

Atmospheric pollen count in North Delhi region

Raj Kumar, Manoj Kumar, Kajal Robinson, Priyanka Shah, Indu Bisht, Nitesh Gupta

Department of Respiratory Allergy and Applied Immunology, National Centre of Respiratory Allergy Asthma and Immunology, Vallabhbhai Patel Chest Institute, University of Delhi, New Delhi, India

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Abstract

Introduction: Airborne pollen data varies from place to place due to floristic diversities in a geographical region. In Delhi, a variety of trees, weeds, and grasses produce a variety of pollens, and climatic conditions are also known to affect the pollen concentration. **Aim:** This study was designed to describe the prevalence of pollen in North Delhi region during the year 2013-2014. **Materials and Methods:** Atmospheric pollen was collected on daily bases by using Volumetric Burkard (UK) 24 h air sampler with the speed of 10 L/min airflow. Pollen was counted with light microscopy (Olympus, Japan) and the average monthly pollen count was studied from May, 2013 to April 2014. **Results:** A total of 42,232 pollens were collected for 1-year (2013-2014). The maximum and minimum pollen was counted for year 2013 in the month of September (4805 pollens) and December, (1973 pollens), respectively. The average pollen concentration started increasing in the year 2013 from the months of May to June (239.33, 279.38 pollen/m³/month) and started falling in 2013 in months of July to August (227.47, 148.60 pollen/m³/month). The pollen concentration again started increasing in year 2013 in the months of September, October and November (282.65, 275.73, and 245.44 pollen/m³/months) and started declining in December 2013 till the months of next year 2014 January, February, (131.53, 133.82, 139.56 pollen/m³/months). An increase in pollen concentration was noted in 2014 in the months of March and April (274.31, 263.75 pollen/m³/month). The humidity correlated significantly with the average pollen count in the year 2013 in June ($P = 0.025$, $r = -0.556$), July ($P = 0.00$, $r = -0.848$), August ($P = 0.033$, $r = -0.552$), September ($P = 0.007$, $r = -0.627$) and October ($P = 0.001$, $r = -0.755$). The average temperature correlated significantly with the average pollen count in 2013 October ($P = 0.042$, $r = -0.530$). **Conclusion:** The current study provides a preliminary data of pollen count in North Delhi region. The results will provide information to the allergy practitioners in order to advise avoidance of exposure to allergens.

Keywords: Humidity, pollen concentration, temperature

Introduction

Aerobiological survey is the study of pollen in the atmosphere and other bio particles. [1] The environmental air is never completely free from the incidence of microbial propagules, which are collectively termed as air spora. The concentration and composition of atmospheric pollen flora depends upon the local vegetation, climate, and geographic location. Allergic diseases such as bronchial asthma, allergic rhinitis, and atopic dermatitis are dramatically increasing all over the world including developing countries like India. Today, more than 30% of the population is known to suffer from one or other allergic ailment. Major causative agents implicated are pollen grains, fungal spores, dust mites, insect debris, animal epithelia, etc. Several aerobiological studies have been conducted in different parts of the country to ascertain aerial concentration and seasonality of pollen grains and fungi. In 1992, an "All India Coordinated Project on Aeroallergens and Human Health" was undertaken to discover the quantitative and qualitative prevalence of aerosols at different centers in the country. [2]

Many studies have examined daily asthma admissions or emergency room visits in relation to short-term fluctuations in air pollutants level. [3] Few studies have investigated the relationship between asthma attacks and aeroallergen levels on a daily basis. Other studies have found that grass pollen counts were significantly associated with asthma morbidity, which increased on wet and stormy days. [4] Rainfall and

thunderstorms have been suggested to be important effect modifiers in the relationship between grass and asthma morbidity. In addition, in the wet season the highest values of grass pollen were predicted to increase asthma admissions. [5],[6],[7]

In Delhi, several atmospheric surveys for airborne pollen have been carried out for qualitative and in some cases, quantitative variations over the last three decades. Dua and Shivpuri in 1962, Nair in 1963, Singh and Shivpuri in 1971, Singh et al. in 1980, 1981, 2003, Malik et al. in 1991 have surveyed airborne in various parts of India. [8],[9],[10],[11],[12],[13],[14] After 1999, we could not trace any study in the Delhi region hence this study has been conducted to compare with the previous studies. Weather condition such as rainfall, humidity etc., plays an important role for the pollen concentration. The pollen count varies with the weather condition.

The goal of the present study was to determine the correlation between the pollen count variations with the weather conditions.

Materials and methods

The study of airborne pollen concentrations in Delhi was carried out from May 2013 to April 2014. The samples were collected on daily bases by using 24 h Volumetric Burkard Air Sampler (UK). For collection of pollen sample, pollen station was set up at the roof of the multistoried building (up to 20 m height) of Vallabhbhai Patel Chest Institute, located in University of Delhi (North Campus), New Delhi. Temperatures in Delhi range from -2.2 - 48.5°C (28 - 119.3°F). The annual mean temperature is 25°C (77°F); monthly mean temperatures range from 13°C to 32°C (55 - 90°F). The average annual rainfall is approximately 714 mm (28.1 in), most of which falls during the monsoon in July and August, the average date of the advent of monsoon winds in Delhi is 29 June.

Preparation of the 24 h Sampler's

The Burkard 24 h Lid Assembly using standard 3 inch $\times$ 1 cm microscope slide cleaned with a dry tissue paper and then the slide coated with a thin and uniform layer of petroleum jelly with the help of a painting brush. The slide was placed on the clock assembly by marking to show the start of the trace. Hold the wind vane with one hand, unlocked the revolving part of the trap, and climb down before releasing the wind vane. The slide carriage will move clockwise in an upward direction at 2 mm/h and putted back into the trap with secured locking bar. The sampler was started by connecting it with the power supply (12V) and left for 1-day recording [Figure 1].

Figure 1: Volumetric Burkard Air Sampler (UK)

After 24 h recording, the slide was removed from the sampler trap and stained the sample present on the slide with the glycerine jelly [Figure 2]. The slide was protected with a coverslip and examines it under a light microscope.

Figure 2: Slide containing sample band

Statistical analysis

Pearson correlation test was performed to find a correlation between pollen concentrations with humidity (%) and temperature ($^{\circ}\text{C}$) for 1-year data. In the study, the correlation was statistically significant. The significant correlation and their P values are analyzed by using SPSS version 16.0 statistical software (SPSS Inc. Released 2007. SPSS for Windows, Version 16.0. Chicago, SPSS Inc).

Results

A total of 193 days Bukhard sampler run out of the annual catch of 42232 pollen/m³ recorded during May 2013 to April 2014 period [Graph 1 [Additional file 1]].

Monthly pollen concentration showed variation during different months of the year [Graph 2 [Additional file 2]]. The maximum pollen concentration was observed in the month of September (4805 pollens) and minimum in the months of December (1973 pollens). The average pollen concentration start increasing from the month of May, June (239.33, 279.38 pollen/m³ /month) due to rise in the speed of the wind, which helped in distributing the pollen grain. As the humidity increases more pollen was collected [Graph 3 [Additional file 3]] and [Graph 4 [Additional file 4]]. The pollen count start declining from the month of July, followed by August (227.47, 148.60 pollens/m³ /month), coincided with the maximum rainfall witnessed during the month, which removed the pollen from the atmosphere [Graph 5 [Additional file 5]] and [Graph 6 [Additional file 6]]. Similarly, the pollen concentration increasing again from the month of September, October, and November (282.65, 275.73, and 245.44 pollens/m³ /month) [Graph 7 [Additional file 7]] and [Graph 8 [Additional file 8]] and again start declining from the month of December, January, and February, (131.53, 133.82, and 139.56 pollens/m³ /month), respectively [Graph 9 [Additional file 9]], [Graph 10 [Additional file 10]], [Graph 11 [Additional file 11]]. Similarly, pollen concentration start increasing (spring-early summer) again from the month of March and April (274.31 and 263.75 pollens/m³ /month), respectively [Graph 12 [Additional file 12]], [Graph 13 [Additional file 13]], [Graph 14 [Additional file 14]]. During the study period, the mean temperatures varied between 13.30°C in January 2014 and 33.06°C May 2013 [Table 1].

Table 1: Mean pollen count, temperature and humidity level variation between May 2013 to April 2014

The humidity correlated significantly with the average pollen count in the month of June ($P = 0.025$, $r = -0.556$), July ($P = 0.00$, $r = -0.848$), August ($P = 0.033$, $r = -0.552$), September ($P = 0.007$, $r = -0.627$), and October ($P = 0.001$, $r = -0.755$), respectively. Similarly, the average temperature correlated significantly with the average pollen count in the month of October ($P = 0.042$, $r = -0.530$).

Discussion

Studies on airborne allergenic pollen grains have been carried out time to time in several countries and also different states, cities of India. [9],[12],[13],[15],[16],[17],[18],[19],[20],[21]

In the aerobiological study of Hyderabad; Tando-Jam: Sindh, have recognized 27 pollen grain types in which grass pollen grain type was most abundant about 28% of the total pollen count. [22] As per Johnson and Marsh in 1965; [23] Freidhoff et al. in 1986; [24] Andersson and Jonas in 2003 studies over the world 40% allergic patients are sensitive to grass pollen allergy. [25]

Singh and Shivpuri, [10] Singh and Babu, [11] and Malik et al. [14] recorded in Delhi study the most dominant pollen types were grasses, Amaranth, Ailanthus, Ricinus, Morus, Xanthium, Cannabis, Artemisia, and Holoptelea. In Lucknow, 30 pollen types were reported by Lakhanpal and Nair, [26] whereas, in other study, Mittre and Khandelwal reported 36 types. [27]

Chaturvedi et al. observed that the highest percentage of grass pollen was reported from Aurangabad (80.64%), followed by Bhavnagar (70.26%) and Raipur (66.73%), all in Central India. [28] The aerobiological surveys at Pune revealed Cicer, Ricinus communis, Holoptelea, heno/Amaranth, Argemone, Cocos nucifera, and Hibiscus as the dominant pollen types were recorded. [29]

Shivpuri et al. in 1960 introduce Delhi pollen calendar after that Singh et al. in 1990 pollen calendars of 12 different states of India was introduced to establish chronologic correlation between the concentration of pollen in air and seasonal allergic symptoms. [30],[2]

Our results of pollen counts with meteorological parameters such as temperature, rainfall, wind speed, and relative humidity are similar to the results of a previous study of pollen allergy in Delhi. [12] In our study, the rise in the speed of the wind from May to June had helped in distributing the pollen grain and more the humidity, more pollen was collected [Graphs 3 and 4]. Low pollen count was recorded from the month of July, August [Graphs 5 and 6] and again decline from December, January, and February due to rainfall or heavy moisture in the atmosphere [Graphs 10-12].

The role of metrological factors over the peak incidence in the atmosphere is also well- established. The pollens were the highest concentration during March-June and September-October, and lowest occurrence was found during August and December with respect to temperature and humidity [Table 1]. Similar observations were reported earlier by Leuschner in 1974. [31] Sudha and Agashe in 1996 [32] also reported maximum airborne pollen concentration in the month of October and November from Bangalore city. Jato et al. in 1996 [33] and Al-Doory et al. in 1982 [34] have also been studies the annual variation in pollen concentration due to climatic factors. Rainfall also has a profound impact on pollen concentration in the air by inhibiting anthesis or washing off effect. Hyde and Williams in 1943 and Oommachan et al. in 1996 have similar to the findings of the reduction in the number of pollen grains during rainy seasons. [35],[36]

In other study, Sahney and Chaurasia in 2008 studied seasonal variations of airborne pollen in Allahabad recorded the highest pollen counts were obtained in the month of March and lowest in the months of July. [37] In our study, we also recorded the similar pattern, pollen concentration start increasing to June month and then start declining for the month of July to August of rainfall. A significant positive correlation of average pollen count with humidity in the months of June, July August, September, and October were observed. Temperature correlation with pollen count was observed only in the October. According to a report high concentration of *Amaranthus* pollen was found in October in various cities of Saudi Arabia having more or less similar climate Hasnain et al. in 2007, [38] as well as an elevated number of grass pollen grain is reported in October by Bilisik et al., in 2008 and Waqar et al. in 2010. [39],[40]

The study will be useful for providing information to the allergy practitioners and allergic peoples in order to avoid exposure to allergens in the particular area during the particular time.

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Figure 1-2

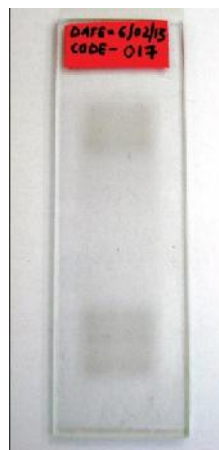
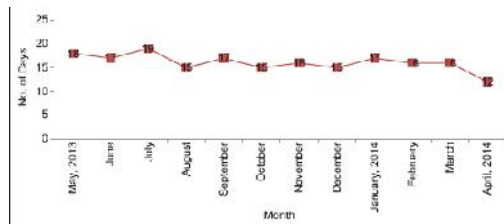


Table 1

Month	Pollen (m^{-3})	Humidity (%)	Temperature ($^{\circ}\text{C}$)
May 2013	239.33	39.06	33.06
June 2013	279.38	71.56	31.83
July 2013	227.47	80.50	30.62
August 2013	148.60	90.73	29.04
September 2013	282.65	73.29	26.66
October 2013	275.73	74.13	25.28
November 2013	245.44	67.16	20.55
December 2013	131.53	73.60	15.02
January 2014	133.82	79.94	13.30
February 2014	139.56	75.81	14.78
March 2014	274.31	71.34	19.42
April 2014	210.35	72.58	24.02

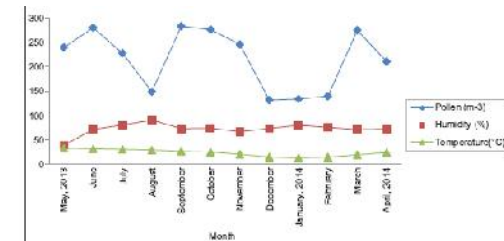
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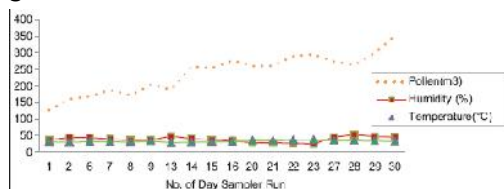
Graph 1: Number of day sampler run from May 2013 to April 2014

2



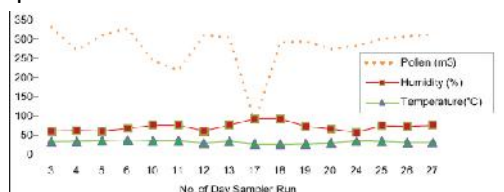
Graph 2: Mean pollen, temperature and humidity level variation between 1 Year (May 2013 to April 2014)

3



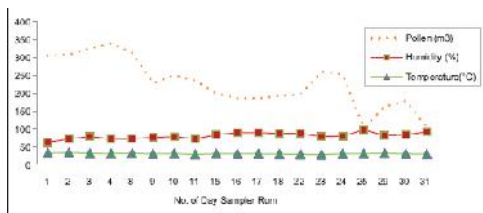
Graph 3: Pollen count, temperature and humidity level of month May 2013

4



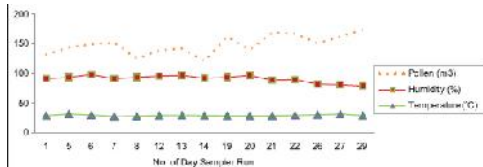
Graph 4: Pollen count, temperature and humidity level of month June 2013

5



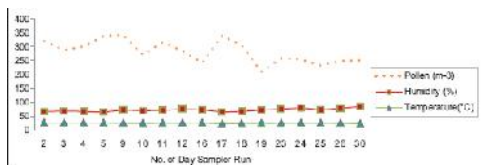
Graph 6: Pollen count, temperature and humidity level of month July 2013

6



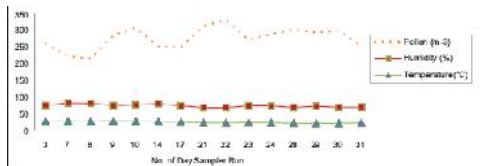
Graph 6: Pollen count, temperature and humidity level of month August 2013

7



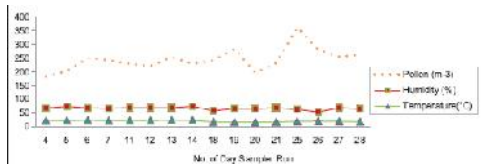
Graph 7: Pollen count, temperature and humidity level of month September 2013

8



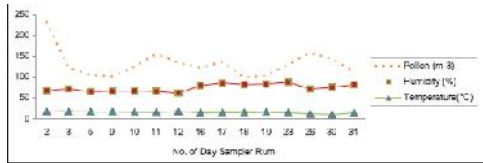
Graph 8: Pollen count, temperature and humidity level of month October 2013

9



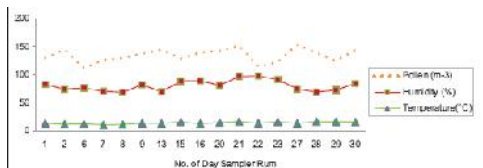
Graph 9: Pollen count, temperature and humidity level of month November 2013

10



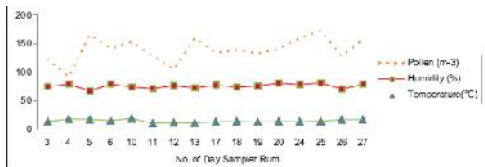
Graph 10: Pollen count, temperature and humidity level of month December 2013

11



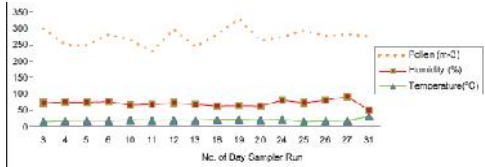
Graph 11: Pollen count, temperature and humidity level of month January 2014

12



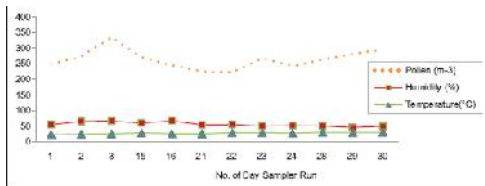
Graph 12: Pollen count, temperature and humidity level of month February, 2014

13



Graph 13: Pollen count, temperature and humidity level of month March, 2014

14



Graph 14: Pollen count, temperature and humidity level of month April, 2014