p=0.03
Spring	19(14.4%)	23(12.2%)	

Table 40

Patients who were polysensitive were more likely to be symptomatic during a change in weather (20.7%) than patients who were monosensitive (8.3%). This difference was statistically significant (p=0.03). Pearson Chi-square test was used to compare seasonal exacerbation of symptoms with monosensitivity and polysensitivity.

m) Relationship between diurnal variation and polysensitivity versus monosensitivity in patients with AR (n=320)

	Monosensitivity(n=132)	Polysensitivity(n=188)	
Morning	114(87.0%)	169(90.4%)	p=0.44
Afternoon	9(6.9%)	7(3.7%)	
Night	8(6.1%)	11(5.9%)	

Table 41

Majority of patients reported that they had maximum allergic symptoms in the morning hours i.e 87% in the monosensitive group and 90.4% in the polysensitive group. Pearson Chi-square test was used to compare diurnal variation of symptoms in monosensitive and polysensitive groups. The results were not significant(p=0.44).

n) Relationship location of maximum symptoms and polysensitivity versus monosensitivity in patients with AR (n=320)

	Monosensitivity(n=132)	Polysensitivity(n=188)	
Indoors	95(72.0%)	115(61.5%)	p=0.1
Outdoors	37(28.0%)	72(38.5%)	

Table 42

Variation of symptoms in monosensitive and polysensitive groups with exposure to both indoor and outdoor allergens was compared. More patients who were monosensitive (71.9%) than polysensitive (61.5%) reported that they had maximum allergic symptoms indoors. This difference was not statistically significant(p=0.1).

o) Relationship between positive family history and polysensitivity versus monosensitivity in patients with AR (n=320)

	Monosensitivity(n=132)	Polysensitivity(n=188)	
Absent	102(77.3%)	137(73.3%)	
Mother	18(13.6%)	30(16.0%)	p=0.8
Father	8(6.1%)	13(7.0%)	
Grandmother	2(1.5%)	1(0.5%)	
Grandfather	0(0%)	1(0.5%)	
Sister	1(0.8%)	4(2.1%)	
Brother	1(0.8%)	1(0.5%)	

Table 43

Over 70% of patients in both groups did not have a significant family history of allergic diseases. Among those with a positive family history, most patients reported a maternal history of allergies (13.6% in the monosensitive group and 16% in the polysensitive group). The difference between monosensitive and polysensitive groups was not significant, however(p=0.8).

p) Relationship between severity and polysensitivity versus monosensitivity in patients with AR (n=320)

	Monosensitivity(n=132)	Polysensitivity(n=188)	
Mild	87(65.9%)	65(34.6%)	p=0.00
Moderate-severe	45(34.1%)	123(65.4%)	

Table 44

In the monosensitive group, the majority of the patients (65.9%) had mild symptoms while in the polysensitive group, the majority (65.4%) had moderate-severe symptoms.

The difference in the severity of disease was statistically significant(p=0.00).

q) Relationship between type of allergic rhinitis and polysensitivity versus monosensitivity in patients with AR (n=320)

	Monosensitivity	Polysensitivity	
Intermittent	71(53.8%)	111(59%)	p=0.35
Persistent	61(46.2%)	77(41%)	

Table 45

Among patients with polysensitivity, 59% of them had intermittent allergic rhinitis whereas in the monosensitive group 53.8% of patients reported intermittent disease. Persistent disease was also similarly distributed (41% versus 46.2%, respectively). On comparing intermittent and persistent diseases in patients with monosensitivity and polysensitivity, no significant difference was found between the two groups(p=0.35).

r) Comparison of those with monosensitivity vs polysensitivity in allergic rhinitis with dermatitis

	Monosensitivity	Polysensitivity	
Dermatitis present	25(18.9%)	24(12.8%)	p=0.13
Dermatitis absent	107(81.1%)	164(87.2%)	

Table 46

In both monosensitive and polysensitive groups, majority of patients did not have associated allergic dermatitis (81.1% in monosensitive group and 87.2% in polysensitive group). Dermatitis was reported in 18.9% of those with monosensitivity and 12.8% of those with polysensitivity. Results were compared and they were not statistically significant(p=0.13).

s) Comparison of those with monosensitivity vs polysensitivity in allergic rhinitis with bronchial asthma

	Monosensitivity	Polysensitivity	
Bronchial asthma present	19(13.6%)	27(14.9%)	p=1
Bronchial asthma absent	114(86.4%)	160(85.1%)	

Table 47

Among patients that are monosensitive, 13.6% had associated bronchial asthma while among polysensitive patients, 14.9% had associated bronchial asthma. Overall, most patients in both groups did not have bronchial asthma. Pearson Chi-square test was used to compare the 2 groups and the difference was not statistically significant (p=1)

Diagnosis	Monosensitive	Polysensitive	p
Allergic rhinitis	132(41.3%)	188(58.7%)	
Allergic rhinitis without comorbid illness	94(29.4%)	138(43.1%)	0.70
Allergic rhinitis with bronchial asthma	19(5.9%)	27(8.4%)	1.00
Allergic rhinitis with dermatitis	25(7.8%)	24(7.5%)	0.15
Allergic rhinitis with at least one of the comorbidities-asthma or dermatitis	38(11.8%)	50(15.6%)	0.70

Table 48. Sensitivity patterns among allergic rhinitis alone and along with comorbid illnesses

We compared monosensitive and polysensitive patients in terms of whether they had allergic rhinitis alone or allergic rhinitis with bronchial asthma and dermatitis. More patients with one of the coexisting diseases appeared to be polysensitive than monosensitive. However, the difference was not statistically significant (p=0.70). Demographic factors showed no association with polysensitivity on univariate analysis as seen above. Risk factors related to symptomatology were then analysed.

Univariate analysis of risk factors for polysensitivity was performed using 6 different variables to see which of these factors predisposed to polysensitivity. These variables were:

i. Nasal block
ii. Nasal discharge
iii. Itching of eyes
iv. Seasonal exacerbation
v. Indoors vs outdoors
vi. Severity of disease (as determined by ARIA classification)

Table 49. Univariate analysis of risk factors for poly sensitivity in patients with AR (n=320)

Variables	Patients with poly-sensitivity	%	Patients with mono-sensitivity	%	Univariate analysis O.R.	95% C.I.	p
Nasal block							
• Present	153	81.4%	93	70.5%	1.833	1.08,3.09	**0.023**
• Absent	35	18.6%	39	29.5%			
Nasal discharge							
• Present	162	86.2%	104	78.8%	1.677	0.93,3.01	0.084
• Absent	26	13.8%	28	21.2%			
Itching skin/eyes							
• Present	134	71.3%	82	62.1%	1.513	0.94,2.42	0.086
• Absent	54	28.7%	50	37.9%			
Location							
• Indoors	115	61.5%	95	71.9%	0.622	0.38,1.00	0.1
• Outdoors	72	38.5%	37	28.0%			
Severity							
• Mild	65	34.6%	87	65.9%	3.658	2.28,5.84	**<0.0001**
• Moderate-severe	123	65.4%	45	34.1%			
Seasonal exacerbation							**0.03**
• Summer	15	8.0%	11	8.3%			
• Rain	73	38.8%	52	39.4%			
• Winter	38	20.2%	39	29.5%			
• Weather change	39	20.7%	11	8.3%			
• Spring	23	12.2%	19	14.4%			

The results of univariate analysis showed that patients who were monosensitive resembled those who were polysensitive in terms of several demographic and clinical features. A few differences between the two groups was evident, however. The finding of significance in this study was that patients with polysensitivity appear to have a more severe type of allergic rhinitis than those with monosensitivity (p=0.00). The other significant differences between these two groups of patients were that polysensitive patients were more likely to have nasal block and greater seasonal exacerbation of allergic symptoms.

We then conducted a multivariate analysis of risk factors to see if any of the risk factors significant on univariate analysis were significant on multivariate analysis too. Our results were as follows:

Table 50. Multivariate analysis of risk factors for polysensitivity in patients with AR (n=320)

Variables	Patients with poly-sensitivity	%	Patients with mono-sensitivity	%	Multivariate analysis O.R.	95% C.I.	p
Nasal block							
• Present	153	81.4%	93	70.5%	**1.814**	1.01, 3.25	**0.04***
• Absent	35	18.6%	39	29.5%			
Nasal discharge							
• Present	162	86.2%	104	78.8%	1.152	0.60, 2.18	0.66
• Absent	26	13.8%	28	21.2%			
Itching skin/eyes							
• Present	134	71.3%	82	62.1%	1.255	0.74, 2.11	0.39
• Absent	54	28.7%	50	37.9%			
Location							
• Indoors	115	61.5%	95	71.9%	0.757	0.43, 1.32	0.93
• Outdoors	72	38.5%	37	28.0%			
Severity							
• Mild	65	34.6%	87	65.9%	**3.712**	2.28, 6.02	**0.000***
• Moderate-severe	123	65.4%	45	34.1%			
Seasonal exacerbation							
• Summer	15	8.0%	11	8.3%	0.99	0.79, 1.23	0.93
• Rain	73	38.8%	52	39.4%			
• Winter	38	20.2%	39	29.5%			
• Weather change	39	20.7%	11	8.3%			
• Spring	23	12.2%	19	14.4%			

Multivariate analysis of risk factors showed that only nasal block and severity of disease (as per the ARIA classification) were associated with polysensitivity. Thus, a patient with nasal block was 1.8 times more likely to be polysensitive than monosensitive. Similarly, a patient with moderate/severe allergic rhinitis was 3.7 times more likely to be polysensitive than monosensitive. Seasonal exacerbation, although significant on univariate analysis was not found to be significant on multivariate analysis.

DISCUSSION

The study was designed to assess the relationship of sensitization patterns (monosensitivity and polysensitivity) with severity of allergic rhinitis among adult patients. Outpatient charts were analysed and patients with clinical suspicion of allergic rhinitis with a positive skin allergy test were recruited retrospectively for the study. A total of 320 patients, 18 years and older were enrolled into the study.

Age distribution among those diagnosed with allergic rhinitis

Assessment of the age distribution in the cohort indicated that the disease prevalence was greater among young adults. The disease presentation was maximum between the ages of 18 and 35 years prior to and following which there was a descending trend in prevalence. A similar hospital- based study on 2883 outpatients visiting a hospital in the Republic of Korea, found that the prevalence of allergic rhinitis showed a progressive decline after peaking at 20-29 years of age(89)**.** A study by Alsowaidi et al (90) on school-children aged 13 years and older along with their parents, reported a significantly higher prevalence of allergic rhinitis in those aged 19 and older compared to other age groups. Ng and Tan(91) studying a cross-section of adults in the community aged 20 -74 years in Singapore found that the highest prevalence of allergic rhinitis was in the 20 to 39 year age group. A community- based study on adults aged 30 years and over from New Delhi, India also reported that two thirds of their symptomatic individuals belonged to the youngest group with ages that ranged from 30 to 49 years(4).

The increased prevalence of allergic rhinitis at a younger age has been sometimes ascribed to the “allergic march” where symptoms of skin rashes and food allergies in

childhood precede the onset of allergic rhinitis in late adolescence and young adulthood(92). Such individuals show progressive features of allergic sensitisation.

Gender predisposition in allergic rhinitis

In this study most of the patients were males (65.5%), reflecting a greater utilisation of medical care by male patients. Similarly, the CARAS survey (Coexistence of Allergic Rhinitis and Asthma) by Jaggi et al(32) which was a community -based study performed in 10 cities of India to determine the coexistence of allergic rhinitis and asthma, found higher prevalence of concomitant allergic rhinitis and asthma among males as compared to females. Cirillo et al(88) who compared sensitization evaluated by skin prick test with the well-being of the patient, found that polysensitization was greater among males than females and was associated with poorer quality of life. Alsowaidi et al(90) also found that among their study population of 6543 school-children and parents, there were more (53%) boys than girls in the cohorts. In a community-based study by Sinha et al(4) from India which assessed the risk factors of allergic rhinitis, more than half the study population were constituted by males. The sole study which found a female preponderance of AR (61.1%) was a hospital-based study on adults from Malaysia(93).

Occupational distribution

Among study participants, it was found that most patients with symptoms were students and housewives, followed by professionals. In a cross-sectional study done in India among 1200 individuals by Sinha et al(4), 132 (11%) were clinically diagnosed with allergic rhinitis. Among the patients, a large number of men were employed in semiskilled/unskilled work(32%) and among the women, 80% were housewives**(9)**. All of these individuals spent

more time indoors which corresponded with increased exposure to indoor allergens. There is data that indicates that control of indoor allergen volume can reduce allergic diseases. Park et al(95) reported that use of air purifiers with HEPA filters significantly limited allergies and reduced need for medication among those symptomatic. The presence of several low and high molecular weight inhalant allergens was reported in a study by Moscato et al(96) that assessed the prevalence of occupational rhinitis. It was noted that pesticides, cleaning agents and paints were responsible for allergic manifestations in many individuals with occupational exposure to the same. Similarly, a study done in Denmark(94) found that exposure to wheat and rye flour among new bakers triggered the onset of allergy and asthma-like symptoms.

Area-wise distribution of allergic rhinitis

Most of the patients (38.1%) came to our hospital from West Bengal and Bangladesh. Data on allergic rhinitis from India is limited. According to a study published by Sinha et al(4), the prevalence of allergic rhinitis in Delhi among adults in the community was 11% . The CARAS survey which determined the prevalence of concomitant allergic rhinitis and asthma across India, showed that the southern states had a prevalence as high as 80%(32). Since many of our patients came from different parts of the country and only 8.4% patients i.e 27 of 320 belonged to Tamil Nadu, this cohort cannot be considered a homogenous group. Environmental exposure to aeroallergens at their place of residence, may be responsible for sensitization, despite any ethnic(97). The allergen extracts used for skin allergen tests are usually specific to that particular geographic location to which the population is sensitized. The allergen extracts used in this study and in our hospital are made from allergens available in India. However, some regional differences may occur and

hence, negative results may not indicate a lack of allergy to a particular allergen.

Urban vs rural location

A total of 190 of the 320 patients (59.4%) recruited for the study resided in an urban locality while 130 (40.6%) resided in a rural area. Although not statistically significant, as most of our patients were from outside Tamil Nadu, this pattern was consistent with higher number of urban patients likely to travel for healthcare from these areas. Mahesh et al(97) in a study based in Mysuru, India, found that the area of residence, whether urban or rural, was significantly associated with sensitization to different allergens. The authors found that younger patients (< 21 years) from rural areas had higher sensitization to fungal allergens whereas younger patients from urban areas had greater sensitization to cockroaches. No such differences were noted in older subjects. Data from other parts of the world suggest that greater sensitization is significantly associated with urbanization(98–100)**.**

Allergic rhinitis and diurnal variation

Majority of the patients had maximum symptoms in the morning hours. No association was found between the time of the day and allergic symptoms, however. In contrast, Storms et al(101) found that nasal congestion followed a diurnal rhythm and was worst in the night and early morning.

Positive family history of allergic rhinitis

Our study did not show any association between the presence of allergic rhinitis and a family history of allergy. In contrast, Sinha et al(4) found that a family history of atopy in a first degree relative increases the odds of an individual having allergic rhinitis . Some authors have also found that a positive family history is considered significant when allergic

rhinitis and asthma coexist(32). Asha'ari et al(8)(8) showed that despite the presence of allergy among first degree relatives in most patients, this was not associated with the severity or chronicity of allergic rhinitis.

Symptoms of allergic rhinitis

In our study, we analysed the prevalence of each of the allergic symptoms and the most common ones were sneezing(seen in 85.6% of the patients), rhinorrhoea(in 83.4%) and nasal block(among 76.8%). Our findings are similar to the results of several other studies where sneezing, nasal itching and rhinorrhoea were the main presenting symptoms and nasal block was less common(4,32,93,102)**.** Asha'ari et al(93) did an epidemiological study in Malaysia where they evaluated 142 patients who were diagnosed with allergic rhinitis, both clinically and via skin allergy test. Nasal itching and sneezing were the main presenting complaints and these symptoms were mostly seen among those with intermittent allergic rhinitis($p<0.05$). Sinha et al (4) studied the Indian population and their manifestations to aeroallergens. In this study, patients were recruited if they had intermittent or persistent features of allergic rhinitis as per ARIA guidelines. Out of the total study population, rhinorrhoea was the most prevalent clinical feature seen in 128 patients (i.e. 97%); more common in patients belonging to the 6^{th} decade of life. The other common features were nasal itching (88%), nasal block (74%) and sneezing (33%). It was also reported that 33% had coexisting asthma along with allergic rhinitis(4). Sleep disturbance was an additional statistically significant symptom seen in those with moderate-severe allergic rhinitis(93). According to data published by Jaggi et al(32) sneezing (71.78%) followed by watery, runny nose (63.59%) were the most common AR symptoms in a survey conducted across ten Indian cities. Long et al(102) reported that majority i.e. 85% of their

study population of 1000 individuals presented with nasal itchiness. This was followed by other symptoms such as sneezing, watery rhinorrhoea and nasal block. Besides the exposed allergens, environmental and genetic factors are believed to have played a role in the clinical variability of allergic rhinitis.

Common triggers

According to our study, common allergen triggers as reported by patients included household chemicals, chemical repellents and cotton/wool. Based on the allergen skin test, majority of patients had a positive response to dust mites 59.4% and 56.6% were sensitive to *D.pteronyssinus* and *D.farinae* respectively. Other allergens that a number of patients tested positive for, were house dust and cockroach. It was noted that almost all of these were indoor allergens. This was also consistent with the finding that maximum symptoms were seen while indoors. Most common allergens in the study by Asha'ari were dust mites and cat dander(93); the study also revealed that there was no significant link between severity of allergic rhinitis, asthma being a comorbid disease and urban living. According to the study by Sinha et al(4), lack of cross ventilation, overcrowding, exposure to tobacco smoke, occupational exposure to smoke/dust, clinical allergy and positive family history of allergies were seen to be significantly associated with allergic rhinitis on multivariate analysis. From the resultant ROC model, it was inferred a patient above 30 years of age, irrespective of gender and socioeconomic class, living in an overcrowded house with limited cross ventilation, who also had dust/smoke exposure, positive family history and clinical allergic manifestations has 80% probability of having allergic rhinitis. According to the data from CARAS survey(32), an important risk factor in the existence of a unified airway disease is the sensitization and exposure to household aeroallergens such as dust mites, cockroach

allergen, passive smoking, exposure to biomass fuel, and the presence of pets($p<0.05$). It was also noted that keeping pets indoors, increased the risk of allergic rhinitis and asthma coexistence by two folds.

Severity of AR

According the ARIA guidelines, allergic rhinitis is classified on the basis of severity into mild and moderate/severe. In this cohort 182 patients had intermittent type of allergic rhinitits with mild disease reported in 35% of the patients and 21.9% with moderate/severe allergic rhinitis. Among the 138 patients with persistent symptoms, 12.5% had mild symptoms and 30.6% had moderate/severe disease. The data indicate that most patients that tend to present to the hospital have moderate/severe disease. This finding was similar to that of Asha'ari and Bousquet(93) (103).

Asha'ari et al published a cross sectional study in which 90 patients were present at completion. 28 patients had intermittent type of allergic rhinitis of which 10% had mild and 21.1% had moderate/severe disease. In the same cohort, among the 62 patients with persistent allergic rhinitis, 20% had mild disease while 48.9% had moderate/severe disease. In another study by Bosquet et al, 3052 patients with allergic rhinitis(both clinically and on skin prick test) were recruited. Among the study population, 195 patients had mild allergic rhinitis (11% intermittent; 8% persistent type) and 2616 has moderate-severe disease (35% intermittent; 46% persistent disease). Moderate-severe allergic rhinitis has a significant impact on the patient's activities of daily living, work or sleep. This was reported by more than 80% of those with moderate-severe rhinitis and 40% of those with mild disease.

Polysensitisation versus monosensitisation: prevalence

Polysensitisation is an immunological response of the body to a variety of allergens (usually > 1 allergen) while monosensitisation is the production of an immunological response to a single allergen. The prevalence of polysensitisation and monosensitisation assumes great significance in the context of immunotherapy and this information has great epidemiological value too. In our study, 41.2% were monosensitive and 58.8% were polysensitive. Similar results have been described by other authors too. Kumar et al(78), studying patients aged < 45 years in Delhi, India, who were diagnosed to have allergic rhinitis or bronchial asthma or both found that monosensitisation was present in 44.4% of patients.

Ciprandi et al(104) studying a large cohort of 2415 subjects found that over ¾ of patients were polysensitised to a variety of allergens which included dust mites, grasses, tree pollens and molds. Only 25.7% of patients were monosensitised. Aburuz et al(87) reporting on a hospital- based cohort of patients diagnosed with allergic rhinitis from Jordan, found that only 9% of patients were monosensitised, the majority being polysensitised. Even among children, polysensitisation has been shown to be more common than monosensitisation. Bot et al(85) studying children aged 6-18 years diagnosed with allergic rhinitis found that 69% of children were polysensitised. In the study by Fiocchi(84), only 14% of children were monosensitised, the greater number being polysensitised. Ciprandi et al(82) suggest that polysensitisation starts in childhood itself and that monosensitisation is rare among adults. In their study they found that while 90% of their patients aged 3.5 to 65 years were polysensitised, only 10 % were monosensitised. While most studies show a greater degree of polysensitisation compared to monosensitisation, a relatively higher

degree of monosensitisation is seen in some Indian studies than the Western studies described above(78).

Comparison of monosensitive and polysensitive patients in terms of various parameters:

Polysensitisation versus monosensitisation: effect of age

Our data shows that the disease manifestation is maximum among the younger population who are between the ages of 18 and 35 years (69.6%), following which there is sharp fall in prevalence. Yet we did not find any association between polysensitisation and age (p=0.83). Ciprandi and Cirillo(77) published a cross sectional study that evaluated allergic features and sensitization among 2415 individuals in Italy. It was found that the mean age in monosensitive and polysensitive groups were 25.6 and 24.2 years respectively; this difference was statistically insignificant. Asha'ari et al(93) recruited 142 patients aged 18 years and older into their study, in which mean age was 32.6 years. This study did not describe any correlation between age and sensitisation patterns. However, among patients older than 60 years with allergic rhinitis, it was reported that severity and sensitisation were less as compared to the rest of the study subjects(93,104). De Bot et al(85) studying 784 children aged 6-18 years with allergic rhinitis found that polysensitisation was more common among the younger (9-13 years) age group rather than the older (14-18 years) age group. Some studies have shown that polysensitisation increases with age. Silvestri et al(86) published a study done among 165 asthmatic children who were monosensitive. It was noted that 43.6% of them tested polysensitive with age in time for a second survey done 2-10 years later. Such changes in sensitisation may be related to environmental factors

wherein a person is exposed to a greater number of allergens with age and hence exhibits greater sensitisation.

Polysensitisation versus monosensitisation: effect of gender

The data on association between polysensitisation and gender is limited. Allergic rhinitis is a disease which is more commonly seen among male patients. The number of male patients were almost double that of females in our study. However, we did not find any association between polysensitisation and gender (p=0.34). Similarly, de Bot et al(85) studying 784 boys and girls found no significant increase in the prevalence of polysensitisation among either gender (p=0.11). In contrast, Kim et al(80) studying 130 children with allergic rhinitis found that while there were equal numbers of boys and girls in the monosensitised group, there were a little over double the number of boys as girls in the polysensitised group. In this cohort, polysensitisation was clearly almost twice as frequent among boys as girls.

Polysensitisation versus monosensitisation: effect of location of residence

Few studies have shown the association between place of residence and type of sensitisation. In our study, 59.4% of the patients resided in an urban locality while 40.6% resided in a rural area. As most of our patients were from outside Tamil Nadu, this pattern is consistent with a higher number of urban patients who are more likely to travel for healthcare services. We did not find any association between polysensitisation and place of residence (whether urban or rural) in our study. In contrast, Elholm et al(105) found that urban dwellers were more likely to be polysensitised than rural or farm dwellers. In their study, the authors reported on a cohort comprising of 184 males between the age of 30-40

years from 11 muncipalities in southwestern Copenhagen who were administered skin prick test and tested for serum IgE. Among these patients, 83% were born and raised in an urban setting, 15% were born and brought up in a town, 0.5% were born and raised in a rural locality, and 2% were born and raised on a farm. Those coming from an urban locality had an increased sensitivity to all tested allergens compared to those who came from all other areas(105). Song et al(106) reported that urban residence and polysensitisation were significantly associated among the elderly population in Korea. A greater exposure of urban dwellers to pollutants and, hence, more allergens could be the reason why polysensitisation is more common among those living in urban areas.

Polysensitisation versus monosensitisation: effect of occupation

We found that most patients with symptoms were students (81 patients; 25.3%) or housewives (76 patients, 23.8%) indicating that the allergen triggers that the patients were exposed to were located indoors. A study on occupation induced allergic rhinitis in Australia investigated 3 spice mill workers i.e the 3 index cases that reported work related upper and lower airway symptoms following exposure for 6-8 months. These patients previously had no similar symptoms and their response was assessed using skin prick test, serum IgE and pulmonary function tests. Only 2 of the 3 patients had atopy on skin prick test on the common allergen panel. But it was revealed that all 3 individuals were polysensitive to work-related allergens, the commonest ones being garlic powder and chilli pepper. Therefore, even among individuals who were previously asymptomatic, polysensitization was thought to increase the risk of developing allergic rhinitis and asthma(107).

In contrast, a German study among baker apprentices, comprised of 114 individuals analysed over 20 months, showed no such association. In this study the clinical profile of baker apprentices was determined using questionnaires, spirometry and skin prick test. The results of the study showed that the incidence of rhinitis, asthma and occupational sensitisation peaked at the end of 4 months but the study reported no significant correlation between allergic symptoms and sensitisation(94).

Polysensitisation versus monosensitisation: effect on nasal and eye symptoms

One of the risk factors for polysensistisation considered in this study was the

presence of nasal and eye symptoms. Symptoms of nasal block, discharge, sneezing and epiphora were specifically studied. A multivariate analysis showed that nasal block was correlated significantly with polysensitivity ($p=0.02$). No such association was found for any of the other symptoms, even though sneezing and nasal discharge were more commonly present overall. Similar findings were noted by Gelardi et al who also found that polysensitive patients had a greater likelihood of experiencing severe nasal obstruction($p=0.0006$), sneezing($p=0.0001$) and watery rhinorrhoea($p=0.014$) as compared to monosensitive patients(108). Ciprandi and Cirrillo(77) also noted a higher symptom score in polysensitised patients compared to monosensitised patients.

Polysensitisation versus monosensitisation: effect on coexistent bronchial asthma and dermatitis

Allergic rhinitis and asthma

Several studies from around the world have described the concurrent existence of allergic rhinitis and bronchial asthma (30,109). However, the association between bronchial asthma and allergic rhinitis and polysensitisation has not been extensively studied. In the study done by us, among patients who were found to be monosensitive, 13.6% had associated bronchial asthma while among polysensitive patients, 14.9% had associated bronchial asthma. There was, therefore no association between the presence of bronchial asthma and the presence of polysensitisation. Interestingly, Cirillo et al found that there was an inverse correlation between Asthma Quality of Life (AQLQ) scores and polysensitisation in patients with intermittent asthma. Ciprandi et al also reported on the association between polysensitisation and bronchial asthma.

Allergic rhinitis and dermatitis

In both monosensitive and polysensitive groups belonging to the study population, majority of patients did not have associated allergic dermatitis (81.1% in monosensitive group and 87.2% in polysensitive group). Dermatitis was reported in 18.9% of those with monosensitivity and 12.8% of those with polysensitivity.The prevalence of atopic dermatitis has been reported to be 1-3% by some authors and many of these patients are sensitive to aeroallergens/food allergens (110). In contrast, other authors have reported that atopic dermatitis and polysensitization were not significantly correlated(111). A study by Carlsen et al(112) showed that the severity of dermatitis and extent of involvement of the body are a

result of the duration of exposure to specific allergens, and not on the sensitivity pattern.

Polysensitisation versus monosensitisation: effect on severity of AR

Author/Year of study	Patient number; Age range	Study conclusion (with respect to sensitization and severity of disease):
Cirillo/2005	n=185 Mean age of 21.3 ± 3.7 years	Significant association between polysensitization and a poor quality of life (p=0.007)
Ciprandi/2008	n=418 Age range 35-65 years	Polysensitization is associated with natural progression of allergic rhinitis, not significant in predicting severity of allergic rhinitis or concomitant asthma(p=0.47)
Ciprandi, Cirillo/2011	n= 1958 Mean age 24.6± 5 years	Greater severity was significantly associated with polysensitivity(p<0.05)
Aburuz/2011	n= 538 Age:18 years and older	Greater severity was significantly associated with polysensitivity(p value not documented)
Kumar/2020	n= 183 Age range: 27.15 ± 12.64 years	Sensitization patterns and severity of disease were not statistically correlated(p=>0.05)
Our study	n=320 Age:18 yrs and older	Severity of allergic rhinitis and nasal block as symptom were significantly associated with polysensitivity. (p=0.0001)

Correlation between polysensitivity of skin allergy test and severity of allergic rhinitis

On of the important findings of our study is that the association between moderate-severe allergic rhinitis and polysensitivity is significant(p=<0.0001). Our findings are similar to that of other studies. The 2005 study by Cirillo(88) among 185 young men with

intermittent asthma looked at the association of sensitization and quality of life. In a polysensitized state, individuals are exposed and sensitized to more aeroallergens than those that are monosensitized. This also meant that their nasal and respiratory mucosa could remain in a state of persistent inflammation. Cirillo used this concept to describe the significant association between polysensitization and a poor quality of life**.**

In a cross-sectional observational study by Ciprandi and Cirillo(77) conducted in 2011, 2415 naval officers were assessed for allergic rhinitis. Those with history of asthma, upper respiratory infections or on immunotherapy were excluded from the study. Investigations revealed that majority of the study subjects (1824 patients; 74.3%) were polysensitized and 621 (25.7%) of them were monosensitized. It was noted that greater severity was significantly associated with polysensitivity.

Aburuz et al(87) conducted a study in a Jordanian population of 538 patients. The aim of the cross-sectional study was to evaluate the response to allergens, administered via skin allergy tests. Patients were classified based on seasonal and perennial symptoms. Grass and pollen triggered seasonal symptoms while animal dander and dust mite were noted to be common perennial allergens. These details were essential for counselling patients. This study also reported that there was a correlation between sensitization and severity of allergic rhinitis**.**

The POLISMAIL study was done in 26 provinces in Italy by Ciprandi et al(82).Among the target population of 418, 73% had persistent allergic rhinitis, 71.5% had symptoms that were moderately-severe. A large majority i.e 90% tested polysensitive on skin allergy tests while 10% tested monosensitive. Polysensitization is associated with natural progression of

allergic rhinitis and statistical analysis indicated that it was not significant in predicting severity of allergic rhinitis or concomitant asthma. However, it was noted that polysensitized patients were at risk of developing severe bronchial asthma. Polysensitivity is also of clinical significance in evaluating allergic rhinitis since specific immunotherapy can be considered as a method of management. In contrast to these studies, a study by Kumar et al on 183 patients with allergic rhinitis, showed no association between severity of rhinitis and polysensitivity.

Polysensitisation represents an immunological phenomenon that results from increased exposure to allergens with age or place of residence. The results of studies and showing its various associations is listed in Table 50. It may be associated with greater manifestations of allergy like bronchial asthma or allergic rhinitis and may be the cause for persistent inflammation along the respiratory tract. It is thus seen to be associated with greater frequency of nasal symptoms and severity in many studies, including the present study.

CONCLUSION

This study on adult Indian patients with allergic rhinitis provided many interesting findings. The study highlights the fact that allergic rhinitis, a common problem in young adults in India, is chiefly associated with multiple indoor allergens. The majority of these adults have polysensitisation. Although allergic rhinitis is associated with several symptoms, it is nasal block which shows the greatest association with polysensitisation. Further, polysenistisation is strongly associated with more severe disease. These findings have important clinical implications.

BIBLIOGRAPHY

1. Bousquet J, Khaltaev N, Cruz AA, Denburg J, Fokkens WJ, Togias A, et al. Allergic Rhinitis and its Impact on Asthma (ARIA) 2008*. Allergy. 2008;63(s86):8–160.

2. Skoner DP. Allergic rhinitis: definition, epidemiology, pathophysiology, detection, and diagnosis. J Allergy Clin Immunol. 2001 Jul;108(1 Suppl):S2-8.

3. Asha'ari ZA, Yusof S, Ismail R, Che Hussin CM. Clinical features of allergic rhinitis and skin prick test analysis based on the ARIA classification: a preliminary study in Malaysia. Ann Acad Med Singap. 2010 Aug;39(8):619–24.

4. Sinha B, Vibha, Singla R, Chowdhury R. Allergic Rhinitis: A neglected disease - A community based assessment among adults in Delhi. Journal of Postgraduate Medicine. 2015 Jul 1;61(3):169.

5. Bousquet J, Van Cauwenberge P, Khaltaev N, Aria Workshop Group, World Health Organization. Allergic rhinitis and its impact on asthma. J Allergy Clin Immunol. 2001 Nov;108(5 Suppl):S147-334.

6. Ciprandi G, Cirillo I, Vizzaccaro A, Tosca M, Passalacqua G, Pallestrini E, et al. Seasonal and perennial allergic rhinitis: is this classification adherent to real life? Allergy. 2005 Jul;60(7):882–7.

7. Wise SK, Lin SY, Toskala E, Orlandi RR, Akdis CA, Alt JA, et al. International Consensus Statement on Allergy and Rhinology: Allergic Rhinitis. Int Forum Allergy Rhinol. 2018 Feb;8(2):108–352.

8. Brozek JL, Bousquet J, Baena-Cagnani CE, Bonini S, Canonica GW, Casale TB, et al. Allergic Rhinitis and its Impact on Asthma (ARIA) guidelines: 2010 revision. J Allergy Clin Immunol. 2010 Sep;126(3):466–76.

9. Bousquet J, Bewick M, Arnavielhe S, Mathieu-Dupas E, Murray R, Bedbrook A, et al. Work productivity in rhinitis using cell phones: The MASK pilot study. Allergy. 2017 Oct;72(10):1475–84.

10. Bousquet J, Hellings PW, Agache I, Amat F, Annesi-Maesano I, Ansotegui IJ, et al. Allergic Rhinitis and its Impact on Asthma (ARIA) Phase 4 (2018): Change management in allergic rhinitis and asthma multimorbidity using mobile technology. Journal of Allergy and Clinical Immunology. 2019 Mar 1;143(3):864–79.

11. Braido F, Baiardini I, Scichilone N, Musarra A, Menoni S, Ridolo E, et al. Illness perception, mood and coping strategies in allergic rhinitis: are there differences among ARIA classes of severity? Rhinology. 2014 Mar;52(1):66–71.

12. Nicolaou N, Siddique N, Custovic A. Allergic disease in urban and rural populations: increasing prevalence with increasing urbanization. Allergy. 2005 Nov;60(11):1357–60.

13. Beasley R. Worldwide variation in prevalence of symptoms of asthma, allergic rhinoconjunctivitis, and atopic eczema: ISAAC. The Lancet. 1998 Apr 25;351(9111):1225–32.

14. Asher MI, Keil U, Anderson HR, Beasley R, Crane J, Martinez F, et al. International Study of Asthma and Allergies in Childhood (ISAAC): rationale and methods. Eur Respir J. 1995 Mar;8(3):483–91.

15. Allergic rhinitis, rhinoconjunctivitis, and eczema: prevalence and associated factors in children - Singh - 2018 - The Clinical Respiratory Journal - Wiley Online Library [Internet]. [cited 2019 Sep 16]. Available from: https://onlinelibrary.wiley.com/doi/abs/10.1111/crj.12561

16. Singh S, Sharma BB, Salvi S, Chhatwal J, Jain KC, Kumar L, et al. Allergic rhinitis, rhinoconjunctivitis, and eczema: prevalence and associated factors in children. Clin Respir J. 2018 Feb;12(2):547–56.

17. Young MC. Rhinitis, sinusitis, and polyposis. Allergy Asthma Proc. 1998 Aug;19(4):211–8.

18. Pawankar R, Mori S, Ozu C, Kimura S. Overview on the pathomechanisms of allergic rhinitis. Asia Pac Allergy. 2011 Oct;1(3):157–67.

19. Naclerio RM. Allergic rhinitis. N Engl J Med. 1991 Sep 19;325(12):860–9.

20. Naclerio RM, Proud D, Togias AG, Adkinson NF, Meyers DA, Kagey-Sobotka A, et al. Inflammatory mediators in late antigen-induced rhinitis. N Engl J Med. 1985 Jul 11;313(2):65–70.

21. Solley GO, Gleich GJ, Jordon RE, Schroeter AL. The late phase of the immediate wheal and flare skin reaction. Its dependence upon IgE antibodies. J Clin Invest. 1976 Aug;58(2):408–20.

22. Dolovich J, Hargreave FE, Chalmers R, Shier KJ, Gauldie J, Bienenstock J. Late cutaneous allergic responses in isolated IgE-dependent reactions. J Allergy Clin Immunol. 1973 Jul;52(1):38–46.

23. Pawankar RU, Okuda M, Hasegawa S, Suzuki K, Yssel H, Okubo K, et al. Interleukin-13 expression in the nasal mucosa of perennial allergic rhinitis. Am J Respir Crit Care Med. 1995 Dec;152(6 Pt 1):2059–67.

24. Pawankar R, Ra C. Heterogeneity of mast cells and T cells in the nasal mucosa. Journal of Allergy and Clinical Immunology. 1996 Dec 1;98(6, Part 2):S248–62.

25. Bradding P, Feather IH, Wilson S, Bardin PG, Heusser CH, Holgate ST, et al. Immunolocalization of cytokines in the nasal mucosa of normal and perennial rhinitic subjects. The mast cell as a source of IL-4, IL-5, and IL-6 in human allergic mucosal inflammation. J Immunol. 1993 Oct 1;151(7):3853–65.

26. Ozu C, Pawankar R, Takizawa R, Yamagishi S, Yagi T. Regulation of mast cell migration into the allergic nasal epithelium by RANTES and not SCF. Journal of Allergy and Clinical Immunology. 2004 Feb 1;113(2, Supplement):S28.

27. Lilly CM, Nakamura H, Kesselman H, Nagler-Anderson C, Asano K, Garcia-Zepeda EA, et al. Expression of eotaxin by human lung epithelial cells: induction by cytokines and inhibition by glucocorticoids. J Clin Invest. 1997 Apr 1;99(7):1767–73.

28. Sekiya T, Miyamasu M, Imanishi M, Yamada H, Nakajima T, Yamaguchi M, et al. Inducible Expression of a Th2-Type CC Chemokine Thymus- and Activation-Regulated Chemokine by Human Bronchial Epithelial Cells. Journal of immunology (Baltimore, Md : 1950). 2000 Sep 1;165:2205–13.

29. Pawankar R. Mast cells as orchestrators of the allergic reaction: the IgE-IgE receptor mast cell network. Current Opinion in Allergy and Clinical Immunology. 2001 Feb;1(1):3–6.

30. Pedersen PA, Weeke ER. Asthma and allergic rhinitis in the same patients. Allergy. 1983 Jan;38(1):25–9.

31. Bachert C, Vignola AM, Gevaert P, Leynaert B, Van Cauwenberge P, Bousquet J. Allergic rhinitis, rhinosinusitis, and asthma: one airway disease. Immunol Allergy Clin North Am. 2004 Feb;24(1):19–43.

32. Jaggi V, Dalal A, Ramesh BR, Tikkiwal S, Chaudhry A, Kothari N, et al. Coexistence of allergic rhinitis and asthma in Indian patients: The CARAS survey. Lung India. 2019 Oct;36(5):411–6.

33. Alsowaidi S, Abdulle A, Shehab A, Zuberbier T, Bernsen R. Allergic rhinitis: prevalence and possible risk factors in a Gulf Arab population. Allergy. 2010 Feb 1;65(2):208–12.

34. Osman M. Therapeutic implications of sex differences in asthma and atopy. Arch Dis Child. 2003 Jul;88(7):587–90.

35. Chong SN, Chew FT. Epidemiology of allergic rhinitis and associated risk factors in Asia. World Allergy Organ J [Internet]. 2018 Aug 6 [cited 2019 Sep 13];11(1). Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6091170/

36. Ng TP, Tan WC. Epidemiology of Allergic Rhinitis and its Associated Risk Factors in Singapore. Int J Epidemiol. 1994 Jun 1;23(3):553–8.

37. Saulyte J, Regueira C, Montes-Martínez A, Khudyakov P, Takkouche B. Active or passive exposure to tobacco smoking and allergic rhinitis, allergic dermatitis, and food allergy in adults and children: a systematic review and meta-analysis. PLoS Med. 2014 Mar;11(3):e1001611.

38. Lindgren A, Stroh E, Nihlén U, Montnémery P, Axmon A, Jakobsson K. Traffic exposure associated with allergic asthma and allergic rhinitis in adults. A cross-

sectional study in southern Sweden. Int J Health Geogr. 2009 May 6;8:25.

39. Li Y, Jiang Y, Li S, Shen X, Liu J, Jiang F. Pre- and Postnatal Risk Factors in Relation to Allergic Rhinitis in School-Aged Children in China. PLoS One [Internet]. 2015 Feb 3 [cited 2019 Sep 14];10(2). Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4315592/

40. Strachan DP. Hay fever, hygiene, and household size. BMJ. 1989 Nov 18;299(6710):1259–60.

41. Strachan DP. Hay fever, hygiene, and household size. BMJ. 1989 Nov 18;299(6710):1259–60.

42. Matheson MC, Walters EH, Simpson JA, Wharton CL, Ponsonby A-L, Johns DP, et al. Relevance of the hygiene hypothesis to early vs. late onset allergic rhinitis. Clin Exp Allergy. 2009 Mar;39(3):370–8.

43. Holt PG. Environmental factors and primary T-cell sensitisation to inhalant allergens in infancy: reappraisal of the role of infections and air pollution. Pediatr Allergy Immunol. 1995 Feb;6(1):1–10.

44. Ponsonby A-L, Glasgow N, Pezic A, Dwyer T, Ciszek K, Kljakovic M. A temporal decline in asthma but not eczema prevalence from 2000 to 2005 at school entry in the Australian Capital Territory with further consideration of country of birth. Int J Epidemiol. 2008 Jun;37(3):559–69.

45. Juniper EF, Guyatt GH. Development and testing of a new measure of health status for clinical trials in rhinoconjunctivitis. Clin Exp Allergy. 1991 Jan;21(1):77–83.

46. Juniper EF, Thompson AK, Ferrie PJ, Roberts JN. Development and validation of the mini Rhinoconjunctivitis Quality of Life Questionnaire. Clin Exp Allergy. 2000 Jan;30(1):132–40.

47. Mavroudi A, Chrysochoou E-A, Boyle RJ, Papastergiopulos A, Karantaglis N, Karagiannidou A, et al. Validation study of the pediatric allergic rhinitis quality of life questionnaire. Asian Pac J Allergy Immunol. 2016 Jun;34(2):159–65.

48. Larrabee YC, Reisacher W. Intradermal testing after negative skin prick testing for patients with high suspicion of allergy. Int Forum Allergy Rhinol. 2015 Jun;5(6):547–50.

49. Miadonna A, Leggieri E, Tedeschi A, Zanussi C. Clinical significance of specific IgE determination on nasal secretion. Clin Allergy. 1983 Mar;13(2):155–64.

50. Hemmings O, Kwok M, McKendry R, Santos AF. Basophil Activation Test: Old and New Applications in Allergy. Curr Allergy Asthma Rep. 2018 Nov 15;18(12):77.

51. Crobach M, Hermans J, Kaptein A, Ridderikhoff J, Mulder J. Nasal smear eosinophilia for the diagnosis of allergic rhinitis and eosinophilic non-allergic rhinitis.

Scand J Prim Health Care. 1996 Jun;14(2):116–21.

52. Malm L, Gerth van Wijk R, Bachert C. Guidelines for nasal provocations with aspects on nasal patency, airflow, and airflow resistance. International Committee on Objective Assessment of the Nasal Airways, International Rhinologic Society. Rhinology. 2000 Mar;38(1):1–6.

53. Position paper: Allergen standardization and skin tests. The European Academy of Allergology and Clinical Immunology. Allergy. 1993;48(14 Suppl):48–82.

54. Bernstein IL, Storms WW. Practice parameters for allergy diagnostic testing. Joint Task Force on Practice Parameters for the Diagnosis and Treatment of Asthma. The American Academy of Allergy, Asthma and Immunology and the American College of Allergy, Asthma and Immunology. Ann Allergy Asthma Immunol. 1995 Dec;75(6 Pt 2):543–625.

55. Allergen skin testing. Board of Directors. American Academy of Allergy and Immunology. J Allergy Clin Immunol. 1993 Nov;92(5):636–7.

56. Bousquet J, Heinzerling L, Bachert C, Papadopoulos NG, Bousquet PJ, Burney PG, et al. Practical guide to skin prick tests in allergy to aeroallergens. Allergy. 2012;67(1):18–24.

57. Pepys J. Skin tests. Br J Hosp Med. 1984 Sep;32(3):120, 122, 124.

58. Valyasevi MA, Maddox DE, Li JT. Systemic reactions to allergy skin tests. Ann Allergy Asthma Immunol. 1999 Aug;83(2):132–6.

59. Erel F, Sarioglu N, Kose M, Kaymakci M, Gokcen M, Kepekci AH, et al. Intradermal Skin Testing in Allergic Rhinitis and Asthma with Negative Skin Prick Tests. Iranian Journal of Allergy, Asthma and Immunology. 2017 Jun 17;16(3):193–7.

60. WAO White Book on Allergy | World Allergy Organization [Internet]. [cited 2020 Jun 12]. Available from: https://www.worldallergy.org/wao-white-book-on-allergy

61. Nevis IF, Binkley K, Kabali C. Diagnostic accuracy of skin-prick testing for allergic rhinitis: a systematic review and meta-analysis. Allergy Asthma Clin Immunol [Internet]. 2016 Apr 27 [cited 2020 Apr 1];12. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4848807/

62. Norrman G, Fälth-Magnusson K. Adverse reactions to skin prick testing in children - prevalence and possible risk factors. Pediatr Allergy Immunol. 2009 May;20(3):273–8.

63. Larsen JN, Dreborg S. Standardization of Allergen Extracts. Methods Mol Biol. 2019;2020:63–76.

64. Mailing H-J, Weeke B. Position Paper: Immunotherapy. Allergy. 1993;48(s14):9–35.

65. Bousquet J, Lockey R, Malling HJ, Alvarez-Cuesta E, Canonica GW, Chapman MD, et al. Allergen Immunotherapy: Therapeutic Vaccines for Allergic Diseases. Annals of Allergy, Asthma & Immunology. 1998 Nov 1;81(5):401–5.

66. Bousquet J, Van Cauwenberge P, Khaltaev N, Aria Workshop Group, World Health Organization. Allergic rhinitis and its impact on asthma. J Allergy Clin Immunol. 2001 Nov;108(5 Suppl):S147-334.

67. Ab S. Allergen Preparation and Standardization: An Updat. GJO [Internet]. 2018 Sep 11 [cited 2021 Feb 13];17(4). Available from: https://juniperpublishers.com/gjo/GJO.MS.ID.555968.php

68. Skamstrup Hansen K, Bindslev-Jensen C, Stahl Skov P, Sparholt SH, Nordskov Hansen G, Niemeijer NR, et al. Standardization of food allergen extracts for skin prick test. Journal of Chromatography B: Biomedical Sciences and Applications. 2001 May 25;756(1):57–69.

69. Heinzerling L, Mari A, Bergmann K-C, Bresciani M, Burbach G, Darsow U, et al. The skin prick test - European standards. Clin Transl Allergy. 2013 Feb 1;3(1):3.

70. Wang J, Wu Y, Li J, Huang X, Zhu R. Eight Aeroallergen Skin Extracts May Be the Optimal Panel for Allergic Rhinitis Patients in Central China. Int Arch Allergy Immunol. 2017;173(4):193–8.

71. Dey D, Mondal P, Laha A, Sarkar T, Moitra S, Bhattacharyya S, et al. Sensitization to Common Aeroallergens in the Atopic Population of West Bengal, India: An Investigation by Skin Prick Test. Int Arch Allergy Immunol. 2019;178(1):60–5.

72. The use of standardized allergen extracts. American Academy of Allergy, Asthma and Immunology (AAAAI). J Allergy Clin Immunol. 1997 May;99(5):583–6.

73. Alvarez-Cuesta E, Bousquet J, Canonica GW, Durham SR, Malling H-J, Valovirta E, et al. Standards for practical allergen-specific immunotherapy. Allergy. 2006;61 Suppl 82:1–20.

74. Migueres M, Dávila I, Frati F, Azpeitia A, Jeanpetit Y, Lhéritier-Barrand M, et al. Types of sensitization to aeroallergens: definitions, prevalences and impact on the diagnosis and treatment of allergic respiratory disease. Clin Transl Allergy. 2014;4:16.

75. Jong AB de, Dikkeschei LD, Brand PLP. Sensitization patterns to food and inhalant allergens in childhood: A comparison of non-sensitized, monosensitized, and polysensitized children. Pediatric Allergy and Immunology. 2011;22(2):166–71.

76. Bousquet P-J, Castelli C, Daures J-P, Heinrich J, Hooper R, Sunyer J, et al. Assessment of Allergen Sensitization in a General Population-Based Survey (European Community Respiratory Health Survey I). Annals of Epidemiology. 2010 Nov 1;20(11):797–803.

77. Ciprandi G, Cirillo I. Monosensitization and polysensitization in allergic rhinitis. European Journal of Internal Medicine. 2011 Dec 1;22(6):e75–9.

78. Kumar. Allergic sensitization in nasobronchial allergy patients and its correlation with total immunoglobulin E level [Internet]. [cited 2021 Feb 23]. Available from: https://www.ijaai.in/article.asp?issn=0972-6691;year=2020;volume=34;issue=2;spage=63;epage=67;aulast=Kumar;type=3

79. Katotomichelakis M, Danielides G, Iliou T, Anastassopoulos G, Nikolaidis C, Kirodymos E, et al. Allergic sensitization prevalence in a children and adolescent population of northeastern Greece region. International Journal of Pediatric Otorhinolaryngology. 2016 Oct 1;89:33–7.

80. Kim KW, Kim EA, Kwon BC, Kim ES, Song TW, Sohn MH, et al. Comparison of allergic indices in monosensitized and polysensitized patients with childhood asthma. J Korean Med Sci. 2006 Dec;21(6):1012–6.

81. Skin tests used in type I allergy testing Position paper. Sub-Committee on Skin Tests of the European Academy of Allergology and Clinical Immunology. Allergy. 1989;44(s10):11–59.

82. Ciprandi G, Alesina R, Ariano R, Aurnia P, Borrelli P, Cadario G, et al. Characteristics of patients with allergic polysensitization: the POLISMAIL study. European annals of allergy and clinical immunology. 2008 Dec 1;40:77–83.

83. Burbach GJ, Heinzerling LM, Edenharter G, Bachert C, Bindslev-Jensen C, Bonini S, et al. GA(2)LEN skin test study II: clinical relevance of inhalant allergen sensitizations in Europe. Allergy. 2009 Oct;64(10):1507–15.

84. Fiocchi A, Pecora V, Petersson CJ, Dahdah L, Borres MP, Amengual MJ, et al. Sensitization pattern to inhalant and food allergens in symptomatic children at first evaluation. Italian Journal of Pediatrics. 2015 Dec 8;41(1):96.

85. de Bot CM, Röder E, Pols DH, Bindels PJ, van Wijk RG, van der Wouden JC, et al. Sensitisation patterns and association with age, gender, and clinical symptoms in children with allergic rhinitis in primary care: a cross-sectional study. Prim Care Respir J. 2013 Jun;22(2):155–60.

86. Silvestri M, Rossi GA, Cozzani S, Pulvirenti G, Fasce L. Age-dependent tendency to become sensitized to other classes of aeroallergens in atopic asthmatic children. Ann Allergy Asthma Immunol. 1999 Oct;83(4):335–40.

87. Aburuz S, Bulatova N, Tawalbeh M. Skin prick test reactivity to aeroallergens in Jordanian allergic rhinitis patients. East Mediterr Health J. 2011 Jul;17(7):604–10.

88. Cirillo I, Vizzaccaro A, Klersy C, Baiardini I, Marseglia GL, Canonica GW, et al. Quality of life and polysensitization in young men with intermittent asthma. Ann Allergy Asthma Immunol. 2005 Jun;94(6):640–3.

89. Hong S-N, Won JY, Nam E-C, Kim TS, Ryu Y-J, Kwon J-W, et al. Clinical Manifestations of Allergic Rhinitis by Age and Gender: A 12-Year Single-Center Study. Ann Otol Rhinol Laryngol. 2020 Sep;129(9):910–7.

90. Alsowaidi S, Abdulle A, Shehab A, Zuberbier T, Bernsen R. Allergic rhinitis: prevalence and possible risk factors in a Gulf Arab population. Allergy. 2010 Feb 1;65(2):208–12.

91. Ng TP, Tan WC. Epidemiology of Allergic Rhinitis and its Associated Risk Factors in Singapore. Int J Epidemiol. 1994 Jun 1;23(3):553–8.

92. Ebert CS, Pillsbury HC. Epidemiology of allergy. Otolaryngol Clin North Am. 2011 Jun;44(3):537–48, vii.

93. Asha'ari ZA, Yusof S, Ismail R, Che Hussin CM. Clinical features of allergic rhinitis and skin prick test analysis based on the ARIA classification: a preliminary study in Malaysia. Ann Acad Med Singap. 2010 Aug;39(8):619–24.

94. Skjold T, Dahl R, Juhl B, Sigsgaard T. The incidence of respiratory symptoms and sensitisation in baker apprentices. The European respiratory journal : official journal of the European Society for Clinical Respiratory Physiology. 2008 May 1;32:452–9.

95. Park KH, Sim DW, Lee SC, Moon S, Choe E, Shin H, et al. Effects of Air Purifiers on Patients with Allergic Rhinitis: a Multicenter, Randomized, Double-Blind, and Placebo-Controlled Study. Yonsei Med J. 2020 Aug;61(8):689–97.

96. Moscato G, Siracusa A. Rhinitis guidelines and implications for occupational rhinitis. Curr Opin Allergy Clin Immunol. 2009 Apr;9(2):110–5.

97. Mahesh PA, Kummeling I, Amrutha DH, Vedanthan PK. Effect of area of residence on patterns of aeroallergen sensitization in atopic patients. Am J Rhinol Allergy. 2010 Oct;24(5):e98-103.

98. Christensen SH, Timm S, Janson C, Benediktsdóttir B, Forsberg B, Holm M, et al. A clear urban-rural gradient of allergic rhinitis in a population-based study in Northern Europe. Eur Clin Respir J. 2016;3:33463.

99. Cingi C, Cakli H, Us T, Akgün Y, Kezban M, Ozudogru E, et al. The prevalence of allergic rhinitis in urban and rural areas of Eskişehir-Turkey. Allergol Immunopathol (Madr). 2005 Jun;33(3):151–6.

100. Platts-Mills T a. E, Erwin E, Heymann P, Woodfolk J. Is the hygiene hypothesis still a viable explanation for the increased prevalence of asthma? Allergy. 2005;60 Suppl 79:25–31.

101. Storms WW. Pharmacologic approaches to daytime and nighttime symptoms of allergic rhinitis. Journal of Allergy and Clinical Immunology. 2004 Nov 1;114(5, Supplement):S146–53.

102. Long AA. Findings from a 1000-patient internet-based survey assessing the impact of morning symptoms on individuals with allergic rhinitis. Clin Ther. 2007 Feb;29(2):342–51.

103. Bousquet J, Neukirch F, Bousquet PJ, Gehano P, Klossek JM, Le Gal M, et al. Severity and impairment of allergic rhinitis in patients consulting in primary care. J Allergy Clin Immunol. 2006 Jan;117(1):158–62.

104. Ciprandi G, Comite P, Ferrero F, Fontana V, Bruzzone M, Mussap M. Serum allergen-specific IgE, allergic rhinitis severity, and age. Rhinology. 2016 Sep;54(3):231–8.

105. Elholm G, Linneberg A, Husemoen LLN, Omland Ø, Grønager PM, Sigsgaard T, et al. The Danish urban-rural gradient of allergic sensitization and disease in adults. Clin Exp Allergy. 2016 Jan;46(1):103–11.

106. Song W-J, Sohn K-H, Kang M-G, Park H-K, Kim M-Y, Kim S-H, et al. Urban-rural differences in the prevalence of allergen sensitization and self-reported rhinitis in the elderly population. Ann Allergy Asthma Immunol. 2015 Jun;114(6):455–61.

107. Van der Walt A, Jeebhay M. Work-related allergy and asthma to inhaled spices: A review. Current Allergy and Clinical Immunology. 2010 Jan 1;23:186–92.

108. Gelardi M, Ciprandi G, Incorvaia C, Buttafava S, Leo E, Iannuzzi L, et al. Allergic rhinitis phenotypes based on mono-allergy or poly-allergy. Inflamm Res. 2015 Jun;64(6):373–5.

109. Bachert C, Vignola AM, Gevaert P, Leynaert B, Van Cauwenberge P, Bousquet J. Allergic rhinitis, rhinosinusitis, and asthma: one airway disease. Immunology and Allergy Clinics of North America. 2004 Feb 1;24(1):19–43.

110. Silvestre Salvador J, Romero-Pérez D, Encabo-Durán B. Atopic Dermatitis in Adults: A Diagnostic Challenge. J Investig Allergol Clin Immunol. 2017 Apr 10;27(2):78–88.

111. Gosnell AL, Schmotzer B, Nedorost ST. Polysensitization and individual susceptibility to allergic contact dermatitis. Dermatitis. 2015 Jun;26(3):133–5.

112. Carlsen BC, Andersen KE, Menné T, Johansen JD. Sites of dermatitis in a patch test population: hand dermatitis is associated with polysensitization. Br J Dermatol. 2009 Oct;161(4):808–13.

ANNEXURES

Appendix I.

A RETROSPECTIVE CROSS-SECTIONAL STUDY TO DETERMINE THE ASSOCIATION OF SEVERITY OF ALLERGIC RHINITIS AND POLYSENSITIVITY IN SKIN ALLERGY TESTING AMONG ADULT PATIENTS EVALUATED AT A TERTIARY HOSPITAL IN SOUTH INDIA

PROFORMA

Study No: Date of Skin Allergy Test (SAT):

Hospital No:

Age:

Gender:

Address:

Occupation:

Disease presentation:

1.	Symptoms	Present(Y/N)	Absent(Y/N)
2.	Nasal block		
3.	Watery rhinorrhoea		
4.	Sneezing		
5.	Epiphora		
6.	Itching skin/eyes		

Duration of symptoms (Intermittent i.e <4 days per week or <4 weeks per year/Persistent):

Severity of complaints: Mild/Moderate-Severe

Seasonal worsening:

1.	Spring	(Y/N)
2.	Summer	(Y/N)

3.	Rainy season	(Y/N)
4.	Winter	(Y/N)
5.	Weather change	(Y/N)

Time of day where symptoms are worse:

1.	Morning	(Y/N)
2.	Afternoon	(Y/N)
3.	Night	(Y/N)

Place where symptoms are worse:

1.	Indoors	(Y/N)
2.	Outdoors	(Y/N)
3.	At work	(Y/N)

Environmental triggers:

1.

2.

3.

Previous AST(Y/N):

Family history(Y/N):
If yes,

1.	Father	(Y/N)
2.	Mother	(Y/N)
3.	Siblings	(Y/N)
4.	Grandparents	(Y/N)

List of current medications for allergy:

a) Tablets
b) Nasal sprays
c) Nasal drops
d) Injections

List of current medication for comorbid illness:

Appendix II.

A RETROSPECTIVE CROSS-SECTIONAL STUDY TO DETERMINE THE ASSOCIATION OF SEVERITY OF ALLERGIC RHINITIS AND POLYSENSITIVITY IN SKIN ALLERGY TESTING AMONG ADULT PATIENTS EVALUATED AT A TERTIARY HOSPITAL IN SOUTH INDIA

CONSENT FOR SKIN ALLERGY TESTING

The procedure of skin allergy testing has been explained to me. I understand that this test is usually safe. However, there are chances of developing adverse reactions like increased itching, redness and other severe allergic reactions including anaphylactic shock. I also have no objection to the results of this test being used for therapeutic, academic and research purposes. I hereby give full informed consent to undergo skin allergy testing.

Date: Patient:

Doctor/Staff Nurse: Witness:

Appendix III.

A RETROSPECTIVE CROSS-SECTIONAL STUDY TO DETERMINE THE ASSOCIATION OF SEVERITY OF ALLERGIC RHINITIS AND POLYSENSITIVITY IN SKIN ALLERGY TESTING AMONG ADULT PATIENTS EVALUATED AT A TERTIARY HOSPITAL IN SOUTH INDIA

DETAILS OF SKIN ALLERGEN TEST:

Common Allergen Panel: No. of positive responses:

No.	Allergen	Response
1.	Negative control	
2.	Dust mite- D.pteronyssinus	
3.	Dust mite- D.farinae	
4.	House dust	
5.	Cockroach	
6.	Cotton dust	
7.	Parthenium hysterophorus	
8.	Cat dander	
9.	Wheat dust	
10.	Positive control	

Additional Allergen Screening Panel: No. of positive responses:

No.	Allergen	Response
1.	Parthenium hysterophorus	
2.	Amaranthus spinosus	

3.	Eucalyptus sp.	
4.	Acacia Arabica	
5.	Mangifera indica (Mango)	
6.	Azadirachta indica (Neem)	
7.	Brassica nigra (Black mustard)	
8.	Chenopodium murale	
9.	Zea mays (Maize)	
10.	Cocos nucifera (Coconut)	

Fungal Panel: No. of positive responses:

No.	Allergen	Response
1.	Negative control	
2.	Aspergillus fumigatus	
3.	Aspergillus niger	
4.	Aspergillus flavus	
5.	Curvularia lunata	
6.	Alternaria alternate	
7.	Penicillium sp.	
8.	Candida albicans	
9.	Rhizopus nigricans	
10.	Positive control	

Common Food Allergen Panel: No. of positive responses

No.	Allergen	Response
1.	Milk	
2.	Wheat	
3.	Fish(Sardine)	
4.	Chicken	
5.	Prawn	
6.	Egg(Whole)	
7.	Paneer	
8.	Coconut	
9.	Lemon	
10.	Ajinomoto	

Any additional allergen tested:

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
NO.	Age	Gender	State	Locality	Occupation	nvironmental trigge	nvironmental trigger	nvironmental trigger	Nasal bloc	sal dische	Sneezing	Epiphoraing skin /	Duration	onal wors	Perennial	orst_Timi	t_Symton	evious A	Family histo	EVERIT	ittent/	Per	History_of_allergen
1	3	1	4	2	4	2	5	6	2	1	2	2	2	2	2	2	1	2	1	1	1	1	0
2	5	1	1	1	7	5	6		1	1	1	2	2	5	5	2	1	1	2	1	2	2	0
3	2	1	2	1	5	1	5	6	1	2	1	2	1	2	5	2	1	1	2	2	1	1	0
4	2	1	5	1	3	5	6		1	1	1	2	2	2	5	2	1	2	1	1	1	1	0
5	3	1	1	1	7	1	5	6	1	1	1	2	2	1	2	2	1	2	1	1	2	1	0
6	3	1	2	1	4	4	5		2	1	1	2	2	2	2	2	1	2	1	1	1	1	1
7	4	1	1	2	2	10	5		2	1	1	2	2	2	3	2	1	1	2	1	2	1	0
8	4	1	5	2	5	1	5	6	1	1	1	2	2	2	5	2	1	1	2	1	2	2	0
9	3	2	2	2	1	1	5	6	1	1	1	2	2	3	3	2	1	2	2	1	2	2	0
10	5	1	4	2	7	1	5	6	1	2	1	1	1	1	3	2	1	1	2	1	1	1	1
11	3	2	1	2	1	8	5	6	1	1	1	2	1	2	2	1	1	1	1	1	2	1	1
12	6	1	1	1	2	10	5	6	1	1	1	2	2	3	3	2	1	2	1	2	2	2	0
13	2	1	4	1	3	1	5	6	2	1	1	1	2	2	5	2	1	1	1	1	1	1	0
14	3	1	1	1	4	1	5		1	1	1	1	1	3	2	2	1	1	1	1	2	1	0
15	5	2	1	1	1	10	5	6	2	1	1	1	1	2	1	2	1	1	1	1	2	1	0
16	2	2	1	1	3	1	5		1	2	1	1	1	2	3	2	1	1	1	1	1	1	0
17	5	1	4	2	4	5	6		1	1	1	1	1	2	5	1	1	1	2	1	1	2	1
18	2	2	2	2	1	7	5	6	1	1	2	1	1	4	1	1	1	1	1	1	1	1	0
19	5	2	4	1	1	5	6		2	1	1	1	2	3	2	2	1	1	1	1	1	1	0
20	3	1	1	1	2	4	5	6	1	1	1	1	2	1	2	1	2	2	1	1	1	1	0
21	5	2	1	2	1	5	3		1	1	1	1	2	5	3	2	3	1	1	1	1	1	0
22	3	1	1	2	5	1	5	6	1	1	1	1	1	3	3	2	1	1	2	1	2	2	0
23	4	2	1	1	1	1	5	10	2	1	1	2	2	1	5	1	1	1	2	1	2	1	0
24	3	1	5	1	5	5			1	1	2	1	2	4	5	1	2	3	2	1	1	2	0
25	4	2	1	1	1	8	5		2	2	1	1	2	3	3	1	1	1	2	1	1	2	1
26	2	1	4	1	3	4	5		1	1	1	2	2	3	3	2	3	2	2	4	1	1	1
27	2	1	4	1	3	2	3	5	1	1	1	2	2	4	3	1	1	1	2	6	2	1	0
28	6	1	1	1	7	1	5		1	1	1	2	2	2	3	1	3	2	1	2	1	1	0
29	3	2	5	2	1	1	5	6	2	1	1	2	1	4	2	2	1	1	1	1	2	2	0
30	2	2	2	2	1	1	5	6	1	1	1	2	1	2	1	2	2				2	1	1
31	3	1	5	1	5	3	5		1	1	1	1	2	2	5	1	1	1	2	1	2	2	1
32	4	2	1	1	1	1	2	5	1	1	1	1	1	4	3	1	3	1	2	1	2	1	1
33	5	2	5	2	1	1	5		1	1	1	1	1	2	1	1	1	1	2	1	2	1	1
34	3	2	2	2	3	7	1	5	1	1	1	1	1	1	3	2	3	1	1	2	1	1	1
35	3	2	4	1	3	1	4	5	1	1	1	1	1	2	5	1	3	2	2	6	1	1	1
36	4	2	1	2	7	1	5	6	1	1	2	2	2	2	3	2	1	1	2	1	1	1	0
37	2	1	1	1	3	5			1	1	1	1	2	2	3	1	1	1	1	1	2	2	2
38	3	1	5	1	6	1	2	5	1	1	1	1	1	2	4	1	1	2	2	1	2	1	0
39	3	1	5	1	7	1	5	6	1	1	1	1	1	2	5	1	1	2	2	1	2	1	1
40	4	1	1	1	2	1	5	6	1	1	1	1	1	2	5	1	1	2	2	1	1	1	1
41	4	2	1	1	5	1	5	1	1	1	1	1	1	2	5	1	1	2	2	1	1	1	1
42	2	1	1	2	2	1	5	6	2	2	2	1	1	1	1	2	2	1	2	1	1	1	1
43	3	1	1	1	6	1	5	6	1	1	1	1	1	3	3	2		1	2	1	1	2	1
44	2	1	5	2	3	5	6		2	1	1	1	1	2	3	2	1	1	2	1	1	2	0
45	4	1	4	1	6	1	5	6	2	2	1	2	1	2	2	2	1	1	1	1	2	2	1
46	2	1	5	1	6	7	5	6	2	1	2	2	2	4	3	2		2	2	7	2	1	1

Appendix IV.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
46	2	1	5	1	6	7	5	6	2	1	2	2	2	4	3	2		2	2	7	2	1	1
47	5	1	4	1	7	5	6		1	2	2	2	1	4	1	2	1	1	2	1	1	2	0
48	2	2	4	1	1	1	5		2	1	1	2	2	3	3	1	1	2	2	2	1	2	0
49	3	1	1	2	6	1	5	6	2	1	2	2	2	3	2	2	1	2	1	1	1	2	0
50	6	2	5	2	2	1	5	6	2	2	1	1	2	3	5	2	1	1	2	1	2	1	1
51	2	1	2	2	4	1	5	6	1	1	1	2	1	2	3	2	1	1	2	2	2	2	0
52	6	2	5	2	1	7	5	6	2	1	1	2	1	5	2	2	1	1	2	1	2	2	1
53	2	2	1	2	1	1	5	6	2	1	1	2	2	2	2	2	1	1	1	4	2	2	0
54	3	1	4	1	5	4	5	6	2	1	2	2	2	5	3	1	1	1	1	1	1	2	1
55	3	2	1	2	6	2	5	6	1	1	1	2	2	3	2	2	1	1	2	1	2	2	0
56	4	2	1	2	3	1	2	4	1	1	1	1	1	2	4	1	1	2	2	1	2	1	0
57	2	1	5	2	3	1	5	6	1	1	1	2	2	2	2	1	2	1	2	2	2	1	1
58	4	1	1	1	5	1	5	6	1	1	1	2	1	2	1	2	1	1	2	1	1	1	0
59	3	2	4	1	1	3	5	6	1	2	1	1	2	2	2	1	1	1	2	1	2	1	1
60	5	2	4	1	7	3	5	6	1	1	1	2	1	2	3	2	1	1	1	1	2	1	0
61	3	2	1	2	1	2	5	6	2	1	1	2	1	2	2	1	1	1	2	1	1	1	0
62	2	2	5	1	3	1	1	5	1	1	1	1	1	4	1	1	1	1	2	3	2	1	0
63	5	2	1	1	1	1	5	6	1	2	1	1	1	4	3	1	1	1	2	1	2	2	0
64	2	1	4	1	3	4	5	6	1	1	2	1	2	2	5	2	1	1	2	1	2	1	1
65	2	1	1	1	3	4	5	6	2	1	1	1	2	2	2	2	1	2	2	1	2	2	1
66	3	2	5	1	1	2	5	1	1	1	1	1	1	2	4	1	1	1	2	1	2	1	1
67	6	2	1	2	1	1	5	6	2	1	1	2	1	2	2	2	3	1	2	1	2	1	4
68	4	1	5	1	2	7	5	6	2	2	1	2	2	1	2	1	1	1	2	1	2	1	1
69	4	2	5	1	1	7	5	6	1	1	1	2	1	2	3	2	3	1	2	2	2	1	0
70	5	1	5	1	7	1	1	2	1	1	1	1	1	2	4	1	1	2	2	1	2	2	1
71	3	1	4	1	6	1	2	5	1	1	1	1	1	2	5	1	1	2	2	1	2	2	0
72	2	1	5	1	7	1	2	5	1	1	1	1	1	2	4	1	1	2	2	1	2	1	1
73	3	1	1	2	3	1	2	5	1	1	1	1	1	2	4	1	1	2	2	1	2	2	1
74	2	1	1	2	3	1	2	5	1	1	1	1	1	2	4	1	1	2	2	1	1	1	1
75	3	1	1	2	6	1	2	5	1	1	1	1	1	5	2	1	1	2	2	1	2	2	1
76	3	1	4	2	5	1	5	6	1	1	1	1	1	2	3	2	1	1	2	1	2	1	0
77	3	1	4	1	2	8	5	6	1	1	1	1	1	2	5	1	1	2	2	2	1	1	0
78	3	1	1	1	4	2	5	6	1	1	1	1	2	4	3	1	1	1	1	2	2	2	1
79	3	2	1	2	4	7	5	6	1	1	1	1	1	2	2	1	1	1	2	2	1	1	1
80	2	1	1	1	7	1	2	4	1	1	1	1	1	2	4	1	1	2	2	1	2	1	0
81	2	1	1	2	3	1	2	4	1	1	1	1	1	2	5	2	1	2	1	1	2	1	0
82	3	1	5	1	7	1	2	4	1	1	1	1	1	2	5	1	1	2	2	1	2	2	0
83	2	1	1	2	4	1	1	2	1	1	1	1	1	2	4	1	1	2	2	1	2	2	0
84	5	2	1	1	6	1	5	6	1	1	2	1	1	2	2	2	3	1	2	2	2	2	1
85	2	2	1	2	1	1	5	6	1	2	1	1	2	2	2	1	1	1	1	2	1	1	0
86	5	1	5	2	6	1	5	6	2	1	1	1	2	5	3	2	1	1	2	1	2	1	1
87	3	1	5	2	3	3	5	6	2	1	1	1	2	5	2	2	1	1	1	1	2	2	1
88	3	2	1	1	3	8	5		1	1	1	1	1	3	2	2	1	1	2	1	2	2	1
89	3	1	3	1	3	2	5	6	2	1	1	2	1	2	3	2	1	1	1	2	2	1	1
90	6	1	2	1	7	3	5	6	1	1	2	2	1	2	1	2	1	1	2	1	2	2	1
91	2	1	1	1	3	7	5	6	2	1	1	2	1	2	3	2	1	1	1	1	2	2	0
92	2	1	5	2	3	1	10		1	1	1	1	2	1	2	1	1	1	2	1	1	2	1

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
93	4	1	4	2	7	1	5	6	1	1	1	1	1	2	5	1	1	1	2	3	2	1	0
94	3	1	4	2	7	1	2	5	1	1	1	1	1	2	5	1	1	2	2	1	1	1	0
95	2	1	4	2	5	3	5	6	1	1	1	1	2	2	3	1	3	2	2	7	1	2	1
96	2	2	2	2	3	1	5	6	1	1	1	2	2	2	2	2	1	1	2	1	1	1	0
97	2	1	1	2	3		5		2	1	1	1	2	2	1	2	1	1	2	1	2	1	1
98	3	2	2	2	1	1	5	6	1	1	1	2	2	2	2	2	1	2	2	1	1	2	0
99	3	1	5	1	7	1	5	6	2	2	1	1	2	2	2	2	1	1	2	1	1	2	1
100	4	1	1	1	6	4	5	10	1	1	1	1	1	3	3	1	1	1	2	3	2	1	1
101	3	2	1	2	1	8	5	6	2	1	1	2	1	2	1	1	3	1	1	3	2	2	1
102	4	1	4	2	5	3	5	6	2	1	1	1	2	2	2	2	1	1	1	1	1	1	1
103	5	1	5	1	2	1	5	6	2	2	2	1	2	3	2	2	1	1	2	1	2	2	1
104	3	1	5	1	3	4	5		1	1	1	1	1	1	2	2	1	2	1	2	1	2	1
105	6	1	5	1	7	2	5	6	1	1	1	1	1	1	2	2	1	3	2	1	1	2	1
106	3	1	2	2	5	1	5	6	2	1	1	1	2	2	3	2	1	1	2	1	1	2	1
107	3	1	4	1	7	8	5	6	1	1	1	2	2	2	2	2	1	1	1	2	1	1	1
108	3	2	4	1	1	7	5	6	1	1	1	2	1	2	2	1	1	1	2	3	1	1	1
109	5	1	5	1	5	8	5	4	1	1	1	1	2	5	3	2	1	3	2	2	1	2	1
110	3	1	5	1	7	1	5	6	1	2	1	1	1	3	4	2	1	2	2	1	1	2	0
111	4	1	2	2	3	8	5	6	2	1	1	1	2	2	2	2	1	2	2	1	2	2	1
112	5	2	4	1	1	2	5	6	1	1	1	1	1	3	2	2	1	1	2	1	1	2	1
113	4	1	2	1	2	1	5	6	1	1	1	1	1	5	2	1	1	1	2	3	1	2	0
114	4	2	4	2	1	1	6	5	1	1	1	1	1	3	2	2	1	1	1	1	2	1	0
115	4	1	4	2	6	2	5	6	1	1	1	1	1	2	3	2	1	1	1	1	2	1	0
116	2	1	5	2	3	7	5	6	1	1	1	1	1	2	5	1	1	1	1	2	1	2	0
117	3	1	1	2	6	1	2	5	1	1	1	1	1	2	5	1	1	2	2	3	2	2	0
118	3	1	4	2	3	1	2	5	1	1	1	1	1	2	4	1	1	2	2	1	2	1	1
119	4	2	1	2	1	2	5	1	1	1	1	1	1	2	4	1	1	2	2	1	2	1	1
120	4	2	1	2	1	1	2	5	1	1	1	1	1	2	4	1	1	2	2	1	2	1	1
121	5	1	4	2	7	1	5	1	1	1	1	1	1	2	5	1	1	2	2	1	1	1	1
122	4	1	5	2	4	1	5	6	1	1	1	1	1	2	3	2	1	3	2	1	2	2	0
123	6	1	2	2	4	10	5	6	1	2	2	1	2	1	2	2	1	2	2	2	2	2	0
124	3	2	5	1	1	4	5	6	1	1	1	1	2	1	2	2	1	1	2	1	2	2	0
125	3	2	5	1	1	1	5	6	1	1	1	1	1	1	2	1	1	1	2	1	2	2	1
126	3	1	4	1	6	1	5	6	1	1	1	1	2	3	3	2	1	1	2	1	1	2	1
127	3	2	1	1	1	1	5	6	1	1	1	2	2	5	2	2	1	1	2	1	2	1	1
128	3	1	1	2	3	8	5		1	2	2	1	1	2	1	1	1	1	2	3	1	2	1
129	4	1	1	1	3	1	5	6	1	1	1	2	2	2	2	2	1	1	2	1	2	2	1
130	5	1	4	1	5	3	5	6	1	1	2	1	1	3	1	2	1	1	2	2	1	2	1
131	5	1	4	2	5	10	5	6	1	1	2	1	1	3	2	1	1	1	2	1	2	2	1
132	5	1	5	1	3	1	5	6	1	1	2	1	1	3	2	1	1	1	2	1	1	2	0
133	4	1	4	1	6	1	5	6	2	1	1	1	1	3	3	2	1	1	2	1	2	1	1
134	3	1	4	2	7	2	5	6	1	1	1	2	1	3	3	2	1	1	1	1	2	2	1
135	3	2	5	1	1	1	5	6	1	1	1	2	1	2	5	1	1	1	1	1	1	2	0
136	3	2	1	2	6	2	5	6	1	1	1	2	2	3	2	2	1	1	2	1	2	2	0
137	4	2	1	2	3	1	2	4	1	1	1	1	1	2	4	1	1	2	2	1	2	1	0
138	2	1	5	2	3	1	5	6	1	1	1	2	2	2	2	1	2	1	2	2	2	1	1
139	4	1	1	1	5	1	5	6	1	1	1	2	1	2	1	2	1	1	2	1	1	1	0
140	3	2	4	1	1	3	5	6	1	2	1	1	2	2	2	1	1	1	2	1	2	1	1

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
141	5	2	4	1	7	3	5	6	1	1	1	2	1	2	3	2	1	1	1	1	2	1	0
142	3	2	1	2	1	2	5	6	2	1	1	2	1	2	2	1	1	1	2	1	1	1	0
143	2	2	5	1	3	1	1	5	1	1	1	1	1	4	1	1	1	1	2	3	2	1	0
144	5	2	1	1	1	1	5	6	1	2	1	1	1	4	3	1	1	1	2	1	2	2	0
145	2	1	4	1	3	4	5	6	1	1	2	1	2	2	5	2	1	1	2	1	2	1	1
146	2	1	1	1	3	4	5	6	2	1	1	1	2	2	2	2	1	2	2	1	2	2	1
147	3	2	5	1	1	2	5	1	1	1	1	1	1	2	4	1	1	1	2	1	2	1	1
148	6	2	1	2	1	1	5	6	2	1	1	2	1	2	2	2	3	1	2	1	2	1	4
149	4	1	5	1	2	7	5	6	2	2	1	2	2	1	2	1	1	1	2	1	2	1	1
150	4	2	5	1	1	7	5	6	1	1	1	2	1	2	3	2	3	1	2	2	1	1	0
151	5	1	5	1	7	1	1	2	1	1	1	1	1	2	4	1	1	2	2	1	2	2	1
152	3	1	4	1	6	1	2	5	1	1	1	1	1	2	5	1	1	2	2	1	2	2	0
153	2	1	5	1	7	1	2	5	1	1	1	1	1	2	4	1	1	2	2	1	2	1	1
154	3	1	1	2	3	1	2	5	1	1	1	1	1	2	4	1	1	2	2	1	2	2	1
155	2	1	1	2	3	1	2	5	1	1	1	1	1	2	4	1	1	2	2	1	1	1	1
156	3	1	1	2	6	1	2	5	1	1	1	1	1	5	2	1	1	2	2	1	2	2	1
157	3	1	4	2	5	1	5	6	1	1	1	1	1	2	3	2	1	1	2	1	2	1	0
158	3	1	4	1	2	8	5	6	1	1	1	1	1	2	5	1	1	2	2	2	1	1	0
159	3	1	1	1	2	2	5	6	1	1	1	1	2	4	3	1	1	1	1	2	2	2	1
160	3	2	1	2	4	7	5	6	1	1	1	1	1	2	2	1	1	1	2	2	1	1	1
161	2	1	1	1	7	1	2	4	1	1	1	1	1	2	4	1	1	2	2	1	1	1	0
162	2	1	1	2	3	1	2	4	1	1	1	1	1	2	5	2	1	2	1	1	1	1	0
163	3	1	5	1	7	1	2	4	1	1	1	1	1	2	5	1	1	2	2	1	2	2	0
164	2	1	1	2	4	1	1	2	1	1	1	1	1	2	4	1	1	2	2	1	2	2	0
165	5	2	1	1	6	1	5	6	1	1	2	1	1	2	2	2	3	1	2	2	1	2	1
166	2	2	1	2	1	1	5	6	1	2	1	1	2	2	2	1	1	1	1	2	1	1	0
167	5	1	5	2	6	1	5	6	2	1	1	1	2	5	3	2	1	1	2	1	2	1	1
168	3	1	5	2	3	3	5	6	2	1	1	1	2	5	2	2	1	1	1	1	2	2	1
169	3	2	1	1	3	8	5		1	1	1	1	1	3	2	2	1	1	2	1	2	2	1
170	4	1	3	1	3	2	5	6	2	1	1	2	1	2	3	2	1	1	1	2	2	1	1
171	6	1	2	1	4	3	5	6	1	1	2	2	1	2	1	2	1	1	2	1	2	2	1
172	2	1	1	2	4	1	2	4	1	1	1	1	1	2	4	1	1	2	2	1	1	1	1
173	2	2	1	2	1	2	4	5	1	1	1	1	1	2	1	1	1	2	2	1	2	2	1
174	3	1	2	1	5	1	2	4	1	1	1	1	1	2	4	1	1	2	2	1	1	1	1
175	4	2	1	2	1	1	2	6	1	1	1	1	1	2	4	1	1	2	2	3	2	2	1
176	2	1	1	2	6	1	2	4	1	1	1	1	1	2	4	1	1	2	2	1	1	2	1
177	4	1	4	2	7	1	2	4	1	1	1	1	1	2	4	1	1	2	2	2	2	1	0
178	2	2	4	2	1	1	2	4	1	1	1	1	1	2	4	1	1	2	2	1	1	1	0
179	3	1	4	1	6	2	5	6	1	1	2	1	1	3	2	1	3	3	2	1	2	2	0
180	3	1	5	1	6	1	5	6	1	1	2	1	1	2	3	2	1	1	1	1	2	2	0
181	3	1	5	1	5	2	5	7	2	1	2	1	2	2	2	2	1	1	2	1	2	2	1
182	3	1	5	1	5	5	5	6	1	1	1	1	1	1	2	2	2	2	1	1	1	1	0
183	3	1	1	2	6	3	5	6	1	1	2	2	1	5	2	2	1	1	2	1	1	2	0
184	2	1	1	1	3	7	5	6	1	1	2	2	1	2	3	2	1	1	1	2	1	2	0
185	2	2	1	1	1	4	5	6	1	1	1	1	1	5	2	1	1	1	1	1	1	2	0
186	4	1	1	1	4	1	5	6	2	2	1	1	1	1	5	2	1	1	1	1	1	1	0
187	2	1	1	2	3	1	5		1	1	1	2	2	2	2	2	1	3	2	3	2	2	0

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
188	3	1	5	1	5	5	6	1	1	1	1	2	2	2	1	1	3	1	2	1	2	2	0
189	2	2	5	2	3	5		7	1	1	2	1	1	2	1	2	3	2	1	1	2	2	0
190	2	1	5	1	3	5			1	2	2	1	1	2	2	1	3	1	2	1	2	2	1
191	3	1	2	1	2	1	4	5	1	2	1	1	1	2	2	1	1	1	2	1	1	1	0
192	3	1	5	1	4	5	6	7	2	1	1	1	1	3	3	2	1	1	1	1	2	2	1
193	2	2	5	1	3	8	5	4	1	1	1	2	1	1	2	2	1	1	1	3	1	1	2
194	4	1	1	1	6	1	5	6	2	1	1	1	1	2	2	1	1	3	1	1	2	1	0
195	5	2	1	1	1	5	6	4	1	2	1	1	1	2	1	1	1	1	2	1	1	1	0
196	2	1	1	1	3	4	5	6	1	1	1	1	1	2	1	1	1	3	1	1	1	1	0
197	3	2	1	2	1	7	5	6	1	1	1	1	1	2	3	2	2	1	1	1	1	2	0
198	3	1	5	2	5	2	5	6	1	1	1	2	2	2	3	2	1	1	2	1	1	2	0
199	4	1	4	1	7	8	5	6	1	1	1	1	1	2	2	1	1	3	2	1	2	2	0
200	3	2	2	1	1	2	5	6	1	1	1	2	1	2	1	2	1	2	1	2	2	2	0
201	3	2	2	1	1	1	5		2	2	1	1	1	2	5	2	1	1	2	1	2	1	0
202	5	1	5	1	7	7	5	6	1	2	1	1	1	5	2	2	1	3	2	3	1	1	0
203	2	1	5	1	3	4	5	6	1	1	1	2	1	5	2	2	1	1	2	1	1	1	1
204	2	2	4	1	1	1	5	6	1	1	1	2	2	3	2	1	1	1	1	2	1	1	1
205	2	2	1	2	3	1	2	4	1	1	1	1	1	2	4	1	1	2	2	1	1	1	1
206	2	2	1	2	3	1	2	4	1	1	1	1	1	2	5	1	1	2	2	1	2	2	1
207	2	2	1	2	3	1	2	4	1	1	1	1	1	2	4	1	1	2	2	1	2	2	1
208	2	1	1	2	5	1	2	4	1	1	1	1	1	2	4	1	1	2	2	1	2	2	1
209	2	1	1	2	6	1	2	4	1	1	1	1	1	1	4	1	1	2	2	1	1	2	1
210	3	1	1	2	7	1	2	4	1	1	1	1	1	2	4	1	1	2	2	1	2	2	1
211	2	1	4	1	3	1	2	4	1	1	1	1	1	2	4	1	1	2	2	1	1	1	0
212	2	2	4	1	1	1	2	4	1	1	1	1	1	2	4	1	1	2	2	1	2	2	0
213	2	1	5	1	3	1	2	4	1	1	1	1	1	2	4	1	1	2	2	1	2	2	0
214	4	1	1	2	7	1	5	3	1	2	1	2	1	4	2	2	1	1	1	2	2	2	0
215	2	1	4	1	3	3	5	6	2	1	1	1	1	2	3	2	1	1	2	1	2	1	1
216	2	1	5	1	3	2	5	6	1	1	1	2	1	3	3	2	1	2	1	3	2	2	0
217	5	1	1	2	6	3	5	6	1	1	1	1	1	2	3	2	1	2	2	2	2	2	1
218	5	2	4	1	1	3	5	6	2	2	2	2	1	5	3	2	1	1	2	1	2	2	1
219	5	1	4	1	5	2	5	6	1	2	2	2	1	2	1	2	2	2	2	3	2	1	0
220	2	2	5	1	3	2	3	5	2	1	1	1	1	2	5	2	1	2	1	4	1	1	0
221	3	2	4	1	1	7	5	6	1	1	1	2	1	2	3	2	1	1	2	1	1	1	0
222	3	1	1	2	3	3	5	6	1	2	2	2	1	2	2	2	1	1	2	3	1	1	0
223	4	2	5	1	1	3	5	6	2	2	1	1	2	4	3	2	1	1	1	1	1	1	0
224	2	1	3	1	3	7	5	6	2	1	1	1	2	2	5	2	1	1	2	1	1	1	0
225	5	2	5	1	6	8	5	6	2	2	1	2	2	2	2	2	1	1	1	3	1	1	1
226	2	1	5	1	3	2	5	6	1	1	2	1	2	2	2	1	2	2	2	1	2	2	1
227	3	2	5	1	5	1	5	6	2	1	1	1	1	3	3	2	2	1	1	1	1	1	0
228	3	1	1	2	6	8	5	6	2	1	1	2	1	4	2	1	1	1	1	1	2	1	1
229	3	1	2	1	7	1	2		2	1	1	1	1	2	2	2	1	1	1	1	1	1	0
230	2	1	4	2	3	2	5	6	1	1	1	1	2	4	3	2	1	1	2	2	1	2	0
231	3	1	5	1	6	1	5	6	1	1	1	2	1	1	3	2	1	1	1	1	1	1	0
232	3	1	4	2	2	8	5	6	1	1	1	2	1	2	2	1	1	2	1	1	2	1	0
233	2	2	2	1	3	4	5	8	1	1	2	1	1	1	2	2	3	1	1	1	1	1	0
234	3	2	4	1	6	2	5	6	2	1	1	1	1	2	2	2	1	1	2	1	2	1	0

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
235	3	2	5	1	1	8	5		2	2	1	1	2	2	2	2	1	1	2	1	1	1	0
236	2	1	1	2	3	7	5	6	1	2	1	1	1	2	3	2	2	1	2	1	2	1	0
237	5	2	4	2	1	8	5	6	1	1	2	1	1	5	5	2	1	1	2	3	2	1	0
238	3	1	4	1	5	3	5	6	1	1	1	1	1	2	5	2	1	1	2	1	2	2	0
239	2	1	1	2	3	2	5		2	2	2	1	1	2	2	1	2	2	1	2	2	2	0
240	2	1	1	2	3	1	5		1	2	2	1	1	2	3	2	1	1	2	1	1	1	0
241	3	1	1	2	7	2	5	6	1	1	1	2	1	2	2	2	1	1	2	3	1	1	0
242	3	2	5	1	3	8	5	6	1	1	1	1	1	1	3	2	1	1	2	1	1	1	0
243	2	1	1	2	3	2	5	6	1	1	1	1	2	3	2	1	1	1	1	2	1	1	0
244	2	2	5	2	1	1	5	6	1	1	1	1	2	4	2	2	1	1	2	1	1	1	0
245	5	2	1	1	1	3	5	6	1	1	1	1	2	5	2	2	1	1	2	1	2	2	0
246	6	2	5	2	1	1	2	5	1	1	2	1	2	2	2	2	1	2	2	1	1	1	1
247	4	2	5	2	5	7	5	6	1	2	1	1	1	2	2	2	1	1	2	1	1	1	0
248	6	2	2	1	1	1	2	4	1	1	1	1	1	2	4	1	1	2	2	2	2	2	1
249	2	1	5	1	3	1	2	5	1	1	1	1	1	2	4	1	2	1	2	1	2	2	1
250	2	1	2	1	2	1	2	4	1	1	1	1	1	2	4	1	1	2	2	1	1	1	1
251	2	2	4	1	1	1	2	4	1	1	1	1	1	2	4	1	1	1	2	2	1	1	1
252	2	1	1	2	3	1	2	4	1	1	1	1	1	2	4	1	1	2	2	1	1	1	1
253	2	1	1	2	3	1	2	4	1	1	1	1	1	2	4	1	1	2	2	1	2	1	1
254	3	1	5	1	7	1	2	4	1	1	1	1	1	2	5	1	1	1	2	2	2	1	1
255	3	1	4	1	7	1	2	5	1	1	1	2	2	2	4	1	1	1	2	1	1	1	1
256	3	2	4	1	6	5	2	6	1	1	1	2	1	2	3	1	2	2	2	6	1	1	1
257	3	1	5	1	5	2	5	6	1	2	2	1	2	3	5	2	1	1	2	1	1	1	1
258	3	2	4	2	1	7	5	6	2	1	1	2	1	2	2	2	1	1	2	1	1	1	1
259	3	2	1	1	2	3	5	6	2	1	1	1	1	1	2	2	1	1	2	1	1	1	1
260	3	1	4	1	5	1	5	6	2	1	1	2	1	5	2	2	1	1	2	1	2	2	1
261	3	2	1	2	1	5	4	6	2	1	1	2	2	2	5	2	1	1	2	1	1	1	1
262	5	2	1	2	1	7	5	6	1	2	1	1	2	1	2	2	1	3	2	1	1	1	1
263	2	2	5	1	5	8	5	6	1	1	2	1	1	2	2	2	1	2	2	1	1	1	1
264	3	1	4	2	5	5	6	1	2	2	1	1	2	3	2	2	1	1	2	1	1	1	0
265	3	1	4	1	6	5	6	1	1	2	1	1	1	3	2	2	1	1	2	1	2	1	1
266	3	1	4	2	5	5	6	2	1	1	1	2	2	2	3	2	1	1	2	1	2	2	0
267	3	1	5	1	4	7	5	6	1	1	1	2	1	3	2	2	1	1	2	1	1	1	1
268	2	2	4	1	3	3	10	2	2	1	2	1	2	3	2	1	1	1	2	1	2	2	1
269	4	2	1	1	1	10	5	6	2	1	1	1	2	3	2	2	1	1	1	1	2	2	1
270	6	2	1	2	1	3	5	6	2	2	1	1	2	3	2	2	1	1	2	1	1	1	1
271	4	1	5	1	6	4	5	6	1	2	1	1	2	2	3	2	1	1	2	1	1	1	1
272	2	1	1	2	3	4	5	6	2	1	1	1	1	2	3	2	1	1	2	1	1	2	1
273	5	1	5	1	5	4	5	6	1	1	2	1	1	4	2	2	1	2	2	1	2	1	1
274	3	2	1	1	1	1	2	1	1	1	1	2	1	2	1	2	1	1	2	1	1	1	1
275	3	1	1	1	2	1	3	1	2	1	2	1	1	2	2	1	1	2	2	6	1	2	1
276	3	2	2	1	1	10	5	6	1	1	1	2	1	3	3	2	1	3	2	1	2	2	1
277	3	2	4	1	2	3	5	10	1	1	1	1	1	2	2	2	1	2	1	2	1	1	1
278	3	1	5	1	6	2	5	4	1	1	1	2	2	2	3	2	1	1	2	1	2	2	1
279	3	1	1	2	3	3	5	6	1	1	1	1	2	2	2	2	1	1	2	1	2	2	1
280	2	2	5	1	3	5	8		1	1	1	2	2	1	2	1	1	3	2	1	1	1	0
281	3	1	1	1	6	1	5	6	1	1	1	2	1	2	2	2	1	1	2	1	1	1	0
282	3	1	5	1	6	5	6	8	1	1	1	1	2	3	3	2	1	2	2	1	2	2	0

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
282	3	1	5	1	6	5	6	8	1	1	1	1	2	3	3	2	1	2	2	1	2	2	0
283	3	1	4	1	3	1	10	5	1	1	1	2	2	2	3	2	1	1	2	1	1	1	0
284	3	2	4	1	1	3	5	6	1	1	1	2	1	3	3	2	1	1	2	2	2	2	0
285	3	1	4	1	7	1	5	6	1	1	2	1	2	2	2	2	1	2	1	1	2	2	0
286	2	1	4	2	3	8	5	6	1	2	2	1	1	4	2	2	1	1	2	1	1	2	2
287	4	1	4	1	7	1	5	6	2	1	1	2	1	2	2	2	1	1	2	1	2	2	1
288	3	2	5	2	1	1	5	6	1	1	1	1	2	5	2	1	1	1	2	1	2	2	1
289	3	1	4	1	7	2	5	6	1	2	1	2	1	2	2	2	1	2	2	3	1	1	1
290	3	2	1	1	1	2	4	1	1	1	1	1	1	2	4	1	1	2	2	2	1	2	0
291	3	2	5	1	1	1	2	4	1	1	1	1	1	2	4	1	1	2	2	1	1	1	1
292	4	1	1	2	5	1	2	5	1	1	1	1	1	2	4	1	1	2	2	1	2	1	1
293	5	1	1	1	7	1	2	4	1	1	1	1	1	2	4	1	1	2	2	1	2	1	1
294	3	1	1	2	6	1	2	4	1	1	1	1	1	2	4	1	1	2	2	1	1	1	1
295	2	1	5	1	7	1	2	3	1	1	1	1	1	2	1	1	1	2	2	1	2	1	0
296	4	2	1	1	1	1	2	3	1	1	1	1	1	1	2	1	1	2	2	1	1	1	0
297	2	1	2	1	3	1	2	4	1	1	1	1	1	2	4	1	1	2	2	1	2	2	0
298	4	2	1	1	3	1	2	4	1	1	1	1	1	2	4	1	1	2	2	1	2	2	0
299	3	1	5	2	5	1	2	4	1	1	1	1	1	2	4	1	1	2	2	1	1	1	0
300	5	2	5	2	6	1	5	6	2	1	1	1	2	3	3	2	1	3	2	1	1	1	0
301	2	1	1	1	3	2	5	6	1	2	1	2	1	2	3	2	1	1	2	1	2	2	0
302	3	2	2	1	6	1	5	6	1	2	1	1	1	5	5	2	1	1	2	1	1	1	0
303	3	1	1	2	4	5	2	6	2	1	1	1	2	2	2	1	1	2	1	3	2	2	0
304	2	1	4	1	3	8	4	6	1	2	1	1	1	3	3	2	1	1	2	2	1	1	0
305	3	1	4	1	6	5	6	5	1	1	1	1	2	2	2	2	1	1	2	2	1	1	0
306	3	1	4	1	4	8	5	6	1	1	1	2	1	2	2	2	2	1	1	1	2	2	1
307	3	1	4	1	5	1	5	6	2	1	1	1	1	2	3	2	1	1	2	2	1	1	1
308	3	2	1	1	1	3	5	6	1	1	1	1	1	2	1	2	1	1	2	1	2	2	1
309	5	2	4	1	1	1	5	6	1	1	1	2	1	3	2	2	1	1	2	2	1	1	1
310	3	1	5	1	2	3	5	6	1	2	1	1	1	3	5	2	1	2	1	6	1	1	2
311	2	2	1	2	1	7	5	6	1	1	2	1	1	2	2	1	1	2	2	1	1	1	2
312	4	1	5	1	6	8	5	6	1	2	2	2	1	2	2	2	1	1	2	1	1	1	1
313	3	1	1	2	7	1	5	6	2	1	1	2	2	3	2	2	1	1	2	1	1	1	0
314	3	2	2	2	3	1	5	6	1	2	1	2	2	2	2	2	1	1	2	1	1	2	0
315	2	1	1	1	2	1	5	6	1	1	1	2	1	2	2	2	1	1	2	1	1	1	0
316	4	2	4	2	1	1	5	6	1	2	1	1	1	2	2	2	1	1	1	2	1	1	0
317	3	2	5	1	2	10	5	6	1	1	1	1	1	5	2	2	1	1	2	1	1	1	0
318	3	1	4	1	4	8	5	7	1	1	1	2	1	2	3	2	1	1	1	1	2	2	0
319	2	1	5	1	2	1	5	5	1	1	1	1	2	2	2	2	1	2	2	5	1	1	0
320	3	1	4	2	6	1	5	6	1	2	1	2	2	2	3	2	1	1	2	1	1	1	0

A	B	C	D	E	F	G	H	I	J	K	L	M	N
NO	Positive_Control_(Wheal_diameter)(mm)	pteronyssinus	farinae	House_dust	Cockroach	Cotton_dust	Cat_Dander	Wheat_dust	Parthenium	NUMBER_OF_POSITIVE_RESPONSES	NO_OF_POSITIVE_ADDITIONAL_ALLERGENS	Dermatitis	Bronchial asthma
1	8	8	3	0	0	0	0	0	0	2	0	0	0
2	5	5	0	0	0	0	0	0	0	1	ND	0	0
3	5	0	0	5	0	0	0	0	0	1	0	1	0
4	5	5	0	0	0	0	0	0	0	1	ND	0	0
5	8	0	3	8	0	0	0	0	0	2	ND	0	0
6	5	5	0	0	0	0	0	0	0	1	ND	0	1
7	5	5	0	0	0	0	0	0	0	1	0	1	0
8	9	9	4.5	0	4.5	0	0	0	0	3	ND	0	0
9	8	8	6	0	0	0	0	0	0	2	0	0	0
10	5	5	0	0	0	0	0	0	0	1	1	0	0
11	4	4	0	0	0	0	0	0	0	1	0	0	0
12	5	0	5	0	0	0	0	0	0	1	0	0	1
13	8	8	0	0	0	0	0	0	0	1	ND	0	0
14	5	5	5	0	0	0	0	0	0	2	0	0	0
15	8	0	0	0	0	0	3	0	3	2	ND	0	0
16	5	5	0	0	0	0	0	0	0	1	ND	0	1
17	7	0	0	0	0	0	0	0	3.5	1	0	0	0
18	5	5	0	0	0	0	0	0	0	1	0	1	0
19	8	8	0	0	0	0	0	0	0	1	0	1	0
20	4	4	0	0	0	0	0	0	0	1	ND	0	0
21	5	5	0	0	5	0	0	0	0	2	0	0	0
22	5	5	0	0	0	0	0	0	0	1	ND	0	1
23	8	8	8	8	8	0	0	0	0	5	ND	0	0
24	8	4	0	0	0	0	0	0	0	1	0	0	0
25	5	5	0	0	0	0	0	0	0	1	ND	1	0
26	8	8	0	0	0	0	0	0	0	1	ND	0	0
27	6	6	6	0	6	6	0	0	0	4	ND	0	0
28	6	0	0	0	0	0	0	0	6	1	ND	0	0
29	6	6	0	0	0	0	0	0	0	1	ND	0	0
30	6	6	6	0	0	0	0	0	0	2	ND	0	0
31	8	4	0	0	0	0	8	0	0	2	0	0	0
32	4	4	0	0	0	0	0	0	0	1	0	0	1
33	5	5	5	0	5	0	0	0	0	3	0	0	0
34	5	5	0	0	0	0	0	0	0	1	ND	0	0
35	4	4	0	0	0	0	0	0	0	1	0	0	0
36	5	5	0	0	0	0	0	0	0	1	ND	0	0
37	5	5	0	0	0	0	0	0	0	1	ND	0	0
38	6	6	6	0	6	6	0	0	0	3	ND	0	0
39	5	5	5	5	0	0	0	0	0	3	0	0	0
40	5	0	5	0	0	0	0	0	0	1	0	0	0
41	5	5	0	0	0	0	0	0	0	1	0	0	0
42	5	5	0	0	0	0	0	0	0	1	0	0	0
43	5	5	0	0	0	0	0	0	0	1	0	0	0
44	5	0	0	0	5	0	0	0	0	1	0	0	0
45	5	5	0	0	0	0	0	0	0	1	0	0	0
46	4	4	0	0	4	0	0	0	0	2	ND	0	0
47	6	0	0	0	6	0	0	0	0	1	ND	0	0
48	6	0	0	6	0	0	0	0	0	1	ND	1	0
49	5	5	0	0	0	0	0	0	0	1	0	0	0
50	6	0	0	0	0	0	0	0	6	1	ND	1	0
51	7	0	0	0	3.5	0	0	0	0	1	0	1	0
52	5	0	0	0	5	0	0	0	0	1	0	1	0
53	5	5	5	0	0	0	0	0	0	2	ND	0	0

A	B	C	D	E	F	G	H	I	J	K	L	M	N
53	5	5	5	0	0	0	0	0	0	2	ND	0	0
54	6	0	0	0	0	0	3	0	0	1	1	0	0
55	6	3	0	0	3	0	0	0	3	3	1	1	0
56	8	8	4	4	4	0	0	0	0	4	0	0	0
57	6	6	6	0	0	3	0	0	0	3	0	0	0
58	7	0	3.5	0	0	0	0	0	0	1	1	1	0
59	9	4.5	4.5	0	4.5	0	0	0	0	3	ND	0	1
60	6	0	0	0	3	0	0	0	0	1	ND	1	1
61	10	0	0	5	0	0	0	0	0	1	ND	0	0
62	7	3.5	3.5	3.5	3.5	0	3.5	0	0	5	ND	0	0
63	7	7	7	3.5	3.5	3.5	0	0	3.5	6	1	0	0
64	7	7	3.5	0	0	0	0	0	0	2	1	0	0
65	8	0	4	0	0	0	0	0	0	1	1	0	1
66	7	0	3.5	3.5	3.5	3.5	0	3.5	0	5	ND	0	1
67	8	0	0	0	4	0	0	4	0	2	0	0	0
68	7	0	0	0	0	0	3.5	0	0	1	3	0	0
69	7	0	3.5	0	3.5	0	0	0	0	2	1	0	0
70	7	0	3.5	3.5	0	3.5	0	0	0	3	0	0	0
71	6	3	3	3	0	0	3	3	0	5	ND	0	0
72	7	3.5	3.5	3.5	0	3.5	0	0	3.5	5	2	0	0
73	8	4	0	0	4	4	0	0	4	4	ND	0	0
74	6	3	3	3	0	3	0	0	0	4	ND	0	0
75	6	3	3	3	0	3	0	3	0	5	ND	0	0
76	6	3	0	0	6	0	0	0	0	2	0	0	0
77	6	3	3	0	0	0	0	0	0	2	1	0	0
78	6	3	0	0	6	3	0	0	3	4	0	0	0
79	7	0	0	0	3.5	0	3.5	0	0	2	2	0	0
80	8	4	4	4	0	4	0	0	0	4	ND	1	0
81	6	0	0	3	0	3	0	0	0	2	ND	1	0
82	8	4	4	4	0	0	4	0	0	4	ND	0	0
83	6	3	3	3	0	3	0	0	0	4	3	0	0
84	7	3.5	3.5	0	0	0	0	0	0	2	1	0	0
85	6	0	0	0	0	0	0	0	3	1	0	0	0
86	6	0	0	0	0	0	3	0	3	2	2	0	0
87	6	0	3	0	0	3	0	0	0	2	ND	0	0
88	6	0	0	6	3	0	0	0	0	2	0	0	0
89	6	3	3	0	3	0	0	0	0	3	0	1	0
90	6	0	0	0	3	3	0	3	3	4	0	0	0
91	5	5	0	0	0	0	5	0	0	2	0	0	0
92	6	3	0	0	0	0	0	0	0	1	0	0	0
93	8	8	4	0	0	0	0	0	0	2	ND	0	0
94	6	6	3	0	0	0	0	0	0	2	ND	0	0
95	6	6	0	0	0	0	0	0	0	1	ND	0	0
96	5	5	0	0	0	0	0	0	0	1	0	0	0
97	7	3.5	3.5	0	0	0	0	0	0	2	ND	0	0
98	5	5	0	5	0	0	0	0	0	2	ND	0	0
99	5	5	0	0	0	0	0	0	0	1	0	0	0
100	7	3.5	3.5	0	0	0	0	0	0	2	ND	1	0
101	6	0	6	0	3	0	0	0	0	2	0	1	0
102	5	5	0	0	0	0	0	0	0	1	0	0	0
103	6	3	3	0	0	0	3	0	0	3	0	0	1
104	5	0	0	0	0	0	0	5	0	1	ND	0	0
105	6	0	0	0	6	0	0	0	0	1	0	0	0
106	5	0	0	0	0	0	5	0	0	1	ND	0	0

A	B	C	D	E	F	G	H	I	J	K	L	M	N
107	4	0	0	0	4	0	0	0	0	1	ND	0	0
108	5	0	0	0	0	0	5	0	0	1	ND	0	0
109	5	3	0	0	0	0	0	0	0	1	ND	0	0
110	4	4	0	0	0	0	0	0	0	1	0	0	0
111	5	5	0	0	0	0	0	0	0	1	0	0	0
112	4	4	0	0	0	0	0	0	0	1	0	0	0
113	5	0	0	0	0	0	0	0	5	1	0	0	0
114	6	6	3	0	0	0	3	0	0	3	0	0	0
115	5	5	0	0	0	0	0	0	5	2	0	1	0
116	4	0	0	0	4	0	0	0	0	1	ND	1	0
117	6	6	0	0	0	0	0	0	0	1	ND	0	0
118	6	3	0	0	3	0	0	0	0	2	ND	0	0
119	6	6	3	0	0	0	0	0	0	2	ND	0	0
120	6	0	3	0	0	0	0	0	0	1	ND	1	0
121	6	3	0	0	0	0	0	0	0	1	ND	1	0
122	5	5	0	0	0	0	0	0	0	5	1	1	0
123	6	0	0	3	0	0	0	0	3	2	1	0	0
124	8	4	0	0	0	0	0	0	0	1	ND	0	0
125	5	5	0	0	0	0	0	0	0	1	0	0	1
126	5	0	5	0	0	0	0	0	0	1	0	0	1
127	6	3	3	3	0	0	0	0	0	3	1	0	0
128	5	0	5	0	0	0	0	0	0	1	0	0	0
129	6	6	6	3	0	0	0	0	0	3	0	0	0
130	6	0	3	0	0	0	0	0	0	1	2	0	0
131	7	7	7	3.5	0	0	0	0	0	3	ND	0	1
132	5	0	0	0	5	0	0	0	0	1	0	0	0
133	6	0	0	3	0	0	0	0	0	1	1	0	0
134	6	6	6	0	0	3	0	6	0	4	0	1	0
135	6	3	0	0	0	0	0	0	0	1	0	0	0
136	6	3	0	0	3	0	0	0	3	3	1	1	0
137	8	8	4	4	4	0	0	0	0	4	0	0	0
138	6	6	6	0	0	3	0	0	0	3	0	0	0
139	7	0	3.5	0	0	0	0	0	0	1	1	1	0
140	9	4.5	4.5	0	4.5	0	0	0	0	3	ND	0	1
141	6	0	0	0	3	0	0	0	0	1	ND	1	1
142	10	0	0	5	0	0	0	0	0	1	ND	0	0
143	7	3.5	3.5	3.5	3.5	0	3.5	0	0	5	ND	0	0
144	7	7	7	3.5	3.5	3.5	0	0	3.5	6	1	0	0
145	7	7	3.5	0	0	0	0	0	0	2	1	0	0
146	8	0	4	0	0	0	0	0	0	1	1	0	1
147	7	0	3.5	3.5	3.5	3.5	0	3.5	0	5	ND	0	1
148	8	0	0	0	4	0	0	4	0	2	0	0	0
149	7	0	0	0	0	0	3.5	0	0	1	3	0	0
150	7	0	3.5	0	3.5	0	0	0	0	2	1	0	0
151	7	0	3.5	3.5	0	3.5	0	0	0	3	0	0	0

A	B	C	D	E	F	G	H	I	J	K	L	M	N
151	7	0	3.5	3.5	0	3.5	0	0	0	3	0	0	0
152	6	3	3	3	0	0	3	3	0	5	ND	0	0
153	7	3.5	3.5	3.5	0	3.5	0	0	3.5	5	2	0	0
154	8	4	0	0	4	4	0	0	4	4	ND	0	0
155	6	3	3	3	0	3	0	0	0	4	ND	0	0
156	6	3	3	3	0	3	0	3	0	5	ND	0	0
157	6	3	0	0	6	0	0	0	0	2	0	0	0
158	6	3	3	0	0	0	0	0	0	2	1	0	0
159	6	3	0	0	6	3	0	0	3	4	0	0	0
160	7	0	0	0	3.5	0	3.5	0	0	2	2	0	0
161	8	4	4	4	0	4	0	0	0	4	ND	1	0
162	6	0	0	3	0	3	0	0	0	2	ND	1	0
163	8	4	4	4	0	0	4	0	0	4	ND	0	0
164	6	3	3	3	0	3	0	0	0	4	3	0	0
165	7	3.5	3.5	0	0	0	0	0	0	2	1	0	0
166	6	0	0	0	0	0	0	0	3	1	0	0	0
167	6	0	0	0	0	0	3	0	3	2	2	0	0
168	6	0	3	0	0	3	0	0	0	2	ND	0	0
169	6	0	0	6	3	0	0	0	0	2	0	0	0
170	6	3	3	0	3	0	0	0	0	3	0	0	0
171	6	0	0	0	3	3	0	3	3	4	ND	0	0
172	8	0	0	4	0	0	0	0	0	1	ND	0	0
173	8	4	4	0	0	0	0	0	4	3	ND	0	0
174	8	8	4	4	0	4	0	0	0	4	ND	0	1
175	6	6	6	3	0	0	0	0	0	3	ND	0	0
176	6	6	6	0	3	0	0	0	0	3	1	0	0
177	6	6	6	0	3	0	0	0	0	3	ND	0	0
178	5	5	0	0	0	0	0	0	0	1	ND	1	0
179	5	0	5	0	0	0	0	0	0	1	ND	0	0
180	5	0	5	0	0	0	0	0	0	1	ND	0	0
181	5	5	0	0	0	0	0	0	0	1	ND	0	0
182	6	0	3	3	0	3	0	0	0	3	ND	0	0
183	6	6	6	3	0	0	0	0	6	4	1	0	0
184	5	0	5	0	0	0	0	0	0	1	0	1	0
185	5	0	5	0	0	0	0	0	0	1	0	0	0
186	5	5	5	0	0	0	0	0	0	2	ND	0	0
187	6	6	3	3	3	0	0	0	0	4	ND	0	1
188	5	0	5	0	0	0	0	0	0	1	0	0	0
189	5	0	5	0	0	0	0	5	0	2	ND	0	0
190	7	7	7	0	3.5	0	0	0	0	3	ND	0	0
191	6	3	3	0	0	3	0	0	0	3	ND	0	0
192	6	0	6	0	3	0	0	0	0	2	ND	0	0
193	6	0	0	3	0	0	0	0	0	1	ND	0	0
194	5	0	5	0	0	0	0	0	0	1	0	0	0
195	6	0	0	3	0	0	0	0	0	1	1	1	0

A	B	C	D	E	F	G	H	I	J	K	L	M	N
195	6	0	0	3	0	0	0	0	0	1	1	1	0
196	6	6	0	0	0	0	0	0	0	1	0	0	0
197	5	0	5	0	0	0	0	0	0	1	ND	0	1
198	6	0	0	3	0	0	0	0	0	1	ND	0	0
199	7	0	0	0	0	0	3.5	0	0	1	0	0	0
200	6	3	3	3	0	0	0	0	0	3	0	0	0
201	6	6	6	0	0	0	3	0	0	3	ND	0	0
202	4	4	4	0	0	0	0	0	0	2	ND	0	0
203	6	0	0	3	3	0	0	0	0	2	0	0	0
204	4	0	4	0	0	4	0	0	4	3	0	0	1
205	6	0	3	0	0	0	0	0	0	1	0	1	1
206	6	6	6	0	0	0	0	0	0	2	0	0	1
207	7	0	0	3.5	0	0	0	0	3.5	2	ND	0	0
208	6	3	3	0	3	0	0	0	0	3	ND	0	1
209	6	0	0	3	0	0	0	0	0	1	ND	0	0
210	6	6	3	0	0	0	0	0	0	2	ND	0	1
211	6	3	3	0	0	0	0	0	0	2	ND	0	0
212	6	0	0	3	0	0	0	0	0	1	ND	1	0
213	6	3	3	3	0	0	0	0	0	3	ND	1	0
214	5	5	5	0	5	0	0	0	0	3	0	0	1
215	5	5	0	0	0	0	0	0	0	1	0	0	0
216	4	4	4	0	0	0	0	0	0	2	ND	0	0
217	5	0	0	0	0	5	0	0	0	1	0	0	1
218	6	6	6	0	0	0	3	0	0	3	1	0	1
219	6	0	3	0	0	0	0	0	0	1	0	0	0
220	5	5	0	0	0	0	0	0	0	1	0	0	1
221	6	0	3	0	0	0	3	0	0	2	0	0	0
222	5	0	5	0	0	0	0	0	0	1	0	0	0
223	6	0	0	3	0	3	0	0	0	2	0	0	1
224	5	0	5	0	0	0	0	0	0	1	0	0	0
225	4	4	0	0	0	0	0	0	0	1	0	0	0
226	5	0	5	0	0	0	0	0	0	1	0	1	1
227	5	5	0	0	0	0	0	0	0	1	0	0	0
228	7	3.5	3.5	0	0	0	0	0	0	2	ND	0	1
229	6	0	3	0	0	0	0	0	0	1	ND	0	0
230	6	3	6	3	3	0	0	0	0	4	0	1	0
231	7	0	3.5	0	0	0	0	0	0	1	ND	0	0
232	7	0	0	3.5	0	0	0	0	0	1	ND	0	0
233	6	3	3	0	0	0	0	0	0	2	0	0	0
234	5	5	5	0	0	0	0	0	0	2	0	0	1
235	5	5	5	0	0	0	0	0	0	2	ND	0	0
236	6	0	3	6	0	0	0	0	0	2	0	0	1
237	6	0	0	3	3	0	0	0	0	2	0	0	0
238	5	5	5	0	0	0	0	0	0	2	0	0	1
239	5	0	5	0	0	0	0	0	0	1	ND	0	0

A	B	C	D	E	F	G	H	I	J	K	L	M	N
239	5	0	5	0	0	0	0	0	0	1	ND	0	0
240	5	0	5	0	0	0	0	0	0	1	ND	0	0
241	6	3	3	3	6	0	0	0	0	4	1	1	0
242	5	0	0	5	0	0	0	0	0	1	0	0	0
243	4	0	0	0	4	0	0	0	0	1	0	0	0
244	4	4	4	4	4	0	0	0	0	4	ND	0	0
245	6	3	3	0	0	0	0	0	0	2	0	0	0
246	6	3	3	3	0	0	0	0	0	3	0	0	0
247	4	4	4	0	0	0	0	0	0	2	1	0	1
248	6	0	0	0	0	0	3	0	0	1	ND	0	0
249	6	3	3	0	0	0	0	0	0	2	ND	0	0
250	6	3	3	3	0	0	0	0	0	3	ND	0	0
251	7	3.5	3.5	0	0	0	0	0	0	2	ND	0	0
252	6	3	3	3	3	3	0	0	0	5	ND	1	0
253	6	3	3	0	0	0	0	0	0	2	ND	0	0
254	6	0	3	3	3	3	0	0	0	4	ND	0	0
255	6	3	3	0	0	0	0	0	0	2	ND	0	0
256	7	3.5	3.5	3.5	0	3.5	0	0	3.5	5	1	1	0
257	7	0	3.5	0	0	0	0	0	0	1	0	0	0
258	6	3	0	3	0	0	3	3	0	4	0	0	0
259	6	0	3	3	0	0	0	0	0	2	0	0	0
260	4	4	4	0	0	0	0	0	0	2	0	0	1
261	5	0	0	5	0	0	0	0	0	1	0	1	0
262	5	5	5	0	0	0	0	0	0	2	0	0	0
263	6	0	0	0	3	0	0	0	0	1	ND	0	0
264	6	0	0	0	0	0	0	0	3	1	ND	0	0
265	5	5	5	0	0	0	0	0	0	2	ND	0	0
266	7	3.5	3.5	0	0	0	0	0	0	2	ND	0	0
267	8	0	4	0	0	4	0	0	0	2	ND	0	0
268	8	0	0	0	0	4	0	4	4	3	ND	0	0
269	7	3.5	3.5	3.5	0	0	0	3.5	0	4	ND	0	0
270	8	0	0	0	0	0	4	0	0	1	ND	0	0
271	10	0	5	0	0	5	0	0	0	2	ND	0	0
272	6	0	3	0	0	0	0	0	0	1	0	0	0
273	6	0	3	3	0	0	0	0	0	2	0	0	0
274	6	3	3	0	3	6	0	0	0	4	0	0	1
275	5	5	5	5	0	0	0	0	0	3	ND	0	0
276	7	0	3.5	0	0	0	0	0	0	1	2	0	0
277	5	5	5	0	0	5	0	0	5	4	ND	0	0
278	6	0	3	6	0	0	0	0	0	2	ND	0	0
279	5	0	5	0	0	0	0	0	0	1	ND	0	0
280	6	3	3	0	0	0	0	0	0	2	ND	1	0
281	9	0	0	4.5	0	0	0	0	0	1	ND	0	0
282	5	0	0	0	5	0	0	0	0	1	ND	0	0
283	5	0	5	0	5	0	0	0	0	2	ND	0	0

A	B	C	D	E	F	G	H	I	J	K	L	M	N
283	5	0	5	0	5	0	0	0	0	2	ND	0	0
284	8	4	4	0	0	0	0	0	0	2	1	1	0
285	7	7	3.5	0	0	0	0	0	0	2	ND	1	0
286	5	5	0	0	5	0	0	0	0	2	0	0	1
287	6	0	6	6	3	0	0	0	0	3	0	0	0
288	7	3.5	3.5	3.5	0	0	0	0	0	3	0	1	1
289	5	5	5	0	0	0	0	0	0	2	0	0	0
290	6	3	3	0	3	0	0	0	0	3	ND	0	0
291	6	3	3	3	0	3	0	0	0	4	ND	0	0
292	6	0	0	3	0	0	0	0	0	1	ND	1	1
293	8	4	8	4	0	0	0	0	0	3	ND	0	0
294	7	0	3.5	0	0	0	0	0	0	1	ND	0	0
295	7	3.5	3.5	0	0	0	0	0	0	2	ND	0	0
296	6	3	3	0	0	0	0	0	0	2	ND	0	0
297	6	0	0	0	3	0	0	0	0	1	ND	0	0
298	8	4	8	4	0	0	0	0	0	3	ND	0	0
299	6	3	3	0	0	0	0	0	0	2	ND	0	0
300	9	4.5	4.5	0	0	0	0	0	0	2	ND	0	0
301	6	0	0	3	0	0	0	0	0	1	ND	0	0
302	7	0	0	3.5	0	0	0	0	0	1	0	0	0
303	10	5	5	5	0	0	0	0	0	3	0	0	0
304	6	3	3	0	3	0	0	0	0	3	0	1	0
305	5	0	5	5	0	0	5	0	0	3	0	0	0
306	5	0	0	5	0	0	0	0	0	1	ND	0	0
307	5	5	5	5	5	0	0	0	0	4	ND	0	0
308	6	6	3	0	0	3	0	0	0	3	0	1	0
309	5	5	5	0	0	0	0	0	0	2	0	0	1
310	5	5	5	0	0	0	0	0	0	2	ND	1	0
311	7	0	0	3.5	0	0	3.5	0	0	2	0	0	1
312	6	0	0	3	0	0	0	0	0	1	0	1	1
313	8	0	0	4	0	0	0	0	0	1	0	0	0
314	9	4.5	0	0	4.5	0	0	0	0	2	0	0	0
315	5	5	0	0	5	0	0	0	0	2	1	0	1
316	6	6	3	3	0	0	0	0	0	3	1	0	0
317	5	0	5	0	0	0	0	0	0	1	ND	0	0
318	6	3	6	3	0	3	0	0	3	5	2	0	1
319	6	3	3	0	3	0	0	0	0	3	0	0	0
320	5	0	5	0	0	0	0	0	0	1	0	0	0

Appendix V.

OFFICE OF RESEARCH
INSTITUTIONAL REVIEW BOARD (IRB)
CHRISTIAN MEDICAL COLLEGE, VELLORE, INDIA

Dr. B.J. Prashantham, M.A., Dr. Min (clinical)
Director, Christian Counselling Center
Chairperson, Ethics Committee

Dr. Anna Benjamin Pulimood, MD., Ph.D.,
Chairperson, Research Committee, Principal

Dr. Suceena Alexander, MD., DM., FASN.,
Secretary, Ethics Committee, IRB
Additional Vice-Principal (Research)

April 10, 2021

Dr. Shilpa Susan Mathew,
PG Registrar,
Department of ENT - 3,
Christian Medical College,
Vellore – 632 002.

Sub: Fluid Research Grant: New Proposal:
A retrospective cross-sectional study to determine the association of severity of allergic rhinitis and polysensitivity in skin allergy testing among adult patients evaluated at a tertiary hospital in South India over a period of 2 years.
Dr. Shilpa Susan Mathew, Employment Number: 29875, PG Registrar , ENT, Dr.Rupa Vedantam Employment Number: 09296, ENT Mr. Bijesh Yadav , Employment number: 33244, Biostatistics.

Ref: IRB Min. No. 13642 [OBSERVE] dated 02.12.2020.

Dear Dr. Shilpa Susan Mathew,

I enclose the following documents:-

1. Institutional Review Board approval 2. Agreement

Could you please sign the agreement and send it to Dr. Suceena Alexander, Addl. Vice Principal (Research), so that the grant money can be released.

With best wishes,

Dr. Suceena Alexander
Secretary (Ethics Committee)
Institutional Review Board

Dr. Suceena Alexander MD DM FASN
Secretary - (Ethics Committee)
Institutional Review Board
Christian Medical College,
Vellore - 632 002, Tamil Nadu, India.

Cc: Dr.Rupa Vedantam, ENT - 3, CMC, Vellore

OFFICE OF RESEARCH
INSTITUTIONAL REVIEW BOARD (IRB)
CHRISTIAN MEDICAL COLLEGE, VELLORE, INDIA

Dr. B.J. Prashantham, M.A., Dr. Min (clinical)
Director, Christian Counselling Center
Chairperson, Ethics Committee

Dr. Anna Benjamin Pulimood, MD., Ph.D.,
Chairperson, Research Committee, Principal

Dr. Suceena Alexander, MD., DM., FASN.,
Secretary, Ethics Committee, IRB
Additional Vice-Principal (Research)

April 10, 2021

Dr. Shilpa Susan Mathew,
PG Registrar,
Department of ENT - 3,
Christian Medical College,
Vellore – 632 002.

Sub: Fluid Research Grant: New Proposal:
A retrospective cross-sectional study to determine the association of severity of allergic rhinitis and polysensitivity in skin allergy testing among adult patients evaluated at a tertiary hospital in South India over a period of 2 years.
Dr. Shilpa Susan Mathew, Employment Number: 29875, PG Registrar , ENT, Dr.Rupa Vedantam Employment Number: 09296, ENT Mr. Bijesh Yadav , Employment number: 33244, Biostatistics.

Ref: IRB Min. No. 13642 [OBSERVE] dated 02.12.2020.

Dear Dr. Shilpa Susan Mathew,

The Institutional Review Board (**Blue**, Research and Ethics Committee) of the Christian Medical College, Vellore, reviewed and discussed your project titled "A retrospective cross-sectional study to determine the association of severity of allergic rhinitis and polysensitivity in skin allergy testing among adult patients evaluated at a tertiary hospital in South India over a period of 2 years" on December 02, 2020.

The Committee reviewed the following documents:

1) IRB Application Format
2) Waiver of Consent
3) Proforma
4) Cvs. Of Drs. Rupa, Bijesh, Shilpa.
5) No. of Documents 1 – 4.

The following Institutional Review Board (Blue, Research & Ethics Committee) members were present at the meeting held on December 02, 2020 in the New IRB Room, Christian Medical College, Vellore 632 004.

Dr. B.J. Prashantham, M.A., Dr. Min (clinical)
Director, Christian Counselling Center
Chairperson, Ethics Committee

Dr. Anna Benjamin Pulimood, MD., Ph.D.,
Chairperson, Research Committee, Principal

Dr. Suceena Alexander, MD., DM., FASN.,
Secretary, Ethics Committee, IRB
Additional Vice-Principal (Research)

Name	Qualification	Designation	Affiliation
Dr. Anna Benjamin Pulimood	MD, PhD	Principal, Chairperson-Research Committee, IRB, CMC, Vellore	Internal, Clinician
Dr. B. J. Prashantham	MA (Counseling Psychology), MA(Theology), Dr. Min (Clinical Counselling)	Chairperson, Ethics Committee, IRB. Director, Christian Counseling Centre, Vellore	External, Social Scientist
Dr. Suceena Alexander	MD., DM., FASN	Secretary – (Ethics Committee), IRB, Addl. Vice Principal (Research), Professor of Nephrology, CMC, Vellore	Internal Clinician
Dr. Shyam Kumar NK	DMRD, DNB, FRCR, FRANZCR	Professor, Radiology, CMC, Vellore	Internal, Clinician
Ms. Grace Rebekha	M.Sc., (Biostatistics)	Lecturer, Biostatistics, CMC, Vellore	Internal, Statistician
Mr. C. Sampath	BSc, BL	Advocate, Vellore	External, Legal Expert
Mr. Samuel Abraham	MA, PGDBA, PGDPM, M. Phil,BL.	Sr. Legal Officer, Vellore	External Legal Expert
Rev. Rainard Pearson	BA., B. Th., M. Div.,	Sr. Chaplin, CMC, Vellore.	Internal, Social Scientist
Dr. Jayaprakash Muliyil	MD, MPH, Dr PH (Epid), DMHC	Retired Professor, CMC, Vellore	External, Scientist & Epidemiologist
Dr. Barney Isaac	DNB (Respiratory Diseases)	Associate Professor, Pulmonary Medicine, CMC, Vellore	Internal, Clinician
Mrs. Pattabiraman	BSc, DSSA	Social Worker, Vellore	External, Lay Person
Dr. Joe Varghese	MBBS, MD Biochemistry	Professor, Department of Biochemistry	Internal Clinician
Dr. Balu Krishna	MBBS MD DNB DMRT	Professor, Department of Radiotherapy, CMC Vellore	Internal Clinician
Dr. Rohin Mittal	MS , DNB	Professor, Department of General Surgery, CMC Vellore	Internal Clinician
Dr. Winsely Rose	MD (Paed)	Professor, Paediatrics, CMC Vellore	Internal, Clinician
Dr. Sathish Kumar	MD, DCH	Professor, Child Health, CMC, Vellore	Internal, Clinician

Dr. B.J. Prashantham, M.A., Dr. Min (clinical)
Director, Christian Counselling Center
Chairperson, Ethics Committee

Dr. Anna Benjamin Pulimood, MD., Ph.D.,
Chairperson, Research Committee, Principal

Dr. Suceena Alexander, MD., DM., FASN.,
Secretary, Ethics Committee, IRB
Additional Vice-Principal (Research)

Dr. Santosh Varughese	MBBS, MD	Professor, Nephrology, CMC, Vellore	Internal, Clinician
Dr. Anuradha Rose	MBBS, MD, MHSC (Bioethics)	Associate Professor, Community Health, CMC, Vellore	Internal, Clinician
Mrs. Rebecca Sumathi Bai	MSc Nursing	Professor and Head of Specialty Nursing, CMC Vellore	Internal, Nurse
Dr. John Jude Prakash	MBBS, MD,	Professor, Clinical Virology, CMC, Vellore	Internal, Clinician
Mrs. Mahasampath Gowri	M.Sc Biostatistics	Lecturer, Biostatistics CMC, Vellore	Internal, Statistician
Dr. Rekha Pai	MSc, PhD	Associate Professor, Pathology, CMC, Vellore	Internal,Basic Medical Scientist
Dr. Premila Abraham	M.Sc. Ph.D	Professor, Department of Biochemistry, CMC, Vellore	Internal Clinician

We approve the project to be conducted as presented.

Kindly provide the total number of patients enrolled in your study and the total number of Withdrawals for the study entitled: "A retrospective cross-sectional study to determine the association of severity of allergic rhinitis and polysensitivity in skin allergy testing among adult patients evaluated at a tertiary hospital in South India over a period of 2 years" on a monthly basis. Please send copies of this to the Research Office (research@cmcvellore.ac.in).

The Institutional Ethics Committee expects to be informed about the progress of the project, Any **adverse events** occurring in the course of the project, any **amendments in the protocol and the patient information / informed consent**. On completion of the study you are expected to submit a copy of the **final report**. Respective forms can be downloaded from the following link: http://172.16.11.136/Research/IRB_Polices.html in the CMC Intranet and in the CMC website link address: http://www.cmch-vellore.edu/static/research/Index.html.

Fluid Grant Allocation:

A sum of 3,500/- INR (Rupees Three Thousand Five Hundred Only) will be granted for 2 years.

Yours sincerely,

Dr. Suceena Alexander
Secretary (Ethics Committee)
Institutional Review Board

Dr. Suceena Alexander, MD.,DM.,FASN.
Secretary - (Ethics Committee)
Institutional Review Board
Christian Medical College

IRB Min. No. 13642 [OBSERVE] dated 02.12.2020

CHRISTIAN MEDICAL COLLEGE, VELLORE
AGREEMENT TO BE SIGNED BEFORE RELEASE OF ANY RESEARCH GRANT
*****

1. I understand that the research grant is sanctioned only for the specific project approved by the Institutional Review Board and should be used exclusively for this project

2. I note that the project will become operational with effect from the date on which the grant is received, and I agree to complete it within the stipulated time.

3. I agree to submit promptly and regularly, the periodical (Half Yearly for One Year Project/Annually for Two years project) reports and the final report of the work done, in the approved format.

4. If I plan to leave the institution on before the completion of the project. I will submit a complete and detailed report of the work done by me on the project till the date of relief and transfer the project, either to the Guide or to the Co-Investigator for completion and submission of the Final Report.

5. I agree that any publication arising out of this project will carry an acknowledgement of the financial support of the Christian Medical College Fluid Research Fund.

Fluid Grant Allocation:

A sum of 3,500/- INR (Rupees Three Thousand Five Hundred Only) will be granted for 2 years.

PRINCIPAL

Dr. Shilpa Susan Mathew, Emp. No. 29875
E-Mail shilpamathew11@gmail.com

Dr. Rupa Vedantam, Emp. No. 09296
E-Mail rupavedantam@cmcvellore.ac.in

Project Title: A retrospective cross-sectional study to determine the association of severity of allergic rhinitis and polysensitivity in skin allergy testing among adult patients evaluated at a tertiary hospital in South India over a period of 2 years.

Ref: IRB Min. No. 13642 [OBSERVE] dated 02.12.2020