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Original Research Article

Addressing the increasing incidence of allergic diseases in young working individuals and their effective management with sublingual immunotherapy in Mumbai

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ABSTRACT

Background: Allergic diseases are on an increase in office workers and students, as a result of climate change and environmental exposure. Our objective here was to define the role of the skin prick test in identifying common inhalant allergens in allergic rhinitis patients and selecting the allergens for optimum sublingual immunotherapy.
Methods: 773 patients were tested in Mumbai from November 2018 to December 2023 by skin prick test. Sublingual Immunotherapy was initiated in 301 patients. Pre and post-therapy SNOT22 symptom score was noted for 3-6 months in a subset of 50 patients.
Results: It was found that 52% were in the age group 20-40 with almost equal male /female ratio, 95% primarily had allergic rhinitis, house dust mite allergy 84%, pollen allergies were the next most common, 63% each being Prosopis and Amaranthus. 40% opted for sublingual immunotherapy, from which a subset of 50 patients, 35 %, showed significant improvement verified by statistical analysis in the first 6 months.
Conclusions: It was found that 52% were in the age group 20-40 with almost equal male /female ratio, 95% primarily had allergic rhinitis, house dust mite allergy 84%, pollen allergies were the next most common, 63% each being Prosopis and Amaranthus. 40% opted for sublingual immunotherapy, from which a subset of 50 patients, 35%, showed significant improvement verified by statistical analysis in the first 6 months.

Keywords: Allergen immunotherapy, Allergic rhinitis, Patient reported outcomes, Skin prick test, SNOT 22 score, Sublingual immunotherapy

INTRODUCTION

Recently, allergic diseases have been on the increase throughout the world. Climate change due to progressive urbanization, lifestyle and diet changes, excessive antibiotic use, air pollution, traffic, fungi, infectious agents, and tobacco smoke are high-risk factors to the progression of allergic diseases.[1,2]

Allergies due to allergen-specific IgE antibodies can be detected in vivo (skin tests) or in vitro.[3] Skin prick testing (SPT) is the simplest, quickest and cheapest way to detect allergen sensitization. Charles H. Blackley in 1865 was the first to document skin prick testing. In 1924, Lewis and Grant first described SPT. SPT has been found to have a good diagnostic accuracy.[4]

In vivo testing by RAST has been discontinued since 2010, by the National Institute of Allergy and Infectious Diseases (NIAID)/National Institutes of Health (NIH) The standard test for in vitro IgE at the moment is Immunocap testing for allergen-specific IgE. Of late, Component Resolved Diagnostics (CRD) being more accurate is popular, but it is not affordable to most.[3]

Allergen immunotherapy (AIT) can modify the progression of the disease and improve the quality of life by stopping the progression of the allergic March, preventing new sensitizations, and reducing the use of medication. AIT modulates the pathophysiology of allergic mechanisms. AIT against house dust mites, insect venom, and selected pollen is effective. Allergic rhinitis works by increasing IL-10, TGF-alpha, and IgG4 levels and T reg cell counts, achieving immune tolerance.[5]

International studies recommend AIT for the treatment of allergic rhinitis and asthma.[6-8] AIT is the only therapy that induces long-term tolerance to allergens even on discontinuation. AIT given for 3 years is effective for at least two years.[9,10] The SNOT 22 symptom score has been found effective in for assessing pre and post therapy results in allergic rhinitis patients.[8,10,11] The sublingual immunotherapy (SLIT)-tablet form of AIT is more convenient for children, adolescents, and their caregivers, with a better safety profile than SCIT.[14,15]

In the present study, we aimed to determine the incidence of allergic rhinitis, the most common allergens, the selection of allergens for SLIT. The efficacy of SLIT, and the most common types of patients suffering from allergic rhinitis.

METHODS

Type of study

It was a progressive cohort observational study in epidemiology.

A total of 773 patients were tested for allergies by the skin prick test from November 2018 to December 2023 at Nucare ENT and allergy clinic, Mumbai. A detailed clinical history of all patients was taken along with physical examination. Informed consent for data collection has been obtained from all the patients. The proforma for the history and consent form has been obtained. The protocol of skin prick testing is followed as stated in the WAO position paper on allergy 2020.[3] The inclusion criteria were patients with allergic rhinitis, skin rashes, urticaria, asthma, stomach upset, and chronic cough. The exclusion criteria were pregnant females, patients unable to discontinue antihistaminic medication, patients with skin lesions not responding to therapy, immunocompromised patients, and patients on immunosuppressive drugs. Limited allergens were tested on infants and children less than 5 years of age, which included dust mites and pollen.

The general history, duration of symptoms, and SNOT 22 score on a Likert 6-point scale from 0 to 5 were taken to determine the severity of allergic rhinitis symptoms 0= no symptoms, 5 = severe symptoms affecting quality of life. Additional symptoms for skin rash, urticaria, angioedema, and stomach upset have been included. The patients were asked to stop antihistaminic medication, oral steroids, and cough syrup for at least a week before testing. However, in extreme cases, a 3-day gap was sufficient to obtain satisfactory results. Patients with severe allergies who were unable to stop the medication were excluded. At the same time, pricking was done with utmost care with patients with dermographism.[3] Standardized allergen extracts were used. The allergy testing kit and vaccines for SLIT have been sourced from Creative Diagnostic Medicare Pvt. Ltd., Mahape Navi Mumbai.

SPT was performed with a positive control of histamine of a minimum 3 mm and a negative control of saline 1-2 m. As per the allergy test results, SLIT was initiated after counselling the patients about the treatment and results. Informed consent was taken for SLIT from all the patients.

The vaccines were prepared by mixing the allergen extracts per the guidelines for mixing with dust, fungus, and pollen as separate sets, which were to be taken on separate days to prevent degradation by proteases.[13] The final concentration of Pollen extract was 1% w/v, and for dust mite extract was 0.2%. The schedule for administering SLIT drops was as follows: the patients were advised to administer the drops below the tongue, preferably early in the morning on an empty stomach, keeping them there for a few minutes and then swallowing. They were advised not to eat or drink anything for ½ to 1 hour after taking the drops. 3 bottles of increasing concentration 1:500, 1:50, 1:10 2 days a week, gradually increasing by 2, 4, 6, 8, 10 drops, starting with bottle number 1, then bottle number 2 followed by bottle number 3, followed by maintenance dose of 10 drops once a week for 2 months, once in 15 days, once in 3 weeks, finally once a month. This treatment was continued for a total of 3 years. The schedule could be customized as per patient responses, in case of triggering of symptoms in spite of anti-histaminic medication the number of drops could be reduced. Sometimes, a further dilution for patients with a wheal size of 6mm or more has been administered. For a few patients, stronger concentrations of 2% and 5% w/v were given. In the case of dust mite allergies, it was 0.5% and 1%.

Each of the patients had to fill out the SNOT 22 score at the first visit when allergy testing was conducted. The follow-up SNOT 22 score has been recorded after patients finished the therapy for 1st phase (5-6 months) as a PROM in the form of a Google Doc form.[9] The mathematical functions and statistics were recorded as standard for Microsoft Excel. Results have been represented in graph form and as paired t-test, p, and Z values.

RESULTS

The age range was from 1.5 to 88 years; majority of the patients, 52%, were in the age group 20-40, with 19%

being 10-20 years of age. The male-to-female ratio was almost equal, with 49% of them being females and 51% males. 18% had a history of allergies since childhood, whereas 40% had a history of 1 to 6 years.

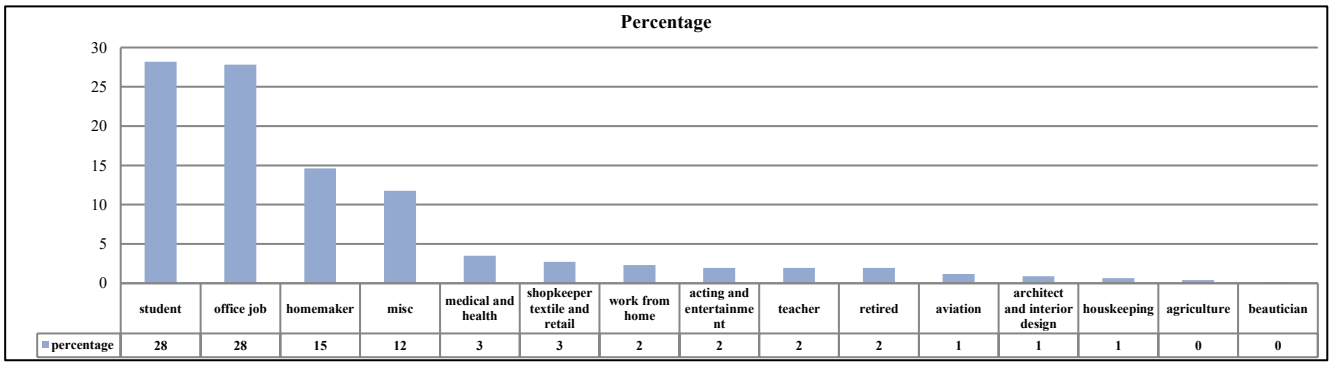

Figure 1: Distribution of test patients according to occupation, showing majority as students and office workers.

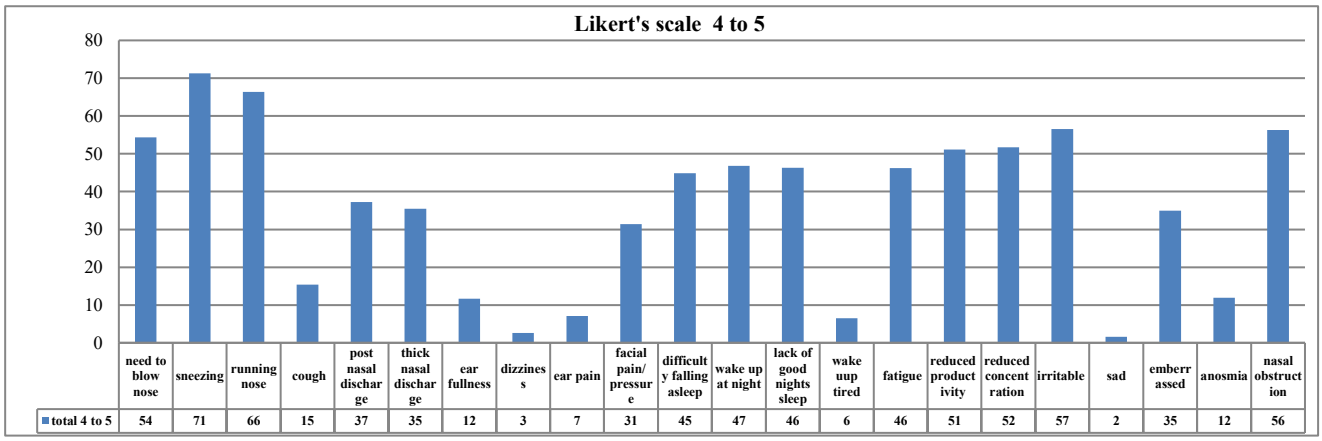

Figure 2: Symptom severity as per SNOT 22 score Likert's scale 4 to 5.

As shown in Figure 1, 28% of the patients were students, 28% were office workers, such as corporate, IT workers, bank employees, and businesspeople, and 15% were homemakers (female).

6% had no nasal symptoms 4.8% had related eye symptoms, while 5% had a history of environmental exposure and change of location. 7 of them had known drug allergies. Patients with urticaria had some mild nasal symptoms; a few had both urticaria and allergic rhinitis, and asthma. The percentage of patients with allergic rhinitis was 95%, asthma 6%, with the rest 10% having airway reactivity. The incidence of urticaria was 25%, with at least 4 patients having dermographism, 8% having food allergy, with 4% having seafood allergy, rest 20% had an unknown trigger. 40% of the patients had a history of skin rashes, of which 12% had food allergies including seafood, non-vegetarian food, milk, fruits, and processed foods, 9 patients had rashes with weather changes and sunlight exposure, 16 had rashes with pressure, heat, cold, sweat, after taking bath, 3 had with drugs, around 19 had trigger with dust, 67% had no known trigger. The incidence of stomach upset was 24%. Symptoms, including constipation, reflux, vomiting, diarrhea, and bloating, were noted. 3 patients had a definite history of seafood allergy, 3 gave a history of gluten and wheat allergy, and 20% had unknown triggers. Only one gave a definite history of milk allergy. Angioedema was noted in 13%, with 4 having a history of anaphylaxis after consuming seafood, 11 had triggers with seafood, 33 with other foods, only 1 had allergies triggered with cat. A few had triggers with dust, temperature, etc., and 80% had an unknown trigger. However, none of them had anaphylaxis while undergoing the test, though vasovagal syncope occurred in a select few. 10 patients had drug allergy, Steven Johnson's syndrome in 3, with aspirin allergy in 2, NSAIDS, cetirizine, and Anti-tuberculosis therapy allergy.

6% had a history of smoking, 2% were passively exposed to smoke, most commonly, father, grandfather, husband, coworkers, and neighbors. 8% had hypertension, 4% had diabetes, 6% had hypothyroidism, with 0.2% hyperthyroid, 70% had not checked for vitamin B_{12}, 16% were normal, 14% were deficient. 19% had low vitamin D_3 levels, 13% had normal, while the rest 68% had not been checked. 2.3 patients % had adenotonsillar surgery, 3.1% had FESS, 1.8% had septoturbinoplasty, 05% had nasal trauma total of 7% had ENT-related surgeries 41%

had a family history, 12% father's side, 11 all relatives, 14% mother's side total of 7 with both parents, 10% other relatives etc.

The history of allergic rhinitis was taken as per the SNOT 22 score. As per Figure 2, the following were the major symptoms on a Likert scale of 4-5: 71% had sneezing, 66% had a running nose, 57% had irritability, 56% had nasal obstruction, 54% needed to blow their nose, 52 and 51% had reduced concentration and reduced productivity, 46% had fatigue and sleep disturbances, 35% had thick nasal discharge and post nasal discharge, 35% were embarrassed by their condition, while only 15% had a sinus headache and 12% had related ear symptoms of pressure or pain.

Table 1: Percentage of allergens tested positive on skin prick test.

Name	Percentage	Range of wheal size, median in mm
House dust mites (*D. pteronyssinus*, *D. farinae*, *Blomia tropicalis*)	84	3-10, 3-5
Prosopis	63	3-6, 3-4
Amaranthus	63	3-5, 3-4
Dust	63	3-5, 3-4
Parthenium	56	3-6, 3
Cockroach	52	3-6, 3
Mosquito	50	3-6, 3
Pollen	47	3-6, 3
Yeast	46	3-6, 3
Spinach	44	3-5, 3
Crabs	44	3-6, 3
Insect	43	3-6, 3
Human dander	41	3-5, 3
Peanut	39	3-5, 3
Dog	39	3-5, 3
Shrimp	37	3-6, 3
Banana	36	3-5, 3
Tobacco	36	3-5, 3
Pigeon	36	3-5, 3
Guava	35	3-5, 3
Brinjal	35	3-5, 3
Epithelia	35	3-5, 3
Curd	34	3-5, 3
Cat	34	3-5, 3
Vegetables	29	3-5, 3
Milk products	26	3-5, 3
Nuts	26	3-5, 3
Aspergillus	25	3-5, 3
Fruits	24	3-5, 3
Fungus	20	3-5, 3
Egg white	17	3-6, 3

Of the 773 patients, total histamine and saline wheal size reactions on average were 5 mm- 43% and 6 mm- 40% 6% and 4% were 7 mm and 8 mm, respectively. 1% had a wheal size of 10 mm. 95% of the wheal size for saline was1mm, and 5% 2 mm, with a few patients having a wheal above 3 mm. Median wheal size was 3, with dust mite skin prick test allergens solely showing a wheal size of 3-12. Extensive tests have been performed for 162 allergens; the most relevant ones are highlighted in Table 1.

Of the total 773 patients tested, 39% of patients opted for SLIT, i.e. 301. 57% were in the age group 20-40, with 19% being 10-20, and 13% 40-50. 51% were males and 49% females. 34% patients followed up; SLIT, as per percentage of patients, was prescribed for the following allergens: house dust mites (*D. farinae*, *D. pteronyssinus*, *Blomia tropicalis*), 84%, Prosopis, 28%, Parthenium, 19%, *Chenopodium murale* 13.2% Amaranthus, Cynodon, 10% each Ischemum, 7%, *A. fumigatus* 6.6%, *Cocos nucifera* 6%, Alternaria, and *Samanea saman* 5.3%. 101 patients took the booster dose for SLIT, 55%were males and 45% females. They were equally distributed in the age group of 11-40; 50 patients documented follow-up out of the total initial SLIT. The patients continued SLIT for dust mites, 85%, Prosopis 27%, Parthenium 22%, *Chenopodium murale* 15% Amaranthus 14%, Cynodon 12%, *A. fumigatus* 9%. 44% had allergic rhinitis from 0-3 years, 18% since childhood, 14% from 3-6 years, and 12 % 6-12 years; 62% had taken treatment from 3-6 months, 28% from 1-3 years, and 10% irregular follow up. Table 2 Shows verbal feedback from patients.

Table 2: Verbal feedback.

Remarks	N
Good Improvement	40
Restarted	8
Discontinued	4
Highly sensitive with smaller doses	2
Mental and developmental issues	2
Mild improvement of sneezing. Eye symptoms still	2
Not much improvement	2
Symptomatic after 3rd booster on treatment	2
Symptoms recurred	2
Restarted 4 years later	2
Finished 3 years	2
Rediluted	2
No feedback	30
Grand total	100

DISCUSSION

Since this study has been done primarily in an ENT clinic, 95% of the patients had allergic rhinitis as the main symptom. The patients were evaluated with the SNOT 22 score, the most common symptoms being sneezing,

running nose, irritability, and nasal blockage. Allergic disorders are seen affect quality of living, productivity, concentration and work efficiency. An equal number of patients were males and females, showing gender as not being an influencing factor in this study. Majority of the patients, 52% were in the prime working age group of 20-40, with a significant number being school going children, showing that work environment like office or classrooms with a closed setup and poor ventilation or air conditioning contributed significantly to dust mite allergy, *D. farinae*, *D. pteronyssinus* and *Blomia tropicalis*.[16] A significant number, 44% of them had a recent onset of symptoms of 0-3 years further suggesting that dust mite exposure at work and school was the culprit. Histamine reactions tested positive up to a wheal size of 5-6 mm, with a few having wheal size up to 10 mm. The wheal size for saline tested 1-2 mm, with an occasional 3 mm reaction where the patient had dermographism.[3] 84% patients tested positive for dust mite allergens, with wheal size going up to 12 mm in some cases. The next most common allergen was house dust, 63%, pollen with Prosopis (mesquite) and Amaranthus being at the same level of 63%. Since Mumbai has a tropical climate, plants specific to Mumbai are a contributing factor. As India is a large country with different regions having varying climates, leading to diverse flora, species of pollen vary as per regional climate.[17] A pollen calendar can be useful in such cases.[18] Total patients having dust allergy were 58%, pollen allergy 47%, of which parthenium was significant at 56%, insect allergy was 43%, with 52% cockroach and 50% mosquito allergy. 46%patients tested positive for yeast allergy 36% were allergic to tobacco. Egg white allergy was 17%. 26% patients tested positive for milk products, 34%, being the highest for curd. 24% patients tested positive for fruits, the highest being banana 36% and guava 35%. 30% patients tested positive for food grains. Bengal gram was the highest at 41%, wheat being 17%, and rice 27%. 29% patients were positive for vegetables, the highest being 44% for spinach and brinjal 35%. 26% patients were positive for nut allergies, out of which 39% patients were positive for peanut allergy. Total patients with allergies to epithelia was 35%, with patients allergic to cat and dog being 34 and 39%, the highest allergy being human dander at 41%, leading to the importance of proper hygiene especially in places where bedding is used and not cleaned properly like sleeper trains, dorms, etc. 20% of the patients were allergic to fungi, 25% having allergies to the Aspergillus group. 44% of the patients were sensitized to shellfish, but since they had dust mite allergies, due to cross-reactivity between Der P 10 and tropomyosin they were asymptomatic.[19] Passive smoking is a common risk factor. Smokers may not have symptoms of allergic rhinitis, leading to a high risk of affecting the lower respiratory tract.[20] Allergies to curd, banana, and guava are significant since they contain biogenic amines which cause competitive inhibition of histamine degradation, in which case clinical history was important.[21] Peanut, pet and human dander allergies too were significant, though no episode of anaphylaxis due to peanut allergy has been noted.

As per Figure 3, family history is an important factor in the epidemiology of allergic diseases. 41% of the patients had family history of allergies, out of which 35% have a single relative with either allergic rhinitis, asthma, or urticaria.[22] Most of the patients had skin rashes, 40% urticaria 25%.[23] Lower respiratory tract symptoms such as airway hyper reactivity were less. 24% of patients had stomach related issues as a symptom. 13% of the patients had angioedema, with 4 patients having a history of anaphylaxis to seafood. However, none of them had anaphylaxis or any severe adverse reaction requiring admission while undergoing SPT, showing the safety of skin prick testing.[24]

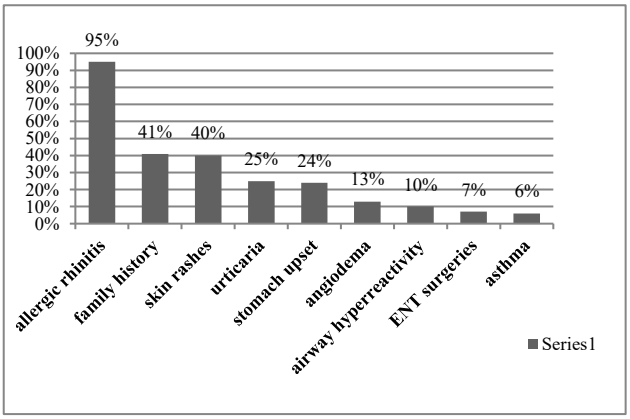

Figure 3: Percentage of patients.

67% of the patients had specific allergies. Since the majority of patients had allergic rhinitis, gluten, milk, seafood, and other allergies were not as much.

This shows that inhalant allergens such as dust mites, pollen, fungi and insects are significant for causing symptoms of allergy in India.[17]

Out of the patients tested, 39% opted for SLIT, most of them being 20-40 years old, 57%, school-going children were 19%. 34% of these patients followed up for booster doses. 50% of these patients, 17% of the total patients on SLIT followed up. Patients with dust mite allergies continued with SLIT, 88 and 85% of the total patients, SLIT given most commonly for the allergens of Prosopis 27%, Parthenium 22%, *Chenopodium murale* 15%, Amaranthus 14%, Cynodon 12%, *A. fumigatus* 9%.

India has a diverse geography, climate, and flora. The common pollen allergens in western India are Poaceae and Chenopodiaceae/Amaranthaceae, according to the pollen calendar. *Azadirachta indica*, *Parthenium hysterophorus*, *Moringa oleifera*, *Prosopis julifera*, *Casuarina equisetifolia*, *Eucalyptus spp.*, *Syzygium spp*. are most prevalent. Climate change, global warming, and

increased carbon emissions have prolonged the pollen season globally and increased the pollen count.[25,26]

A sample size of 50 patients taking SLIT has been analysed, out of which 62% had taken slit for 3-6 months. Figure 4 shows the results of patients pre and post SLIT, showing significant improvement post therapy for symptom score on a Likert scale 4-5. Symptom score significantly improved in the first 6 months, indicating improvement in the quality of life.

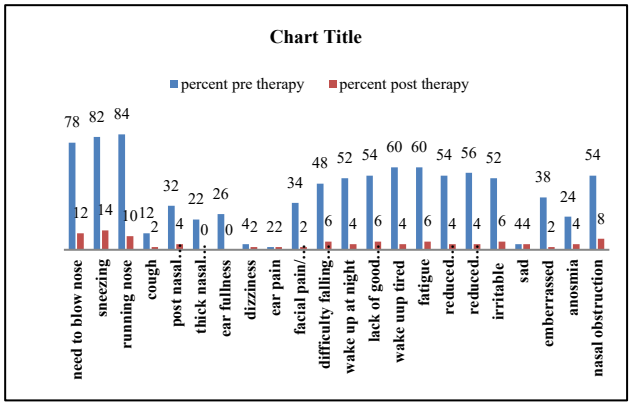

Figure 4: Pre and post SLIT symptom score on a Likert's 6-point scale 4-5.

Further statistical analysis was done, which is presented in Table 3. The t-stat value of 12.178 indicates that the sample mean difference pre and post SLIT was significantly large compared to the standard error of the differences. The two-tailed p value was extremely small (essentially close to zero), showing significant symptom control. The critical t-value for a two-tailed test at the 0.05 significance level was 2.0096. Since the computed t-statistic (12.178) was far greater than this critical value, the result is statistically significant.

Table 3: t-test: paired two sample for means of the above data.

	Pre slit	Post slit
Mean	2.199091	0.765541
Variance	0.666208	0.604735
Observations	50	50
Pearson correlation	0.389637	
Hypothesized mean difference	0	
df	49	
t Stat	11.50479	
P(T≤t) one-tail	7.84E-16	
t Critical one-tail	1.676551	
P(T≤t) two-tail	1.57E-15	
t critical two-tail	2.009575	

As displayed in Table 4, The p value was extremely small (close to 0). This concludes that there was a significant difference between the pre and post therapy, showing the efficacy of therapy. The t-stat value of 11.5048 indicates a significant difference between pre and post treatment, with a large effect size relative to the variation in the data. The two-tailed critical t-value was 2.0096 at a significance level of 0.05 (using 49 degrees of freedom). Since the calculated t-stat (11.5048) was far greater than the critical value (2.0096), the result was statistically significant. The p value (both one-tailed and two-tailed) was extremely small, indicating that the observed difference between pre and post-therapy is statistically significant. The z-statistic (4.9170) was much greater than the critical z-value (1.9600 for two-tailed, 1.6449 for one-tailed), further confirming the statistical significance of the result.

Table 4: For the 4 specific criteria of need to blow nose, sneezing, running nose, nasal obstruction t-test: paired two sample for means.

	Pre SLIT	Post SLIT
Mean	3.73	1.431667
Variance	1.912857143	1.42735
Observations	50	50
Pearson correlation	0.471833998	
Hypothesized mean difference	0	
df	49	
t Stat	12.17799148	
P(T≤t) one-tail	9.8134E-17	
t Critical one-tail	1.676550893	
P(T≤t) two-tail	1.96268E-16	
t Critical two-tail	2.009575237	

Similar studies have been found. The CAPRI study was conducted in 2012 on the QOL of patients with allergic rhinitis.[27] Allergic rhinitis has been found to impair work productivity more than diseases like diabetes type 2 and hypertension. In a similar study conducted by Roohi et al in Kashmir, 86.4% of the patients had allergic asthma, 67.5% had allergic rhinitis. Only 1.6% of urticaria patients had an identifiable aeroallergen detected by SPT alone. In 58% patients of allergic rhinitis and 42% of patients with allergic asthma with Positive SPT, Allergen immunotherapy was effective in reducing severe symptoms.[28]

A similar study by Demoly et al showed the significance of AIT with statistically significant reduction of rhinitis symptoms and medication scores, improved quality of life, and a reduced combined rhinoconjunctivitis score compared with placebo in the period of efficacy assessment.[29]

In a study conducted in Malaysia by Lim et al in 2015 to detect associations between asthma, airway symptoms, rhinitis in office workers, house dust mites (HDM), cat allergy, and HDM levels in office dust. Patients positive to SPT for *D. pteronyssinus*, *D. farinae*, and cat allergy were 50.3%, 49.0%, and 25.5%, respectively. Totally

9.6% had doctor-diagnosed asthma, 15.5% had a current wheeze and 53.0% had current rhinitis.[30] In a study conducted by Chester et al, on comparison of 4 methods of delivery of allergen immunotherapy, SLIT was found to be the preferred and safer route for treatment.[14,15] Allergen immunotherapy is the future of allergy treatment.[31]

The limitations of SLIT are that many patients discontinue SLIT after initial symptoms relief. Proper follow up is difficult to assess as patients do not respond to provided forms. In this particular study further long term follow up is awaited.

CONCLUSION

This study has led to the following conclusions: The incidence of allergic rhinitis is on an increase in urban settings like Mumbai, especially in office goers and high school children as the spend most of their time in closed rooms, poorly maintained and ventilated only by air conditioners. House dust mites are the most common allergens, more of recent onset, with pollen being a close second. Commonest symptoms for allergy are sneezing, running nose, nasal blockage and irritability, which impair the quality of life significantly. These patients, being educated and having good awareness, are more compliant with SLIT. SPT is a major diagnostic tool in the diagnosis and treatment of specific allergies. SLIT drops for the same have been found effective in the first six months, significantly improving the quality of life and work efficiency of the patients. This shows that SPT and SLIT should be used as the primary choice for the diagnosis and treatment of inhalant allergies.

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Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Singh AB, Kumar P. Climate change and allergic diseases: an overview review. Front Allerg. 2022;3:964987.
2. Pacheco SE, Guidos-Fogelbach G, Annesi-Maesano I, Pawankar R, d'Amato G, Latour-Staffeld P, et al. Climate change and global issues in allergy and immunology. J Allerg Clin Immunol. 2021;148(6):1366-77.
3. Ansotegui IJ, Melioli G, Canonica GW, Caraballo L, Villa E, Ebisawa M, et al. IgE allergy diagnostics and other relevant tests in allergy, a World Allergy Organization position paper. World Allerg Organ J. 2020;13(2):100080.
4. Nevis IF, Binkley K, Kabali C. Diagnostic accuracy of skin-prick testing for allergic rhinitis: a systematic review and meta-analysis. Allerg Asthma Clin Immunol 2016;12(1):20.
5. Pavón-Romero GF, Parra-Vargas MI, Ramírez-Jiménez F, Melgoza-Ruiz E, Serrano-Pérez NH, Teran LM. Allergen immunotherapy: current and future trends. Cells. 2022;11(2):212.
6. Bousquet J, Schünemann HJ, Togias A, Bachert C, Erhola M, Hellings PW, et al. Next-generation allergic rhinitis and its impact on asthma (ARIA) guidelines for allergic rhinitis based on grading of recommendations assessment, development and evaluation (GRADE) and real-world evidence. Allergy Clin Immunol. 2020;145(1):70-80.e3.
7. Global Initiative of Asthma. Global Strategy for Asthma Management and Prevention. GINA. 2021. Available from: https://ginasthma.org/wp-content/uploads/2021/05/GINA-Main-Report-2021-V2-WMS.pdf. Accessed on 15 September 2021.
8. Pfaar O, Bachert C, Bufe A, Buhl R, Ebner C, Eng P, et al. Guideline on allergen-specific immunotherapy in IgE-mediated allergic diseases. Allerg J Int. 2014;23(8):282-319.
9. Chong AX, Alvarado R, Rimmer J, Campbell RG, Kalish L, Png LH, et al. Comparison of allergen immunotherapy alone and in conjunction with turbinate surgery for nasal obstruction in perennial allergic rhinitis patients. Ann Oto Rhino Laryngol. 2024 Jun;133(6):545-53.
10. Durham SR, Walker SM, Varga EM, Jacobson MR, O'Brien F, Noble W, et al. Long-term clinical efficacy of grass-pollen immunotherapy Engl J Med. 1999;341(7):468-75.
11. Khan AH, Reaney M, Guillemin I, Nelson L, Qin S, Kamat S, et al. Development of Sinonasal Outcome Test (SNOT-22) domains in chronic rhinosinusitis with nasal polyps. Laryngoscope. 2022;132(5):933-41.
12. Kennedy JL, Hubbard MA, Huyett P, Patrie JT, Borish L, Payne SC. Sino-nasal outcome test (SNOT-22): a predictor of postsurgical improvement in patients with chronic sinusitis. Ann Allerg Asthma Immunol. 2013;111(4):246-51.
13. Daigle BJ, Rekkerth DJ. Practical recommendations for mixing allergy immunotherapy extracts. Allerg Rhinol. 2015;6(1):ar-2015.
14. Chester JG, Bremberg MG, Reisacher WR. Patient preferences for route of allergy immunotherapy: a comparison of four delivery methods. Int Forum Allerg Rhinol. 2016;6(5):454-9.
15. Calderón MA, Simons FER, Malling HJ, Lockey RF, Moingeon P, Demoly P. Sublingual allergen immunotherapy: mode of action and its relationship with the safety profile. Allergy. 2012;67(3):302-11.
16. Murrison LM, Brandt EB, Myers JB, Hershey GKK. Environmental exposures and mechanisms in allergy and asthma development. J Clin Invest. 2019;129(4):1504-15.
17. Kumar R, Kumar M, Bisht I, Singh K. Prevalence of aeroallergens in patients of bronchial asthma and/or allergic rhinitis in India based on skin prick test reactivity. Indian J Allerg Asthma Immunol. 2017;31(2):45-55.

18. Sing AB, Kumar P. Aerial pollen diversity in India and their clinical significance in allergic diseases. Indian J Clin Biochem. 2004;19(2):190-201.
19. Farioli L, Losappio LM, Giuffrida MG, Pravettoni V, Micarelli G, Nichelatti M, et al. Mite-induced asthma and IgE levels to shrimp, mite, tropomyosin, arginine kinase, and Der p 10 are the most relevant risk factors for challenge-proven shrimp allergy. Int Arch Allerg Immunol. 2017;174(3-4):133-43.
20. Gómeza RM, Croceb VH, Zernottic ME, Muiñod JC. Active smoking effect in allergic rhinitis. World Allerg Organ J. 2021;14:100504.
21. Sánchez-Pérez S, Comas-Basté O, Costa-Catala J, Iduriaga-Platero I, Veciana-Nogués MT, Vidal-Carou MC, et al. The rate of histamine degradation by diamine oxidase is compromised by other biogenic amines. Front Nutr. 2022;9:897028.
22. Agache A, Akdis C. Precision medicine and phenotypes, endotypes, genotypes, regiotypes, and theratypes of allergic diseases. J Clin Invest. 2019;129(4):1493-503.
23. Pfaar O, Bonini S, Cardona V, Demoly P, Jakob T, Jutel M, et al. Perspectives in allergen immunotherapy: 2017 and beyond. Allergy. 2018;73:5-23.
24. Sellaturay P, Nasser S, Ewan P. The incidence and features of systemic reactions to skin prick tests. Ann Allerg Asthma Immunol. 2015;115(3):229-33.
25. Bhattacharya K, Sircar G, Dasgupta A, Gupta Bhattacharya S. Spectrum of allergens and allergen biology in India. Int Arch Allerg Immunol. 2018;177(3):219-37.
26. Reinmuth-Selzle K, Kampf CJ, Lucas K, Lang-Yona N, Fröhlich-Nowoisky J, Shiraiwa M, et al. Air pollution and climate change effects on allergies in the anthropocene: abundance, interaction, and modification of allergens and adjuvants. Environ Sci Tech. 2017;51(8):4119-41.
27. Caballer BD, Rodríguez M, Fraj J, Cerecedo I, Antolín-Amérigo D, Colás C. Allergic rhinitis and its impact on work productivity in primary care practice and a comparison with other common diseases: the cross-sectional study to evaluate work productivity in allergic rhinitis compared with other common diseases (CAPRI) study. Am J Rhinol Allerg. 2012;26(5):390-4.
28. Rasool R, Shera IA, Nissar S, Shah ZA, Nayak N, Siddiqi MA, et al. Role of skin prick test in allergic disorders: a prospective study in Kashmiri population in light of review. Indian J Dermatol. 2013;58(1):12-7.
29. Demoly P, Emminger W, Rehm D, Backer V, Tommerup L, Kleine-Tebbe J. Effective treatment of house dust mite–induced allergic rhinitis with 2 doses of the SQ HDM SLIT-tablet: results from a randomized, double-blind, placebo-controlled phase III trial. J Allerg Clin Immunol. 2016;137(2):444-51.
30. Lim FL, Hashim Z, Than LT, Md Said S, Hisham Hashim J, Norbäck D. Asthma, airway symptoms and rhinitis in office workers in Malaysia: associations with house dust mite (HDM) allergy, cat allergy and levels of house dust mite allergens in office dust. PloS One. 2015;10(4):e0124905.
31. Larsen JN, Broge L, Jacobi H. Allergy immunotherapy: the future of allergy treatment. Drug Discov Today. 2016;21(1):26-37.

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