ejpmr, 2016,3(5), 690-696

SJIF Impact Factor 3.628

EUROPEAN JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.ejpmr.com

Research Article

ISSN 2394-3211

EJPMR

STUDY OF POLLENS AS CAUSATIVE AGENT IN RESPIRATORY ALLERGIC DISORDERS BY INTRADERMAL SKIN TEST IN TERAI AREA

Sushil Chaturvedi[1*] and Rachna Chaturvedi[2]

[1]District Tuberculosis Officer Lucknow.
[2]Amity Institute of Biotechnlogy, Amity University Uttar Pradesh, Lucknow Campus.

***Corresponding Author: Dr. Sushil Chaturvedi**
District Tuberculosis Officer Lucknow.

Article Received on 22/03/2016 **Article Revised on 12/04/2016** **Article Accepted on 02/05/2016**

ABSTRACT

The present study was carried out to assess the prevalence of airborne pollen in Terai area of eastern Uttar Pradesh (Nepal Border) and to evaluate the allergic effect of pollens in patients of respiratory allergy. Terai area has been established as very emergent to respiratory allergic disorders usually due to aeroallergens present in the environment. Pollens are common of them and considered as a potent source of aeroallergens for respiratory allergic disorders such as asthma and allergic rhinitis. The patients who have reported were having symptoms of respiratory allergy as breathlessness, runny nose, sneezing, congestion of the nose, and itchy, red and watery eyes. Ninety Six patients of respiratory allergic disorders were included for intradermal skin test with 44 common pollen allergens. The Age group of included patients was 12-48 years and male female ratio was 3 : 2.Skin sensitivity as observed in this small study was highest by Prosopis julifera (34%).It is followed by Eucalyptus (30%),Partheenium (26%),Ageratum sp.(25%),Holoptelia (22%),Ricinus (16%),Chenopodium (16%),Cassia (14%),Brassica (13%),and Amaranthus (11%). 38% pollens among 44 included in this study were not having any significant allergic effect. 24% patients out of 96 had not shown positive skin sensitivity test. The data obtained from this study will be helpful in interpreting the allergic effect of available pollens and its correlation with approximate flowering periods of plants.

KEYWORDS: Allergy, pollens, allergens allergic rhinitis, asthma, skin Prick test,

INTRODUCTION

Respiratory allergic disorders are found the most common chronic disorders present worldwide and respiratory allergy is also prevalent amongst all residents with increasing tendency throughout the world in all populations with ever increasing trend. The term respiratory allergy refers to quantifiable manifestations of both upper and lower respiratory tract due to allergy.[1] In the nineteenth century for the first time, laid the foundations of the diagnosis and appropriate treatment of seasonal allergic diseases The second half of the 20th century has appreciated an rise in the occurrence of allergic diseases, correlating with fluctuating atmosphere and standard of living as noteworthy causes. In India, an increase in allergic disease from 10% to 30% has been reported in the last 40 years[2] and also between 15% and 20% of persons agonize from allergic expressions such as allergic rhinitis and bronchial asthma, and other disorders which weaken the value of life of the affected individuals. Present time additional 300 million of the residents is known to suffer from single or many respiratory allergic disorders disturbing the socioeconomic worth of life[3] In view of the alarming increase in allergic disorders, such as allergic rhinitis, bronchial asthma and atopic dermatitis casing as high as 30% of the population all over the world. There is a cumulative awareness in the occurrence and association of bio particulate matter in the earth's environment and their impact on human health. This interdisciplinary approach is known as aerobiology. The bio particulates associated to cause allergic symptoms are pollen grains, fungal spores, pest debris, household dust mites, animal dander, chemical compounds, foodstuffs, etc.[4,5,6,7] Among all these agents, pollen grains and fungal spores are the most chief allergens present in the air. Pollen grains are well known to be common causative agents in respiratory allergic disorders like rhinitis, conjunctivitis, dermatitis, bronchial asthma, etc. or to be as resource of atmospheric pollution.[8,9] Airborne bio-pollutants pose an excessive problem globally due to their allergenic properties. Agents triggering respirational allergies in human beings of living origin are collectively known as Bio-aeroallergens.[10] Allergic diseases are complicated multifactorial diseases and their development and phenotypic manifestation depends on an interaction between environmental acquaintance to allergens and non-specific adjuvant factor and genetic factors.[11] Pollen grains as aeroallergen are well studied from corner to corner of world and are important source of pollinosis. Respiratory system is one of the target organ

of airborne pollens taken in by inhalation. Pollen allergy has a noteworthy medical influence all over Europe, and there is a body of evidence proposing that the majority of respiratory allergic disorders persuaded by pollens in Europe has been on the rise in the past decades.[12,13,14,15] Pollen allergy has been one of the highest collective models used to study the interrelationship amongst air contamination and respiratory allergic disorders. Particularly from clinical point of view, it is significant to know the details about the different pollen season and the pollen load in the atmosphere. According to the differences recorded in numerous years of remarks in airborne pollen, pollen calendars are haggard as a support to allergy analysis and controlling.[16,17,18,19] In the present study, the patients were screened from east India for determining their cause respiratory allergic disorders using skin testing methods.

MATERIALS AND METHODS

The present study was conducted in the patients who are suffering from so many respiratory allergic disorders such as allergic rhinitis, bronchial asthma and who have attended allergy clinic. The study group comprised of 96 patients. A comprehensive history was taken and detailed clinical examination was performed and respiratory allergic disorders were defined as per the questionnaire. The questionnaire used in the present study based on the objective to compile the information on respiratory symptoms and detecting a diagnosis of different respiratory allergic disorders.

All the routine investigations in all cases giving emphasis on blood eosinophilia, stool examination, X-ray chest, and pulmonary function test were performed for exclusion purpose.

In the present study the patients were in between 12–48 years of age with recurrent attack of paroxysmal rhinitis and dyspnoea. A defined history of respiratory allergy to inhalants, with emphasis on allergy due to exposure to different type of pollens were included. All patients were having seasonal or perennial attacks of asthma. All cases that were excluded had the presence of other causes of dyspnoea like cardiac, renal, and infective condition of lungs. All the pregnant and lactating mothers and also the patients suffering from tropical pulmonary eosinophilia, emphysema bronchitis, and tuberculosis are not included in the present study. The present study was carried out in an allergy clinic with the objective to detect the important factors in respiratory allergic disorders.

Pollen antigens used for the present study were arranged from Allergen Division Curewel (India) Limited an Indo –vulgar joint venture. Antigens used in present study for intradermal testing were always kept in refrigeration at 4^0C . Before performing intradermal test, oral drugs were stopped but inhaled drugs were continued. Oral anti histamines were stopped 3 days before and oral sympathomimetic were stopped 36 hrs before performing the test The patients were also asked to avoid ephedrine, adrenaline, aminophylline, and other bronchodilators about 24 hours prior to the test. The site of test was anterior aspect of forearm and lateral part of the upper arm. Care was taken not to have any hair over the area where the skin test was being performed.

Patients on corticosteroids for more than two weeks were called for allergy testing at least after three weeks. About 0.01 ml of each extract in conc. Of 1:500 w/v was injected intradermal using a sterile hypodermic needle. The common sites used for the skin test were the volar aspect of the for arms starting about 5cm proximal to the crease of the wrist and the lateral aspect of the upper arms. Phosphate Buffer saline was used as negative control and histamine as positive control. The skin is cleaned with 70% alcohol swab and allowed to dry. The individual test sites are 5 cm apart just to avoid overlapping of reactions. The tests were read after 15 to 20 minutes graded according to criteria. Assessment of skin reactivity was done according to criteria proposed by Shivpuri including modifications. Positive reaction with association of history was incorporated in this study. Patient anxieties toward the performance of skin test were avoided by explaining in detail about the procedure before performing the test. Criteria of positivity and grading is given in Table 1.

Table 1: Criteria of positivity and grading of skin tests

Grade	Size of wheel
Grade 1 +	2.5 times or more of the negative control
Grade 2 +	3 times or more of the negative control
Grade 3 +	4 times or more of the negative control
Grade 4 +	4 – 6 times or more of the negative control with pseudopodia

Pollens used in the Study

1. Adhatoda vasica
2. Ageratum conyzoides
3. Ailanthus excels
4. Amaranthus hybridus
5. Amaranthus spinosus
6. Argemona maxicana
7. Artmisic scoparia
8. Asphodelus tenuifolius
9. Azedirechta indica
10. Brassica compestris
11. Cannabia sativa
12. Carica napaya
13. Cassia occidentelis
14. Cassis sinmon
15. Canchrus cilioris
16. Chonopodium allum
17. Chenopodium murrain
18. Clarodondrum chlomoldes
19. Crntoevs nurvolo
20. Cyndon declyion
21. Cypprus rotundus
22. Lodonea viscosa
23. Ehretia movie

24. Eucalyptus terreticornis
25. Gynandropsis gynandra 26. Holoptelia intecrifolia
27. Imperata cylindrical
28. Kigelie pinnata 29. Lawsonia enermii
30. Maerua arenaria
31. Melia azadierch 32. Morus albe.
33. Partheenium hysterophorous
34. Penisetum typhoides 35. Prosopta juliflora
36. Putranjiva roxburghi
37. Ricinus communis 38. Rumex dentatus
39. Salvadora persica
40. Sorghum vulgare 41. Suaeda fructicosa
42. Typha angustata
43. Xanthium strumarium 44. Zea mays

RESULTS

In the present study the sum of patients were 96.Out of these 56 (60%) were male and 36 (39.2%) were female. Average age of patients was 30 (Table 2).Skin sensitivity to various pollen allergens is shown in Table 3.Out of 96 symptomatic patients in which allergy test was performed, about 6 % patients had not shown any response to pollens, 24 % had not shown any significant sensitive reaction while rest 70 % patients had shown positive reaction (Table 3 and Fig 1). Table 3 reveals that Prosopta juliflora had proved most offending allergen (36%) followed by Eucalyptus terreticornis (34%), Partheeinum hysterophorous (30%), Haloptelia intecrifolia (22%), Melia azadierch (21%), Ageratum conyzoides (20%), Amarenthus hybridus (18%), Amarenthus spinosus (18 %), Salvadora persica (18%), Ehretia movie (18 %), Maerua arenaria (18%), Ricinus communis (16%), Chonopodium allum (16%), Chenopodium murrain (16%), Artmisic scoparia (15%) Cassia occidentelis (14%), Cassia sinman (14%), Brassica compestris (13%), Adhatoda vasica (12%), Crntoevs nurvolo (12%), Gynandropsis gynandra, (12%). In terai region 24% pollens among 44 were having sensitivity less than 10% like Ailanthus excelsa, Asphodelus tenuifolius, Azedirechta indica, Cannabia sativa, Carica napaya, Canchrus cilioris, Clarodondrum chlomoldes, Cyndon declyion, Lodonea viscosa, Imperata cylindrical, Kigelie pinnata, Lawsonia enermii, Morus albe, Pennisetum typhodes, Putranjiva roxburghii, Xanthium strumarium, Zea mays. 6 % have not shown any response are Cypprus rodentus, Rumax dentatus, sorghum vulgare and Typha angustata.

Table: 2 Age Distribution of Patients.

Age distribution	No. Of Patients	% of Patients	Average age
10 -20	18	18.75	17
20-30	51	53.12	26
30 - 40	16	16.66	34
40 - 50	11	11.45	43

Table: 3 Pollen Sensitivity (%) in Patients and Grading of sensitivity

S.N.	Name of Pollen	Sensitivity in Patients (%)	Grade 1	Grade 2	Grade 3	Grade 4
1	Adhatoda vasica	12	-	100	+	+
2	Ageratum conyzoides	20	22	8	2	+8
3	Ailanthus excels	4	-	-	-	-
4	Amaranthus hybridus	18	22	64	14	-
5	Amaranthus spinosus	18	80	20	-	-
6	Argemona maxicana	12	68	32		
7	Artmisic scoparia	15	65	35	-	-
8	Asphodelus tenuifolius	4	-	-	-	-
9	Azedirechta indica	8	-	-	-	-
10	Brassica compestris	13	40	48	12	-
11	Cannabia sativa	8	-	-	-	-
12	Carica napaya	8	70	30	-	-
13	Cassia occidentelis	14	16	54	30	-
14	Cassia Sinman	14	26	66	8	-
15	Casis Sinman	-	-	-	-	-
16	Canchrus cilioris	6	-	-	-	-
17	Chonopodium allum	16	34	54	12	-
18	Chenopodium murrain	16	52	48	-	-
19	Clarodondrum chlomoldes	6	-	-	-	-
20	Crntoevs nurvolo	12	84	16	-	-
21	Cyndon declyion	8	-	-	-	-
22	Cypprus rotundus	-	-	-	-	-
23	Lodonea viscosa	4	-	-	-	-
24	Ehretia movie	18	72	28	-	-

25	Eucalyptus terreticornis	34	36	64	-	-
26	Gynandropsis gynandra	12	68	32	-	-
27	Holoptelia intecrifolia	22	26	56	18	-
28	Imperata cylindrical	4	-	-	-	-
29	Kigelie pinnata	6	-	-	-	-
30	Lawsonia enermii	8	-	-	-	-
31	Maerua arenaria	18	32	54	14	-
32	Melia azadierch	21	66	26	8	-
33	Morus albe.	4	-	-	-	-
34	Partheenium hysterophorous	30	18	54	28	-
35	Penisetum typhoides	8	-	-	-	-
36	Prosopta juliflora	36	12	36	34	18
37	Putranjiva roxburghi	4	-	-	-	-
38	Ricinus communis	16	24	18	18	-
39	Rumex dentatus	-	-	-	-	-
40	Salvadora persica	18	22	70	8	-
41	Sorghum vulgare	-	-	-	-	-
42	Suaeda fructicosa	12	82	18	-	-
43	Typha angustata	-	-	-	-	-
44	Xanthium strumarium	4	-	-	-	-
45	Zea mays	6	-	-	-	-

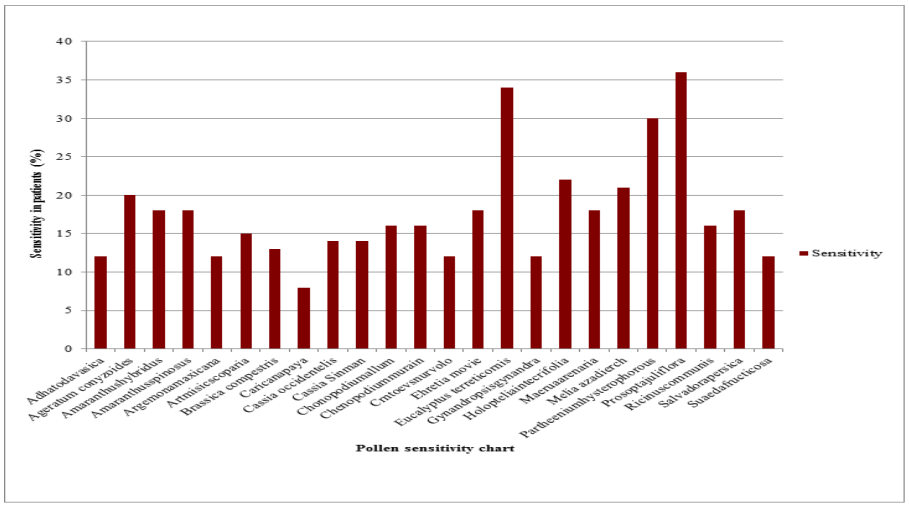

Fig 1 Pollen Sensitivity (%) in patients of different pollens

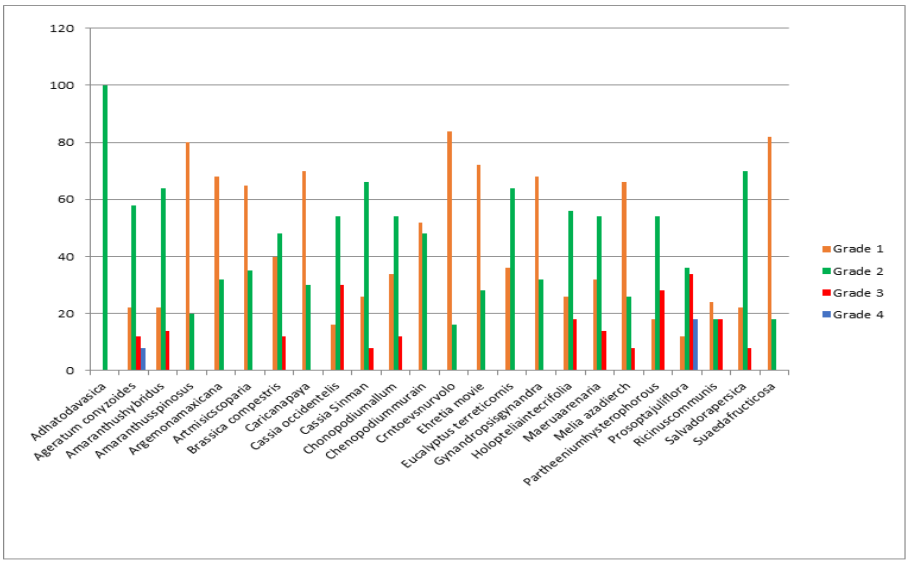

Fig 2 Pollen Sensitivity Grading Chart of different pollens

DISCUSSION

Pollen grains as aeroallergen and as cause of pollinosis are well studied world-wide. Respiratory system is the well-known target system which is effected by airborne pollens taken by means of inhalation. This consequences are well studied in form of immediate hypersensitivity disorders, in hereditarily susceptible persons and late hypersensitivity disorders in others triggering quantifiable expressions of allergic rhinitis, allergic alveolitis, asthma, atopic dermatitis, etc. Bostock[20] was the first to detect pollen as the source of hay fever (allergic rhinitis). Later Blackley[21] recognised that grasses are significant origin of hay fever in UK. After more than 40 years, Scheppegrell[22] from USA, sensed the necessity for field survey and aerial surveys to notice the aeroallergens from the air. Further studies throughout the world are in favour that the pollen grains may be considered as the major causative agent for respiratory allergic disorders[23,24,25,26,27,28,29,30,31,32] However, according to the various studies it was observed that cases of respiratory disorders persuaded by pollens are growing may be associated to numerous factors, along with increased air pollution.[33,34]

Important pollen allergens were identified for Delhi by Shivpuri and his colleagues were Ageratum, Ailanthus, Amaranthus, Anogeissus pendula, Artemisia, Cassia siamea, Cenchrus, Chenopodium, Cynodon, Ipomoea fistulosa, Paspalum distichum and Poa annua [35,36,37] .Most of them were also identified from terai area in present study.

It is evident from previous studies and survey that from Northern India, important allergens identified are: Prosopis juliflora, Ricinus communis, Morus, Mallotus, Alnus, Quercus, Cedrus, Argemone, Amaranthus, Chenopodium, Holoptelea, and grasses,from Central India the important pollen allergens are: Argemone, Brassica, Cannabis, Asphoedelus, Parthenium, Cassia, Azadirachta, grasses, Alnus, Betula, Malotus, Trewia nudiflora,from Eastern India, allergenically significant pollen types were found as: Lantana, Cucurbita maxima, Cassia fistula, Cocos nucifera and Calophyllum inophyllum and from South India Cassia, Ageratum, Salvadora, Ricinus, Albizia lebbeck and Artemisia scoparia have been reported as clinically important aeroallergens.[38,39,40] Rao et al.[41] recorded allergenicity to Parthenium hysterophorus pollen extracts in 34% patients of allergic rhinitis and 12% bronchial asthma patients from Bangalore that is in favour of results of present study in which 30% sensitivity is recorded to Partheeinum hysterophorous. Shivpuri and Parkash [42] observed Prosopis juliflora as a major cause of pollinosis with 12% patients showing a positive skin reaction. In present study Prosopta juliflora had proved most offending allergen (36 %).

The predominant pollens in the earlier studies were Pennisetum followed by Artemisia and Sorghum vulgare [43] while in present study Peninisetum and Sorghum vulgare were not having any significant results Also in semi urban areas of Secunderabad, Partheenium was prevalent that is evident from our study showing 30 % Senstivity. Brassica was most common allergen reported from Bhopal and Kanpur, also have 13 % sensitivity in present study. Amaranthus was the common pollen reported from Delhi and Ammaranthus hybridus and Ammaranthus spinosus were having 18% sensitivity in our study. Also observation was made with predominant pollen Gynandropsis gynandra[44] which was positive in 2.2% in our study.

CONCLUSION

In the present study the occurrence of multiple allergic pollens were highlighted within the region of investigation. The individuals suffering from different respiratory disorders were frequently sensitive to more than one allergen. Heredity, cooking gas, and smoking were the risk factors besides sensitivity to inhalant allergens such as pollens as major source. In the present study, higher prevalence of respiratory disorders was observed among men as compared with women and maximum no. of patients were in the age group 40 – 50 years. In this study, maximum of the cases using skin tests exhibited that the disease was either perennial or seasonal according to occurrence of pollens. Hence it may be concluded that by the identification of allergens primary involvement of current disease and adaptation of following natural history of disease is allowed. A positive skin test does not permanently suggest clinical disease but correlation of positive skin test with clinical symptoms and periodic variation will help in diagnosis, and might be attempted to assist in preparation of antigen for hypo sensitization of patient.

REFERENCES

1. Blackley C. On hay fever. Experimental researches. Abington: Oxford Historical Books, 1988.
2. Sharma, S., Kathuria, P. C., Gupta, K. C., Nordling, C., Ghosh, B., & Singh, A. B, 2006. Rodriguez-Rajo, F. J., Jato, V., & Aira, M. J. Pollen content in the atmosphere of Lugo (NW Spain) with reference to meteorological factors (1999–2001). Aerobiologia, 2003; 19: 213–225.
3. Based on an estimated population of 303 million in 2007 U.S. POPClock. U.S. Census Bureau.
4. Kang B, Jones J, Johnson J, Kang IJ. Analysis of indoor environment and atopic allergy in urban populations with bronchial asthma. Ann Allergy, 1989; 62: 30–34. [PubMed]
5. Shivpuri DN. Clinically important pollens, fungal and insect allergens for nasobronchial allergy patients in India. Aspects Allergy Appl Immunol, 1980; 13: 19–23.
6. Lacey J, Crook B. Fungal and actinomycete spores as pollutants of the workplace and occupational allergens. Ann Occup Hyg, 1988; 32: 515–533. [PubMed]
7. Loureiro G, Rabaça MA, Blanco B, Andrade S, Chieira C, Pereira C. Aeroallergens sensitization in

an allergic paediatric population of Cova da Beira, Portugal. Allergol Immunopathol (Madr), 2005; 33: 192–198.[PubMed
8. Gioulekas D, Papakosta D, Damialis A, Spieksma F, Giouleka P, Patakas D. Allergenic pollen records (15 years) and sensitization in patients with respiratory allergy in Thessaloniki, Greece. Allergy, 2004; 59: 174-84.
9. D'Amato G, Liccardi G, D'Amato M, Holgate S. Environmental risk factors and allergic bronchial asthma. Clin Exp Allergy, 2005; 35: 1113-24.
10. Singh AB, Singh A, 1994. Pollen allergy a global scenario. In: Agashe SN (Ed.), Recent Trends in Aerobiology, Allergy, and Immunology, New Delhi: Oxford & IBH Pub. Co., 1994; 143–170.
11. Ober C, Do genetics play a role in pathogenesis of asthma? Journal of Allergy and Clinical Immunology, 1998; 101: 3417–3420.
12. D'Amato G. Allergenic pollen in Europe. In: D'Amato G, Bonini S, Bousquet J, Durham S, Platts-Mills T, editors. Pollenosis 2000: A global approach. JGInt. Publisher, 2001.
13. D'Amato G, Spieksma F. Th. M, Liccardi G et al. Pollen-related allergy in Europe. Position Paper of the European Academy of Allergology and Clinical Immunology. Allergy, 1998; 53: 567–578.
14. D'Amato G, Dal Bo S, Bonini S. Pollen-related allergy in Italy. Ann Allergy, 1992; 68: 433–437.
15. Burney PGJ, Malmberg E, Chinn S, Jarvis D, Luczynska C, Lai E. The distribution of total and specific serum IgE in the European community respiratory health survey. J Alle.
16. Bope ET, Rakel RE, Conn's Current Therapy, Philadelphia, PA: W.B. Saunders Company, 2005; 880.
17. Rusznak C, Davies RJ ABC of allergies. Diagnosing allergy. BMJ, 1998; 316(7132): 686–9.
18. Grammatikos AP "The genetic and environmental basis of atopic diseases". Ann. Med., 2008; 40(7): 482–95.
19. De Swert LF "Risk factors for allergy". Eur. J. Pediatr, 7, 1999; 158(2): 89–94.
20. Kino T, Oshima S. Allergy to insects in Japan. I. The reaginic sensitivity to Bostock J. Case of a periodical affection of the eyes and chest. Med Chir Trans, 1819; 10: 161–165. [PMC free article] [PubMed]
21. Blackley CH. Experimental researches on the causes and nature of catarrhus æstivus (hay-fever or hay-asthma) London: Baillière, Tindall & Cox, 1873.
22. Scheppegrell W. Hay fever in the Southern States. Southern Med J., 1916; 9: 614–615.
23. Mandal J, Chanda S, Gupta-Bhattacharya S. Current status of airborne pollen grains in Kolkata with special reference to their allergenic signifi cance. Indian J. Aerobiol, 2006; 19: 19-30.
24. Rawat A, Sigh A, Roy I, Kumar L, Gaur SN, Ravindran P, Bhatnagar AK, Singh AB. Assessment of allergenicity to Mallotus phillipensis pollen in atopic patients in India: A new allergen. J Invest Allergol Clin Immunol, 2004; 14(3): 198-207.
25. Rodriguez- Rajo FJ, Vato J, Aira MJ. Pollen content in the atmosphere of Lugo (NW Spain) with reference to meteorological factors (1999-2001). Aerobiologia, 2003; 19: 213-25.
26. Stennett PJ, Beggs PJ. Pollen in the atmosphere of Sydney, Australia, and relationships with meteorological parameters. Grana, 2004; 43: 209-16.
27. Banik S, Chanda S. Airborne pollen survey of central Calcutta, India, in relation to allergy. Grana, 1992; 31:72-5.
28. Chakraborty P, Gupta Bhattacharya S, Chakraborty C, Lacey J, Chanda S. Airborne allergenic pollen grains on a farm in West Bengal, India. Grana, 1998; 37: 53-7
29. Mishra R, Singh B, Oommachan M. Airborne pollen fl ora of Jabalpur-the central India. Aerobiologia, 2002; 18: 73-81.
30. Mahadik UD, Niphadkar PV, Dhar HL. Clinical Evaluation and Immunochemical Characterization of Peltophorum pterocarpum pollen from Mumbai (India), Journal of the Association of Physicians of India, 2003; 51: 1204.
31. Tripathi DM, Kale M, K, Rajan KE. Atmospheric pollen and fungal spores at Pune city. Indian J Allergy Asthma Immunol, 2004; 18(1): 45-50.
32. Chanda S, Mandal S, Lahiri SC. Occurrence of allergenic pollen in the atmosphere of Calcutta-Another cause for organic environmental pollution. Science and culture, 1978; 44: 175-7.
33. Emberlin J, Savage M, Jones S. Annual variations in grass pollen seasons in London 1961-1990, trends and forecast models. Clin Exp Allergy, 1993; 23: 911-918.
34. D'Amato G.,Holgate ST. The impact of air pollution on respiratory health. European Respiratory Monograph n.21 .Sheffield, UK,2002
35. Shivpuri DN, Parkash D. A study in allergy to prosopis juliflora tree (Hindi name: Kabuli Keekar) Ann Allergy, 1967; 25: 643–648. [PubMed]
36. Shivpuri DN, Singh AB, Babu CE. New allergenic pollens of Delhi State, India, and their clinical significance. Ann Allergy, 1979; 42: 49–52. [PubMed]
37. Singh BP, Singh AB, Parkash D. Skin reactivity to airborne pollen and fungal antigens in patients of Naso Bronchial Allergy of Hill Regions (India) In: Chandra N, editor. Atmospheric biopollution. Karad: Environmental Publication; 1987; 125–134.
38. Acharya PJ. Skin test response to some inhalant allergens in patients of naso-bronchial allergy from Andhra Pradesh. Asp Allergy App Immunol, 1980; 13: 14–18.
39. Agashe SN, Anand P. Immediate type hypersensitivity to common pollen and molds in Bangalore city. Asp Allergy App Immunol, 1982; 15: 49–52.

40. Agashe SN, Soucenadin S. Pollen productivity in some allergenically significant plants in Bangalore. Indian J Aerobiol. 1992; 63–67.
41. Rao M, Prakash O, Subba Rao PV. Reaginic allergy to Parthenium pollen: evaluation by skin test and RAST. Clin Allergy, 1985; 15: 449–454. [PubMed]
42. Shivpuri DN, Parkash D. A study in allergy to prosopis juliflora tree (Hindi name: Kabuli Keekar) Ann Allergy, 1967; 25: 643–648.
43. Anuradha B, Vijayalakshmi V, Suman Latha G, Hari Sai Priya V, Murthy KJR, Profile of pollen allergies in patients with asthma, allergic rhinitis, and urticaria in Hyderabad. The Indian Journal of Chest Diseases and Allied Sciences, 2006; 48: 221–222.
44. Latha, Suman G, 2002. A study of induction of blocking antibodies after hyposensitisation with Gynandropsis gynandra pollen. PhD Thesis. Osmania University.