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HOUSE DUST MITES AND POLLENS AS RISK FACTORS IN ALLERGIC MANIFESTATIONS

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ABSTRACT

House dust mites and pollens play a major role in parthenogenesis of allergic disorders particularly asthma and rhinitis. The most commonly found house dust mites are *Dermatophagoids farinae*, *Dermatophagoides pteronyssinus and Blomia tropicalis. Parthenium hystrophorus*, *Morus alba*, *Ageratum* spp, *Cannabis sativa*, *Pennisetun typhoides*, *Amaranthus*, *Xanthiumstrumariun*, *Chenopodium album*, *Eucalyptus* spp, *Chenopodium murale*, *Asphodelus* spp, *Imperata cylinderica* and *Brassica compestris* were the major pollens found in North India. During present study, 400 patients with allergic manifestations who visited ENT department of Rajindra hospital, Patiala from 2013 to 2015 were considered. The patients were divided into 7 groups based on clinical findings 1. Allergic rhinitis 2. Asthma 3) Allergic rhinitis and Asthma 4. Dermatitis 5. Allergic rhinitis and Dermatitis 6. Asthma and Dermatitis and 7. Control. of the 400 patients, skin prick tests were performed on 165 patients falling in these 7 groups. Based on positivity to skin test and sensitivity to the antigens individuals were also categorized into 7 groups. The results of investigations and skin tests have been discussed in this paper. According to our observation maximum number of patients was sensitive to dust mites followed by dust mites and pollens only.

KEYWORDS : Asthma, Allergic rhinitis, House dust mites, Pollens, Dermatitis

The aerobiologists and allerologists have been working for the last many years to find out the allergenic potentials of dust mites, fungal spores and pollens (Agashe and Vinay, 1980; Tilak, 1982; Van-Hage et al., 1987). All these aeroallergens are found in close environment of man and their role vary with the environmental conditions such as climatic factors and degree of exposure (Deschildre, 1999 and Melson and Brinchl, 2001). Indoor levels of allergens play a major role in the development of sensitization and triggering asthmatic attacks in children as worked out by Flaherty et al. (1984), Samson (1985). House dust mites, in particular *Dermatophagoides pteronyssinus* and *D. farinae* have been shown to play an important role in the parthenogenesis of asthma and atopic diseases. (Plattis-Mill and De Weck, 1989; Plattis-Mill, 1992 and Peat et al.,1996). Mite allergen level of >2µg/gm of dust (100 mites per gram) is considered as risk level for sensitization and symptoms of asthma (Munir 1998 and Dreberg 1998).

Similarly pollens are another risk factor for allergy. Although they are the problems in outdoor allergy but considerable amount of pollens are present in indoor environment. Most airborne tree pollens are shed during spring and early summer, grass pollens during midsummer, weed pollens during late summer and rain fall. When pollens are released in large number they produce allergic problems such as allergic rhinitis and hay fever.

Several epidemiological and diagnostic studies have reported an increasing prevalence of allergic reactivity to these allergens (Semik- Orzech et. al., 2008). However, the exact prevalence of allergic sensitization is not known, mainly due to lack of standardized allergen extracts and due to overwhelming number of allergenic species that are able to elicit IgE mediated reactions. The effective in vivo and in vitro diagnosis of allergies is based on availability of well-characterized allergen preparation (Kurup et. al., 2000). The present study is aimed at determining the prevalence of IgE mediated allergy to dust mites and pollens as well as contribution of sensitization to these aeroallergens with respect to allergic manifestations.

MATERIALS AND METHODS

A retro prospective study was conducted on 400 patients who visited ENT department of Rajindra hospital, Patiala from 2013 to 2015. All patients were subjected to full ENT examination. Patients were selected based on symptoms of sneezing, watery rhinorrhoea, nasal obstruction, eye symptoms (in the form of redness, watering of eyes and itching), itching of nose, throat and ear and any

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asthma related symptoms. Investigations done on such patients included X-ray/CT scan of paranasal sinuses, nasal endoscopy and spirometry. Based on above criteria 165 patients of the 400 patients were selected for Skin prick tests. Tests were conducted in the allergy center of Department of ENT, Rajindra Hospital Patiala with commercially available antigens. The flexor expects of the forearm or the lateral aspect of upper arm of the patient was used as the site for testing. Buffer saline was used as negative control and histamine acid phosphate as a positive control. The significance of negative control is that it shows the physiological conditions and general reactivity of skin whereas the positive control shows the skin reactivity to minute dose of histamine and to what extent. A 26- gauge tuberculin syringe with ½ inch bevel sterile hypodermic needle was used for injection and 0.01ml of the solution was injected intradermally. This raised bleb of 2mm, which in 15- 20 minutes attained the size of 4-5mm without an erythema. A separate syringe and needle was used for each antigen. A distance of 4mm was kept between two skin prick test sites. The reaction was examined for one hour at an interval of 15-20 minutes. The strength of each reaction by the degree of erythema and area of weal formed was observed and compared with the controls.

The total serum IgE levels were also detected with ImmuoCAP phadia 100 (Thermo Fisher Scientific, USA) of the patients who were positive for one or more allergens.

Based on clinical findings and investigations done, patients were categorized into seven groups 1. Allergic rhinitis 2. Asthma 3. Allergic rhinitis and Asthma 4. Dermatitis 5. Allergic rhinitis and Dermatitis 6. Asthma and Dermatitis 7. Normal as control. Skin prick tests were performed on 165 individuals. Based on positivity to skin tests and sensitivity to antigens individuals were categorized into 4 groups: 1. Positive towards dust mites 2. Positive towards pollens 3. Positive towards pollen and dust mites and 4. Negative to all of them. Patients were excluded from the study if they had clinical features of vasomotor rhinitis, COPD, if they had received treatment of corticosteroid or the other immunosuppressive therapy during preceding 6 months, if they had elevated IgE levels caused by another disease or if they had ever received allergen immunotherapy.

Data Analysis

Data was analyzed statistically by using chi square to see whether the two attributes taken are independent or dependent. It has been calculated at two levels, at 0.05% level it was considered significant and at 0.01% levels was considered highly significant.

Table 1 : Descriptive Characteristics of Patients Who Visited the ENT Department

	Males (%)	Females (%)	Total
Number of Individuals	225 (56.25%)	175 (43.8%)	400
Age of Individuals (Mean ± S.D)	36.5 ±17.4*	35.4 ± 17.8*	35.9 ± 17.6*

*p<0.01 was considered to be significant

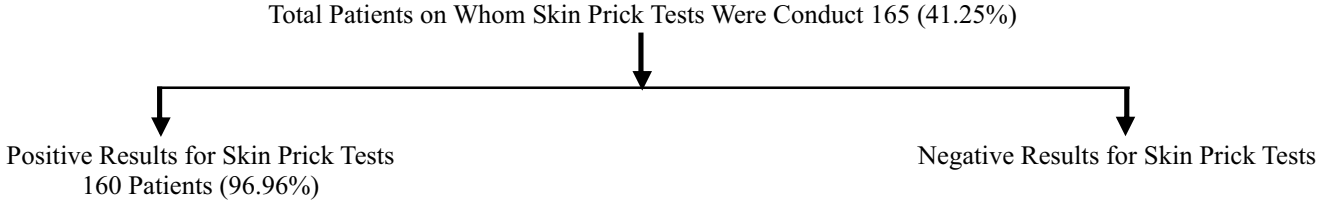

Table 2 : Gender and Age of Individuals Selected for Skin Prick Tests

	Males (%)	Females (%)	Total
Number of Individuals	90 (54.54%)	75 (45.45%)	165
Age of Individuals (Mean ± S.D)	35.3 ± 16.5*	34.5 ± 16.8*	34.9 ± 16.5*

*p<0.01 was considered to be significant

Table 3: Number, Percentage and Age of Individuals Sensitive to Different Allergens

Allergens	Number	Percentage	Age
DM	62	37.58	34.3 ± 16.5
DM/P	50	30.30	35.4 ± 16.8
P	48	29.09	34.4 ± 16.7
Nill	5	3.03	34.3 ± 16.5

Table 4 : Prevalence of Patients to Allergen Sensitivity

Allergens Disorders	Sensitive to dust mites		Sensitive to dust mites and pollens		Sensitive pollens		Total	
	No.	%	No.	%	No.	%	No.	%
Control	2	40	1	20	2	40	5	3.12
Asthma	13	38.23	11	32.35	10	29.41	34	21.25
Allergic rhinitis	12	37.5	10	31.25	11	34.36	33	20.62
Allergic rhinitis and asthma	10	43.48	08	34.78	05	21.74	23	14.4
Dermatitis	10	41.66	07	29.17	07	29.17	24	15
Allergic rhinitis and Dermatitis	08	36.36	07	31.82	07	31.82	22	13.8
Asthma and Dermatitis	07	36.84	06	31.58	06	31.58	19	11.9
Total	62	38.75	50	31.25	48	30	160	

Table 5: Number of Individuals Sensitized to Different Type of Dust Mites

Dust mites	Number of Individuals	Percentage (%)
D. farinae	86	52.12
D. pteronyssinus	72	43.64
G. destructor	64	38.79
T. putrescentiae	62	37.56
A. siro	57	34.55

RESULTS

Of the 400 subjects selected for the present study 225 were males (56.25%) and 175 were females (43.8%). Skin prick tests were performed only on 165 subjects of these 165 subjects whose history was suggestive of allergy. Of these 160 subjects were found to be sensitized for one or more allergens. History of where 5 subjects did not give any response to the allergens (Table 1) though their history was suggestive of allergy.

Of the 165 subjects 90 (54.54%) were males in the age group of 34.3 ± 16.5 and 75 (45.45%) in the 34.5 ± 16.8 were females (Table 2).

It has been observed that of the 165 positive subjects 62 i.e. 37.58% were sensitive to dust mites only, 50 i.e. 30.30% were sensitive to dust mite and pollens, 48 i.e. 129.09% were sensitive to pollens only, 3.03% did not show sensitivity to any of the allergen. According to our observation maximum number of patients were sensitive to dust mites only followed by dust mites and pollens and pollens only (Table 3).

It has been observed from that patient with asthma and allergic rhinitis showed greater sensitivity than patients with other conditions. Statistically there is no dependence on allergen type and disease (Table 4).

From dust mites, allergens of *Dermatophagoids farinae, Dermatophagoids pteronyssinus, Glycyphagus destructor, Tyrophagus putrescentiae* and *Acarus siro* were selected. It has been observed that 52.12% were sensitized

Figure 1 : Screening for Contributory Factors

Primary reason for coming to Allergy & Asthma Specialists:

_____

_____

Check your main symptoms- those that prompted your visit here:

Head or Nose	Chest	Skin	Insect Stings
○ Sneezing	○ Cough	○ Eczema	○ Hives
○ Post nasal drainage	○ Shortness of Breath	○ Swelling	○ Shortness of Breath
○ Nose Blocking	○ Hoarseness	○ Hives	○ Itching
○ Runny Nose	○ Wheezing	○ Itching	○ Swelling
○ Sinus Infection	○ Chest Infection		○ Dizziness
○ Sore Throat	○ Voice Loss		○ Fainting
○ Ear Blocking			
○ Headache			
○ Snoring			
○ Nosebleeds			
○ Eye Symptoms			

How many years have you suffered from the chief complaints of :

Head or Nose symptoms _____ Chest symptoms _____

Skin symptoms _____ Insect Sting reactions _____

Please indicate Pattern of symptoms:

	Head/Nose	Chest
Year rounds, no seasonal change	_____	_____
Year rounds, worse seasonally	_____	_____
Seasonally only	_____	_____

If seasonal, list months:_____

Are your symptoms worse at night? O Yes O No

Do you note increased symptoms from any of the following?

Allergens	Irritants	Ingestants	Weather
○ Dead Grass	○ Soap	○ Drugs	○ Cold fronts
○ Mown Grass	○ Perfumes	○ Alcoholic Beverages	○ Windy Days
○ Hay	○ Cleaning agents	○ Foods	○ Damp weather
○ Dead Leaves	○ Detergents	Other (list):	○ Temperature change
○ House Dust	○ Smoke		

to be cont..

○ Cats ○ Paint _____

○ Dogs ○ Hair spray _____

Please check the ones that best describe your home:

○House (Age____) ○ Apartment ○ City ○ Country

Do you have a basement? ○ Yes ○ No

Type of heating system: ○ Central ○ Floor ○ Electric ○ Other

Type of pillow: ○ Synthetic ○ Down

Type of mattress: ○ Conventional ○ Waterbed

Do you have stuffed animals? ○ Yes ○ No

Do you have carpet in your home? ○ Yes Type_____ ○ No

Are your symptoms worse anywhere in your home? ○ Yes Location: _____ ○ No

Do you have pets at home? ○ Yes What kind: _____ ○ No

Are your pets kept: ○ Inside ○ Outside

Are your symptoms worse at your work place/school? ○ Yes ○ No

Have your symptoms been so severe as to cause you to miss work or school? ○ Yes ○ No

If so, how many days?_____

Has travel affected your symptoms? ○ Yes ○ No

Do you have hobbies that expose you to allergens or irritants? ○ Yes ○ No

If yes, explain briefly: _____

List medicines you use for relief of allergy symptoms (including nose drops and sprays):

_____

_____

List other drugs you take for any reason. (include all over the counter drugs, creams, suppositori es, eyedrops, etc.):

_____

_____

Can you take Aspirin? ○ Yes ○ No

Are you allergic to any medications? ○Yes ○ No

If yes, please list: _____

What type of reaction occurs? _____

Have you ever taken hypo-sensitization shots (allergy shots) before? ○ Yes ○ No

Have you ever had a sinus x-ray? ○ Yes ○ No If yes, when? _____

Where?_____

to be cont..

Have you ever had a chest x-ray? ○ Yes ○ No If yes, when? _____
Where?_____

Do you smoke? ○ Yes ○ No

If yes, how many packs per day? ____ How long? _____

Have you ever smoked? ○ Yes ○ No

If yes, how many packs per day? ____ How long? _____

Does anyone you live with smoke? ○ Yes ○ No If yes, who? _____

Are you exposed to smoke at work or school? ○ Yes ○ No

Is there a history of any of the following in your family?

○ Asthma ○Eczema ○ Hives ○ Hay fever ○ Nasal polyps

If so, which family member? _____

Have you ever been treated in an emergency room? ○ Yes ○ No

If yes, how many times? _____

For what were you treated? _____

List hospitalization in order of most recent:

Cause of Hospitalization	Age
_____	_____
_____	_____
_____	_____

Circle any of following that you might have had:

Stomach ulcer Glaucoma High Blood Pressure Diabetes

Circle any of problems that you might have had with the following:

Blood Bones Head Nervous system Urinary tract

List any medical problems you have not noted above: _____

Table 6 : Number of Individuals Sensitized to Different Type of Pollens

Pollens	Number of Individuals	Percentage (%)
Parthenium hystrophorus	69	41.82
Morus alba	58	35.15
Ageratum sp.	57	34.55
Cannabis sativa	52	31.52
Pennisetum typhoides	52	31.52
Amaranthus spinosus	51	30.91
Xanthium strumariun	51	30.91
Chenopodium album	49	29.69
Imperata cylindrica	47	28.48
Chenopodium murale	46	27.88
Asphodelus sp.	37	22.42
Eucalyptus sp.	36	21.82
Brassica campestris	35	21.21

Figure 2 : Allergens Used for Allergy Testing

ALLERGEN TESTING

Name: _____ Date: _____

Date of Birth: _____ Sex: _____

Location of Test(s): _____

TREES	PRICK	ID
Boxelder-Maple		
Sycamore		
Hackberry		
Walnut		
Elm		
Oak Mix		
Pecan		
Willlow		
Ash		
Beech		
Cottonwood		

GRASS	PRICK	ID
Birch Mix		
Cedar, Mountain		
Pine Mix		
Bermuda		
Rye		
Johnson		
Timothy		
Bahia		
Kentucky Blue		
Redtop		
Orchard		
Meadow Fescue		
Sweet Vernal		

WEEDS	PRICK	ID
Ragweed Mix		
English Plantain		
Russian Thistle		
Lambs Quarter		
Careless-Pigweed		
Marshelder-Poverty		
Dock,Sorrel		
Cocklebur		
Mugwort		

MOLDS	PRICK	ID
Alternaria		
Hormodendrum		
Helminthosporium		
Aspergillus fumigatus		
Rhizopus		
Aspergillus niger		
Fusarium		
Penicillium notatum		

ENVIRONMENTALS	PRICK	ID
Dust Mite F.		
Dust Mite P.		
Cat 1 (Hair)		
Cat 2 (Pelt)		
Dog		

MEDICATION WHICH MAY AFFECT TESTING

MEDICATION	DATE OF LAST DOSE

to be cont..

	Feathers_____
	TREES: GRASSES: WEEDS - 1:20
	COCKROACH: DOG - 1:10
	DUST MITES F.; DUST MITE P.; - 10000 AU/ML
	CAT (HAIR): CAT (PELT) – 10000 BAU/MI
COMMENTS	
_____ _____ _____ _____	
Control – Positive – Histamine_____	
Control – Negative_____	
# PRICK_____ TIME_____ EMPLOYEE	
I.D.s_____ TIME_____ INITIALS_____	

Table 7: Comparative Total IgE Levels (IU/ml) Among Patients With Various Allergic Conditions Who Were Sensitive to Pollens and Dust Mites

Category	Pollens	Dust Mites	Pollens/DM
Allergic rhinitis	419.5±48.47 306.89,532.11	375.54±41.62 255.12,495.9	454.3±53.39 332.12,576.48
Allergic asthma	521.54±64.55* 366.32,676.76	500.44±53.43* 355.31,645.56	559.64±69.32* 441.96,677.32
Allergic asthma and Allergic rhinitis	653.95±79.4* 585.92,681.98	641.1±36.35* 579.66,702.54	794.33±80.58* 632.11,956.55

*p<0.01 was considered to be highly significant, **p<0.05 was considered to be significant

to *D. farinae*, 43.64% were sensitized to *D. pteronyssinus*, 38.79% were sensitized to G. destructor, 37.56% were sensitized to *T. putrescentiae*, and 34.55% were sensitized to *A. siro* (Table 5).

From the pollens, allergens of *Parthenium hystrophorus, Morus alba, Ageratum spp, Cannabis sativa, Pennisetun typhoides, Amaranthus, Xanthium strumariun, Chenopodium album, Imperata cylindrica, Chenopodium murale, Asphodelus spp, Eucalyptus spp* and *Brassica compestris* were selected. It has been observed that 41.82 % were sensitized to *Parthenium hystrophorus*, 35.15% were sensitized to Morus alba, 34.55% were sensitized to *Ageratum spp*, 31.52% were sensitized to *Cannabis sativa*, 31.52% were sensitized to *Pennisetum typhoides*, 30.91% were sensitized to *Amaranthus spp*, 30.91% were sensitized to *Xanthium strumariun*, 29.69% were sensitized to *Chenopodium album*, 28.48% were sensitized to *Imperata cylindrica*, 27.88% were sensitized to *Chenopodium murale*, 22.42% were sensitized to *Asphodelus spp*, 21.82% were sensitized *Eucalyptus spp* and 21.21% were sensitized to *Brassica compestris* (Table 6).

Total IgE levels were detected in the patients with AR, Asthma and both AR and asthma. Total IgE levels were found to be higher in individuals who were sensitive to pollens followed by dust mites in all categories of allergy patients (*Allergic rhinitis*, Asthma and Both). IgE levels were significantly high in the patients who were sensitive to all the allergens i.e. pollens and dust mites (Table 7).

DISCUSSION

Dust mite and pollen antigens play an important role in the position of allergies. Indoor level of these allergens plays a major role in the development of sensitization and triggering asthmatic attack.

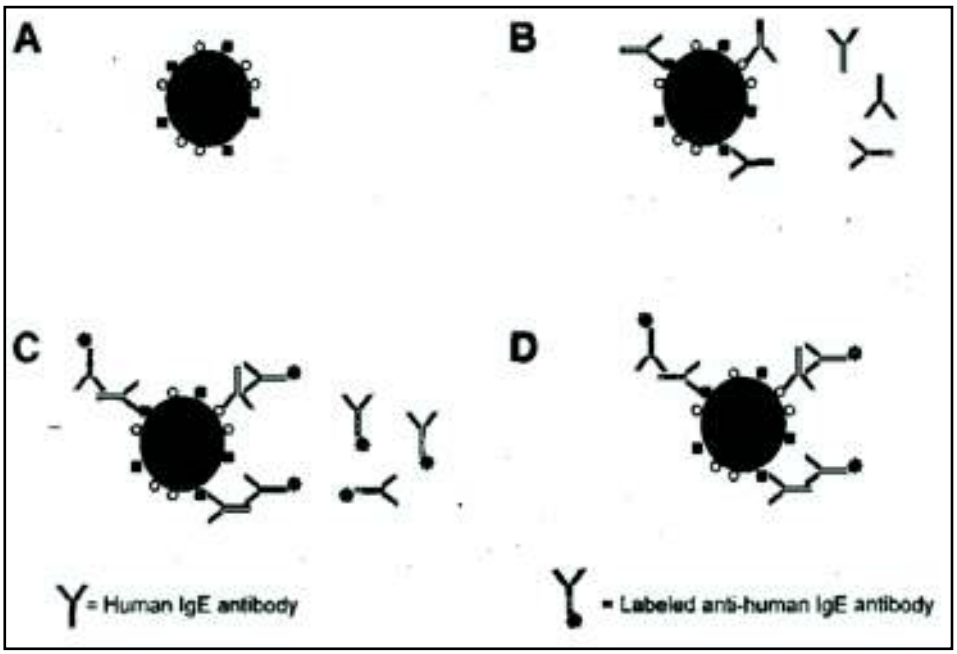

Figure 3 : Schematic presentation of an immunosorbent assay for allergen-specific IgE antibody. (A) Allergen represented by small circles and squares has been bound to solid phase. (B) Serum that may contain IgE antibodies specific for the allergen is incubated with the solid phase. Specific antibodies bind to the allergen, and non-bound antibodies are removed by washing. (C) Labeled antihuman IgE antibody is incubated with the solid phase, and the anti-IgE antibody binds to the immobilized IgE. Nonbound anti-IgE is washed away. (D) The amount of anti-lgE antibody on the solid phase is proportional to the concentration of allergen-specific IgE in the serum tested[21].

Immunoglobulin E specific antigens (allergens) induces type I hypersensitivity (allergic) respiratory reaction in sensitized subjects causing rhinitis or asthma (Horner et al., Hebling, 1995). The qualitative knowledge of these allergens in a given region is of great importance and concerned as they cause several respiratory diseases and skin diseases when inhaled. The present study intended to explore the clinical profile of the individuals who were sensitized to different type of aeroallergens and to find out their relation with skin test. The overall incidence of allergy to various allergens in our study was found to be significant. The incidence of allergy to dust mites allergen sensitivity has been found to be the most significant (37.58%) followed by and pollens only (29.09%).

Skin prick test was found to be most reliable and available method for allergen sensitivity. (Bapna and Mathur, 1990). In which SPT was accepted as gold standard, in *vitro* testing has proved less sensitive. Reported sensitivities has ranged from 4% to 92.2%, present studies showed that skin test positivity was 96.97% in properly selected cases. The present studies demonstrate if the case has been selected properly after taking thorough history and preliminary basic investigation of the patient, the incidence of positivity of skin prick tests appears to be quite high. Among the individuals who were sensitized to allergens, 37.58% of the individuals were sensitized to dust mites, 30.30% were sensitive toward pollens and dust mites, 29.09% were sensitive to pollens.

The role of mites in causing allergies however remained vaguely defined for a long time till Spieksma and Boezman (1967) suggested that the mite *Dermatophagoides pteronyssinus*, which is commonly found in house dust, was chief cause of its allergenicity. Studies by Miyamato et al., (1968) and Mithchell et al.

(1969) have revealed that the potency of house dust antigens is dominated by the total number of mites found in the house dust. Increase in exposure to house dust mites increases the prevalence of current asthma in children who were positive to skin prick tests for house dust mites. The present studies confirm these findings. More is the exposure more will be the prevalence of diseases. Mite allergen levels of >2µg/gm of dust (100 mites per gram) is considered as risk level for sensitization and symptoms of asthma and other allergic disorders. Studies by Munir (1998) and Dreberg (1998) showed that susceptible young children can become sensitive to house dust mites at 10-100 times lower concentration. During the present studies higher concentration of dust mites have been observed than those reported in studies by Plattis-Mill et al. (1982), Piacentini et al. (1993).

The percentage of patients showing markedly positive skin reactions to antigenic extracts of 13 pollens, varied from 2.4% to 16.9% with an average of 9.65%. The overall incidence of SPT reactivity was highest against the antigenic extract of pollen belonging to family Asteraceae and Moraceae. High prevalence of grass pollen allergy has been reported from different parts of the world (Shivpuri et al. 1979; Singh et al. 1987; Stam and Timmermans, 1989; Hirsch et al. 2000; Erbas et al. 2007; Mandal et al. 2008; Ahlawat et al. 2013). In compliance to our study, *Cynodon sp., Imperata sp.* and *Pennisetum sp.* have been reported to be common aeroallergens from Delhi (Dua and Shivpuri, 1962; Shivpuri et al. 1979; Singh et al. 1987; Rajkumar, 2003).

Chenopodium murale, C. album, Imperata cylindrica, Amaranthus spinosus and *Xanthium strumarium* were also among important allergens eliciting skin reactivity in 27.88%, 29.69%, 28.48%, 30.91% and 30.91% of the subjects respectively has been observed during the present study. *A. spinosus* has been shown to be predominant allergen from Delhi (Singh and Dahiya, 2002). Sharma et al. (2009) also reported high positivity (23.5 %) against the antigenic extract of this pollen from Assam. In our study low incidence of positivity were found against the antigenic extract of *Eucalyptus eucalyptus* and *Brassica compestris*. Our findings are in accordance with the findings of Agnihotri and Singh, 1971 and Prasad et al. 2009. According to them Eucalyptus sp. did not show any markedly positive skin reaction among the patients of nasobronchial allergy. In present study the antigenic extract of *Parthenium hystrophorus*, Morus alba and Ageratum sp. showed high incidence of allergenicity i.e. 41.82%, 35.15% and 34.55% respectively. These findings are in accordance with Agashe et al. 1983; Malik et al. 1990. Whereas these findings are in contrary to the observations made by Rajkumar, 2003; Boral et al. 2004; Chauhan and Goyal, 2006 from other parts of the country where they registered moderate skin reactivity to *Parthenium hystrophorus* and *Morus alba*.

The role of the different pollen allergens varies with environment conditions, such as climatic factors, pollution and degree of exposure. The knowledge on diurnal, seasonal and annual fluctuations in airborne pollen in any geographical area is essential for effective diagnosis and treatment of pollen allergy. Because of change in the climatic conditions, observation on diurnal and seasonal prevalence becomes very important (D'Amato et al. 2002). Therefore a continuous monitoring of aerial pollen diversity is important.

In Conclusion, the present study was intended to identify Dust mites and pollens that are responsible for allergic rhinitis and asthma in the population of north India. Proper history taking followed by skin tests, total/specific IgE in vitro tests, fungal culture in specific cases are helpful in the diagnosis of allergic manifestations and their treatment.

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REFERENCES

Agashe S.N. and Vinay P., 1980. Aero biological studies of Banglore city. Part II. A Preliminary report in: Advances in pollens, spore research V-VII. P.K.K. Nair Ed, 185-193.

Agashe S. N., Anand P., Manjunath K. and Jacob N. A., 1983. Airborne pollen survey at Bangalore. Asp. Allergy and Appl. Immunol., **16**: 53-57.

Agnihotri M. S. and Singh, A. B., 1971. Observations of pollinosis in Lucknow with special reference to offending factors. Asp. Allergy and Appl. Immunol., **5**: 135-141.

Ahlawat M., Dahiya P., and Chaudhary D., 2013. Aeropalynological study in Rohtak city, Haryana, India: A 2 year study. Aerobiologia, **29** (1): 121-129.

Bapna A. and Mathur U.S., 1990. The relationship of allergic bronchial asthma, cutaneous sensitivity and serum IgE. Lung India, **8**: 76-8.

Boral D., Chatterjee S. and Bhattacharya K., 2004. The occurrence and allergising potential of airborne pollen in West Bengal, India. Ann. Agric. Environ. Med., **11**(1): 45-52.

Chauhan S. V. S. and Goyal R., 2006. Pollen calendar of Agra city with special reference to allergenic significance. J. Environ. Biol., **27**(2): 275-281.

Deschildre A., 1999. Allergens and respiratory allergy. Aeroallergens. Arch. de Pediatr, **6**: 48- 54.

Dreberg S., 1998. Mite allergens, collection, determination, expression of results and risk levels for sensitization and symptoms induction. Allergy (Copenhagen), **53**(48): 88- 91.

Dua K. L. and Shivpuri D. N., 1962. Atmospheric pollen studies in Delhi area in 19581959. J. Allergy, 33: 507512.

D'Amato G., Liccardi G., D'Amato M. and Cazzola M., 2002. Outdoor air pollution, climatic changes and allergic bronchial asthma. Eur. Respir. J., **20** (3): 763-776.

Erbas B., Chang J. H., Dharmage S., Ong E. K., Hyndman R. and Newbigin E., 2007. Do levels of airborne grass pollen influence asthma hospital admissions? Clin. Exp. Allergy, **37**(11): 1641-1647.

Flaherty D.K., Deck F.H., Cooper J., Bishop K., Winzenburger P.A., Smith L.R., Bynum L. and Witmer W.B., 1984. Bacterial endotoxin isolated from a watery spray humidification system as a putative agent of occupation related lung disease. Infect. Immunol., **43**: 206- 212.

Hirsch T., Neumeister V., Weilan, S. K., Von Mutius E., Hirsch D., Grafe H., et al., 2000. Traffic exposure and allergic sensitization against latex in children. J. Allergy Clin. Immunol., **106**(3): 573-578.

Horner W.E, Hebling A., Salvaggio J.E. and Lehrer S.B., 1995. Fungal Allergens. Clin. Microbiol. Rev., **8**(2): 161-79.

Kurup V., Shen H.D. and Banerjee B., 2000. Respiratory fungal allergy. Microb. Infect., **9**: 1101-10.

Malik P., Singh A. B., Babu C. R. and Gangal S. V., 1990. Head high airborne pollen grains from different areas of metropolitan Delhi. Allergy, 45: 248305.

Melson T. and Brinchl H.J., 2001. Asthma and indoor environment in Nepal. Thorax, **56**: 477-81.

Mithell W.F., Wharton G.W., Larson D.G. and Modic R., 1969. House dust mites and insects. Ann. Allergy, **27**: 93-99.

Miyamoto T.S. Oshima T. Ichizaki and Sato S., 1968. Allergy identity between the common floor mite (*Dermatophagoides farinae*, 1961) and house dust as a causative organism in bronchial asthma. J. Allergy, **42**:14.

Munir A.K.M., 1998. Risk levels for allergens. Are they meaningful. Where should samples be collected and how should they be analyzed. Allergy (Copenhagen), **53**(48): 84-87.

Mandal J., Chakraborty P., Roy I., Chatterjee S., and Gupta-Bhattacharya S., 2008. Prevalence of allergenic pollen grains in the aerosol of the city of Calcutta, India: A two year study. Aerobiologia, **24**: 151164.

Peat J.K., Tovey E., Toelle B.G., Haby M.M., Gray E.J. and Mahmic A., 1996. House dust mite allergens: a major risk factor for childhood asthma in Australia. Am. J. Respir. Crit. Care Med., **153**: 141 6.

Piacentini G.L., Martinati L., Fornari A., Comis A., Carcereri L. and Boccagni P., 1993. Antigen avoidance in a mountain environment: influence on basophil releasability in children with allergic asthma. J. Allergy Clin. Immunol., **92**: 644-650.

PlattisMills T.A.E. and Tovey E.R., Mitchell E.B., Moszoro H., Nock P. and Wilkins S.R., 1982. Reduction of bronchial hyperresponsiveness during prolonged allergen avoidance. Lancet, **2**: 678-80.

PlattisMills T.A.E. and De Weck A., 1989. Dust mite allergens and asthma a worldwide problem, J. Allergy Clin. Immunol., **83**: 416-27.

PlattisMills T.A.E., 1992. Dust mite allergens and asthma: report of a second international workshop. J. Allergy Clin. Immunol., **89**: 1046-60.

Prasad R., Verma S. K., Dua R., Kant S., Kushwaha R. A. S. and Agarwal S. P., 2009. A study of skin sensitivity to various allergens by skin prick test in patients of nasobronchial allergy. Lung India, **26**(3): 70-73.

Rajkumar P. S., 2003. A study of skin sensitivity to various allergens by intradermal test in patients with respiratory allergy (*Bronchial asthma* and *Allergic rhinitis*) in India. Int. Med. J. Thailand, **19**(3): 202-206.

Samson R.S., 1985. Occurrence of moulds in modern living and working environments. Eur. J. Epedemiol. 1: 54-61.

Semik-Orzech A., Barezyk A. and Pierzchala W., 2008. The influence of sensitivity to fungal allergens on the development and course of allergic diseases of the respiratory tract. Pneumonol Allergy Pol., **76**: 29-36.

Singh B. P., Singh A. B., and Parkash D., 1987. Skin reactivity to airborne pollen and fungal antigens in patients of NasoBronchial Allergy of Hill Regions (India). In N. Chandra (Ed.), Atmospheric bio pollution (pp. 125134). Karad: Environmental Publication.

Singh A. B. and Dahiya P., 2002. Antigenic and allergenic properties of *Amaranthus spinosus* pollena commonly growing weed in India. Ann. Agric. Environ. Med., **9**(2):147-151.

Sharma D., Dutta B. K. and Singh A. B., 2009. Biochemical and immunological studies on eight pollen types from South Assam, India. Iran. J. Allergy, Asthma Immunol., **8**(4):185-192.

Shivpuri D. N. and Singh A. B., and Babu C. E., 1979. New allergenic pollens of Delhi state, India and their clinical significance. Ann. Allergy, **42**(1): 4952.

Spieksma F.T.M. and Spieksma-Boezman M.I.A., 1967. The mite fauna of house dust with particular reference to *Dermatophagoides pteronyssinus* (Trouessart, 1897) (Psoroptidae : Sarcopti formes). Acarologia, **9**: 226-241.

Stam J. and Timmermans A., 1989. The diagnosis of IgEmediated allergy of the upper airways. Nederlands Tijdschrift voor Geneeskunde, **133**(35): 1759-1760.

Tilak S.T., 1982. Aerobiology. Vajayanti Prakashan Aurangabad, 211pp.

Van Hage H.M., Johansson S.G. and Zetterstrom O.; 1987. Predominance of mite allergy over allergy to pollens and animal danders in a farming population. Clin. Exp. Allergy, **17**: 417-23.