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RESEARCH ARTICLE

House dust mite sensitivity among rural and urban allergic rhinitis and asthmatic patients of Punjab, India.

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Abstract

House dust mites (HDM) belonging to the order Astigmata are generally the principle mites found in dust from human dwellings. During present study, 550 patients (290 from rural area and 260 from urban area of Punjab) with allergic rhinitis and asthma who visited ENT department of Rajindra hospital, Patiala from 2014 to 2016 were considered. Of the 550 patients, skin prick tests were performed on 200 patients (100 from rural and 100 from urban area) who were diagnosed with allergies. Of these 200 patients, 185 patients were found to be sensitive to HDM. Of these 185 sensitized patients, 100 were from rural area and 85 were from urban area. Whereas 15 patients did not give any response to the allergens. They all belong to Urban area. In the present study house dust mites belonging to the genus *Dermatophagoides* were abundant in the homes of allergic rhinitis and asthmatic patients residing in urban as well as rural areas of Punjab. The total mite density and the *Dermatophagoides pteronyssinus* mite density was somewhat higher in dust samples collected from rural areas whereas *Dermatophagoides farinae* mite density was higher in dust samples collected from urban areas. In regard to skin test reactivity, it was noted that urban patients were more sensitized to *Dermatophagoides farinae* allergen and rural patients were more sensitized to *Dermatophagoides pteronyssinus* allergen.

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Introduction:-

The global prevalence of asthma and other allergies has increased in both developed and developing countries over the last few decades (GINA, 2010). Some 235 million people worldwide suffer from this non-communicable immune disorder (The global asthma report of 2011). House dust mites (HDMs) have a well-established causal role in patients with persistent allergic respiratory diseases, such as allergic rhinitis (AR) and allergic asthma (AA) (Plattis-Mills and 1992 and Sporik *et al.*, 1992). These atopic diseases lead to increased burden of diseases and health care costs, particularly in patients with uncontrolled or poorly controlled diseases (Masoli *et al.*, 2004 and Canonica *et al.*, 2007). Allergic rhinitis is a nasal disorder induced by immunoglobulin E (IgE)-mediated immune response and characterised by symptoms including rhinorrhoea, sneezing, nasal obstruction and itching (Bousquet *et al.*, 2008). It is one of the most common atopic diseases all over the world.

Allergic rhinitis and asthma commonly occur in the same person (Corren, 1997 and Vingola *et al.*, 1998). Asthma can be more severe in subjects with allergic rhinitis compared with those without allergic rhinitis (Dixon *et al.*, 2006). Sensitization to specific allergens can make asthma more difficult to control. Development of sensitization to perennial allergens early in life combined with exposure to high allergen levels was predictive of chronic asthma and reduced lung function in the children at age 13 (Gergen *et*

al., 2009). Mite sensitivity asthma is less common at altitude with low humidity and very few mites (Charpin *et al.*, 1988 and Sporik *et al.*, 1995).

House dust mites (Pyroglyphidae) and the storage mites (Acaridae and Glycyphagidae) belonging to the order Astigmata (Colloff and Spieksma, 1992) are generally the principle mites found in dust from human dwellings. The major house dust mites are the Pyroglyphidae mites, i.e., *Dermatophagoids pteronyssinus*, *Dermatophagoids farinae*, *Dermatophagoids microceras* and *Euroglyphus maynei*. HDM allergy is the most prevalent cause of allergic sensitization that afflicts asthmatics.

House dust mites are tiny creatures related to ticks, chiggers and spiders that live in close association with humans. Mites feed on human and animal skin scales. Many species of mites are the sources of potent allergens that sensitize and induce IgE-mediated allergic reactions in humans. Most of the mite allergens are proteins, and the allergic response mechanism to these allergens is the same as it is for allergens from other biological sources, such as plant pollens, moulds, and foods (Arlian, 2001).

The prevalence of asthma and allergic diseases is attributable to differential exposure and sensitization to allergens. Pattern of allergen sensitization vary between populations (Burney *et al.*, 1997 and Chinn *et al.*, 1999) and between socioeconomic strata within the population (Pollart *et al.*, 1989 and Kattan *et al.*, 1997).

Materials and Methods:-

A retro prospective study was conducted on 550 patients (290 from rural and 260 from urban area of Punjab) suffering from allergic rhinitis and allergic asthma who visited ENT department of Rajindra hospital, Patiala from 2014 to 2016. 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 asthma related symptoms. Investigations done on such patients included X-ray/CT scan of paranasal sinuses, nasal endoscopy and spirometry.

Based on above criteria 200 patients (100 patients from rural and 100 patients from urban area) of the 550 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 aspects 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.

Based on clinical findings and investigations done, patients were categorized into four groups 1) Allergic rhinitis 2) Asthma 3) Allergic rhinitis and Asthma 4) Normal as control. 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 or if they had ever received allergen immunotherapy.

Within the scope of study, a total 550 dust samples (290 from rural area and 260 from urban area) were collected from the 550 homes of 550 patients. Samples were found to be positive for dust mites collected from the 530 homes (280 from rural area and 250 from urban area) where as no mites were found in samples collected from remaining 20 homes (10 from rural area and 10 from urban area). The dust

samples were collected from floor, carpets and fabric-covered furniture in living rooms and from beds, pillows, sheets, comforters, and carpets close to the bed in bedrooms using a 1200 W vacuum cleaner (Bosch; München, Germany) applied on an area of 1 m² for 2 min.

Dust samples were collected in zip lock bags from the homes of house dust mite sensitive patient. Each sample was labeled indicating collection time, collection site, collection date and was brought to lab for subsequent studies. The mites were isolated from the dust samples by using Tullgren Berlese funnel (Baker and Wharton, 1952) and floatation method (Fain and Hart, 1986). The permanent slides were prepared in Hoyer's medium given by Walter (2001) and were studied under leica microscope at 20 X and 40 X and identified by using the taxonomic keys given by Krantz (1978).

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.

Results:-

During the present study 550 patients (290 from rural and 260 from urban area of Punjab) were selected. Out of these, 300 patients (160 from rural area and 140 from urban area) were males (54.54%) and 250 patients (130 from rural area and 120 from urban area) were females (45.45%). Skin prick tests were performed only on 200 patients (100 patients from rural and 100 patients from urban area) whose history was suggestive of allergy. Of these 185 patients (100 from rural and 85 from urban area) were found to be sensitized for house dust mite allergens. History of where 15 urban patients did not give any response to the allergens though their history was suggestive of allergy (Table 1).

Out of 550 dust samples (290 from rural area and 260 from urban area) 530 dust samples (280 from rural area and 250 from urban area) were found to be positive for dust mites. Of the 550 mite positive dust samples, a total 7820 mites were isolated. A minimum 1 and maximum 150 mites were found in 1 gram of dust sample. In this study, the collected mites belonged to order Astigmata, Prostigmata, Mesostigmata and Cryptostigmata. Mites belonged to order Astigmata were the most abundant and frequently found in both rural and urban areas of Punjab. Of 7820 mite specimens, 4220 mite specimens were found from the dust samples collected from rural area and 3600 mite specimens were found from the dust samples collected from urban area. In rural area *D. pteronyssinus* (33.36%), belonged to family pyroglyphidae was the most common and frequently found followed by *D. farinae* (22.7%), *Blomia tropicalis* (12.07%), *Acarus siro* (10.18), *Tyrophagus putrescentiae* (6.16), *Lepidoglyphus destructor* (4.69%), *Euroglyphus maynei* (3.55%) respectively. Mites belonged to the order Prostigmata were identified at the genus level and only one genus *Cheyletus* (3.19%) from family cheyletidae was detected, while the identification of the mites belonged to order Mesostigmata (2.01%) and Cryptostigmata (1.84) remained at the order level. The acarological fauna of urban area were also composed of Astigmata, Prostigmata, Mesostigmata and Cryptostigmata order. In urban area *D. farinae* (27.05%), belonged to family pyroglyphidae was the most common and frequently found followed by *D. pteronyssinus* (26.66%), *Blomia tropicalis* (12.22%), *Acarus siro* (10.69), *Tyrophagus putrescentiae* (6.44), *Lepidoglyphus destructor* (5.47%), *Euroglyphus maynei* (3.94%), Prostigmata (3.89%), Mesostigmata (2.22%) and Cryptostigmata (1.44) respectively (Table 5).

Table1:- Descriptive characteristics of patients who visited the ENT Department.

| | Males (%) | Females (%) | Total |
|-------------------------------------|------------------|------------------|------------------|
| Number of Individuals | 300 (54.54%) | 250 (45.45%) | 550 |
| Age of Individuals (Mean \pm S.D) | 36.5 \pm 17.4* | 35.4 \pm 17.8* | 35.9 \pm 17.6* |

*p<0.01 was considered to be significant

Total patients on whom skin prick tests were conduct 200 (36.36%)

Positive results for skin prick tests
185 (rural and urban) patients (92.5%)

Negative results for skin prick tests 15
(urban only) patients (7.5%)

Table 2:- Gender and Age of individuals selected for skin prick tests

| | Males (%) | Females (%) | Total |
|-------------------------------------|------------------|------------------|------------------|
| Number of Individuals | 125 (62.5%) | 75 (37.5%) | 200 |
| Age of Individuals (Mean \pm S.D) | 35.3 \pm 16.5* | 34.5 \pm 16.8* | 34.9 \pm 16.5* |

* $p < 0.01$ was considered to be significant

Of the 200 patients 125 (62.5%) were males in the age group of 35.3 \pm 16.5 and 75 (37.5%) in the 34.5 \pm 16.8 were females (Table 2).

Table 3:- Prevalence of patients to allergen sensitivity

| Allergic diseases | No. of patients sensitive to house dust mites | % of patients sensitive to house dust mites |
|---------------------------------|---|---|
| 1. Allergic rhinitis | 75 | 37.5% |
| 2. Asthma | 60 | 30.0% |
| 3. Allergic rhinitis and asthma | 50 | 25.0% |
| 4. Normal | 15 | 7.5% |

Allergic patients were divided into four groups 1) allergic rhinitis, 2) asthma 3) allergic rhinitis and asthma, 4) normal. It has been observed that 37.5% patients suffering from allergic rhinitis, 30.0% patients suffering from asthma, 25.0% patients are suffering from allergic rhinitis and asthma and 7.5% patients are taken as control (Table 3).

Table 4:- Number of individuals sensitized to different type of house dust mite allergens.

| Dust mites | Number of rural individuals | Percentage (%) | Number of urban individuals | Percentage (%) |
|-------------------------|-----------------------------|----------------|-----------------------------|----------------|
| <i>D. pteronyssinus</i> | 35 | 35 | 15 | 15 |
| <i>D. farinae</i> | 25 | 25 | 30 | 30 |
| <i>G. destructor</i> | 20 | 20 | 20 | 20 |
| <i>T. putrescentiae</i> | 10 | 10 | 10 | 10 |
| <i>A. siro</i> | 10 | 10 | 10 | 10 |

From dust mites, allergens of *Dermatophagoids pteronyssinus*, *Dermatophagoids farinae*, *Glycyphagus destructor*, *Tyrophagus putrescentiae* and *Acarus siro* were selected. It has been observed that 35.0% rural patients were sensitized to *D. pteronyssinus* but 15.0% urban patients were sensitized to this mite, on the other hand 25.0% rural patients were sensitized to *D. farinae* but 30.0% urban patients were sensitized to this mite. And all other rural and urban patients equally sensitized to other three mite allergens (Table 4).

Table 5:- Prevalence of house dust mite fauna in the homes of urban and rural allergic patients of Punjab

| Mites | No. of houses (550) | Mites isolated from the rural area No. % | Mites isolated from the urban area No. % |
|---------------------------------------|------------------------|---|---|
| <i>Dermatophagoides pteronyssinus</i> | 505 | 1408 33.36 | 960 26.66 |
| <i>Dermatophagoides farinae</i> | 500 | 940 22.27 | 990 27.5 |
| <i>Blomia tropicalis</i> | 375 | 536 12.70 | 440 12.22 |
| <i>Acarus siro</i> | 362 | 430 10.18 | 385 10.69 |
| <i>Tyrophagus putrescentia</i> | 205 | 260 6.16 | 232 6.44 |
| <i>Lepidoglyphus destructor</i> | 195 | 198 4.69 | 197 5.47 |
| <i>Euroglyphus mayeni</i> | 147 | 150 3.55 | 142 3.94 |
| <i>Cheyletus</i> | 115 | 135 3.19 | 122 3.89 |
| <i>Mesostigmata</i> | 79 | 85 2.01 | 80 2.22 |
| <i>Cryptostigmata</i> | 50 | 78 1.84 | 52 1.44 |
| Total | | 4220 | 3600 |

Discussion:-

Dust mites 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. Immunoglobulin E specific antigens (allergens) induces type I hypersensitivity (allergic) respiratory reaction in sensitized subjects causing rhinitis or asthma (Horner and 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 house dust mite allergens and to find out their relation with skin test.

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 92.5% 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.

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. Dixit and Mehta (1973), Lal *et al.* (1973), Dar and Gupta (1979). Tripathi and parikh (1983). Tandon *et al.* (1988, 1990) and Saha (1993, 1994) incriminated *Dermatophagoides farinae* as the main cause of respiratory allergy from different parts of India. In the recent past Saha (1993, 1994) and Saha *et al.* (1995) opined that among the possible allergens in our surroundings, house dust mites, particularly the genus *Dermatophagoides* are the most potent allergen in house dust responsible for the participation of attack of bronchial asthma and they also estimated that more than 80% of the asthmatic patients of Calcutta, India are sensitive to *Dermatophagoides farinae* mites. Present study is in accordance to the above findings. During present study, results of dust analysis indicate that the total mite density and the *Dermatophagoides pteronyssinus* mite density were somewhat higher in dust samples collected from rural areas as compared to *Dermatophagoides farinae* which were higher in dust samples collected from urban areas.

In regard to skin test reactivity, it is to be noted that urban patients were more sensitized to skin reaction against *Dermatophagoides farinae* than rural patients and rural patients were more sensitized to skin reaction against *Dermatophagoides pteronyssinus* as compared to urban patients.

Studies by Miyamoto *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 $>2\mu\text{g/gm}$ 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).

In Conclusion, the present study was intended to identify house dust mites that are responsible for allergic rhinitis and asthma in the population of Punjab. Proper history taking followed by skin prick tests were helpful in the diagnosis of allergic manifestations and their treatment.

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