

Prevalence of Allergic Diseases in Humid Tropical Climate of South Assam, India

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Abstract: Prevalence of allergic diseases in the humid tropical climate of South Assam was studied through demographic, biochemical, immunological and clinical investigations. A total of 280 allergic patients were examined out of which 90 patients with seasonal and atopic allergic problems were considered for detail investigation. A large number of patients having family basis of allergy were recorded in South Assam with maximum number in the age group of up to 15 yrs. About 10% patients were suffering from allergic problems by birth. Most of the patients tested clinically showed group II range of eosinophil count (42.4%). Out of the 90 patients sera tested by plate ELISA methods, 82 sera were positive to the tested allergens. Multiple allergenicity was recorded in 60% sera tested. Among 90 patients, 66.6% were having abnormal airway function with 31% showing obstructive disorder. Poor and lower middle class people showed maximum allergic symptoms which could be attributed to the meager diet and negligence in health care and this could lead to the reduction in immunity against environmental allergens. Multiple factors viz., atmospheric allergens load of an area, season and time of exposure, family basis of allergy, economic status of people, hygiene conditions, elevated IgE and eosinophil could be responsible for kind and severity of allergic disorders. Therefore, single factor analysis might not give accurate results for allergy testing and hence multiple ranges of tests should be encouraged in clinical investigations.

Keywords: Demography, Epidemiology, Allergy, Pollen, Fungus, WBCs.

1. INTRODUCTION

Allergic disorders constitute one of the commonest groups of diseases afflicting mankind; they are perhaps next only to the infective disorders. It is reaching epidemic proportions in both the developed and developing world [1]. About 20–30% of the world's population is known to suffer from allergic disorders, such as bronchial asthma, allergic rhinitis, atopic dermatitis, urticaria, etc. [2]. In India the magnitude of the allergic problem is alarming as more than 25% of the population was estimated to suffer from major allergic problem out of which respiratory allergy constituted 73.4%, while allergic rhinitis is about 3–4% [3, 4]. Key factors driving these rising trends are increased exposure to sensitizing allergens and reduced stimulation of the immune system during the critical periods of its development [5]. It is now generally agreed that the most important method of finding out the causative agent in an allergic patient is clinical investigation on patients history of suffering, enquiring into all the circumstances noticed to

precipitate attack and also the condition under which the patient remain free. However, it is important to confirm this information by appropriate biomedical tests [6]. Allergic diseases such as asthma, is found to have genetic basis and children not only inherit a tendency to atopy from their parents but are likely to develop the same allergic disorders [7, 8]. Immunoglobulin E (IgE) is believed to be one of the major mediators of immediate hypersensitivity reaction that underlie atopic conditions such as urticaria, seasonal allergy, asthma and anaphylaxis. Allergic diseases are believed to share a unique mechanism of disease which involve the binding of IgE antibody to surface receptors present on a wide variety of cells, most importantly mast cells and eosinophils [9]. Therefore, immunological and clinical studies on the role of various physiological and chemical factors contributing the allergic disorder in human subject is essential. In the present paper, the prevalence of allergic diseases in humid tropical climate of South Assam (India) was investigated from August 2003 to July 2005, through demographic, biochemical and clinical investigations. Total geographical area of South Assam is approximately 6921 sq. km and it has population of around 36.12 lacks (2011 census). Majority of the people of South Assam are farmer by occupation. The region has

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tropical humid climate with average temperature between 10°C to 35°C and relative humidity between 40 to 97% respectively.

2. MATERIALS AND METHODS

2.1. Demographic Profile

An allergic diagnostic camp was organized in the month of August 2003, at Silchar Heart Care & Allergy Research Centre for clinical investigation and diagnosis of suspected allergic patients of South Assam which lies between 24°5'N latitude and 92°48' E longitude and about 26-27m above mean sea level. The patients were screened for allergic symptoms and suspected patients with allergic cases were considered for further investigation. Patients were pre informed about the investigation to be carried out and consent was obtained from each of them. A total of 280 suspected allergic patients belonging to different age, class, sex and occupation attended the diagnostic camp. Allergy diagnostic profile was developed in the format provided by Patel chest institute, New Delhi, India, in order to distinguish the patients on the basis of their symptoms and sufferings. Factors like, types of allergic disorders, sources of allergy, familial basis of allergy, seasons of suffering, age, sex, occupation and social status of patients were given due importance. Out of 280 suspected allergic patients examined, 90 patients and 5 healthy voluntarily were selected for detailed biochemical and clinical investigation. Blood sample were collected after obtaining written consent and with the accord that they will be provided a copy of their blood test report free of cost. The clinical examination and blood collection of the suspected patients were done by trained doctors in Silchar Medical College and Silchar Heart Care and Allergy Research Centre. These medical centres follow the bio-ethical guidelines of ICMR, India and bio-ethical approval was taken before the beginning of the proposed research work.

2.2. WBC Differential Count

WBC differential count was performed by the method outlined by Albert *et al.* [10] to record the differences in the percentage contribution of each white blood cell (Leucocyte cells) type during allergic disorders. To the dry blood films of suspected allergic patients and healthy volunteers, required amount of Leishman's stain (1% solution of methylene blue, 0.5% Sodium carbonate, 1:1000 solution of eosin in distilled water, Leishman powder) was added to cover the film. After 2-3 min of staining, the stain was diluted with an

equal volume of neutral water and mixed well. After 10 minutes, the slide was washed with gentle stream of water. Finally, after air drying, the slides were examined under microscope for WBCs count. Thousand leucocytes cells were counted per slide and in duplicate. As eosinophils are responsible for activation of mast cells during allergic reactions (hypersensitive inflammation), therefore the total eosinophils count was graded into 5 groups on the basis of percentage contribution as follows: Group I: upto 4% (normal range); Group II: >4 – 10%; Group III: >10 – 15%; Group IV: >15 – 20% and Group V: >20%. Normal ranges of other WBCs were considered as suggested by Choudhuri [11].

2.3. Enzyme Link Immunosorbant Assay (ELISA)

A total of 18 predominant aero-biocomponents (10 fungus and 8 pollens) were selected for immunoglobulin E detection using plate ELISA method. Samples were: *Acacia auriculiformis*, *Amaranthus spinosus*, *Cassia alata*, *Cleome gynandra*, *Cocos nucifera*, *Imperata cylindrica*, *Ricinus communis* and *Trewia nudiflora* among pollens and *Aspergillus clavatus*, *Aspergillus flavus*, *Aspergillus fumigatus*, *Aspergillus humicola*, *Aspergillus nidulans*, *Aspergillus niger*, *Cladosporium herbarum*, *Curvularia lunata*, *Mucor hiemalis* and *Penicillium citrinum* among fungus. Antigen preparation was done following the method adopted by Rawat [12] for pollen and Rawat [13] for fungus with some modification. Modification involves sonication of extracted antigens in ultra sonicator (Labsonic, Sartorius grade) before centrifugation. Sonication was done at 100% amplitude by using 30mm probe for 15 minutes. The suspension was centrifuged at 10,000 rpm for 30 minutes at 4°C. The extract was then lyophilized in small aliquots and stored at -20°C till further use.

ELISA was performed as per the method outlined by Singh *et al.* [14]. ELISA titer plates (Nunc. Riskilde, Denmark) were coated with 100µl (20 to 25µg of protein/well) of 1:100 times diluted antigenic extracts of pollen & fungus and incubated overnight at 4°C. After incubation, the plates were washed with wash buffer (0.05M KH₂PO₄, 0.05M K₂HPO₄, 0.08% NaCl, pH 7.4) three times at 5 minutes intervals. The unbound sites were then blocked by incubating with 200µl blocking buffer (containing 3% BSA) for 2 hrs at 37°C. Repeated washing were done as above. 100µl of suspected allergic patient sera (1:10 times diluted in wash buffer containing 0.05% BSA) was added per well and incubated for 2 hrs at 37°C. Serum from normal

volunteers was also assayed to act as a control. Washing was done as above. 100µl of HRP conjugated antihuman IgE – Epsilon chain specific (SIGMA) diluted to 1:1500 in wash buffer (containing 0.05% BSA) was added per well and incubated for 2 hrs at 37°C followed by repeated washing as mentioned above. Enzyme assay was determined by using O-Phenylenediamine dihydrochloride solution (2mg in 10 ml distilled water + 60µl H₂O₂). The plates were incubated for 15 minutes at 37°C to develop the colour. HCl (2.5N) was used to terminate the reaction (50µl/well) after required incubation. Optical density was measured at 492nm by using plate ELISA reader (BioRad, USA). Intensity of the reaction was classified into 4 different grades based on percent binding, as outlined by Kauffman *et al.* [15].

2.4. Pulmonary Function Test (PFT)

Pulmonary function test (PFT) was carried out by trained doctors of Silchar Heart Care and Allergy Research Centre on 66 out of 90 patients selected for allergy testing. Patients having chest congestion or breathing problem were preferred for the above test considering their willing to participate. PFT was carried out using Spirometer (Spiro Win 2.0, Genesis Medical System) following the method described by Omland *et al.* [16], after setting the standard for Indian subject [17, 18].

Statistical analysis (i.e., Mean, Standard deviation and Spearman Rank Correlation Coefficient test) was done by using MS Excel and SPSS (Version 16.0) to analyze the similarity or variance and dependency of one factor with the other.

3. RESULTS

In order to distinguish the patients on the basis of their symptoms & sufferings, allergy diagnostic profile was developed for all allergic patients attending the camp. A total of 280 suspected allergic patients attended the diagnostic camp. The percentage of male patients was higher (52.8%) than that of the female patients (47.1%). Out of the total patients, 66.4% were suffering from the respiratory allergy, 9.9% from skin allergy (i.e, eczema, urticaria, contact dermatitis, atopic dermatitis, insect bites, etc) and 23.5% were suffering from combined respiratory and skin allergic disease (Figure 1a). Whilst patients were categorized on the basis of their age group, highest number were recorded in the age of >45 yrs, followed by 16-30 yrs group. Similarly, when patients were categorized on the basis

of duration of suffering, 10% were reported to be suffering from allergic problems by birth. Maximum patients (44.3%) were suffering from 1-5 years followed by >5-10 years (25.7%) and >20 years of duration (11.4%) respectively (Figure 1b). Nevertheless, categorizing the patients on the basis of seasonal effect revealed maximum cases of allergy during winter season (48.6%) while 25.7% feel no seasonal variation in allergic problems. Only 11.4% of the patients reported allergic problems during summer. Seasonal effect of allergic diseases was maximum in patients above 45 years (35.0%) and least in young patients under the age group of 15 years (11.0%) respectively (Figure 1c). Diurnal variation in allergic response was also reported in some cases where 35% of the patients reported maximum allergic problems at night followed by morning (26.4%) (Figure 1d). The Family and personal history are the important parts of history in patients of various allergic disorders. Present study showed large number of patients having family basis of allergy (43.6%). Higher percentage was observed in the age group of upto 15 yrs (13.6%) followed by >15-30 yrs (11.4%) respectively and lowest in the age group of >45 yrs. Patients having maternal and paternal basis of allergy were 10% and 11.4% respectively whereas 21% have reported other genetic basis of allergy (i.e, Grand mother, Grand father, Uncle, Aunty, etc). Around 12% of the patients were having both maternal and paternal basis of allergy. Ratio of patients having maternal basis of allergy was equal in both the sex (50% male and 50% female respectively) whereas 62% male and 38% female patients reported paternal basis of allergy (Figure 1e). In the present survey, poor and lower middle class people were having maximum allergic problems (Figure 1f). Among the various group of peoples attended the camp, farmer groups were maximum with suspected allergic cases (Figure 1g). Maximum patients reported that they keep cat and cow as pet animal (Figure 1h). About 81% of the patients belonged to Hindu community, 16% Muslims and the rest 3% were Christian. Majority of the people were non-vegetarian (83%) but greater part of them (67%) do not prefer pork and beef either due to religious credence or health related problems. Only 5% of the patients reported increase in allergic symptoms after consuming brinjal, tomato, egg, prawn and beef.

WBC differential count was carried out with 90 patients and 5 normal volunteers' sera. Out of 90 sera examined, 68 (75.5%) sera showed eosinophils

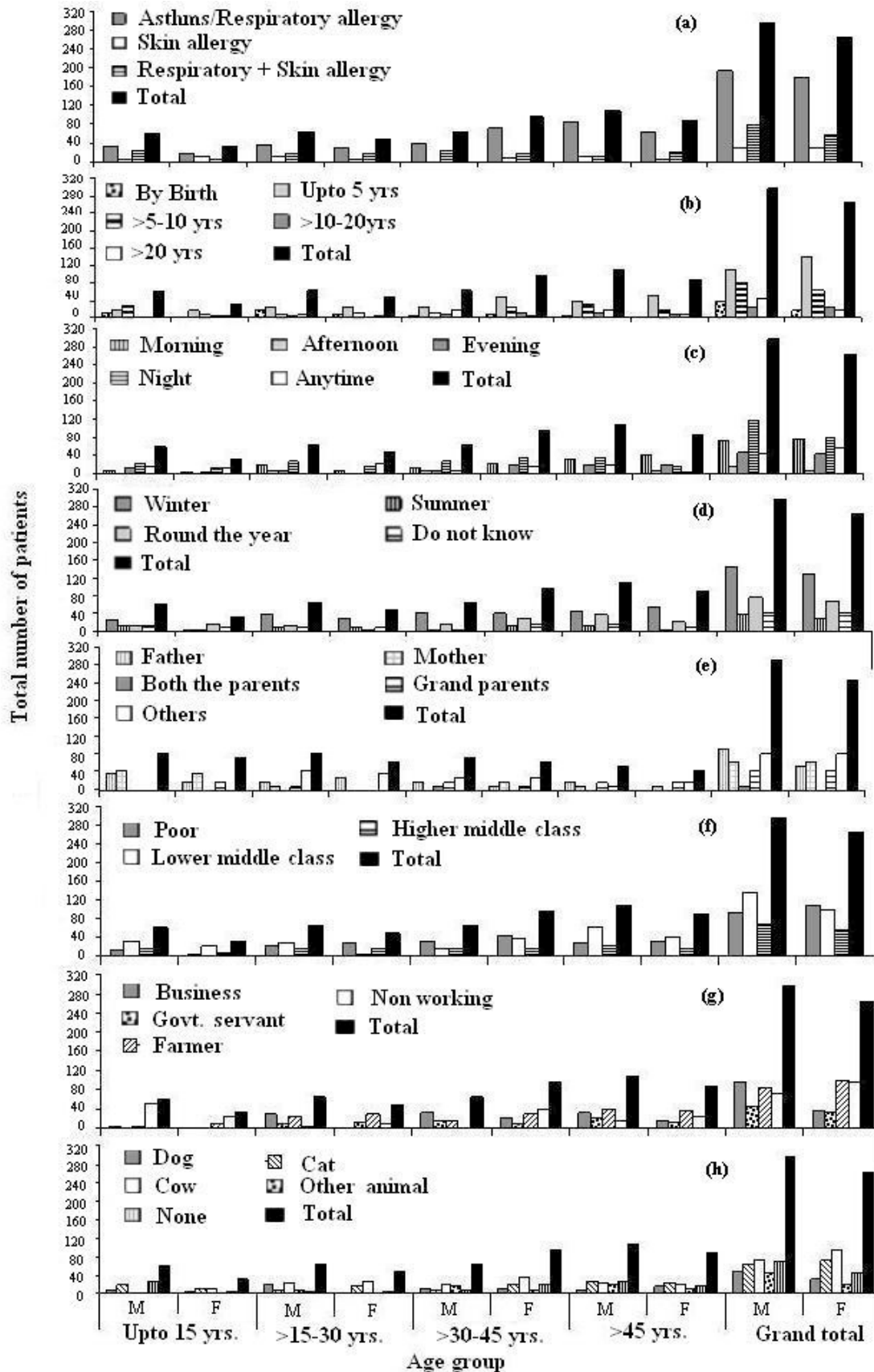


Figure 1: Results of epidemiological studies on the suspected allergic patients. Patients were categorize on the basis of (a) Age, sex and allergic disorders (b) Duration of suffering (c) Season of maximum suffering (d) Time of allergic provocation (e) Familial basis of allergy (f) Social status (g) Occupation (h) Association with pet animals.

percentage higher than the normal range (1-4%) while 22 (24.4%) showed normal range of eosinophils count. Most patient's blood sera showed group II range of eosinophil count (42.4%) followed by group III (15.5%), group IV (11.1%) respectively while lowest was found under group V range (6.4%). Besides eosinophils, percentage of Monocytes, Lymphocytes and Basophils were also found to vary from patients to patients. Among the patients tested, 75.5% were having lower neutrophils count then the normal range while 6.7% were having higher neutrophils count. Higher range of lymphocyte count was recorded in 33.3% of the sera tested whereas 6.7% sera showed lower value than normal range. In case of monocytes, 32.2% showed higher count than normal level while 8.9% of the sera showed higher range of basophils count (Table 1). Statistical analysis (Spearman rank correlation coefficient test) showed significant negative correlation of neutrophils with eosinophils ($r=-0.622$; $p=0.000$), lymphocytes ($r= -0.738$; $p=0.000$) and monocytes count

($r= -0.326$, $p= 0.001$). Similarly, monocytes showed significant positive correlation with basophils count ($r= 0.202$; $p=0.048$). Elevated IgE level was significantly correlated with total eosinophil count ($r=0.327$, $p= 0.002$).

Of the 90 sera samples tested against 18 different extracts (8 pollens and 10 fungus) for the presence of specific IgE, 82 samples have shown positive binding. Blood sera of 70 patients (77.8%) showed positive binding (>30% binding) to fungal extracts while, 64 (71.1%) showed positive binding to pollen extracts. Multiple allergenicity was recorded in 54 (60%) cases (Table 2). Among all the patients' sera tested, maximum has shown +1 grade of binding with the antigenic extracts tested by plate ELISA, followed by +2, +3 and +4 grade (Table 3). Statistical analysis of variance showed a significant deviation in the value of patient's sera from the control OD value at 1% or 5% level of significance (Table 4).

Table 1: Grouping of Patients on the Basis of Age and Percentage Contribution of Different WBCs

	Range (%)	Patients (Age Group in Years)						
		Upto 10	>10-20	>20-30	>30-40	>40-50	>50-60	>60
Eosinophils	Upto 4	1	5	4	4	8	-	-
	>4-10	3	7	8	10	4	4	2
	>10-15	2	-	4	4	-	-	4
	>15-20	2	2	-	-	-	6	-
	>20	2	-	2	-	2	-	-
Neutrophils	Upto 40	-	2	2	4	-	-	-
	>40-50	4	8	8	8	4	6	2
	>50-60	2	2	6	2	2	2	4
	>60	4	2	2	4	8	2	-
Lymphocytes	Upto 40	10	6	8	10	12	10	4
	>40-50	-	8	10	6	2	-	2
	>50-60	-	-	-	2	-	-	-
	>60	-	-	-	-	-	-	-
Monocytes	Upto 2	8	6	12	8	4	8	6
	>2-3	2	-	4	8	8	2	-
	>3-4	-	4	2	-	-	-	-
	>4	-	4	-	2	2	-	-
Basophils	Upto 0.5	10	12	14	12	14	6	4
	>0.5-1	-	-	2	4	-	4	-
	>1-1.5	-	2	-	-	-	-	2
	>1.5	-	-	2	2	-	-	-

Reference range: Eosinophils- 0%–4%; Neutrophils- 50%–60%; Lymphocytes- 25%–40%; Monocytes- 0%–2%; Basophils- 0%–1%.

Table 2: Results of Plate ELISA Carried Out in 90 Allergic Patients Against 18 Antigens Prepared from the Dominant Pollen and Fungal Types of South Assam (10 Fungus and 8 Pollens). Many Patients were Found to have Multiple Allergenicity

Patients Age Groups (Yrs)	Pollen Allergy						Fungal Allergy						Patients Having Both Pollen & Fungal Allergy	
	Allergic to Single Pollen Type		Allergic to 2 Pollen Types		Allergic to Multiple Pollens		Allergic to Single Fungal Species		Allergic to 2 Fungal Species		Allergic to Multiple Fungal Species			
	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Upto 10	-	-	-	-	-	-	2	-	-	2	-	-	6	-
>10-20	-	-	-	-	2	-	-	-	-	2	2	-	4	4
>20-30	-	-	-	-	-	-	2	2	-	-	-	-	4	6
>30-40	-	2	-	-	-	-	-	-	-	2	-	-	10	2
>40-50	2	-	-	-	-	2	-	2	-	-	-	-	4	2
>50-60	2	-	-	-	-	-	-	-	-	2	-	-	4	2
>60	-	-	-	-	-	2	-	-	-	-	-	-	4	-

Table 3: Grading of ELISA on the Basis of Percent Binding of 90 Allergic Patients Sera with Pollen & Fungal Antigen Tested

Antigen Tested	Grading of ELISA Result			
	+1 (30-50%)	+2 (>50-70%)	+3 (>70-90%)	+4 (>90%)
Pollens:				
<i>Acacia auriculiformis</i>	10	0	4	0
<i>Amaranthus spinosus</i>	8	2	2	4
<i>Cassia alata</i>	30	8	0	2
<i>Cleome gynandra</i>	6	6	4	2
<i>Cocos nucifera</i>	2	4	0	0
<i>Trewia nudiflora</i>	14	2	0	0
<i>Imperata cylindrica</i>	4	4	0	0
<i>Ricinus communis</i>	12	4	0	0
Fungus:				
<i>Aspergillus clavatus</i>	0	0	2	0
<i>Aspergillus flavus</i>	26	10	2	2
<i>Aspergillus fumigatus</i>	10	4	0	0
<i>Aspergillus humicola</i>	8	0	2	2
<i>Aspergillus nidulans</i>	6	4	2	2
<i>Aspergillus niger</i>	6	0	0	0
<i>Cladosporium herbarum</i>	4	0	0	0
<i>Curvularia lunata</i>	4	2	0	0
<i>Mucor hiemalis</i>	30	2	0	0
<i>Penicillium citrinum</i>	0	2	4	0

Pulmonary test using Spirometer showed abnormal airway functions in 66.6% cases. Among them 31% were found to have obstructive airway. Severe to very severe airway obstruction was observed in 14.4% of patients, 13.3% showed moderate obstruction and

3.0% shown mild airways obstruction. Around 20% patients were reported to have combine restrictive and obstructive airways functions and the rest 13.3% showed normal airway functions. Severity of obstructive airway function was found to be proportional to the

severity of asthma/respiratory attack. Moreover, patients having moderate to severe obstructive disorders were tested positive to the selected antigens by plate ELISA method. PFT also showed severe to very severe airway restriction in 23.3% of the patients tested while 10% percent of the patients were reported to have moderate airway restriction and 8.9% had mild airways restriction (Table 5).

4. DISCUSSION

Epidemiological investigation of any environmental condition with large number of allergic patients is a well-established scientific method used to identify and measure the nature, distribution, and cause of environmental illness. Effect of seasonal and annual variation in allergic diseases was found to enhance with increase in age. Most of the patients reported

Table 4: Statistical Significance of IgE Level in the Sera of Suspected Allergic Patients Tested. Results Greater than 30% than the Negative Control were Considered Positive

Antigens	No. of Observations		Mean OD		Standard Deviation	Significance
	Patient	Control	Patient	Control		
Pollens:						
<i>Acacia auriculiformis</i>	78	5	0.75	0.07	0.39	<0.01
<i>Amaranthus spinosus</i>	68	5	0.81	0.08	0.36	<0.01
<i>Cassia alata</i>	84	5	0.37	0.03	0.14	<0.01
<i>Cleome gynandra</i>	86	5	0.68	0.04	0.29	<0.01
<i>Cocos nucifera</i>	84	5	0.40	0.04	0.04	<0.01
<i>Imperata cylindrica</i>	62	5	0.35	0.03	0.18	<0.01
<i>Ricinus communis</i>	70	5	0.79	0.05	0.58	<0.01
<i>Trewia nudiflora.</i>	86	5	0.35	0.02	0.09	<0.01
Fungus:						
<i>Aspergillus clavatus</i>	26	5	0.61	0.03	0.49	<0.01
<i>Aspergillus flavus</i>	90	5	0.38	0.02	0.07	<0.01
<i>Aspergillus fumigatus</i>	86	5	0.50	0.03	0.04	<0.01
<i>Aspergillus humicola</i>	68	5	0.80	0.06	0.32	<0.01
<i>Aspergillus nidulans</i>	90	5	0.35	0.02	0.09	<0.05
<i>Aspergillus niger</i>	82	5	0.53	0.05	0.16	<0.05
<i>Cladosporium herbarum</i>	30	5	0.37	0.02	0.10	<0.05
<i>Curvularia lunata</i>	84	5	0.37	0.03	0.08	<0.01
<i>Mucor hiemalis</i>	78	5	0.47	0.02	0.02	<0.05
<i>Penicillium citrinum</i>	64	5	0.49	0.05	0.10	<0.05

Table 5: Pulmonary Function Test Carried Out on 66 Patents Using Spirometer. Several Patients were Found to have Both Obstructive and Restrictive Disorders

Age Group	Sex		Obstructive Disorders						Restrictive Disorders						Normal	
			Mild		Moderate		Severe		Mild		Moderate		Severe			
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Upto 10yrs	9	3	-	-	-	1	5	-	-	-	2	-	2	-	-	2
>10-20yrs	4	4	-	1	-	-	2	-	-	-	2	-	-	2	1	-
>20-30yrs	8	6	-	2	2	-	-	-	2	1	-	-	4	3	-	-
>30-40yrs	8	4	-	-	2	2	2	-	-	-	-	-	4	2	-	-
>40-50yrs	6	4	-	-	2	-	-	1	3	-	-	2	1	-	-	1
>50-60yrs	3	3	-	-	-	1	2	-	-	1	-	-	1	-	-	1
>60yrs	4	-	-	-	1	-	-	-	-	-	2	-	-	-	-	1

above were found to have seasonal allergic problems and winter season was found to trigger the allergic reaction in maximum cases. It could be due to the fact that during winter (dry) seasons the atmospheric condition favours the prevalence of maximum bio-components in the atmosphere as compared to summer due to which there is a greater possibility of patients getting sensitized to different kinds of allergens [19]. Indoor and outdoor airborne pollutants are major factors in the allergy epidemic, with a defined link between the increase in air pollution and the prevalence of allergic diseases [20]. Sharma *et al.* [21, 19], reported large number of aero-biocomponents from South Assam and established link between the prevalence of some common atmospheric pollen/fungi and allergy sensitization. The effect of family pets, such as dogs and cats, on the development of atopic disease has been controversial. In our study, no significant relationship was observed among the people of South Assam with their allergic symptoms and pet animals. Litonjua *et al.* [22] also investigated the independent effects of early life exposure to cats and dogs on the development of allergy. Among food items, tomato, egg, prawn, pork and beef are already known to cause allergy [23,24], but in the present study only a few cases of food allergy (5%) are reported in general survey. However, data from many parts of Asia are still lacking. Large, well-designed epidemiological studies are needed so that the scale of the problem can be understood, public awareness can be increased and important food allergens in the region can be identified [25]. The poor and lower middle class people showed maximum allergic symptoms which could be attributed to the meager diet and negligence in health care and this could lead to the reduction in immunity against environmental allergens. Although the hygiene hypothesis on autoimmune and allergic diseases stated that exposure to allergens in the environment early in life reduces the risk of developing allergies by boosting immune system activity [26]. This hypothesis, however, cannot explain the higher rates of allergic asthma among poor Asian and African in the inner city areas.

Family studies indicate that environment generally influences the expression of allergic diseases [27]. Human genetic factors have strong influence on the severity and specificity of the allergic symptoms [28]. Asthma, eczema and the atopic state are strongly familial and have a genetic basis [5] as seen in the present study. Many epidemiological studies have indicated that maternal phenotype influences the inheritance of asthma and allergy [29-31]. Prescott [32] stated that the presence of asthma, eczema, elevated serum IgE levels and positive skin test in children have

been accompanied by an increased prevalence of asthma or atopy in mothers. Nonetheless, in the present study both the parents were found almost equally responsible for allergic disease transmission to the offspring. Jin *et al.* [33] reported that parent asthma is an independent risk factor for allergic sensitization in their offspring in Chinese population. Supporting the present findings, he has reported that both the parents may be responsible for allergic disease transmission to the offspring. About 16% of the total patients tested above were found below 15 years of age and most of them were found to have familial basis of allergy. Holgolt [1] have reported concordance rates of eczema in twins, indicating strong genetic effects on the disease.

Many of the patients sera tested above were found to be allergenic to more than single antigens. Multiple allergenicity among Indian are also reported by Anuradha *et al.* [34] and Sharma *et al.* [19]. They have also reported that the number of pollens to which patients were sensitive was inversely proportional to the duration of symptoms. But in the present study no such relation was observed between the duration of suffering and multiple allergenicity in patients. However, patients showing multiple allergenicity were found to develop higher percentage of IgE as compared to patients with allergenicity to single or less number of antigens. Supporting the present findings, Choudary *et al.* [35] reported high eosinophils percentage in the sera collected from the patients suffering from different type of allergic diseases. An increased number of blood eosinophils reflect an inflammatory reaction in the airways, which might lead to development of obstructive airflow limitation [36]. Kurt *et al.* [37] reported changes in eosinophil counts and eosinophil apoptosis with the changes in natural pollen exposure and seasonal changes in bronchial hyper-responsiveness (BHR) in seasonal allergic rhinitis (SAR). Eosinophilic inflammation may be present in subject with allergic rhinitis and airway hyper-responsiveness even when there is no symptom of asthma [38]. Besides eosinophils, percentage of other white blood cells was also found to vary from the normal range during the allergic disorders. Chung and Barnes [39] reported that helper T cells, Mast cells, Basophils, Eosinophils and CD8 cells can produce cytokines encoded by the interleukin 4 (IL-4) gene clusters during allergic diseases. Therefore, this aspects should be given due importance while treating the allergic patients. A proper clinical history is an important part for diagnosing various allergic disorders. The allergologist must be fully conversant with the clinical features of disease entity [40].

Atopy is characterized by increased synthesis of IgE for common allergens [41]. According to Halonen *et al.* [42], a significant relationship exists between serum IgE levels and eosinophil in population presumed to be free of parasites where IgE levels presumably provide a better clue to atopy than do skin tests. Avarez *et al.* [43] reported higher eosinophil and serum eosinophil cationic proteins (ECP) in asthma and rhinitis patients than in healthy controls. Present study also showed higher IgE levels in 75.5% of the patients sera tested against 18 different antigens from south Assam. However, in many cases of marked allergic diseases, the serum levels reaches in excess of 100 times than normal but IgE titer rarely approaches baseline levels of other antibody such as IgG. Therefore tight control of IgE may be important to prevent potentially lethal consequences of IgE dependent inflammation. The atopic disorders are increasingly in incidence in development and developing countries and have strong link to environment suggest that solution to stop the epidemic are more likely to come from public health that pharmacological intervention.

Patients suffering from obstructive disorders also showed restrictive dysfunction. This perhaps indicate that the airway dysfunction reported above could either be due to allergy related disease such as emphysema, chronic bronchitis, asthma, etc. or it could be due to some other lung diseases such as interstitial fibrosis, scoliosis, and loss of surfactant (respiratory distress syndrome). Hence, a single factor analysis could not give accurate result and therefore, the multiple ranges of tests are encouraged in clinical investigation. As reported by Koshak and Alamoudi [44], present study also showed positive relationship between the elevated IgE level, abnormal eosinophil count and pulmonary dysfunction during allergic diseases.

In the present study, several factors like prevalence of aeroallergens, age and sex of the patients, genetic basis of allergy, elevated IgE level in blood sera, abnormal eosinophil count and abnormal pulmonary function were found to be associated with kind and severity of allergic disorders. The above study could provide baseline information for further investigation on epidemiology of allergic diseases in South Assam. It is however necessary to understand how environmental factors interact with the human genome to reveal the atopic state, its origin specificity and the associated diseases.

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ABBREVIATIONS

- ELISA = Enzyme linked immunosorbant assay
 PFT = Pulmonary function test
 WBC = White blood cells

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