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Aeropalynological study of prominent airborne pollen allergens in India: A review

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ABSTRACT

An allergic reaction brought by airborne biological allergens is a prerequisite for the beginning of atopic disease. Wind, rain, and active discharge mechanisms release biological allergens into the atmosphere. A number of aerobiological studies have been conducted in various regions of the world to determine the aerial concentration with pollen grain seasonality.Allergists can identify the suspected pollen type causing allergic reactions with the aid of their knowledge of the various pollen types at different times of the year. This review paper aims to assess the existing research on the prevalence and kinds of airborne allergens from various regions of India.Although pollen of specific families isseenthroughout the year in variousconcentrations specifically in variousmonths.This study will provide preceding but useful data to local allergologists for theproper identification and treatment of respiratory allergic diseases. Higher pollen loadsare seen at the location thatare surrounded by a lot of vegetation, indicating spatial variations. In India some important predominant pollen species reported are:*Prosopis juliflora, Morus,Alnus, Mallotus, Ricinus communis, Querecus, Cedrus, Argemone, Amaranthus, Chenopodium, Holoptelea, Brassica, Cannabis,Cocos, Parthenium, grasses and Cassia*.

Key Words: Allergens, Airborne pollen,Spatial variations.

INTRODUCTION

Aeroallergens are a significant factor during the development of respiratory allergic illnesses, especially asthma and rhinitis. The importance of pollen, fungi, animal danders, house dust mites, domestic animals, and insects as triggers cannot be emphasized. Pollen is one of the main bioparticles in air, among other aerobiological elements. Respiratory allergens are one way it has an impact on people's health (Roubelat et al., 2020). A major trigger of allergic rhinitis and bronchial asthma, pollen grains are among the oldest known aeroallergens. A vital disorder that affects an increasing number of people is allergic rhinitis which is seasonal. The most prevalent aeroallergens are typically pollen from weeds, trees, and grasses.

Anemophile plants account for nearly 98% of all pollen grains in the environment, while entomophile plants account for 2% (Molina et al., 2001). They are responsible for causing hypersensitivity in those who are susceptible, which is linked to diseases like atopic dermatitis, bronchial asthma, allergic rhinitis, and hypersensitivity pneumonitis. By being aware of seasonal variations in airborne pollen species, allergists can manage patients with a number of hypersensitive allergy illnesses by identifying the pollen allergens of a specific time in the atmosphere (Albaradie et al., 2013). Additionally, this aids in the planning of recreational or occupational travel for those who suffer from pollinosis (Subiz et al., 2001). The first person to think that pollen might be the result of allergy rhinitis (Tong et al., 2023) (Hay fever). In the UK, grass pollen was the main cause of hay fever (Blakeley et al., 1873). United States laidanemphasis on using airborne surveys to monitor atmospheric aeroallergens(Kola et al., 2019). Since then, numerous studies have been conducted at various locations around worldwide, and pollen is now recognised as the main contributor to respiratory allergy (Green et al., 2004).

Pollen grains are currently being investigated as COVID 19-infected bioaerosols, according to recent studies (Ravindra and Damialis, 2021). Nearly 20–30% of the world's population is thought to experience allergic disorders. Pollen grains, also referred to as aeroallergens, are well-known to cause pollinosis and are well-established as such from every continent(Singh et al., 2012). 10% to 30% of people have allergic diseases and 50% of those people are also sensitive to certain proteins found in pollen (Xiao et al., 2013). over the last few decades, respiratory allergies have become more prevalent around the world. 40 years ago, a Delhi survey found that 1% of the population growth suffered from asthma

(Kumar & Prasad, 2019). However, in 1998,a study revealed that nearly 20–30% of the populationdensity has allergic rhinitis and of this group, nearly 15% develop asthma (Sarma & Sarmah, 2022). A thorough study of atmospheric pollen load is necessary given the increasing prevalence of respiratory disorders because it can be used to identify a region's main allergens. Additionally, the collected data can be organised into pollen calendars, which greatly aids medical professionals in the identification and treatment of allergic diseases. Allergens in one species of pollen might interact with allergens in another species of pollen or in foods. There have also been reports of food allergies related to pollen. With specific reference to pollen allergy in India, we have attempted to briefly review these aspects (Singh and Kumar, 2004). With respect to environmental factors like climate, pollution, and exposure level, different pollen allergens play various roles. The investigation of variations in the seasonal and diurnal prevalence becomes crucial due to climatic change (D'Amato et al., 2002). For an accurate diagnosis and approach of treatment of pollen allergy, one must be aware of the seasonal, diurnal and annual variations in airborne pollen allergens in any given geographic region.

Due to widespread urbanisation and industrialization, the flora is constantly changing, making continuous monitoring of the qualitative and quantitative composition of airborne pollen allergens of the utmost significance. Regarding the quantitative and qualitative prevalence of pollen allergens in the atmosphere, there is lots of information from various parts of India, but little data is accessible from Haryana.

POLLEN ALLERGENS IN VARIOUS PARTS OF THE INDIA

According to flowering seasons and climatic conditions, which are fairly changeable not only in different sections of the country but also in various parts of the world, airborne pollen and its concentration vary throughout the seasons. In Calcutta 1873, Cunningham began the first atmospheric survey in India (Cunningham et al., 1873). Since then, several investigations on the varieties of airborne pollen allergens and their concentration have been conducted throughout India by researchers. Singh and his colleagues were successful in completing a "All India Coordinated Project on Aeroallergens and Human Health" financed by the Ministry of Environment and Forests, Government of India (AICP, 2000). The most significant airbornepollen and fungal allergen from 18 distinct locations have been located, measured, and described for their allergenic characteristics. The most current and scientific knowledge on aeroallergens in India is provided by this. A review on the role of aerobiology in the diagnosis and treatment of allergies and asthma was published by (Singh and Chandni, 2012).

Northern India

Jammu and Kashmir, Himachal Pradesh, Punjab, Haryana,Rajasthan, Delhi, and Chandigarh are all included in the northern region. Surveys have been carried out in Delhi by (Malik et al., 1981). *Grass, Cheno/amaranth,Ricinus, Morus, Xanthium Ailanthus,Artemisia*, *Cannabis* and *Holoptelea* are the most prevalent pollen types identified. From the atmosphere of Lucknow, Lakhanpal and Nair found 30 different pollen kinds (Lakhanpal et al., 1958). Later, significant plants that cause allergies to pollen were discovered in Delhi, including*Anogeissus pendula, Amaranthus, Ageratum Artemisia, Ailanthus, Cenchrus, Cassia siamea,Cynodonand Chenopodium. Pinus roxburghii* from the foothills of the Himalayas was shown to cause strongallergic skin reactions in 16.9% of patients when*Paspalum distichum,Poa annua and Ipomoea fistulosa* were used (Singh et al., 1987). 180 people in Bikaner with nasobronchial allergies were exposed to *Prosopis Julifera* pollen. Of them, 54 had allergic rhinitis, 32 had bronchial asthma and 94 had both. A significant allergic component of *Amaranthus spinosus* pollen was purified and only partially characterised by (Chaudhry et al., 1990) from Bikaner. Figure1.

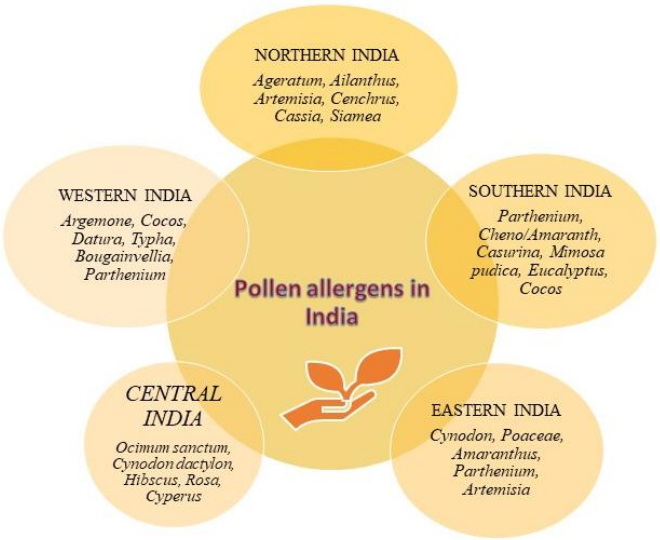

Figure1: Pollen allergens in India

94 pollen types were identified in an aerobiological survey conducted in Delhi with the main producers being Cannabis, *Morus, Chenopod/Amaranth,Artemisia, Prosopis* and *Eucalyptus* (Singh et al., 2003). Following years saw a noticeably lower pollen concentration. Pollen from *Cannabis, Morus, Prosopis, Prosopis* and *Artemisia* were all considerably less abundant.

It has been claimed that the major removal of the vegetation for the construction of roads, flyovers, metros, and industrial complexes between 1990 and 1997 in Delhi may have resulted in a decrease in pollen counts.

A total of 31 different pollen types were detected in Rohtak, Haryana, during an atmospheric assessment of pollen concentration from July 2007 to June 2009. The major contributor to the pollen load was *Cannabis sativa* (28.9%) followed by Poaceae (20.65%), Amranthaceae,Chenopodiaceae(10.56%), *Morus alba* (6.15%), *Parthenium hysterophorus* (6.80%),*Cyperus sp*. (3.20%), *Artemisia sp*. (4.03%)and *Eucalyptus sp*. (3.07%) and other two major pollen seasons were recognised i.e., March-April and July- October (Ahlawat et al., 2013).

In Punjab, an aerobiological survey was conducted between 2012 and 2014. During this time, 30 distinct pollen types from 17 different families were identified. Thirteen distinct pollen species were evaluated for their ability to cause allergic reactions. Meliaceae, Amaranthaceae, Xanthorrhoeaceae, Cannabaceae, Brassicaceae, Myrtaceae, Chenopodiaceae, Poaceae, Moraceaeand Asteraceae are the ten families to which the allergic pollens belong. The Moraceae, Asteraceae and Myrtaceae families of plants are responsible for the majority of the pollen types that were observed during the current investigation (Singh et al., 1992). Burkard's 24-hour spore trap technique was used for aerobiological sampling at Jaipur in 2011 and 2012, and the findings revealed that the pollen count showed two seasonal peaks in March-April and from August to October (Singh et al., 2017).

In 2022, recent study in Chandigarh has been revealed that meteorological parameters and air pollutants also affects the pollen grains situated in the Indo- Gangetic plains (Ravindra et al.,2022). Due to climatic changes, pollen and air pollutants increasing the allergic diseases. Wind and Temperature were the most affecting parameters to pollen grains present in atmosphere. Annual pollen integral of Poaceae,*Parthenium hysterophorous, Cannabis sativa*is positively correlated with temperature and negatively correlated with relative humidity forPoaceae and *Eucalyptus sp*.

Western India

Gujarat, Maharashtra and Goa are all part of westernIndia. *Ricinus, Cicer, Holoptelea, Cocos nucifera, Amaranth, communis, Argemone and Hibiscus* were the most prevalent pollen types, according to aerobiological surveys conducted in Mumbai, Pune, and Kolhapur (Deshpandey and Chitaley, 1976). *Parthenium* was discovered to be the biggest contributor to pollen load at Pune, with two peak seasons from January to April and September to November, whereas *Cassia* and*Cocos* were seen all year long. High concentrations of *Cocos* pollen were noted in April through May and November through December (AICP, 2000).

From August to October, *Datura alba* had an 8.2% annual concentration at Aurangabad. From June to August, *Cleome* contributed 6.8% of the pollen, with *Typha, Alternanthera, Bougainvellia*, and other plants also making significant contributions. The most common allergens in Gujarat responsible for nasobranchial allergies were *Cassia siamea* (29.17%), *Ricinus communis* (25%) and *Morus alba* (25%) (Patel and Choudhary, 2012).

35 different varieties of pollen grains were discovered in the dry and semi-arid region of Bikaner, Rajasthan. In 2001 using the Burkard 7-day volumetric sampler, with concentration of 26.2%, Poaceae came out on top in the study, followed by *Amaranthus,*Cyperaceae, *Chenopodium,* Asteraceae, and Papilionaceae. The total pollen load peaked in March (16.70%) and peaked at its lowest in June (2.5%), according to research (Arora and Jain, 2001). A Burkard 7-day volumetric sampler was used to conduct sampling in 2004–2005 at Miramar Beach in Panaji, the capital of Goa, a well-liked tourist destination where Poaceae species accounted for 85% of the total pollen catch (Prabhudesai et al., 2006).

Peltophorum, Amaranthus,Cynodon,Tridax and *Cassia* all made major contributions. Amravati in the state of Maharashtra showed 41 species by the gravity slide method sampling at three sites during the 2004–2006 period. The plant *Parthenium hysterophorus* had the highest score (41-46%) out of all those that are seen in the air on a seasonal and cyclical basis (Tidke et al., 2013). The second most common group of pollen was Poaceae. For type-1 hypersensitivity reactions in sensitive people, *Parthenium* is well-known. Figure 2.

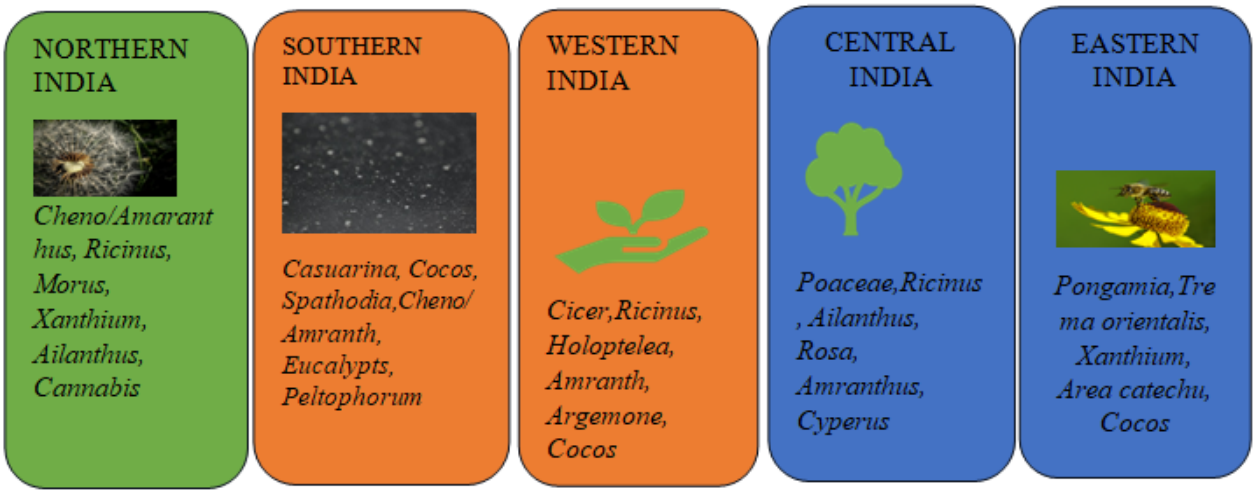

Figure 2: Pollen allergens in India

Southern India

Along with the union territory of Puducherry, it consists of the states of Andhra Pradesh, Kerala, Karnataka, TamilNadu. *Parthenium, Casuarina, Cocos, Spathodia,Cheno/Amaranth,* Poaceae,*Eucalyptus, Peltophorum*and Cyperaceae were found to be the most prevalent pollen types according to studies from Southern India (Singh et al., 2013). Aerobiological surveys conducted at Visakhapatnam, Bangalore, Kodaikanal, Trivandrum and Chennai found that the major prevalent pollen types were *Parthenium, Cheno/Amaranth,Casurina, Spathodia, Cocos and Eucalyptus sp.* However, 24 pollen types were found in Visakhapatnam with Poaceae, *Cocos, Casuarina, Peltophorum, Cyperaceae* and *Eucalyptus sp*. being the most prevalent types (Satheesh et al., 1992). Thiruvananthapuram, the capital of Kerala, India, conducted a qualitative and quantitative analysis of airborne fungal spores and pollen grains in four working locations (market, poultry, saw mill and cow sheds) during a two-year period. A total of 32 airborne pollen types from the outdoors were recorded. The prevalent and predominate pollen types found at all the sites were Poaceae, *Artocarpus, Cocos, Chenopodium* and *Tridax*(Nayer and Jothish, 2013). A total of 28 pollen types, of which 7 were present all year long were detected from the Bangalore city during the one-year period from January 2011 to December 2011. These belonged to the Poaceae family and included *Mimosa pudica, Eucalyptus sp., Tridax sp.,Cocos nucifera,Parthenium hysterophorus*and *Croton sparsiflorus. Parthenium hysterophorus*(23.87%) had the most pollen, followed by Poaceae (16.19%), *Delonix regia* (8.77%), *Mimosa Pudica* (11.31%) and various *Eucalyptus species* (7.58%) (Roopshre et al., 2014). In Chennai, 38 pollen regions from 24 genera were found. Poaceae pollen was the most prevalent and made up 19.4% of the overall pollen load from June to August. The month of August saw the highest concentration of *Acalypha* pollen, whereas the months of January and March observed the highest concentration of *Casuarina* pollen (AICP, 2000). Important South Indian aeroallergens include *Salvadora, Ageratum, Cassia, Ricinus, Albizia lebbeck, Artemisia scoparia*. According to (Arya et al., 2022), 34% of patients with allergic rhinitis and 12% of those with bronchial asthma from Bangalore had strong skin sensitivity to *Parthenium hysterophorus* pollen extracts (Agashe &Soucenadin, 1992).

Table1: Different Pollen allergens

Sr no.	Pollen types	Sites	References
1.	*Cannabis sativa* *Cassia sp.* *Cheno/Amaranth* *Azardirachta sp.* *Eucalyptus* *Mangifera indica* *Parthenium hysterophorous*	Northern India	Ahlawat et al., 2013
2.	*Cicer, Ricinus communis, Holoptelea, Amaranth, Argemone, Cocos, Hibiscus, Parthenium, Datura*	Western India	Gill et al., 2017
3.	*Casuarina, Cocos, Spathodia, Cheno/ Amaranth, Eucalyptus, Pletophorum, Parthenium, Mimosa pudica*	Southern India	Singh et al., 2022
4.	Poaceae,*Ricinus, Ailanthus, Rosa, Amaranthus, Cyperus, Ocimum*	Central India	Verma et al., 2014

	sanctum, Cynadon dactylon		
5.	*Pongamia, Trema orientalis, Xanthium, Area catechu,Cocos, Cynadon, Amaranthus, Parthenium, Artemisia*	Eastern India	Mahesh et al., 2023

Central India

Poaceae, Apocynaceae, Asteraceae, *Ricinus, Amaranth,Holoptelea, Ailanthus, Rosa, Cyperus, Cicer, Argemone,Cocos nucifera and Hibiscus* were identified as the major types of pollen in a survey from Central India (Singh et al., 2017). A total of 40 native and foreign pollen species were discovered during aninvestigation of the pollen flora in the atmosphere of Chhattisgarh, Korba, conducted between March 2007 and February 2008. *Parthenium hysterophorus* (8.43%) and *Cassia siamea* (4.98%) produced the highest proportion of the overall pollen catch, whereas *Cynodon dactylon* (9.42%) and *Ocimum sanctum* (7.13%) dominated the pollen flora (Shukla and Shukla, 2012). An aerobiological study from the city of Agra was completed with specific attention to the allergic relevance of pollens and 35 species of airborne pollen from 23 angiosperm families have been found. Asteraceae (5222/m^3) had the highest pollen concentration in the air and *Parthenium hysterophorus* made up the largest percentage of the total air spora (17.91%) (Chauhan and Goyal, 2006).

Eastern India

States like West Bengal, Bihar, Jharkhand, Odisha and the Andaman & Nicobar Islands are included. There were 59 different pollen types found according to a West Bengal aerobiological survey, in the air with *Pongamia, Trema orientalis, Xanthium, Areca catechu, Cocos,*Asteraceae and Chenopodiaceae being the most prevalent. According to studies conducted at Gauhati, the most common pollen types were *Amaranth, Mangifera,Putranjiva,* Poaceae, *Eucalyptus spp*and Asteraceae (Singh et al., 2017). *Acer, Betula, Alnus nepalensis, Eucalyptus,Bucklandiapopulneaand Pinus* were the predominant tree pollen types from the Eastern Himalayas that were observed (Singh and Devi, 1992). From 2004 to 2006, an aeropalynological survey of Calcutta's atmosphere was conducted.*Trema* (19%), Poaceae (12.98%), *Cocos* (5.7%), *Casuarina* (5.76%), *Azadirachta* (4.65%), *Peltophorum* (3.71%), Cyperaceae (3.68%), *Delonix* (3.18%) and *Areca* (2.56%) were the dominant pollen types (Mandal et al., 2008). In Eastern India, a further investigation was conducted to determine out the dominant air borne pollen grains causes allergies in tropics including India. In different families like Poaceae, Asteraceae allergenic cross reactivity has been reported (Chowdhury et al., 1998). Some species cause diseases showed maximum percentage in eastern India such as *Borassus flabellier* (38.5%), *Cocos nucifera* (45.7%) and*Phoenix sylvestris* (42.85%).

In 1873, first atmospheric study was carried out in Calcutta, to investigate about airborne pollen types and their concentration causes allergic disorders like allergic rhnitis, bronchial asthma, atopic dermatitis in more than 30% of population (Singh et al., 2014). Some common pollen types are *Cynodon,* Poaceae, *Amaranthus,Parthenium, Artemisia.* In Calcutta, the research was conducted to find out the frequencies of airborne pollen grains and leading taxa spreading highly allergic disorders (Mandal et al.,2008). Some of the dominant pollen grains in Calcutta accounted for Trema (19%), Poaceae (12.98%),*Cocos* (5.7%), *Casuarina* (5.76%), *Azadirachta*(4.65%), Cyperaceae (3.68%). In Berhampore town, part of West Bengal, a study was conducted to determine the airborne pollen grains allergising potential. Poaceae (grasses) and Cyperaceae, *Cassia sp*. etc showed maximum pollen frequency (Boral et al.,2000). This study has also revealed the pollen concentration which is inversely connected with humidity and rainfall and favourably correlated with temperature. In India, on Carcia Papaya L. Which is wildly grown in tropics and subtropics, a study was conducted to investigate about pollen grain of Carica Papaya L. has been described as being airborne and causing IgE-mediated hypersensitivity. Pollen from Carica papaya L. reached its peak in January and from September to October (Chakraborty et al., 2005).

DISCUSSION

A study on aeropalynology led to the identification of 31 different pollen varieties. All eightof the main pollen types examined are known to be aeroallergens from various regions of India. (Mandal et al., 2008). The pollen from herbaceous plants predominated in the current research. Also reporting the predominance of these types of pollen in India from various geographical areas (Chaurasia et al., 2008). In different parts of the country, Aerobiological survey has been executed to find out the seasonality and concentration of pollen grains during last fifty years (Singh et al., 2008). According to “Aeroallergens and Human Health” has revealed the presence of aerosols at different locations. Peak season were March-May and August-October.The local flora's flowering season and air pollen were both present in all of the surveys. Due to this, aerospora of any area is a representation of the surrounding vegetation that exhibits annual variations as an outcome of shifting biotic and abiotic variables in succeeding years (Kalkar and Patil, 1994). The investigations concentrated on regularly updating the pollen calendars in each geographical location because this provides information about any seasonal changes in pollen counts, the entrance of new types of pollen and the removal of current pollen types from the atmosphere (Agasheet al., 1999).The studies concentrated on the increased airborne anemophilous pollen concentration.Anemophilous pollen travels farther because it is buoyant, smooth, light, and non-

sticky. These taxa also produce more pollen overall and they are the main source of inhalant pollen allergens (Singh and Malik, 1992; Singh and Kumar, 2002).

Different sampling devices were used by various workers. Studies show that for gatheringsamples of particles smaller than 10um, the Burkard spore trap is the most often used effective air sampling instrument (Frenz et al., 1999). It is a volumetric pollen and spore trap with a continuous flow and time discrimination of the collected particles (Portnoy et al., 2000). Effectively capturing the pollen from the air,it also depends on the location and height of the sampling equipment. The location of the samplers had been suggested by (Ogden et al., 1974).

The degree of pollen allergenicity varies between locations and influenced by a numberof variables, including pollution levels (Knox et al., 1997), the rural or urban environment (Bosch-Cano et al., 2011), particle sizes (Agarwal et al., 1984), and genetic and environmental factors (Ahlholm et al., 1998). According to (Card et al., 2007), pollen serves as a medium for the transmission of a number of infections, making the aeropalynological studies crucial.

Using the Burkard 24 h spore trap system, a form of suction sampler, aerobiological sampling was carried out in Jaipur (Singh et al., 2017). Airborne pollen was collected in Chandigarh from 2018 to 2020 at three distinct places using a Burkard volumetric sampler, and they were examined using a Leica DM5500B-Automated Upright Microscope System (Ravindra et al., 2023). Using a Burkard volumetric-spore sampler, a qualitative and quantitative assessment of airborne pollen in Chandigarh was carried out from 2018 to 2020 (Ravindra et al., 2021). The understanding of the aerospora, distribution and their deposition in a specific area is also made possible by pollen and spores from natural pollen traps such spider webs (Bera et al., 2002).Pollen can spread a variety of bacteria, viruses and fungi (Bhat and Rao, 2020). The likelihood of a relationship between the pollen bioaerosols, COVID-19, meteorological parameters and expected risk in the severity of allergic rhinitis and asthma was investigated by a study team from PGIMER and Punjab University, Chandigarh, India (Ravindra et al., 2021). Greater levels of airborne pollen were linked by (Schaefer et al., 2021) to greater SARS-CoV-2 infection rates. Such results highlighted the significance of aerobiological results as a requirement in allergy evaluation investigations.

CONCLUSION

The most prevalent chronic disorders globally are allergic diseases. Ailments related to allergies impact the socioeconomic more than 300 million people's standard of living people worldwide today. One of main culprits is pollen grain. To determine aerial pollen seasonality and concentration, numerous aerobiological surveys have been carried out in various areas of the globe. Knowing details of the pollen load and pollen season in the atmosphere is crucial, particularly from a therapeutic aspect. Higher plants occasionally bloom during every season, but the precise flowering period can vary from one year to the next and depending on the location. The novelty of the present research is that it shows the initial findings of airborne pollen monitoring carried out in India. Still, not all possible pollen allergens have been recognised. Since allergen avoidance is the preferred method for treating asthma and pollen allergiesin particular, it is necessary to identify all potential allergens both biochemically and molecularly. There are significant concerns that need to be thoroughly researched, such as how allergens relate to the cause of respiratory allergies and the rise in prevalence. There is a need for further research on the genetic components of pollen allergy. In order to establish a chronological relationship between seasonal allergy symptoms and the amount of pollen in the air, doctors and allergic patients might benefit greatly from pollen calendars. The peak times for the different plant pollens must be noted on a pollen calendarthat causes allergy.

The pollen spectrum displayed seasonal variation with clearly marked peaks in autumn and spring. The majority of the pollen load was made up primarily of *C. sativa* and Poaceae, *Morus alba, Eucalyptus, Chenopodium/Amaranthus, Ricinus, Parthenium, Holoptelea, Cicer, Acassia and Cocos*. Among these the potential source of allergy is*Ricinus communis, Parthenium spp., Morus alba and Amaranthus*. Herbaceous plant pollen was more widespread. The data gathered will be helpful to clinicians in identifying the potential allergy risk seasons and managing respiratory allergies of local residents because any of the pollen types encountered during the research are known allergens of airborne pollen. To develop estimates of airborne pollen concentrations in the city, such studies should be conducted over a longer period of time with a greater number of sampling sites. A book on the pollen calendars of 12 distinct Indian states has been published by the Centre for Biochemical Technology Institute of Genomics and Integrative Biology (Council for Scientific and Industrial Research). This book provides information on the crucial pollen season for weeds, grasses and trees that are common in India.The current project is still ongoing in order to investigate long-term trends of seasonal and annual variations. In conclusion, it appears that the frequency of pollen and fungus allergens varies geographically. Since there is still a need to investigate the appealing relationship between prevalence and level of allergenicity in various regions. To identify distributed airborne pollen grains in India's diverse bio-zones, researchers should develop a project to create pollen calendars. Therefore, this study may aid allergologists in making the appropriate diagnosis and ultimately lead to an improvement in the quality of life for those living in the study area. The study's findings could be applied to public awareness campaigns regarding the risks pollen grains pose to people's health.

Conflict of interest: None

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