

FEASIBILITY OF SPECIFIED ALLERGEN PREVENTION IN SCHOOL CHILDREN WITH BRONCHIAL ASTHMA AND ALLERGIC RHINITIS

Hanmant Ganpati Varudkar¹, Bhavya Atul Shah², Arti Julka³, Mahendra Singh Raghuwanshi⁴, Sourav Khosla⁵, Swapnil Jain⁶

¹Professor and HOD, Department of Pulmonary Medicine, R.D. Gardi Medical College, Ujjain, Madhya Pradesh.

²Resident, Department of Pulmonary Medicine, R.D. Gardi Medical College, Ujjain, Madhya Pradesh.

³Professor, Department of Pulmonary Medicine, R.D. Gardi Medical College, Ujjain, Madhya Pradesh.

⁴Resident, Department of Pulmonary Medicine, R.D. Gardi Medical College, Ujjain, Madhya Pradesh.

⁵Resident, Department of Pulmonary Medicine, R.D. Gardi Medical College, Ujjain, Madhya Pradesh.

⁶Resident, Department of Pulmonary Medicine, R.D. Gardi Medical College, Ujjain, Madhya Pradesh.

ABSTRACT

BACKGROUND

Accurate diagnosis of allergy is rarely done in allergic rhinitis and asthma patients. The correct prevention of specified allergens may help in better management of these ailments and prevent progression of disease.

The aim of the study is to study the identification of common allergens and feasibility of allergen avoidance in school children of 9-14 years age group.

MATERIALS AND METHODS

An observational study was done at Ujjain from 2013 to 2015. A questionnaire was distributed in 34 schools covering 10,000 students. Symptom exacting six questions were to be answered by students and parents. Students having AR and/or BA underwent dermal sensitivity testing with 25 common allergens. Monthly follow up was done for a year.

RESULTS

3142 questionnaires were received back, out of which, 2061 were valid. Among these, 694 patients were having positive response to at least one of the questions in questionnaire. Allergy testing could be done in only 42 children, out of 199, due to various reasons. 54.8% patients showed reduction in symptoms after the avoidance, but in 38.1% of cases, the symptoms were persistent.

CONCLUSION

Dermal tests showed sensitivity to house dust, *Aspergillus fumigatus*, rice, egg whole and cat dander. Those patients who prevented allergens had relief of symptoms.

KEYWORDS

Allergic Rhinitis, Bronchial Asthma, School Survey, Allergy Test, Prevention.

HOW TO CITE THIS ARTICLE: Varudkar HG, Shah BA, Julka A, et al. Feasibility of specified allergen prevention in school children with bronchial asthma and allergic rhinitis. J. Evid. Based Med. Healthc. 2017; 4(84), 4933-4940. DOI: 10.18410/jebmh/2017/984

BACKGROUND

Global Strategy for Asthma Management and Prevention Guidelines defines asthma as "a chronic inflammatory disorder of airways associated with increased airway hyperresponsiveness, recurrent episodes of wheezing, breathlessness, chest tightness and coughing."¹

The proportion of Indian school children suffering from bronchial asthma has increased to more than double in the last 10 years. The increase in prevalence of asthma in children may have serious implications in their adult life as

40% of children with trivial wheeze and 70-90% of those with troublesome asthma continue to have symptoms in mid-adult life.² Apart from being the leading cause of hospitalisation for children, it is one of the most important chronic conditions causing elementary school absenteeism. The International Study of Asthma and Allergies in Childhood (ISAAC)³ reported prevalence rates in 6 to 7 years cohort varying from 4.1% in India, Indonesia, Iran and Malaysia to 32.1% in Australia, Brazil, New Zealand and Panama.³

The main risk factors associated with childhood-onset asthma are genetic predisposition, allergic sensitisation, family history of allergy and asthma, viral respiratory infections, bacterial colonisation and tobacco exposure. Along with these, early and persistent sensitisations to perennial allergens are strongly associated with asthma in childhood. Furthermore, childhood-onset asthma is typically associated with other atopic diseases, including allergic rhinitis and atopic dermatitis. Even at adult age, the

Financial or Other, Competing Interest: None.

Submission 27-09-2017, Peer Review 02-10-2017,

Acceptance 15-10-2017, Published 17-10-2017.

Corresponding Author:

Dr. Hanmant Ganpati Varudkar,

#B6/5, Staff Quarters, R. D. Gardi Medical College, Ujjain, Madhya Pradesh.

E-mail: hgvarud@gmail.com

DOI: 10.18410/jebmh/2017/984



amounts of total and specific immunoglobulin IgE are higher in childhood-onset asthma than in adult-onset asthma.⁴ Thus, atopy and allergy seem to be closely linked to asthma starting in childhood.

Cochrane database systematic meta-analysis of house dust mite prevention was widely discussed in 2008. This study categorically expressed inability to prevent exposure to house dust mite with the existing preventive methods. However, we studied the meta-analysis independently and found the following loop holes in the analysis- Out of 74 articles, we could not include 26 articles due to various reasons. Remaining 48 articles had heterogeneous methods of HDM (house dust mite) prevention, i.e. single preventive measures, multiple preventive measures and only chemical methods. Out of 19 trials of multiple preventive measures, 18 had shown favourable results. Therefore, we were hopeful about favourable results of asthma and allergy preventive measures in India.⁵

The present study is, therefore, undertaken with the view to know the most common allergens causing AR and/or BA in children and to assess feasibility of avoidance of these allergens. In this study, an effort is made to identify all the challenges and successes encountered in the study of allergen prevention in school children with asthma and allergic rhinitis from the initial symptomatic survey to the allergy testing and finally allergen prevention.

MATERIALS AND METHODS

It was an observational study carried out in the Ujjain city of Madhya Pradesh from March 2013 to April 2015. School children from 5th, 6th and 7th standards were taken for the study.

Thirty-four schools were selected randomly for the study. The survey was started after obtaining permission from District Education Officer (DEO), Ujjain. Survey was carried out by a single person in a single visit with a single reminder.

In our questionnaire, six symptom exacting questions were formulated in local language regarding symptoms of bronchial asthma and allergic rhinitis. First question covered symptoms of allergic rhinitis, second question covered symptoms of asthma, third question covered clinical diagnosis of asthma, fourth inquired previous diagnosis of allergy by any physician, fifth question inquired previous diagnosis of asthma by physician and sixth question covered family history of allergy. All the questions were to be answered objectively. 10,000 questionnaires were distributed amongst 5th, 6th and 7th standard students. A detailed explanation regarding the questionnaire was done to the teachers. The teachers were asked to further explain the questions to the parents and students. Parents were asked to fill the questionnaires in case of 5th standard students. The 6th and 7th standard students themselves filled the questionnaires after getting proper explanation by teachers. School visit was done only twice; one for distribution and other for collection of forms and only single reminder was given in between via telephone. The forms were thereby collected and screened

thoroughly. This process was completed in three months by a single person.

Those subjects who gave positive response to any of the questions were called through the school administration in OPD of Department of Pulmonary Medicine, R.D. Gardi Medical College, Ujjain. Now, detailed history was obtained regarding spacio-chronological relations of symptoms. The following details were noted- type of construction of houses, i.e. house material, wet walls/floor, ventilation, type of blanket used (cotton/woollen), pets, mould at home and second hand smoking. After proper explanation, relevant general physical examination and systemic examination were done.

Spirometry was performed by spirometer of Spiro Labs Co. Ltd. after explanation and demonstration of procedure following the protocol of American Thoracic Society. Three to eight readings were taken. Routine investigation like complete blood count and absolute eosinophil count were performed.

Those children who had Allergy-Like Symptoms (ALS) and reversible airway disease or auscultatory wheeze (in the absence of other causes of wheeze) were labelled as definite asthmatics. After the diagnosis of bronchial asthma and/or allergic rhinitis was confirmed, the patients were advised dermal sensitivity testing. Parents were advised to avoid giving anti-histaminics and steroids for 48-72 hours prior to the test. Before starting the test, the procedure was well explained to the patient's guardians to allay any apprehension and informed consent was obtained. Glycerinated buffered saline was negative control, while histamine acid phosphate 10 mg/mL in glycerinated buffered saline was taken as positive control.

Allergens were obtained from Creative Diagnostic Medicare Pvt. Ltd., (Mumbai, India). The concentration of allergen used for fungi, dust and epithelia was 5000 protein nitrogen units (PNU)/mL for mite, (D-farina) 1000 PNU/mL was used. For mite (*Dermatophagoides pteronyssinus*) and insects 1000 PNU/mL was used; for food 1% w/v was used. The dermal sensitivity test consisted of 25 skin pricks using 7 types of fungus, 3 types of mites, 1 type of dust allergen, 3 types of epithelial allergen, 1 type of insect and 10 types of common food allergen. These allergens are commonly found in our area.

Under all aseptic precautions, dermal sensitivity test was performed on the volar surface of forearm and the reaction was read after 15-20 minutes. The largest diameter was measured in millimetre to obtain the dimension of the wheal. Reactions indicative of clinical allergy are wheal more than 3 mm in diameter⁶ or larger than histamine.

After reading of skin prick test, positive allergens were noted. A symptom and allergen correlation was established. The time and the place of symptom should match with the presence of the allergen in the environment or food ingestion. The most relevant allergens were selected for prevention. Food allergens were withdrawn from diet completely. Parents were advised for prevention of these allergens. House dust mite prevention was advised

by use of plastic sheets, wet mop at bedtime and vacuum cleaning. Fungal allergen could be prevented by waterproofing, open ventilation and better sanitation. The relevant food allergens and the common recipes containing the relevant allergen were advised to be avoided strictly by the patient and alternative food items were suggested. Instructions were given regarding symptomatic medicines. The medication was to be consumed only when patient develops specified symptoms. Emergency contact number was provided.

Follow up was done after one month to note the severity of symptoms, drugs consumed and compliance to allergen avoidance. Similar follow up was done every 2 months for a total of 1 year to access and evaluate the effect of intervention.

Drop out cases were inquired about from teachers.

Method of Analysis- We evaluated symptoms at each followup by interrogation of the severity of symptoms-absent, same or increased. Compliance to medication use was asked-no medication, same or increased medication. We have evaluated causes for noncompliance at each stage by asking whether prevention was done or not and reason for not doing prevention of allergen.

RESULTS

In a total of 10,000 questionnaires, 3142 questionnaires were received back. Out of 3142 forms, only 2061 were valid (incomplete forms- 979/spoiled forms- 102). Among these, 694 patients were having positive response to at least one of the questions in questionnaire.

Sl. No.	Standard	Form Distributed- Total			Forms Retrieved			Percentage of Form Retrieval (10,000)
		No. of Male (%)	No. of Female (%)	Total (%)	No. of Male (%)	No. of Female (%)	Total (%)	
1.	5 th	1913 (19.13)	1789 (17.89)	3702 (37.02)	344 (11)	526 (16.75)	870 (27.70)	23.5%
2.	6 th	1727 (17.27)	1665 (16.65)	3392 (33.92)	403 (12.80)	651 (20.70)	1054 (33.55)	31%
3.	7 th	1912 (19.12)	994 (9.94)	2906 (29.06)	521 (16.60)	697 (22.2)	1218 (38.75)	42%
	Total	5552 (55.52)	4448 (44.48)	10,000 (100)	1268 (40.35)	1874 (59.65)	3142 (100)	31.42

Table 1. Standard Wise Retrieval of Forms

Here, overall retrieval of forms was 31.42%. The percentage of retrieval in 5th standard is low, and in the 7th standard, it is high (Table 1).

Sl. No.	Question	Questions Pertaining to	No. of Positive Answers	Positive Percentage
1.	1	Chronic symptoms of allergic rhinitis like runny nose, itching	128	18.46%
2.	2	Chronic symptoms of bronchial asthma	155	22.32%
3.	3	Chronic symptoms of wheeze	220	18.65%
4.	4	Previous diagnosis of allergic rhinitis	73	10.51%
5.	5	Previous diagnosis of bronchial asthma	119	17.14%
6.	6	Family history of allergy (including skin, nasal, eyes)	180	25.96%
	Total		875	

Table 2. Details of the Forms Received

Maximum number of positive answer was for symptoms of bronchial asthma (22.32%). Positive family history was present in 25.96% patients (Table 2).

Sl. No.	Age Group	Sex				No. of Forms Received	Percentage
		Male	Percentage	Female	Percentage		
1.	6-7	178	14.03	329	17.6	923	20.37
2.	8-9	181	14.27	306	16.3	1290	50.98
3.	10-11	225	17.74	317	16.91	1102	24.32
4.	12-13	243	19.19	407	21.71	725	16
5.	Above 13	441	34.77	515	27.48	490	10.81
	Total	1268	100	1874	100	3142	

Table 3. Age Wise Distribution of Forms Collected from Schools

Coefficient of correlation up to 13 years is 0.852 for males and 0.851 for females. Maximum number of patients belonged to age group 8 to 11. As the age increases, the compliance is increasing (Table 3).

Sl. No.	Cause	Number of Dropout	Total
1.	Lack of knowledge regarding disease among parents	51%	252
2.	Distance from medical college	9%	47
3.	Fear of injections(multiple pricks)	27%	133
4.	Faith in other systems of medicine- homeopathy, naturopathy	18%	89
5.	Inconvenient timings	15%	71
			592

Table 4. Causes for Dropout

Out of 694 students, 495 did not report to hospital for allergy testing. Thus, only 199 students reported to OPD for allergy testing. Following are the reason for remarkably less number of patients who reported to our OPD (Table 4).

Though apparently, there is difference between drop out in number of forms and drop out as per above table, it can be explained by more than one causes of drop out in same student.

Though 199 patients were eligible for allergy testing, however, procedure could not be done in 53 patients because of following reasons-

1. Fear of prick of lancet in 18 patients (33%).
2. Exacerbation of symptoms of BA/AR occurred in 5 patients (9.43%).
3. Taking antihistaminic drugs on the same day in case of 9 patients (16.98%).
4. Seeing the test being done on other children during allergy testing in case of 21 patients (39.62%).

During the procedure, 2 patients fainted, however, their blood pressure was normal and they recovered without

medication by putting them in supine position. 92 patients had excessive crying during the procedure, hence procedure had to be discontinued.

52 patients had undergone dermal sensitivity testing. Out of 52 patients, 10 patients were lost to follow up. Thus, the study was performed in 42 patients. Out of 42 patients, 25 patients were males (59.52%) and 17 were females (40.47%). 42.8% cases were having diagnosis of both allergic rhinitis and bronchial asthma.

Sl. No.	Clinical Diagnosis	No. of Patients	%
1.	Bronchial asthma	12	28.5%
2.	Allergic rhinitis	12	28.5%
3.	Bronchial asthma with allergic rhinitis	18	42.8%
	Total	42	100%

Table 5. Clinical Diagnosis of Patients

Maximum patients were with diagnosis of bronchial asthma with allergic rhinitis (42.8%), followed by equal cases of bronchial asthma (28.5%) and allergic rhinitis (28.5%) (Table 5).

Sl. No.	Signs and Symptoms	Allergic Rhinitis (n=18)	Bronchial Asthma with/without Allergic Rhinitis (n=24)		
		Number of Patients	Percentage	Number of Patients	Percentage
1.	SOB	0	0%	24	100%
2.	Cough	4	22.2%	24	100%
3.	Wheezing	0	0%	10	41.6%
4.	Sneezing	15	83.3%	11	45.8%
5.	Running nose	18	100%	10	41.6%
6.	Chest tightness	0	0%	10	41.6%
7.	Eyes irritation	8	44.4%	4	16.6%

Table 6. Signs and Symptoms in Study Patients

Runny nose and sneezing were most common symptoms in patients of allergic rhinitis and clinically rhonchi were present in 58.3% cases of bronchial asthma (Table 6).

Maximum patients were from urban area (73.80%) and were above poverty line (83.3%). The Z test applied between allergic rhinitis, bronchial asthma and allergic rhinitis with bronchial asthma showed no significant difference (Table 7).

Socioeconomic Status	Clinical Diagnosis			Total
	Allergic Rhinitis	Bronchial Asthma	Allergic Rhinitis + Bronchial Asthma	
BPL	3	1	3	7
APL	15	11	9	35
Total	18	12	12	42

Table 7. Socioeconomic Status vs. Clinical Diagnosis Cross Tabulation

Sl. No.	Group of Allergens	No. of Test Performed (Total Skin Prick)	No. of Positive Reaction	(%)
1.	Fungi	294 (42*7)	44	15%
2.	Mite	126 (42*3)	14	11.46%
3.	House dust	42	17	41.14%
4.	Food	420 (42*10)	85	20.23%
5.	Epithelia	126 (42*3)	7	5.17%
6.	Insect	42	3	7%
	Total	1050	215	20.47%

Table 8. Pattern of Positive Allergic Reactions

Dermal sensitivity testing was performed in 42 patients who showed positive reactions to a variety of stimulants ranging from fungi, house mite to food and others as shown in Table 8.

Among fungus, *Aspergillus fumigatus* was the commonest allergen observed in 15 (35.7%) patients. Milk and egg whole were predominant among food allergens in 10 (23.08%), while cat dander was highest 9 (21.42%) in epithelial allergens. House dust was commonest allergen found in 17 (50%) in cotton blanket users and foam and dhurrie mattress users. Fungal allergens were found in 9(20.6%) patients living in hut (Table 9, 10, 11, 12).

Sl. No.	Allergens	No. of Patients	Percentage
1.	Food	13	30.9%
2.	House dust mite	16	38.18%
3.	Fungi	8	19.04%
4.	Epithelia	2	4.76%
5.	Insects	3	7.14%
	Total	42	100%

Table 9. Proportion of Patients Showing Symptom Allergen Correlation

Sl. No.	Type of Allergen	Change in Symptoms after Allergen Avoidance (in %Age)			
		Decreased	Increased	Same	Total
1.	Food allergens	11 (84.6%)	1 (7.7%)	1 (7.7)	13
2.	House dust mite	5 (31.25 %)	1 (6.25%)	10 (62.5%)	16
3.	Fungi	4 (50%)	1 (12.5%)	3 (37.5%)	8
4.	Epithelia	1 (50%)	0 (0.0%)	1 (50%)	2
5.	Insects	2 (66.67%)	0(0.0%)	1 (33.33%)	3
	Total	23 (54.8%)	3 (7.14%)	16 (38.09%)	42

Table 10. Change in Symptoms After Allergen Avoidance

1.	Food allergens	10(84.6%)	1(7.7%)	2(7.7)	13
2.	House dust mite	5(30%)	5(10%)	10(62.5%)	16
3.	Fungi	4(50%)	1(12.5%)	3(37.5%)	8
4.	Epithelia	1(50%)	0(0.0%)	1(50%)	2
5.	Insects	2(66.67%)	0(0.0%)	1(33.33%)	3

Table 11. Change in Medications After Allergen Avoidance

DISCUSSION

This was a comprehensive study from questionnaire-based survey of school children to the study of effects after the prevention of specified allergens with the intention of assessment for relevant allergen prevention.

The questionnaire was drafted in Hindi language with special emphasis on simplicity of words and accuracy of symptoms, so that it can be easily understood by parents and children. It was assumed that students of 5th standard were probably too young to understand implications of each question, and therefore, their answers were far from being correct. Their sense of responsibility is less, which might result into multiple fallacies. On the other hand, 6th and 7th standard students are more mature, therefore, their response is expected to be better. Therefore, we had asked the management to get answers to questionnaire of 5th standard students to be filled by the parents.

Though 10,000 questionnaires were distributed, only 3142 could be retrieved. Table number 1 shows standard wise distribution and retrieval of forms of all students. Reasons for deficit in form retrieval were that single person visited only once. Proper counselling of each student or parent could not be done as administrative difficulties were faced. This could have been avoided by recruiting manpower in the form of social workers, counsellors, etc.

and timely collection of forms would have resulted in less number of spoiled forms.

In the 5th standard students, forms retrieval were only 23.5% and 7th standard retrieval was 42%. Though everybody was expected to fill the forms and return to teacher, many healthy students have ignored the teachers' instructions. Since, they were asymptomatic, they have not taken care to return forms. The other reasons are improper communication, limited follow up action and organisational difficulties. It is worth commenting, even though students of 5th standard are generally more symptomatic, the retrieval of form is proportionately less. On the other hand, 7th standard students are less symptomatic, but the proportion of retrieval is high in the same organisational structure. Behavioural difference of sexuality is also obvious in this table. In each group, number of female students is less, but form retrieval is higher than the male students. For instance, there are 19.7% females in 5th standard, but form retrieval was 28.9%, which is proportionately more, whereas male students were 19.13% and form retrieval was 11%.

Family history of allergy (skin, nasal, etc.) was found to be common in our study. 22.6% allergic rhinitis patients had positive family history, while 41.6% bronchial asthma patients had positive family history.

In our study, as in Table 2, 155 forms contained positive answers to the symptoms of bronchial asthma that is 22.32% of the total forms received. Similar prevalence was depicted by Chhabra Gupta, Chhabra P et al⁷ (1998) and Paramesh et al⁸ (2002), i.e. 15.7% and 11.5 to 19.34%, respectively. Singh et al⁹ (2004) reported an urban prevalence of 11.92% and a rural prevalence of 13.72%.

In table 2, the symptoms of wheeze as asked in third question had 225 positive answers, i.e. 18.65% of the total forms received. ISAAC³ phase I reported that a 12-month prevalence of symptoms of wheeze varied between 4.1 and

32.1%. Similar results were found by Chhabra et al¹⁰ (1999) and Raj Kumar et al¹¹ (2008) showed prevalence of wheezing to be 16.7% and 14.72%, respectively.

Prevalence of allergic rhinitis in Table 2 of our study, fourth question of allergic rhinitis, 73 forms had positive answer to the symptoms of allergic rhinitis, i.e. 10.51%. Raj Kumar et al¹¹ (2008) showed higher prevalence of allergic rhinitis to be 21.27%.

Family history-In our study, family history was present in 26.19% of cases; however, Anuradha et al¹² showed 59.16% genetic predisposition in bronchial asthma irrespective of sex. Mahdi et al¹³ showed history of asthma in any member of the family to be 44.5 percent of cases.

Table 3 shows age wise distribution of forms received. In our study, as the age increased, the proportionate collection of age wise retrieval is also increased. Therefore, more effort has to be focussed on younger age group in any work of this nature in future.

Table 4 depicts the causes of drop out from study. Lack of knowledge among parents accounted for 51% of drop outs. As the parents were not aware about allergy testing, its importance, etc. that is why they had declined to avail of our free services. This can be rectified by proper counselling of parents by lectures, pamphlets and audio visual means. Another hurdle in the study was the distance from the place of allergy test centre. Allergy testing was performed in our medical college, which is 5 kilometres away from city. Thus, distance posed a problem in this study. Therefore, allergy testing in the centre of the city usually reduces the dropout rate. 27% of drop outs were due to fear of injections. Extreme fear of injection is a subjective feeling, which however, cannot be modified. However, adopting painless procedures, less number of allergens will be solution to this hurdle. 18% drop outs were due to influence from other systems of medicine like Ayurveda Medicine, Homeopathy, etc. They claim that they cure asthma, that's why patients are attracted. This needs health education of the society on large scale. Then only, this concept can be alleviated. Proper counselling regarding the cause of bronchial asthma and how it can be cured by allergen prevention can lead to better results. Clinicians need to spend more time with the patient. Inconvenient timings accounted for 15% of drop outs. Students are busy in schools, while parents are involved in jobs and business during hospital OPD timings; hence, they find it inconvenient to attend. Thus, the dropout rate could be reduced by collaborating with parents and setting an appropriate time for allergy test.

Table 5 depicts clinical diagnosis of patients, which shows 28.5% patients had allergic rhinitis and bronchial asthma, while 42.8% had a diagnosis of both bronchial asthma and allergic rhinitis.

Table 6 depicts the signs and symptoms in study patients of allergic rhinitis and bronchial asthma with or without allergic rhinitis showing runny nose and sneezing were most common symptoms in patients of allergic rhinitis, while shortness of breath and cough were the commonest in bronchial asthma patients.

Table 7 shows clinical diagnosis and socioeconomic status comparison. Maximum patients with bronchial asthma and allergic rhinitis were from urban area (73.80%) and were above poverty line (83.3%). This can be due to hygiene hypothesis.¹⁴ Also, since this was a city school-based study, so maximum patients resided in city, therefore, urban predominance maybe found. However, Z test between urban and rural population came to be insignificant.

Table 8 shows total number of positive dermal sensitivity test in study patients. House dust (40.47%) gave largest number of positive reaction, followed by fungus (22.44%), food (20.23%), mite (17.46%), epithelia (16.66%) and insect (9.52%). Similar to present study, house dust mites were detected as a common allergen in Qatar according to Sattar HA et al (2003)¹⁵ followed by insects that differs from our study. Pherwani AV et al¹⁶ (1985) studied at Bombay, 81.25% gave a positive reaction to insects followed by dust (71.9%), fungi (40.6%), pollen (37.5%) differ to our study. Jain VK et al (2005)¹⁷ at Bikaner observation was different, where highest positivity to pollen (95%), followed by dust (79%), insects (64%) and fungi (47%). Sethi et al¹⁸ showed positivity of insects allergens 25.6%, food allergen 18.7%, fungi 13.17% and dander 11.5%. The difference observed could be because of different geographical location and different flora and fauna present in the area these studies were performed. The type of habitation probably seems to be important factor for the variations in the observations of different workers in this field. For example, Mumbai is densely populated, humid city. Therefore, insects and fungi would be more prominent. On the other hand, V.K. Jain has worked in rural population of Rajasthan; therefore, his study shows predominance of pollen grains. In most of the studies, differences of housing, food habits, lifestyle, exposure to flora and fauna is restricted to their studies. However, broader perspectives are required.

We have made an attempt to find out spacio-chronological correlations between exposure of various allergens to the patient's symptoms in Table number 9. Since, allergic rhinitis and asthma are mostly type I reactions, they manifest within 20-30 minutes of allergen exposure. Barring food, rest of the allergens in our selection are inhalants. Therefore, spacio-chronological correlation will be more easily understandable. However, in case of food allergen, this relation may not be very obvious. Therefore, we had given considerable allowance for onset of symptoms before food ingestion and relief of symptoms after avoidance. Here, it is worth commenting that food allergens, epithelia (cat dander and wool), insects are easily identifiable and therefore preventable allergens. Thus, in our study, 42.8% patients had clinically confirmed spacio-chronological relation with preventable allergens. Therefore, we expect that they should be symptom free by proper specific preventions. House dust mite and fungi are not easily understood by the patients. The seepage and fungus in the walls can attract the attention of the patients and can be a remediable cause. Thus, patients will be able

to take corrective measures for this seepage. This can also be a preventable cause in selected patients.

You can see effects of prevention of specified allergens on the symptoms of the patient in Table 10. It is worth noting that by food allergen prevention (84.6%), fungi (50%), insects (66.67%), epithelia (50%) symptom reduction has been observed. Though, number of patients are less, the observation is indicative of potentials of specific allergen prevention. The reasons for similar and increase in symptoms can be more complex. In the study of Johansson, synergy of allergy has been described, which is less explored feature of allergen prevention.¹⁹ Synergy is accentuation of symptoms. If more than one allergen enters the body and if one of them is withdrawn, they drop significantly. In complex disease like allergy, this point has to be explored in country like ours where the climate is not in extremes; therefore, patients can adopt more natural lifestyle, i.e. no need of air conditioner, since open atmosphere is feasible, most of the times with least clothing. This reduces the allergen exposure in closed housing. Since, alternative food items are easily available, patient can avoid the specified allergens easily.

Effects of specified allergen avoidance can be seen in table number 11, which shows the changes in medication. It must be re-emphasised that patients were advised to take symptomatic medicines only when symptoms appear. Supportive solutions were made available in case the symptoms flared up.

Here, you can see with food (84.6%) and insect (66.67%) exposure reduction lead to a reduction in requirement of medications. House dust mite seems to be difficult allergen to prevent. Similar remark has been passed by Cochrane study. However, our analysis of their study has been briefly described above in introduction.

Probably, in our country, house dust mite exposure can be easily prevented due to pleasant weather and adopting multiple measures of prevention. Here, we can see with limited number of patients with limited services 30% of the patients had reduction in medication by prevention.

Platts-Mills et al²⁰ demonstrated that long-term dust mite avoidance in sensitised asthmatics resulted in a significant improvement.

Allergen avoidance improves disease control in other atopic disorders like allergic rhinitis.²¹ Early removal of sensitised allergen is associated with better long-term outcome than that after a prolonged exposure.²²

CONCLUSION

In our study, extensive work has been done from survey of school children to the evaluation of effects of specific allergen prevention. The pros and cons in allergen prevention have been meticulously worked out. We have found multiple causes of differing compliance from conducting of survey to bringing symptomatic patient to the OPD. These reasons can be rectifiable by proper health education, individual counselling, intensified health services and improving administration.

The multiple difficulties faced while doing allergy testing can be tackled by reducing the number of allergens, adopting painless procedures and health education.

We have found reduction in symptoms in food allergens and insects, which proves that prevention is effective in identifiable allergens. In some cases of house dust mite and fungi prevention, symptom reduction has been observed. However, larger studies have to be conducted to confirm the observation.

REFERENCES

- [1] Masoli M, Fabian D, Holt S, et al. The global burden of asthma: executive summary of the GINA Dissemination Committee report. *Allergy* 2004;59(5):469-478.
- [2] Reid J, Marciniuk DD, Cockcroft DW. Asthma management in the emergency department. *Can Respir J* 2000;7(3):255-260.
- [3] Mallol J, Crane J, von Mutius E, et al. The International Study of Asthma and Allergies in Childhood (ISAAC) phase three: a global synthesis. *Journal Allergol Immunopathol (Madr)* 2013;41(2):73-85.
- [4] Miranda C, Busacker A, Balzar S, et al Distinguishing severe asthma phenotypes: role of age at onset and eosinophilic inflammation. *J Allergy Clin Immunol* 2004;113(1):101-108.
- [5] Gotzsche PC, Johansen HK. House dust mite control measures for asthma. *Cochrane Database of Systematic Review* 2008;(2):CD001187.
- [6] Leynaert B, Bousquet J, Neukirch C, et al. Perennial rhinitis: an independent risk factor for asthma in nonatopic subjects: results from the European Community Respiratory Health Survey. *J Allergy Clin Immunol* 1999;104(2 Pt 1):301-304.
- [7] Chhabra SK, Gupta CK, Chhabra P, et al. Prevalence of bronchial asthma in school children in Delhi. *Journal of Asthma* 1998;35(3):291-296.
- [8] Paramesh H. Epidemiology of asthma in India. *The Indian Journal of Paediatrics* 2002;69(4):309-312.
- [9] Singh M, Singh SP, Singh K, et al. Prevalence of bronchial asthma among school children in urban and rural areas. *Chest* 2004;126:762S.
- [10] Chhabra SK, Gupta CK, Chhabra P, et al. Risk factors for development of bronchial asthma in children in Delhi. *Ann Allergy Asthma Immunol* 1999;83(5):385-390.
- [11] Kumar R, Singhal P, Jain A, et al. Prevalence of bronchial asthma and allergic rhinitis in school girls in Delhi. *Indian J Allergy Asthma Immunol* 2008;22(2):99-104.
- [12] Anuradha A, Lakshmi Kalpana V, Narsingrao S. Epidemiological study on bronchial asthma. *Indian J Allergy Asthma Immunol* 2011;25(2):85-89.
- [13] Mahdi B, Mahesh PA, Savitha R. Inheritance patterns, consanguinity & risk for asthma. *Indian J Med Res* 2010;132:48-55.

- [14]Brooks C, Pearce N, Douwes J. The hygiene hypothesis in allergy and asthma: an update. *Curr Opin Allergy Clin Immunol* 2013;13(1):70-77.
- [15]Sattar HA, Mobayed H, al-Mohammed AA, et al. The pattern of Indoor and outdoor respiratory allergens in asthmatic adult patients in a humid and desert newly developed country. *Eur Ann Allergy Clin Immunol* 2003;35(8):300-305.
- [16]Pherwani AV, Desai AG, Bhave SY. An analysis of skin prick test reaction in asthmatic children in Bombay. *Ind J Chest Dis And All Sci* 1985;27(4):219-224.
- [17]Jain VK, Modi CS, Gupta K, et al. Clinical spectrum of nasobronchial allergy in patients residing in Thar Desert. Abstract from 39th annual Convention of Indian College of Allergy, Asthma and Applied Immunology, Jaipur 2005. *Ind J Allergy Asthma Immunol* 20025;19(2):102.
- [18]Sethi S, Sarkar B, Gupta SR. A study of intradermal allergy testing in bronchial asthma, Raipur. *Ind J Chest Dis All Sci* 1986;28(3):105-108.
- [19]Nopp A, Johansson SG, Lundberg M, et al. Simultaneous exposure to several allergens has an additive effect on multisensitized basophils. *Allergy* 2006;61(11):1366-1368.
- [20]Platts-Mills TAE, Tovey ER, Mitchell EB, et al. Reduction of bronchial hyperreactivity during prolonged allergen avoidance. *Lancet* 1982;320(8300):675-678.
- [21]Howarth PH, Lunn A, Tomkins S. A double blind, placebo controlled trial of intervent bedding system in perennial allergic rhinitis. *J Allergy Clin Immunol* 1992;89:305.
- [22]Marinho S, Simpson A, Custovic A. Allergen avoidance in the secondary and tertiary prevention of allergic diseases: does it work? *Primary Care Respiratory Journal* 2006;15:152-158.