

Effects of Pollen Allergy on Pulmonary Function Tests

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Abstract

Background: To investigate the effect of high air-borne pollen count on respiratory system.

Methods: This cross sectional (descriptive) study included sixty known asthmatics, of either sex and of all ages. Pollen count as per cubic meter was recorded daily during February to May as reported by meteorological department. History, clinical examination and lung function tests were recorded in each case. The Pulmonary Function Test (PFT) with pollen count of asthmatic patients was correlated.

Results: The PFT of asthmatic patients were adversely affected significantly during pollen season. There was negative correlation of moderate strength with FEV1 in asthmatic patients with high air borne pollen count during the pollen season.

Conclusion: Spirometry was shown to be an effective technique to study the pollen allergy problem in already asthmatic patients.

Key Words: Asthma, Pollen, Pulmonary Function Test (PFT)

Introduction

Respiratory allergic diseases like asthma are increasing in prevalence and severity. For the last few years, this problem in our country particularly in twin cities of Rawalpindi and Islamabad has risen.¹ There are allergens in atmosphere, which initiate allergic responses in susceptible individuals. The allergens are classified as those originating from natural environment and those from chemically contaminated environment. The most frequent allergens from natural environment are inhalants present in pollen grain, mould fungi spores and in fragments of mycelial hyphae.¹

Asthma is recognized as a complex genetic disease, with numerous contributing genes. Gene-environment interactions are identified in which along with genetics, environmental exposure to allergens, tobacco smoke, pollutants, low birth weight and infections all

play a contributing role. Approximately 90% of childhood asthmatics and 17-80% of adult asthmatics are allergic to aeroallergens. These include pollens, fungal spores, castor bean, house dust mite, cockroach, animal dander and low molecular weight chemicals. There is an increased incidence of asthmatic attack during thunderstorm due to thunderstorm-induced grass pollen allergy. The pollen count with other meteorological parameters like maximum temperature, minimum temperature, and humidity is reported in newspapers.^{2,3}

The plants causing pollen allergy in twin cities of Rawalpindi and Islamabad are *Broussonetia papyrifera* (paper mulberry), *Acacia nilotica*, *Cannabis sativa*, *Alternaria alternata*, *Pinus wallichiana*, *Eucalyptus microtheca*, *Taraxacum officinale*. *Broussonetia papyrifera* native to South East Asia is a deciduous tree that produces separate male and female flowers in the spring season. It exhibits aggressive growth and quickly invades disturbed land displacing native plants. It expands locally by producing new plants from its roots. Another plant responsible for air-borne pollen load is *Cannabis sativa* (Bhang) which is native to central and western Asia. It pollinates during rainy season from June to September. Other plants contribute very little in total pollen count.^{4,5}

The pollen count does not remain constant throughout the year but tends to fluctuate depending upon the life history of plant. The meteorological parameter also affects the spread of pollen i.e. count will be highest on warm, dry and breezy days and lowest during chilly and wet days. Pollen concentration can be changed by population growth, land use, tree plantation and cutting industrialization and pollution. Independent of rural and urban condition, the pollen sensitization appears to increase with height where the patient lives.^{6,7}

Urban architecture acts as a barrier to dispersal and concentration of pollen and other pollutants. People living in typically urban districts display high

prevalence of allergy to pollen from ornamental plants and high degree of exposure to the same environment may influence the development of sensitization to particular pollen load associated with the area. Industrialization results in the persistence of air pollutants in urban area associated with many signs of asthma aggravation. These include pulmonary function decrements, increasing bronchial hyper responsiveness, visit to emergency departments, hospital admissions, increased medication use, inflammatory changes, interaction between air pollution and allergen challenges and immune system changes. In contrast to the adult, children are more sensitive to air pollution as they inhale more air than adults in comparison to their body weights. The role of climatic factors (e.g. barometric pressure, temperature and humidity) in triggering and/or exacerbating respiratory allergic symptoms in predisposed subjects is still poorly understood and asthma attacks have been linked with both low and high atmospheric pressure.⁸⁻¹⁰

Vegetation reacts with air pollution over a wide range of pollutant concentrations. Many factors influence the interaction that includes type of air pollutant, plant species, nutrient balance, soil conditions and climatic factors. Plants can absorb pollutants through the leaves or through the root system. In the latter case, deposition of air pollutants on soils can alter the nutrient content of soil in the proximity of the plant, thus, leading to indirect or secondary effects of air pollutants on vegetation. Air pollution can influence the plant allergenic content, and by affecting plant growth, it can affect both the amount of pollen produced and the amount of allergenic proteins contained in pollen grains.¹¹⁻¹²

Subjects and Methods

This study was conducted in Department of Physiology, Armed Forces Postgraduate Medical Institute Rawalpindi from February to May 2006. Subjects comprised of 60 known asthmatic patients. They were taken from Asthma clinic Holy family Hospital Rawalpindi. Inclusion criteria consisted of adult known asthmatics, between 18-60 years of age, having exacerbation during high pollen count season. Exclusion criteria focused on subjects with evidence of pulmonary tuberculosis, chronic obstructive pulmonary disease, chest and spine deformities, smokers, obese subjects having body mass index more than 30kg/m², cardiovascular system problems like congenital heart disease, valvular heart disease and CCF. Relevant anthropometric data regarding age in

years, weight in kilograms, height in centimeters and body mass index (BMI) as weight in kg/m² of asthmatics was recorded. The weight was measured using top-loading scale and height was measured with the scale on weighing machine. Correlation analysis was done to look for the degree of correlation between the daily pollen count and lung function tests. The strength of association was given by “r” value and interpreted as r= 0 - 0.5 taken as moderate and r=>0.5 as strong association and statistical significance was calculated by applying to paired sample “t” test at the level of p value < 0.05 using SPSS version 11.

Results

Asthmatic patients showed majority. Mean age for asthmatic patients was 40.38 ± 15.17 while mean height in cm for asthmatic patients was 148.28 with a standard deviation of 14.62. Mean weight (kg) and standard deviation for asthmatic patients was found as 59.15 ± 12.61. Body mass index was also calculated in asthmatic patients as a mean of 27.58 with a standard deviation of 6.96 (Table 1). The mean ± S.D %PEFR in the asthmatic group was 23.4 ± 11.80. The difference was found highly significant (p-value <0.001).

Table 1: Anthropometric data and lung function tests in asthmatic patients given as Mean ± S.D based on paired sample t-test.

	Asthmatics (n=60)	Mean ± S.D
Anthropometric parameters	Male: Female	19:41
	Age (Years)	40.38 ± 15.17
	Height (cm)	148.28 ± 14.62
	Weight (Kg)	59.15 ± 12.61
	BMI (Kg m ⁻²)	27.58 ± 6.96
Lung Function Tests	%PEFR	23.4 ± 11.8
	%FEV1	36.079 ± 14.951
	%FEV6	38.328 ± 17.278
	%FEV1/FEV6	96.8 ± 18.5

The mean differences of %FEV1 and %FEV6 and found highly significant differences (p-value=<0.001 each).

The combined %FEV1/FEV6 rate was also found significant (p-value=0.005). %PEFR, %FEV1 and %FEV6 were significantly related to the asthmatic group (Table 2; Fig 1). Paper mulberry was the plant causing maximum concentration of air borne pollen count throughout the period from March to May. The other plants were Acacia, Cannabis, Eucalyptus, Alternaria, Pinus and Grasses. Their share in air borne pollen count was not so high and fluctuated throughout the period from March to May (Fig 2).

Table 2: Correlation of percentage predicted values of pulmonary function tests with daily pollen count in asthmatic

	Asthmatic	
	Correlation	Significance
% PEFR	-0.256*	p<0.05
% FEV1	-0.451	p<0.001
% FEV6	-0.417*	p<0.05
% FEV1/FEV6	0.136	p<0.05

Correlation is significant on the basis of paired sample T-Test;p<0.01=Highly significant;p<0.05=Significant;p>0.05=Non-Significant (N.S).

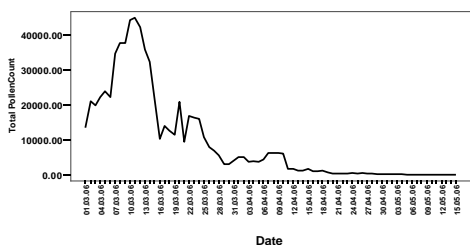


Figure 1: Total Pollen Count in Days

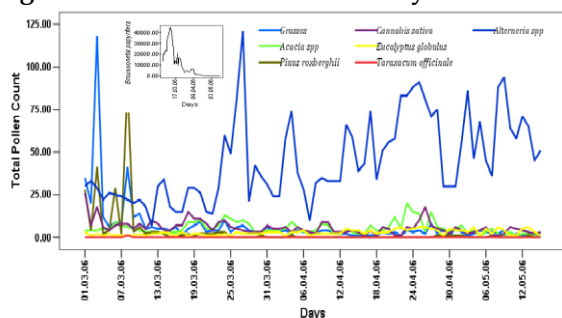


Figure 2: Overall Pollen Trend in Days

Discussion

The world wide increase in incidence, prevalence and severity of respiratory allergic diseases in recent past has been attributed to environmental factors like pollution, weather and excessive exposure to indoor and outdoor aero-allergens due to rapid urbanization, industrialization, excessive vehicle emissions and changes in life style. But for last few years a new form of pollution has emerged as a risk factor for respiratory allergic diseases i.e. pollen allergy. It is due to air-borne pollen generated by different plants i.e. trees, grasses and weeds during particular months of the year.^{13,14}

The plant responsible for this high airborne pollen load is Paper mulberry introduced in 1960s in this region to make the capital green but rapidly spread because of its invasive growth and symbiotic relation

with crows which took its fruit as food and dispersed the seeds in far flung areas. This plant has replaced most of the local plantation in and around twin cities of Rawalpindi and Islamabad. The other plants which contributed in high airborne pollen counts are Cannabis sativa, Pinus spp, Eucalyptus globulus, Acacia spp and grasses but their contribution is very small and pollen of these plants affect the small number of people as compared to pollen of paper mulberry. According to a survey published by Pakistan Medical and Research Council in 1995, 45% of the population of Rawalpindi and Islamabad was found to be sensitive to pollen of paper mulberry and cannabis.¹⁵

In present study the values of PEFR , FEV1, FEV6 and FEV1/FEV6 along with gender, height in centimeters, and weight in kilograms were put into Robert’s formula “1991” to have predicted values of PFT parameters and percentage of predicted values were then calculated and used for analysis. The PFT results in our study for asthmatic patients were found to be low during the pollen season when the airborne pollen count was very high. It was inferred that high airborne pollen count have an effect on PFT of the asthmatic patients and pollen exposure could be an important exacerbating risk factor for asthmatic patients.

The pollen count analysis also revealed that cultural factors like importing of decorative plants for park land and greater international travel has also played an important role in spread of pollen allergy to areas not being effected i.e. pollens of Ragweed Genus Ambrosia has invaded France, North Italy , Austria and Hungary.¹⁶ In our country the urgent compulsion by horticulture department of Capital Development Authority to make the newly constructed capital green in shortest time has compelled them to introduce paper mulberry tree, which has replaced the local trees, and this has resulted in sharp rise of pollen allergy in and around Islamabad. The problem of pollen allergy has not been studied extensively as it was confined to northern areas of Pakistan particularly in twin cities of Rawalpindi and Islamabad, but there are few studies in which pollen allergy was found to be an important precipitating factor.¹⁷⁻¹¹³

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