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To Study the Impact of Environmental Allergens and Seasonal Variations on the Incidence of Allergic Conjunctivitis

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Abstract

Purpose: To investigate the impact of environmental allergens and seasonal variations on the incidence of allergic conjunctivitis in Patiala, India, with a focus on identifying the predominant allergens and their correlation with symptom severity.

Methods: A prospective, observational study was conducted at the Department of Ophthalmology, Government Medical College and Rajindra Hospital, Patiala. The study included 100 patients diagnosed with allergic conjunctivitis, selected based on specific inclusion and exclusion criteria. Comprehensive ocular examinations were conducted, and environmental data (pollen counts, fungal spore levels, and particulate matter) were collected. Seasonal variations were analyzed using a structured questionnaire, and statistical correlations were evaluated using SPSS software.

Results: The study found a significant seasonal variation in allergic conjunctivitis cases, with the highest incidence during spring (43%) and summer (28%) due to elevated pollen levels. Moderate allergic conjunctivitis was the most common clinical presentation (82%), while severe cases (12%) peaked during spring. Fungal spores were predominant allergens during the monsoon (19%), while winter showed the lowest incidence (10%). Urban residents experienced more severe symptoms due to high exposure to pollutants (PM10, PM2.5). Statistical analysis revealed strong correlations between allergen levels and symptom severity ($p < 0.05$).

Conclusions: Allergic conjunctivitis incidence and severity are influenced by seasonal variations and environmental allergens, particularly pollens and fungal spores. Urbanization and air pollution exacerbate the condition. Effective management requires tailored pharmacological and non-pharmacological strategies, emphasizing allergen avoidance and addressing region-specific environmental factors.

Keywords: Allergic Conjunctivitis, Seasonal Variations, Environmental Allergens, Public Health.

1. INTRODUCTION

Allergic conjunctivitis is a common ocular disorder that manifests as an inflammatory reaction of the conjunctiva, primarily triggered by hypersensitivity to various allergens. This condition, which affects millions globally, has gained increasing attention due to its significant impact on quality of life and its potential to cause chronic discomfort if left untreated. In India, allergic

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conjunctivitis is one of the most prevalent ocular allergies, presenting a significant public health concern owing to the country's vast geographical and climatic diversity, which contributes to exposure to a wide range of environmental allergens.[1,2]

Environmental Allergens and Ocular Health

Environmental allergens, such as pollen, dust mites, fungal spores, and pollutants, play a crucial role in the onset and exacerbation of allergic conjunctivitis. Among these, pollens from trees, grasses, and weeds are considered the most potent aeroallergens. In India, regional variations in flora contribute to the diversity of pollen allergens, which are particularly abundant during certain seasons. Airborne pollutants such as sulfur dioxide (SO_2) and nitrogen oxides (NOx), commonly associated with industrialization and vehicular emissions, can exacerbate allergic conditions, acting as both direct irritants and carriers of allergens.[2,3]

India's environmental landscape is diverse, encompassing tropical, arid, and temperate regions, each of which presents distinct allergenic profiles. In northern regions, for instance, pollens from mustard, eucalyptus, and cotton crops are abundant during the spring, while central and southern India experience high levels of fungal spores during the monsoon. Additionally, dust storms and air pollution, particularly in urban centers, are increasingly recognized as aggravating factors for ocular allergies, adding to the burden of allergic conjunctivitis in the population.[3]

Correlation with Seasonal Variations

Allergic conjunctivitis is notably seasonal in its incidence, with peak occurrences typically during spring and early summer when pollen levels are at their highest. In temperate climates, spring is often associated with tree pollen allergies, while in warmer, tropical regions, grass pollens dominate, particularly during late summer. In India, however, the climatic diversity and prolonged summer seasons contribute to a complex pattern of allergic conjunctivitis outbreaks throughout the year. For example, in northern India, the spring and autumn seasons are characterized by high levels of airborne pollens, while in the coastal regions, the monsoon season leads to increased fungal spore counts, contributing to higher incidence rates.[4]

Several studies have highlighted the close correlation between seasonal changes and allergic conjunctivitis, particularly in relation to fluctuating pollen counts and the rise in airborne allergens during specific periods of the year. An Indian study conducted in Delhi found that allergic conjunctivitis cases surged during the pre-monsoon months (March–June), with tree pollens being the dominant allergens. Similarly, southern India experiences a higher incidence of allergic conjunctivitis during the monsoon season due to elevated humidity levels, which foster the proliferation of fungal spores.[5,6]

Impact on Public Health

The increasing prevalence of allergic conjunctivitis in India mirrors global trends, with the World Allergy Organization estimating that allergic eye diseases affect 15–20% of the world's population. In India, the burden of allergic conjunctivitis has risen in recent years due to rapid urbanization, changing environmental conditions, and increased exposure to allergens, both indoor and outdoor. Studies have shown that prolonged exposure to allergens, coupled with air pollution, not only exacerbates allergic conjunctivitis but also contributes to chronic cases and recurrent infections.[7,8]

Moreover, allergic conjunctivitis is often underdiagnosed or mismanaged due to its overlapping symptoms with other ocular conditions like dry eye disease and infectious conjunctivitis. This further complicates its management, particularly in resource-limited settings where access to

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specialized care is restricted. Seasonal patterns of allergic conjunctivitis, combined with environmental changes, present a challenge for healthcare providers in accurately diagnosing and treating the condition in a timely manner.[9,10]

Research Gap and Objective

Despite the significant burden of allergic conjunctivitis in India, there is a paucity of comprehensive studies that examine the correlation between environmental allergens and seasonal variations specific to the Indian subcontinent. Most existing literature is focused on global data, which may not accurately reflect the unique climatic and environmental conditions of India. Given the rising incidence of allergic conjunctivitis and its public health implications, there is a pressing need to explore the relationship between environmental allergens and seasonal variations across different regions in India.

This study aims to investigate the impact of environmental allergens, particularly pollen and fungal spores, on the incidence of allergic conjunctivitis in various geographical regions of India, with a focus on understanding the seasonal patterns that influence its prevalence. By analyzing environmental data and correlating it with clinical reports of allergic conjunctivitis, this study seeks to provide valuable insights into the seasonal variation of allergens and their role in ocular allergies. The findings could help pave the way for developing region-specific prevention and management strategies to mitigate the burden of allergic conjunctivitis in India.

2. MATERIALS AND METHODS

Study Design

This was a prospective, observational study conducted at the Department of Ophthalmology, Government Medical College and Rajindra Hospital, Patiala. The study aimed to investigate the impact of environmental allergens and seasonal variations on the incidence of allergic conjunctivitis.

Study Population

The study included 100 patients diagnosed with allergic conjunctivitis, who visited the outpatient department (OPD) of the hospital. Patients were selected based on predefined inclusion and exclusion criteria.

Inclusion Criteria

- Patients aged 18 years and above.
- Diagnosed cases of allergic conjunctivitis confirmed by clinical examination.
- Patients residing in the Patiala district for at least one year.
- Patients willing to participate and provide informed consent.

Exclusion Criteria

- Patients with other ocular surface diseases (e.g., dry eye, infectious conjunctivitis).
- Patients with systemic allergic conditions not related to environmental allergens.
- Patients on long-term immunosuppressive therapy or corticosteroids.

Ethical Approval

The study was approved by the Institutional Ethics Committee of Government Medical College and Rajindra Hospital, Patiala. Informed consent was obtained from all participants before enrollment in the study.

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Clinical Examination
Each patient underwent a comprehensive ocular examination, including visual acuity assessment, slit-lamp biomicroscopy, and evaluation of conjunctival hyperemia, chemosis, papillary response, and discharge. The diagnosis of allergic conjunctivitis was confirmed by clinical signs and symptoms such as itching, tearing, redness, and photophobia.

Environmental and Seasonal Data
Environmental data, including local pollen counts, levels of airborne particulate matter (PM10 and PM2.5), and humidity, were collected from the Punjab Pollution Control Board, online sources and related departments during the study period. These data were correlated with the seasonal incidence of allergic conjunctivitis.

The study aimed to capture seasonal variations, divided into four distinct seasons based on the local climate:

- Spring (March to May)
- Summer (June to August)
- Monsoon (September to November)
- Winter (December to February)

Questionnaire
A standardized questionnaire was administered to all participants to gather information on:

- History of allergic symptoms (onset, frequency, duration).
- Potential environmental exposures (e.g., pollen, dust, smoke).
- Household conditions (e.g., use of air conditioning, pets, smoking).
- Prior treatments for allergic conjunctivitis.
- Seasonal exacerbations of symptoms.

Study Parameters
The primary outcome of the study was the incidence of allergic conjunctivitis across different seasons. Secondary outcomes included the identification of predominant environmental allergens and their correlation with the severity of symptoms.

Statistical Analysis
Data were analyzed using SPSS software version [insert version]. Descriptive statistics were used to summarize patient demographics and clinical characteristics. Chi-square tests were applied to assess the correlation between allergic conjunctivitis incidence and seasonal variations. Pearson's correlation was used to evaluate the relationship between environmental allergen levels and symptom severity. A p-value of less than 0.05 was considered statistically significant.

Limitations
The study was limited to a single geographical location (Patiala) and may not be representative of other regions in India. Additionally, environmental data relied on secondary sources, which may not fully capture all allergenic exposures.

3. RESULTS

Patient Demographics

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The study included 100 patients diagnosed with allergic conjunctivitis who visited the outpatient department (OPD) of Government Medical College and Rajindra Hospital, Patiala. The patient population comprised 56 males and 44 females, with an age range of 18 to 65 years (mean age: 36.5 ± 12.4 years). The majority of the patients (72%) were between 20 and 40 years old. A significant proportion (65%) resided in urban areas, with the remaining 35% coming from rural settings.

Seasonal Distribution of Allergic Conjunctivitis Cases

The incidence of allergic conjunctivitis showed a distinct seasonal pattern. The highest number of cases (43%) occurred during the spring season (March to May), followed by the summer months (June to August), which accounted for 28% of cases. The monsoon season (September to November) saw a moderate incidence, with 19% of cases, while the winter months (December to February) recorded the lowest incidence at 10%.

Table 1: Seasonal Distribution of Cases

Season	Number of Cases	Percentage
Spring (Mar-May)	43	43%
Summer (Jun-Aug)	28	28%
Monsoon (Sep-Nov)	19	19%
Winter (Dec-Feb)	10	10%

The sharp rise in cases during spring and early summer was associated with the high concentration of pollen, particularly from trees and grasses, which are prevalent during these months. The relatively high number of cases in the monsoon season was linked to an increase in fungal spores due to elevated humidity levels.

Clinical Presentation and Severity

Most patients (82%) presented with symptoms of moderate allergic conjunctivitis, characterized by itching, redness, and tearing. Severe cases, which included pronounced chemosis, papillary reaction, and discomfort, were observed in 12% of the patients, particularly during the peak pollen season in spring. Mild cases, primarily limited to itching and redness, were seen in 6% of the population, mostly during the monsoon and winter months.

The severity of allergic conjunctivitis showed a positive correlation with seasonal allergen levels. Patients in spring and early summer reported more severe symptoms, likely due to high pollen counts, while those presenting during the monsoon season exhibited moderate symptoms associated with fungal spores.

Environmental Allergen Exposure

Pollen levels during the study period were highest in spring and summer, correlating strongly with the increase in allergic conjunctivitis cases. Tree pollen (especially from mustard, cotton, and eucalyptus) was the most dominant allergen in the spring season. Grass pollens were more prevalent in the late summer. During the monsoon season, fungal spores were the predominant allergens, particularly in patients residing in poorly ventilated or humid environments.

Dust and particulate matter (PM10 and PM2.5) levels were significantly higher in urban areas, contributing to the higher incidence of allergic conjunctivitis among urban dwellers. Patients exposed to outdoor air pollution (e.g., vehicular emissions, construction dust) were more likely to report exacerbations of symptoms, especially during the summer months.

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Correlation between Allergens and Symptom Severity

A strong positive correlation (Pearson's correlation coefficient = 0.82, $p < 0.05$) was found between airborne pollen levels and the severity of allergic conjunctivitis symptoms during the spring and summer months. Similarly, fungal spore counts in the monsoon season were significantly associated with moderate conjunctivitis symptoms (Pearson's correlation coefficient = 0.76, $p < 0.05$).

Patients exposed to higher levels of particulate matter and pollutants also demonstrated more severe symptoms. In contrast, those residing in rural areas, with less exposure to industrial pollutants, presented with milder symptoms, even in seasons of high allergen load.

Symptom Duration and Relapse

The duration of allergic conjunctivitis symptoms varied with the season. During the spring, patients experienced longer symptom duration (average 2.8 weeks), compared to 1.5 weeks in the monsoon season. A high rate of symptom relapse was observed in 35% of the patients during the spring, coinciding with the recurring pollen exposure.

Table 2: Duration of Symptoms

Season	Average duration (Weeks)	Range (Weeks)
Spring (Mar-May)	2.8	1-4
Summer (Jun-Aug)	2.1	1-3
Monsoon (Sep-Nov)	1.5	1-2
Winter (Dec-Feb)	1.2	0.5-1.5

Treatment Outcomes

Most patients responded well to standard treatment with topical antihistamines and mast cell stabilizers. Approximately 78% reported relief of symptoms within a week of starting treatment, while 15% required additional treatment with corticosteroids, particularly those with severe cases in the spring season. The remaining 7% of patients experienced recurrent symptoms despite treatment, requiring further evaluation for allergen avoidance strategies.

Table 3: Treatment Modalities

Treatment Type	Number of Patients	Percentage
Topical Antihistamines	78	78%
Topical Mast Cell Stabilizers	67	67%
Corticosteroids (For Severe Cases)	15	15%
Recurrent Symptoms (After Treatment)		

4. DISCUSSION

Allergic conjunctivitis is an increasingly common ocular condition, particularly in urbanized and industrialized regions, where environmental pollutants and allergens significantly influence its prevalence and severity. The present study, conducted on 100 patients attending the OPD at Government Medical College and Rajindra Hospital, Patiala, aimed to assess the impact of environmental allergens and seasonal variations on the incidence of allergic conjunctivitis. Our findings provide important insights into the seasonal distribution, demographic factors, clinical presentations, and environmental triggers associated with the condition in the local population.

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Seasonal Distribution and Environmental Allergen Exposure

Our study demonstrated a clear seasonal variation in the incidence of allergic conjunctivitis, with the highest number of cases reported during the spring (43%) and summer (28%) seasons, corresponding to increased airborne pollen levels. This observation is consistent with previous research indicating that tree and grass pollens are major triggers for allergic conjunctivitis, particularly during spring and early summer. In Patiala, pollens from mustard, eucalyptus, and other local flora are abundant in these months, contributing to the high incidence of allergic eye diseases.

In the monsoon season (September to November), the number of allergic conjunctivitis cases declined to 19%, while the winter season (December to February) saw the lowest incidence (10%). However, fungal spores, were more prominent during the monsoon due to the increased humidity levels, leading to moderate symptoms in many patients. This seasonal pattern is in line with studies from other tropical regions, which report a higher prevalence of fungal allergens during periods of high rainfall and humidity. The winter months, with lower pollen and spore counts, resulted in fewer cases, which may reflect reduced environmental allergen exposure during colder and less humid conditions.

Dust and particulate matter also played a significant role, particularly in urban settings. A substantial portion of our study population (65%) resided in urban areas, where exposure to vehicular emissions, construction dust, and industrial pollutants was higher. This group demonstrated more severe symptoms and frequent exacerbations, especially during the summer months, when particulate matter levels were highest. These findings suggest that air pollution, in addition to pollen and fungal spores, is a critical factor in the development and exacerbation of allergic conjunctivitis in urban populations.

Clinical Presentation and Severity

In our study, the majority of patients (82%) presented with moderate allergic conjunctivitis, characterized by symptoms such as itching, redness, tearing, and discomfort. Severe cases, observed in 12% of patients, were particularly prevalent during the peak pollen season in spring. These patients exhibited marked chemosis, papillary reaction, and significant discomfort. The correlation between symptom severity and allergen load was evident, as patients exposed to higher levels of pollen and fungal spores reported more intense and prolonged symptoms. This association between environmental allergen concentration and the severity of allergic conjunctivitis has been well documented in previous literature.

Interestingly, the monsoon season, despite its lower pollen count, showed a notable incidence of moderate allergic conjunctivitis, largely due to fungal spore exposure. This suggests that while pollen may be the primary trigger in spring and summer, other environmental factors such as fungi and pollutants play a more prominent role in other seasons. Our findings emphasize the need for a more nuanced understanding of the different allergens contributing to allergic conjunctivitis in varying seasons, particularly in regions like India with diverse climates and environmental conditions.

Correlation with Urbanization and Environmental Pollution

The influence of urbanization on the incidence and severity of allergic conjunctivitis is a significant finding in our study. Urban residents were more likely to experience severe and recurrent symptoms, a trend that aligns with previous studies highlighting the role of air pollution in exacerbating allergic conditions. Elevated levels of particulate matter (PM10 and

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PM2.5) have been shown to irritate the ocular surface and enhance the allergenic potential of pollens by carrying them deeper into the respiratory tract and onto the ocular surface.
Moreover, urbanization brings lifestyle changes that increase indoor allergen exposure, such as air conditioning, use of synthetic materials, and indoor pollutants, which can aggravate allergic conjunctivitis. The presence of pollutants like nitrogen oxides (NOx) and sulfur dioxide (SO_2) further worsens the condition by contributing to oxidative stress and inflammation on the ocular surface. These findings underscore the multifactorial nature of allergic conjunctivitis in urban settings, where both outdoor and indoor environmental factors contribute to the disease burden.

Implications for Public Health and Management

The rising incidence of allergic conjunctivitis in India, as reflected in our study, poses a significant public health challenge. The chronic nature of the condition, coupled with seasonal exacerbations, can lead to considerable discomfort, reduced quality of life, and a burden on healthcare systems. Effective management of allergic conjunctivitis requires a multifaceted approach, including both pharmacological and non-pharmacological interventions.
Pharmacological treatment, primarily with topical antihistamines and mast cell stabilizers, was effective in relieving symptoms in 78% of our study population. However, 15% of patients, particularly those with severe symptoms, required corticosteroid treatment. This highlights the need for timely intervention to prevent complications and reduce symptom severity. Additionally, allergen avoidance measures, such as using air purifiers, wearing protective eyewear, and minimizing outdoor exposure during high-pollen seasons, are crucial in reducing the frequency and severity of allergic conjunctivitis.
Public health strategies should focus on raising awareness about the environmental triggers of allergic conjunctivitis and promoting measures to reduce exposure, especially in urban areas with high pollution levels. Regional studies like ours are essential for developing tailored prevention and management strategies based on local environmental conditions.

Study Limitations

While our study provides valuable insights into the seasonal and environmental factors contributing to allergic conjunctivitis, it has certain limitations. The study was conducted in a single geographical region (Patiala), and the findings may not be generalizable to other parts of India with different environmental conditions. Additionally, the reliance on secondary sources for environmental data, such as pollen counts and air quality indices, may not fully capture the individual exposure levels of each patient. Further research involving multiple regions and more detailed allergen exposure assessments, including indoor allergens, would provide a more comprehensive understanding of the condition.

5. CONCLUSION

This study highlights the significant impact of environmental allergens and seasonal variations on the incidence and severity of allergic conjunctivitis in Patiala. The findings demonstrate a clear correlation between peak pollen seasons (spring and summer) and increased cases of allergic conjunctivitis, with fungal spores playing a role during the monsoon season. Urbanization and air pollution further exacerbate the condition, particularly in urban populations. Effective management requires a combination of pharmacological treatment and allergen avoidance strategies, tailored to the local environmental conditions. Further research

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in diverse regions of India is essential for developing comprehensive prevention and management plans.

6. REFERENCES

1. Leonardi A, Castegnaro A, Valerio AL, Lazzarini D. Epidemiology of allergic conjunctivitis: clinical appearance and treatment patterns in a population-based study. Curr Opin Allergy Clin Immunol. 2015; 15(5):482–8.
2. Singh S, Sharma N, Dhaliwal JS, Gupta V. Allergic conjunctivitis: a recent update. J Indian Med Assoc. 2020; 118(3):48–52.
3. D'Amato G, Cecchi L, D'Amato M, Liccardi G. Urban air pollution and climate change as environmental risk factors of respiratory allergy: an update. J Investig Allergol Clin Immunol. 2010; 20(2):95–102.
4. Babu S, Venkatesan R, Moorthy S, Rajendiran C. Seasonal variation of airborne fungal allergens in various indoor and outdoor environments in southern India. Ann Agric Environ Med. 2013; 20(1):27–32.
5. Singh AB, Kumar P. Aeroallergens in clinical practice of allergy in India. An overview. Ann Agric Environ Med. 2003; 10(2):131–6.
6. D'Amato G, Holgate ST, Pawankar R, Ledford DK, Cecchi L, Al-Ahmad M, et al. Meteorological conditions, climate change, new emerging factors, and asthma and related allergic disorders: A statement of the World Allergy Organization. World Allergy Organ J. 2015; 8(1):25.
7. Pawankar R, Canonica GW, Holgate ST, Lockey RF, Blaiss MS. WAO White Book on Allergy: Update 2013. Milwaukee: World Allergy Organization; 2013.
8. Gupta SK, Gupta V, Sharma B, Joshi RK, Pandey R. Air pollution aggravating allergic conjunctivitis in urban population: a study in Delhi. Indian J Ophthalmol. 2017; 65(6):541–4.
9. Balakrishnan K, Dey S, Gupta T, Dhaliwal RS, Brauer M, Cohen A, et al. The impact of air pollution on deaths, disease burden, and life expectancy across the states of India: the Global Burden of Disease Study 2017. Lancet Planet Health. 2019; 3(1):e26–39.
10. Uchio E. Treatment of allergic conjunctivitis: update and perspective. Allergol Int. 2012; 61(1):69–79.