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Association of Smog and Fog with the Prevalence of Asthma and Pneumonia in the Population of Punjab

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Abstract

The present study was conducted to assess the prevalence of asthma and pneumonia due to smog and fog in the affected and normal population of males and females. The data were collected by means of questionnaires and interviews in DHQ (District Headquarters) Hospital, Chiniot, on 500 subjects. All subjects were categorized into two groups with respect to their age. Group A (age ≤ 43) and Group B (age ≤ 84); Group A contained n_A = 376 and Group B contained n_B = 124 subjects, respectively. The parameters like height, weight, BMI, age, and gender were included. The socio-economic status and family history were also included. All the data and parameters were analyzed statistically by chi-square using SPSS software (version 22). 73.6% of subjects showed the presence of Asthma and Pneumonia. 33.6% of samples were affected by Asthma ($p \leq 0.0001$), 40% were infected by Pneumonia (For A group $p \leq 0.0001$) (For B group $p \leq 0.002$), and 26.4% were normal and did not show any symptoms. The climatic conditions such as temperature, humidity, and weather (smog, fog) played a vital role. The increased level of smog and fog is the cause of the prevalence of many respiratory diseases such as shortness of breath (asthma) and pneumonia. The average temperature during October was 31°C, November 21°C, December 18°C, January 16°C, February 19°C and March was 27°C. The results of this study revealed that smog, fog, education, and socio-economic status were also related to the prevalence of these diseases.

Keywords: Asthma, Pneumonia, Smog, Fog, Population of Punjab.

1. Introduction

Smog is a bothersome concoction of gases and airborne particles that is created by smoke and fog in the presence of sunlight. Smog formation is directly correlated with the land's topography and weather (Chang, Xu et al. 2016). Incinerators, landfills, and sewage treatment plants are examples of facilities that treat human waste and release a variety of harmful gases into the atmosphere. Landfills release more than 100 harmful gases. Among them, hydrogen sulfide and methane are the most prevalent (Filippini, Heck et al. 2015).

There are numerous chemicals (a total of 187) that are known to be air toxics, including benzene, chloroform, acetaldehyde, dioxin, polycyclic organic matter, chromium, lead, nickel, and mercury compounds. Cancer and other major health problems, such as birth defects and human reproduction, can be brought on by air pollutants (Mulikat 2022). According to EPA estimates, half of all cancers brought on by air pollution are caused by air toxics released by cars and

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trucks, such as benzene, acetaldehyde, and 1, 3-butadiene. The National Emissions Inventory measures VOC emissions. Numerous compounds, including nitric oxide, nitrogen dioxide, and nitrous oxide, can be created when nitrogen and oxygen combine (Thompson, Shimabuku et al. 2016).

The human body's cardio respiratory system is the primary target of CO. Power plants that burn coal and automobiles that run on diesel produce sulfur dioxide (SO_2). Rain that contains sulfur dioxide (SO_2) dissolves and turns into sulfuric acid, or acid rain, which is harmful to plants. The biggest health risk to young children and asthmatics is sulfur dioxide, which can react in the atmosphere to form fine particles. Pregnancy loss occurs when SO_2 disrupts fetal growth in females (Chen, Kuschner et al. 2007).

PM_{10} is defined as particulates such as dust, pollen, and mold, with a diameter smaller than 10 µm. PM2.5 frequently contains heavy metals such as Cd, Cr, Cu, Fe, Mn, Ni, As, and Pb. Some PM2.5 particles can have sizes as small as 0.1 mm, which is very close to the range of nanoparticles. These particles can adhere to the lungs and enter the bloodstream; some of them even start in the brain (Maher et al., 2016). Over the past few decades, there has been an increasing trend in the frequency of fog over South Asia during the winter months (Syed, Körnich et al., 2012). The phenomenon's crippling effects extend beyond human health because ozone in smog also inhibits vegetation growth, severely damaging crops and forests. It can also hasten the deterioration of rubber tires, paints, and textile dyes (Yoon, Burrows et al., 2014).

Areas with higher ambient pollution levels had higher death rates. Smog is thought to be the cause of over 2 million premature infant deaths in China and India (Jia and Wang, 2017). An increase in pneumonia-related deaths was the immediate result. Many pneumonia-related deaths are referred to as “acute respiratory distress syndrome” or “acute lung injury”. Diseases of the heart, lungs, skin, and eyes, as well as disorders of the nervous system, inflammatory response, and cancer, are all closely linked to exposure to smog, according to numerous studies. The country's economy, irrigation system, and human life have all been impacted in different ways by the rising trend of fog frequencies over the past ten years (Jacquemin, Sunyer et al. 2009).

Children's health and quality of life are greatly impacted by asthma, which is the primary cause of illness and hospitalizations in this age group. The most common non-infectious illness in children is asthma (Zar and Ferkol 2014), which impacts 235 million individuals worldwide, with a rising incidence in low- and middle-income nations. There is strong evidence that preexisting asthma can be made worse by postnatal air pollution (Orellano, Quaranta et al. 2017).

Numerous studies have shown that air pollution has a negative impact on cardio-respiratory disorders (Forouzanfar, Alexander et al. 2015). According to other research, children who live close to roads or wood industries are more likely to get pneumonia, and a ban on diesel-powered cars may lower the number of hospital admissions for the illness (World Health Organization, 2005). According to available data, a number of risk factors could contribute to the development of pediatric pneumonia (Jackson, Mathews et al. 2013, Walker, Rudan et al. 2013, Sonego, Pellegrin et al. 2015). Asthma is a persistent illness. It results in recurring airway narrowing and inflammation (Mehta, Shin et al. 2013, Atkinson, Kang et al. 2014).

2. Materials and Methods

The data were collected from 500 subjects from the general population of Lahore, DHQ (District Headquarters) Hospital, Chiniot, and from different cities of Punjab. The purposely designed questionnaire was used to obtain data in

the present study. The study was conducted on 500 subjects who were divided into two groups on the basis of age: group A and group B. Group A contains 182 males and 194 females; on the other hand, group B contains 72 males and 52 females. The study was carried out from October 2017 to March 2018.

2.1 Experimental Design

To assess the prevalence of Asthma and Pneumonia due to smog and fog in the population of Punjab in 500 subjects, a questionnaire was designed, and information regarding anthropometric measurements like age, gender, family history of that disease, and socioeconomic status was noted as well.

2.2 BMI (Body Mass Index)

BMI is a simple calculation using a person's height and weight. The formula is:

$$BMI = Kg/m^2$$

Where Kg is a person's weight in kilograms, and m^2 is their height in square meters. In order to calculate the BMI, the height must be converted to meters. For that purpose, first the feet of height were converted into inches, then into centimeters (cm), and then into meters (m). At the end, the square of the meter value was taken:

12 inch = 1 feet

1 m = 100 cm

According to the above values, the height in feet was converted into meters. By that procedure, the different BMIs of different samples were obtained.

Underweight = < 18.5; Normal = 18.5–24.9;

Overweight = 25.0–29.0; Obesity = 30.0–>40

2.3 Asthma

Many people had symptoms like coughing, and the duration of coughing was very long and severe in smog and fog during the months of October, November, December, and January. But some people had no symptoms like that. The presence and absence of that symptom showed the presence or absence of some disorders. Shortness of breath was very common. Due to air pollution, some people had difficulty breathing, and this problem was present in samples collected from different areas of Punjab. The duration of these symptoms definitely shows the prevalence of some disorders.

2.4 Pneumonia

Chest pain was also observed on the foggy days. The questionnaire and interview taken from the people estimated that the weather was the reason for the prevalence of these symptoms. In collected samples, some people had this symptom along with other symptoms. Conversely, some did not have this symptom, and some had only this symptom with no other disorders. Some people had a severe type of cold and shivering on smoggy days; some had no problem with that, and some had a mild effect.

The people who had these symptoms had a family history related to them, and some subjects who were affected by these symptoms had no family history, showing that the cause was not related to family history. They might be affected by weather conditions instead.

2.5 Climate Conditions

2.5.1 Temperature

Temperature was the climatic factor that affected many seasonal and other disorders. The temperature was recorded during the smoggy and foggy days from October to March, and was low during December, January, and February. The temperature was around 22–24 °C.

2.5.2 Humidity

Humidity was also very high during 3–4 months, becoming low to high at around 63–74%. Humidity was recorded from October 2017 to March 2018. At high humidity, the temperature was low, e.g., at 74% humidity the temperature was 24°C.

2.5.3 Weather

Smog was recorded from October 2017 to January 2018. In low temperatures

and high humidity, the weather was smoggy. Fog was also recorded in the winter months, e.g., in January and February, typically in the morning before sunrise. The weather was mostly cloudy during October 2017 and January 2018, and partly cloudy during October and January. Passing clouds, scattered clouds, and morning clouds were also present during those months. Haze, overcast conditions, scattered showers, and sprinkles were present in October, November, and December, while light and heavy rain was recorded during February 2018.

2.6 Statistical Analysis

Continuous variables (BMI, height, weight, and age) were expressed as mean ± standard deviation, and qualitative variables (coughing, fever, wheezing, chest pain, shortness of breath, and cold symptoms) were expressed as mean and percentage. The chi-square test was used to measure the significance of differences between qualitative parameters of the two respiratory diseases (asthma, pneumonia) using p-values.

3. Results

This study was conducted on 500 subjects, including males, females, and children of different ages. The ages ranged from 3 to 84 years. These subjects were divided into two groups, group A and group B. Group A consisted of 376 subjects with ages ranging from 3 to 43 years. Group B consisted of 124 subjects with ages ranging from 44 to 84 years.

3.1 Continuous Variables of Group A and Group B

Table 1 shows the mean with standard deviation of both Group A and Group B. The continuous variables used in this study were age, gender, height, weight, and BMI. The mean age with standard deviation of Group A was 25.11±9.74, and of Group B was 58.32±10.91. The mean height with standard deviation of Group A was 1.648±0.25, and of Group B was 1.79±0.14. The mean weight with standard deviation of Group A was 55.20±12.21, and of Group B was 63.09±8.35. The mean BMI with standard deviation of Group A was 19.66±3.44, and of Group B was 19.78±3.31.

Table 1. Continuous variables of group A and group B

Group	Age (years) Mean ±SD	Height (m) Mean ±SD	Weight (kg) Mean ±SD	BMI Mean ±SD
A	25.11±9.74	1.648±0.25	55.20±12.21	19.66±3.44
B	58.32±10.91	1.79±0.14	63.09±8.35	19.78±3.31

3.2 Qualitative Characteristics of Group A

The sample size of this group was 376, with age ranging from 3 to 43 years. The qualitative characteristics of this group were assessed according to two respiratory diseases: asthma and pneumonia. In asthma, the symptoms of coughing, wheezing, chest pain, and shortness of breath were included. In pneumonia, the symptoms of coughing, fever, chest pain, and cold were included. The symptoms of both asthma and pneumonia are much alike because these are respiratory diseases sharing similar symptoms. The family histories of these diseases were also recorded.

3.2.1 Symptoms of Asthma

Table 2 shows the symptoms of asthma. In group A, the total number of males was 182, and the total number of females was 194. The affected people were 284, and the normal were 92. Of the 376 subjects, 130 were affected by coughing, and 246 were normal with no effect of coughing; the mean of the coughing cases

was 0.345 with a percentage of 35% (p = 0.0001, highly significant). Normal cases had a mean of 0.65 and a percentage of 65%. For wheezing, 125 people were affected, with a mean and percentage of 0.33 and 33% (p = 0.0001); normal cases had mean 0.65 and percentage 65%. Shortness of breath affected 130 people, with mean 0.345 and percentage 35%; normal cases showed the same values as above. All the above symptoms indicated that 130 people were suffering from asthma in group A. A total of 130 cases of asthma were found in group A.

Table 2. Prevalence of asthma symptoms due to smog and fog in the population of Punjab from 3 to 43 years, male and female

Symptoms of Asthma	Total n=376	Mean	Percentage %	P-value
Coughing				
+ve	130	0.345	35%	P<0.0001
-ve	246	0.645	65%	
Wheezing				
+ve	125	0.332	33%	P<0.0001
-ve	251	0.667	67%	
Chest pain				
+ve	130	0.345	35%	P<0.0001
-ve	246	0.654	65%	
Shortness of Breath				
+ve	130	0.345	35%	P<0.0001
-ve	246	0.654	65%	
Cases of Asthma				
+ve	130	0.345	35%	P<0.0001
-ve	246	0.654	65%	

3.2.2 Symptoms of Pneumonia

Table 3 shows the symptoms of pneumonia: 150 coughing cases were recorded with a mean value of 0.398 and a percentage of 40% (p = 0.0001, highly significant); 236 normal cases had mean 0.627 and percentage 63%. Chest pain affected 154 people, with mean 0.409 and percentage 41%; 222 normal cases had mean 0.59 and percentage 59%. For cold, 150 people were affected, with a mean value of 0.398 and percentage 40%, matching the coughing symptom values. These symptoms indicated a total of 154 people affected, with p = 0.0001 (highly significant).

Table 3. Prevalence of pneumonia symptoms due to smog and fog in the population of Punjab from 3 to 43 years, male and female

Symptoms of Pneumonia	Total n=376	Mean	Percentage %	P-value
Coughing				
+ve	150	0.398	40%	P<0.0001
-ve	226	0.601	60%	
Fever	140	0.372	37%	P<0.0001
+ve	236	0.627	63%	

-ve				
Chest pain	154	0.409	41%	P<0.0001
+ve				
-ve	222	0.590	59%	
Cold	150	0.398	40%	P<0.0001
+ve				
-ve	226	0.601	60%	
Cases of Pneumonia	154	0.409	41%	P<0.0001
+ve				
-ve	222	0.590	59%	

4. Discussion

This study consisted of 500 subjects; samples were collected via questionnaires and interviews from the local population of Punjab with respect to the two respiratory diseases, asthma and pneumonia. This study included males and females of different age groups. The sample consisted of 254 males and 246 females, conducted on two groups: group A (376 subjects) and group B (124 subjects). The current study showed that of the 500 samples, 368 were affected and 132 were normal. The symptoms of both respiratory diseases were not identical, but shared some overlap, such as coughing and chest pain. Samples were collected from people via questionnaires and interviews. The occurrence of symptoms indicated the presence of a respiratory defect; some people showed no disorder, while others had severe infection. The present study showed that smog and fog during the winter directly and indirectly affected human health, particularly through respiratory diseases such as asthma and pneumonia. The prevalence of asthma and pneumonia due to smog and fog was also measured against weather conditions such as smog, fog, rain, cloud cover, scattered clouds, and sprinkles.

This study revealed that weather pollution such as smog and fog highly affected human health from October to February. Gases released by motors, factories, and chlorofluorocarbons combine with other air pollutants to form smog. Clark and coworkers (2010) studied the effect of smog on human health; when fuels burn, the gases or pollutants that cause smog are released into the atmosphere. In predisposed individuals, the main cause of allergic symptoms is the presence of airborne pollutants. Chronic inflammation is one of the most harmful allergic reactions, and can gradually harm tissue wherever it arises; in some parts of the body, recurring allergic reactions can cause organ damage (Clark, Demers et al. 2010). This confirms that the present findings are related to Clark and colleagues' work.

In the present study, the prevalence of asthma was examined; in group A, of the 182 males and 194 females, 130 members were affected by asthma — 61 of 182 males and 69 of 194 females. Chang (2012) studied asthma patients and concluded that in some cases breathing problems lead to heart problems, even though asthmatics typically only have brief episodes of trouble breathing.

The gases nitrogen dioxide (NO_2), ozone (O_3), volatile organic compounds (VOCs), and particulate matter (PM), which includes soot, are the pollutants that have been studied the most (Bates and Sizto 1987). More than 3% of the yearly disability-adjusted life years lost in 2010 were caused by outdoor air pollution. According to a study of ten European Cities, exposure to pollutants associated with traffic was responsible for 15% of all

exacerbations of childhood asthma and 14% of incident asthma cases in children. This confirms that Chang's work is related to the present work, while the work of Bates, Sizto and Brunekreef is somewhat different but still connected (Chang, Xu et al. 2016).

The consistent rise in asthma prevalence in developed nations has numerous detrimental effects on cardiopulmonary health that have been linked to air pollution, both indoors and outdoors. The gases nitrogen dioxide (NO_2), ozone (O_3), volatile organic compounds (VOCs), and particulate matter (PM), which includes soot, are the pollutants that have been studied the most (Bates and Sizto 1987).

More than 3% of the yearly disability-adjusted life years lost in 2010 were caused by outdoor air pollution. According to a study of ten European Cities, exposure to pollutants associated with traffic was responsible for 15% of all exacerbations of childhood asthma and 14% of incident asthma cases in children. Asthma is significantly exacerbated by urbanization, which may be partially caused by higher levels of outdoor air pollution. The prevalence of asthma is expected to rise globally as a result of fast population growth and rising levels of outdoor air pollution in many developing world cities (Brunekreef, Stewart et al. 2009). While Chang's work is connected to the current work, Bates, Sizto, and Brunekreef's work is somewhat different but still connected. Children of educated mothers have a better outcome than others because they are able to identify the signs and symptoms of pneumonia early and seek medical attention sooner (Sharma, Jain et al. 2013).

Pneumonia is one such infectious killer that has contributed to the deaths of countless people worldwide. Numerous health problems that can result in pneumonia are caused by smog; therefore, those who smoke regularly, have kidney-related conditions, or have diabetes are particularly vulnerable to pneumonia. A lung infection brought on by bacteria, viruses, fungi, or parasites in the air we breathe is known as pneumonia (Marsh, Gilroy et al. 2008). When determining the burden attributable to air pollution, the set of pollutants significantly linked to pneumonia raises the question of which one to use. According to the Global Burden of Disease study (GBD), which took into account both PM and O_3, the former was identified as the primary cause of disability globally (Ghimire, Bhattacharya et al. 2012).

5. Conclusion

The increased level of smog and fog is the cause of the prevalence of many respiratory diseases such as shortness of breath (asthma) and pneumonia. In this study, family history and socioeconomic status played an important role; poorer children were mostly infected with pneumonia. The present study concluded that when temperature was between 18–27°C and humidity was between 61–94% during smoggy and foggy days, 12% of males in group A were affected by asthma and 14% by pneumonia, while in group B, 4% of males were affected by asthma and 5% by pneumonia. In group A, 14% of females were affected by asthma and 20% by pneumonia; in group B, 4% of females were affected by asthma and 4% by pneumonia. Elevated air pollution played a vital role in respiratory diseases, and temperature and humidity were also involved in the prevalence of these diseases. It is concluded that persons who face more exposure to the atmosphere during smog and fog are the major victims of pneumonia and asthma prevalence.

References

Atkinson, R., et al. (2014). "Epidemiological time series studies of PM2.5 and daily mortality and hospital admissions: a systematic review and meta-analysis." Thorax 69(7): 660-665.

Bates, D. V. and R. Sizto (1987). "Air pollution and hospital admissions in

Southern Ontario: the acid summer haze effect." Environmental Research 43(2): 317-331.

Brunekreef, B., et al. (2009). "Self-reported truck traffic on the street of residence and symptoms of asthma and allergic disease: a global relationship in ISAAC phase 3." Environmental Health Perspectives 117(11): 1791-1798.

Chang, C. (2012). "Asthma in children and adolescents: a comprehensive approach to diagnosis and management." Clinical Reviews in Allergy & Immunology 43: 98-137.

Chang, L., et al. (2016). "Impact of the 2015 El Niño event on winter air quality in China." Scientific Reports 6(1): 34275.

Chen, T.-M., et al. (2007). "Outdoor air pollution: nitrogen dioxide, sulfur dioxide, and carbon monoxide health effects." The American Journal of the Medical Sciences 333(4): 249-256.

Clark, N. A., et al. (2010). "Effect of early life exposure to air pollution on development of childhood asthma." Environmental Health Perspectives 118(2): 284-290.

Filippini, T., et al. (2015). "A review and meta-analysis of outdoor air pollution and risk of childhood leukemia." Journal of Environmental Science and Health, Part C 33(1): 36-66.

Forouzanfar, M. H., et al. (2015). "Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks in 188 countries, 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013." The Lancet 386(10010): 2287-2323.

Ghimire, M., et al. (2012). "Pneumonia in South-East Asia region: public health perspective." Indian Journal of Medical Research 135(4): 459-468.

Jackson, S., et al. (2013). "Risk factors for severe acute lower respiratory infections in children – a systematic review and meta-analysis." Croatian Medical Journal 54(2): 110-121.

Jacquemin, B., et al. (2009). "Association between modelled traffic-related air pollution and asthma score in the ECRHS." European Respiratory Journal 34(4): 834-842.

Jia, H. and L. Wang (2017). "Peering into China's thick smog." C&EN Global Enterprise 95(4): 19-22.

Marsh, D. R., et al. (2008). "Community case management of pneumonia: at a tipping point?" Bulletin of the World Health Organization 86: 381-389.

Mehta, S., et al. (2013). "Ambient particulate air pollution and acute lower respiratory infections: a systematic review and implications for estimating the global burden of disease." Air Quality, Atmosphere & Health 6: 69-83.

Mulikat, S. O. (2022). Assessment of Heavy Metals, Persistent Organic Pollutants and Polycyclic Aromatic Hydrocarbons Contamination of Soil and Underground Water of Selected Abattoir Markets in North Central Nigeria, Kwara State University (Nigeria).

Orellano, P., et al. (2017). "Effect of outdoor air pollution on asthma exacerbations in children and adults: systematic review and multilevel meta-analysis." PloS One 12(3): e0174050.

Sharma, S. B., et al. (2013). "The effects of air pollution on the environment and human health." Indian Journal of Research in Pharmacy and Biotechnology 1(3): 391.

Sonego, M., et al. (2015). "Risk factors for mortality from acute lower respiratory infections (ALRI) in children under five years of age in low and middle-income countries: a systematic review and meta-analysis of observational studies." PloS One 10(1): e0116380.

Syed, F. S., et al. (2012). "On the fog variability over South Asia." Climate Dynamics 39: 2993-3005.

Thompson, K. A., et al. (2016). "Environmental comparison of biochar and activated carbon for tertiary

wastewater treatment." Environmental Science & Technology 50(20): 11253-11262.

Walker, C. L. F., et al. (2013). "Global burden of childhood pneumonia and diarrhoea." The Lancet 381(9875): 1405-1416.

Yoon, J., et al. (2014). "Changes in atmospheric aerosol loading retrieved from space-based measurements during the past decade." Atmospheric Chemistry and Physics 14(13): 6881-6902.

Zar, H. J. and T. W. Ferkol (2014). "The global burden of respiratory disease — impact on child health." 49: 430-434.