

# Air Pollution And Its Influence On Health In Lucknow: A Geographic Perspective

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## Abstract

Intelligent groups of people, scientists, planners, and policymakers from various countries have recognised that environmental quality is not always a simple function of nature, as it was in primitive earth. Today, nature's self-regulating mechanisms are inactive. Every developed and emerging country is highly concerned with striking a balance between environmental concerns and economic progress. Dreadful environmental conditions are wreaking havoc on the biological element of these locations' ecosystems. Human beings, as 'one of the most valuable components of the biosphere,' face a constant state of crisis as a result of sullied air, water, and soil degradation. While both water and land pollution are exceedingly harmful, air pollution is unique in its global dispersion of toxins. Air pollution's effect on health is quite complex, as it is caused by a variety of distinct causes, each of which has a unique effect. Not only the ambient air quality in cities is creating worry, but also the indoor air quality in rural and urban locations.

The study is limited to the health consequences of declining air quality in Lucknow. Additionally, the purpose of this study is to ascertain the effects of ambient air quality on the health of the residents of the study area.

**Keywords:** Air Quality, Air Pollutants, Airborne Disease, Health Effects, Lucknow, India

## 1. INTRODUCTION:

Air pollution in Lucknow, the capital of Uttar Pradesh, India, will be studied in this investigation. When a result, it attempts to assess the impact of air contaminants on human health as concentrations rise in the metropolis.

Rapid industrialization, unplanned urbanisation, population increase, and vehicle use have all contributed to environmental problems in both emerging and developed countries. This is well-documented. Excessive concentrations of noxious gases and other substances in the atmosphere can be hazardous to all living things on Earth (Narayan, 2009). An air pollutant is defined as "substances introduced into the air by activity of humanity to levels that produce negative effects on health, property, agricultural yield or to interfere with the enjoyment of property" by WHO in 1996. In broad terms, air pollution can be characterised as a state of disequilibrium in the air induced by the entry of foreign materials from both natural and manmade sources, such that the air harms both biological communities and the human community in particular.

Throughout the world, major cities have grown overburdened by automotive emissions. In Peshawar, annual PM10 concentration is the highest, followed by Rawalpindi (448 ug/m<sup>3</sup>), Mazar-e-Sharif (334 ug/m<sup>3</sup>), Gwalior (329 ug/m<sup>3</sup>),

Ahvaz (320 ug/m<sup>3</sup>), Hamad Town (318 ug/m<sup>3</sup>), Raipur (305 ug/m<sup>3</sup>), Delhi (286 ug/m<sup>3</sup> and Karachi (273 ug/m<sup>3</sup>) in the top 10. (WHO, 2014a). 12 percent of the world's population is subjected to air pollution levels that meet or exceed the Air Quality Guideline (AQG). From 2009 to 2012, annual PM10 levels increased by 6% in major cities around the world (WHO, 2014b). More than 5.5 million people die prematurely each year as a result of indoor and outdoor air pollution, with India and China accounting for 55% of these deaths in 2013 (Indo-Asian News Service, 2016). In 2013, 1.6 million people died prematurely in India and 1.4 million in China.

The number of people dying as a result of air pollution from cars is rising fast in urban areas. In Paris in 2015, world leaders recognised air pollution as a global concern that needs to be reduced in level (Ilyas, 2010). More than a million kilogrammes of smoke a day is being emitted by vehicles in Indian cities including Mumbai, Kolkata, Delhi, Chennai, and Bangalore (Kumar, 2007). Ambient air quality in 35 major Indian cities reveals a consistent rise in emissions of particulate matter (PM), sulphur-dioxide, and nitrogen-dioxide. Nearly half of the cities (52%) are at the critical PM 10 threshold (equivalent or greater than 1.5 times the limit) of particulate matter pollution (CPCB,2010 ).

In light of the foregoing, and as previously indicated, the purpose of this study is to identify air contaminants and their concentration in Lucknow. Air pollution levels in the city of Agra are 204 g/m<sup>3</sup> compared to Faridabad's 162 and Patna's 170, whereas Meerut's 170 g/m<sup>3</sup> is the highest in the country, followed by Faridabad's 162 and Patna's 170. Agra (11 g/m<sup>3</sup>), Varanasi (20 g/m<sup>3</sup>), Mumbai (21 g/m<sup>3</sup>), Allahabad (24 g/m<sup>3</sup>), Faridabad (30 g/m<sup>3</sup>), Ludhiana (32 g/m<sup>3</sup>), and others have lower NO<sub>x</sub> concentrations than Lucknow's 34 g/m<sup>3</sup> (CPCB, 2010). It is clear from this that the air quality in Lucknow's central and southern regions is extremely filthy (Verma, 2004).

There are numerous sources of air pollution, and each of them has a distinct impact on human health. It was deemed a human carcinogen like tobacco smoke, asbestos and arsenic by the World Health Organization as a main cause of cancer deaths worldwide. More than 1,000 million city people around the world are exposed to high levels of air pollution, which are linked to respiratory disease and contribute to a high mortality rate. Most of the main cities' air pollution comes from automobiles.

Both plants and animals can be affected by these pollutants at a very low level. In order to support the inquiry into the accumulation of contaminants, acute and chronic symptoms are examined. The rising amount of air pollution in the United States is to blame for an increase in respiratory illnesses like bronchitis, cough, sore throat, and eye irritation, as well as a host of other ailments (Becker, 1968). Lung cancer and cardiovascular disease deaths are linked to air pollution, according to research (Dockery, 1993). Approximately 29,000 people die each year as a result of inhaling particulates. When other contaminants like nitrogen dioxide are taken into account, the figure jumps to 40,000. 3.7 million people die every year because of air pollution, according to the WHO, with the majority of these deaths occurring in Asia (2.6 million) (Royal College of Physicians, 2016).

An editorial in the medical journal *The Lancet* takes issue with a Royal College of Physicians report titled "Every breath we take: the lifetime impact of air pollution." However, it's possible that our efforts will be in vain. As a result, it is imperative to do study on air pollution levels in various places of the world (in this case, Lucknow city) (*The Lancet* Editorial, 2016).

As documented by the Center for Science and Environment (CSE) and the Global Burden of Disease, India is facing an unprecedented public health crisis due to air pollution. Airborne infections caused by burning wood and biomass, fuel adulteration, car emissions, and traffic congestion have resulted in almost 6,20,000 premature fatalities. After high blood pressure, indoor air pollution, cigarette smoking, and poor nutrition, air pollution is the sixth biggest cause of death in India (*The Times of India*, 2013b). Nearly two-thirds of all lung cancer patients in Hyderabad perished as a direct result of their exposure to the city's severely polluted air, according to the World Health Organization (WHO) (IEA, 2012). Pollutant dispersion is increased during the summer months due to turbulent winds that mix and disperse pollutants. Benzene and other carcinogenic agents are more likely to be found in city air at this time (*The Times of India*, 2013a). Automobile emissions are to blame for the dangerously high incidence of respiratory diseases in

Chennai. Allergens, viruses, and environmental contaminants can cause breathing difficulties. Dust allergy affects a large percentage of people with asthma and bronchitis (Sampath, 2013).

In Kolkata, a spike in SPM levels has resulted in more than 10,000 premature deaths. The average SPM content in ambient air is 310 g/m<sup>3</sup>, with a range of 227.1 to 397 g/m<sup>3</sup> (Ghose, 2005). According to the Ministry of Health and Family Welfare (2009), 1,500,000 Indians have been registered for TB treatment, with 2,77,000 of those from Uttar Pradesh alone, and 6,734 of those from the city of Lucknow. From 2265 in 2001 to 6177 in 2011, the number of TB patients grew by 172 percent over a decade (Central Bureau of Health Intelligence, 2012). In light of this, it is imperative that Lucknow city's air quality and its effect on health be studied. Because pollutants in ambient air are controlled by climatic elements like wind speed and direction as well as relative humidity and temperature, the present research work is structured to evaluate the state of Lucknow's environment and assess the concentration of pollutants in different parts of the city during the pre and post-monsoon period.

Using a Holistic perspective study, the study examines the impact of bad air pollution on Lucknow city and identifies effective mitigation solutions.

The study begins with a description of the research field and then moves on to cover the research methodology. There is also a section on pre- and post-monsoon air quality in the city. Finally, the article examines the health repercussions of air pollution.

### **Area of Research:**

Lucknow, the 'City of Gardens,' is located in the Middle Gangetic Plain, between latitudes 26o30' and 27o10' and longitudes 80o13' to 80o30' (Fig.1).

It has a subtropical climate with a cool, dry winter (December–February) and a hot, humid summer (March - June). Summer temperatures average around 45oC and winter temperatures hover around 30oC, with an annual rainfall of roughly 100 cm (Meteorological Centre, 2010).

Lucknow city has a total population of 2,815,601 people and a geographical area of 310.10 square kilometres (Census of India, 2011). For administrative purposes, the Lucknow Municipal Corporation (LMC) has been divided into 110 wards and six zones. Between 1981 and 2011, the city's urban area increased by around 162 percent. The ever-growing population and fast urbanisation have caused a slew of difficulties, including housing shortages, mushrooming slum growth, encroachment on public land, and the creation of unauthorised colonies (Government of India, 2002).

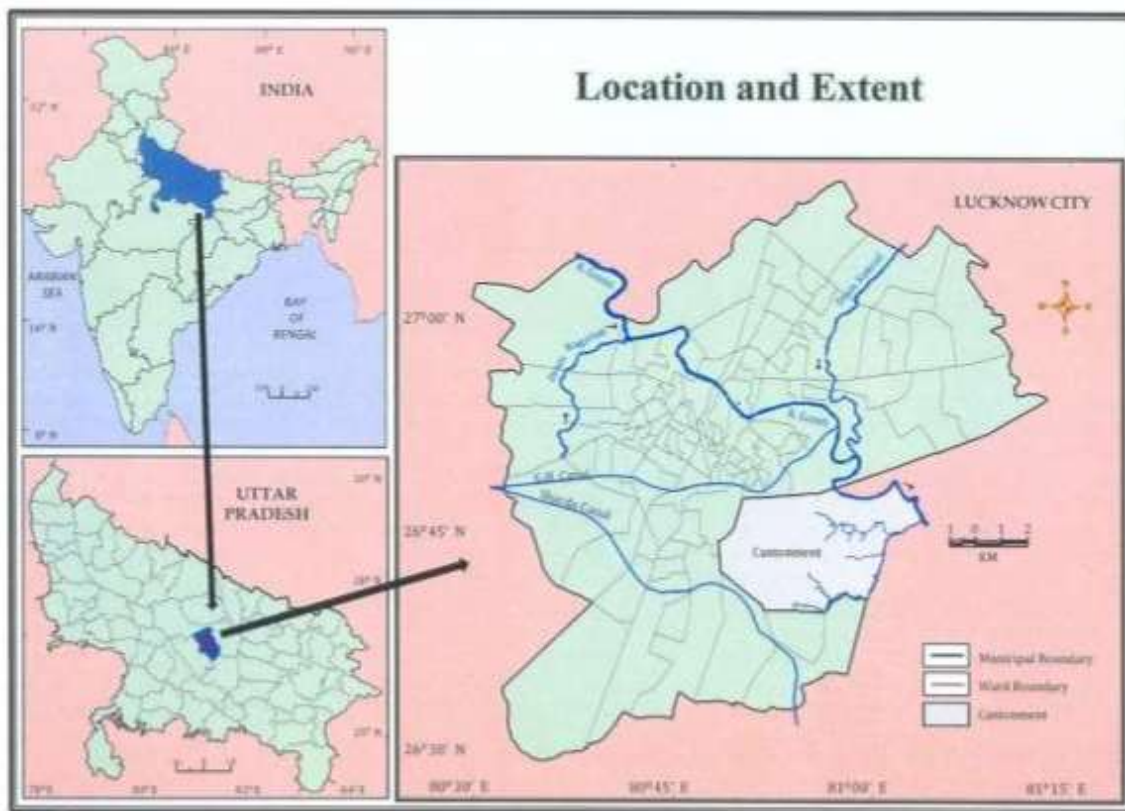


Figure 1 Location Map of Lucknow

### Methodology:

The monitoring stations are chosen based on their geographic location and previous research (Berman, 2010; Shukla, 2010 etc.). Additionally, to assess the ambient air quality status in Lucknow city during the pre- and post-intervention periods, air pollutants such as Respirable Particulate Matter (RSPM or PM<sub>10</sub>), Suspended Particulate Matter (PM<sub>2.5</sub>), Sulphur dioxide (SO<sub>2</sub> (NO<sub>x</sub>)), Nitrogen Oxide Oxides, and Carbon monoxide (CO) are monitored and classified in residential, commercial, and industrial areas. 14 sample stations were selected for this purpose: Vikas Nagar, Indira Nagar, Aliganj, Mahanagar, and Gomti Nagar (residential areas); Chowk, Hazaratganj, Sarai Mali K., Aminabad, Hussainganj, Charbagh, and Alambagh (business areas); and the industrial areas of Talkatora and Amausi are chosen. Due to the speed of the wind and the process of dispersion, the concentration of pollutants is low during the rainy season (July to October). Lucknow receives 200 millimetres of rainfall throughout the rainy season, and as a result, the concentration of air pollutants is lowest during this time. From November to February (post-monsoon period), the concentration of gaseous pollutants such as SO<sub>2</sub> and NO<sub>x</sub> remains extremely high due to calm weather conditions and low dispersion, whereas from March to the arrival of monsoon, the concentration of particulates and gaseous pollutants increases due to turbulence that mixes and enhances the dispersion of pollutants (Narayan, 2009). As a result, the current study compares pre- and post-monsoon changes in pollutant concentrations.

800 people from different parts of the community were interviewed very closely to find out about environmental and health problems in Lucknow, India. The information was then compiled and scientifically analysed using correlation and regression to find out how air pollutants and diseases are linked.

### Lucknow's Air Quality:

## Pre-Monsoon:

Table 1 shows how much air pollution was in the air in Lucknow City before and after the monsoons from 2008 to 2011. Indira Nagar, which is a residential area, had the highest concentration of RSPM for 24 hours in a row. Alambagh, which is a commercial area, had the second highest concentration at 227.28 g/m<sup>3</sup>. There is too much pollution in the air, according to the National Ambient Air Quality Standard. The PM<sub>10</sub> values are above the limit of 100 g/m<sup>3</sup> for industrial, residential, rural, and other areas (NAAQS). This could be because there is a lot of traffic, a lot of congestion at major bus and train stations, and a lot of pollution in the air. This happens both during the day and at night. People also found that Indiranagar has a lot of air pollution because of the rise in building projects, the loss of trees, and the increase in traffic.

Indira Nagar had the highest concentration of fine particulate matter (339.65 g/m<sup>3</sup>), which is a new residential and commercial area. Consequently, there has been a high concentration of SPM level because of how mix functional traits work. Also in Charbagh, the concentration of SPM is very high (410.0 g/m<sup>3</sup>) because it is a commercial area and because there are a lot of cars and people there during working hours (Table 1).

People living in Lucknow city have an average of 14.79 g/m<sup>3</sup> of SO<sub>2</sub> in their city. The range is from 7.42 g/m<sup>3</sup> to 21.13 g/m<sup>3</sup> with an average of 14.79. They are all below the NAAQS level of 80 g/m<sup>3</sup> for SO<sub>2</sub> at all of the stations where they were taken (Table 2.9). Also, the study found that CO and NO<sub>x</sub> concentrations are well below the Central Pollution Control Board's (CPCB) limit of 4000 g/m<sup>3</sup> and 80 g/m<sup>3</sup>. It ranges from 349.50 g/m<sup>3</sup> to 1130.00 g/m<sup>3</sup> for CO and 26.38 g/m<sup>3</sup> to 35.05. (Table 1)

Hence, it is clear from the previous discussion that the concentrations of pollutants in the city vary a lot. The study found that the concentration of pollutants is higher in the central part of Lucknow city than in the south and north-east (except Indira Nagar). This is because there are a lot of people and cars, as well as a lot of small-scale commercial and industrial activities.

## After-Monsoon:

After the monsoon, the concentration of RSPM in Mahanagar (170.02 g/m<sup>3</sup>) and in Alambagh (194.58 g/m<sup>3</sup>) were both high. People living and working in industrial, residential, and commercial areas should not breathe air with more than 100 parts per million of PM<sub>10</sub> in the air (Table 2).

A lot of small particles were found in Mahanagar (362.72/m<sup>3</sup>) and Alambagh (398.85/m<sup>3</sup>), which is a commercial area. SPM was found in a lot of commercial areas because there were a lot of cars and people there during peak hours. Residential and commercial areas that have recently come into existence have a lot of people with SPM levels because they are used for things like building and road construction, transportation and communication (Table 1 shows how many people have SPM levels).

		Average Concentration ( $\mu\text{g}/\text{m}^3$ )									
Area	Sample Station	SPM		RSPM		SO <sub>2</sub>		CO		NO <sub>x</sub>	
		Pre-mon.	Post-mon.	Pre-mon.	Post-mon.	Pre-mon.	Post-mon.	Pre-mon.	Post-mon.	Pre-mon.	Post-mon.
Residential	Vikas Nagar	339.7	311.6	168.1	152.5	17.7	19.0	349.5	520.0	29.5	29.6
	Indira Nagar	379.5	353.2	200.1	163.8	17.8	22.6	978.6	630.0	29.1	34.5
	Aliganj	356.9	298.8	145.7	141.9	14.6	18.0	477.6	480.0	26.9	30.1
	Mahanagar	362.7	362.7	170.0	170.0	7.4	7.4	601.9	543.3	33.9	33.9
	Gomti Nagar	347.0	334.3	175.8	148.2	15.0	21.2	466.0	640.0	26.4	30.2
	Standard	100		60		80		4000		80	
Commercial	Chowk	353.9	382.4	198.0	184.5	17.2	23.8	1025.2	1000.0	31.5	40.2
	Hazaratganj	358.1	358.1	174.6	174.6	7.7	7.7	1016.5	1162.5	33.7	33.7
	Sarai Mali K.	368.5	368.5	173.1	173.1	8.0	8.0	1068.9	1066.7	34.7	34.7
	Aminabad	371.6	347.9	189.2	169.3	17.6	22.4	862.1	1450.0	28.4	36.3
	Hussaingan j	422.4	336.5	205.0	165.5	21.1	21.4	1130.0	980.0	35.8	37.3
	Charbagh	410.5	387.3	202.2	185.6	20.2	24.6	1001.9	1210.0	34.8	43.6
	Alambagh	374.7	398.9	227.3	194.6	19.7	25.2	1071.8	1010.0	33.9	41.5
	Standard	100		60		80		4000		80	
Industrial	Talkatora	390.0	390.0	187.6	187.6	8.2	8.2	962.7	980.4	36.1	36.1
	Amausi	356.6	313.0	168.4	148.6	14.9	21.2	803.8	870.0	30.1	34.9
	Standard	100		60		80		4000		80	

Source: Indian Institute of Toxicology Research (IITR), Lucknow, 2008-2011.

Table 1 Concentration of Air Pollutants in Lucknow City, 2008 and 2011, before and after the rain.

Age-group	Air pollutant and their effect				
	Health Problems	Disease	No response	Total	
Below 18		188	0	24	212 (26.5)
18-30		136	44	20	200 (25.0)
31-60		200	60	16	276 (34.5)
Above 60		108	4	0	112 (14.0)
Total		632 (79.00)	108 (13.5)	60 (7.5)	800 (100)

Source: Personal Survey, 2014

Table 2 Air pollution has affected you and your family over the last year. How did this happen?

Premonsoon: The level of SO<sub>2</sub>, CO, and NO<sub>x</sub> is also below the level that is supposed to be there. SO<sub>2</sub> levels were as high as 18.99  $\mu\text{g}/\text{m}^3$  in commercial areas like Alambagh, Charbagh, and Chowk because of heavy traffic and a lot of people during peak hours. CO levels were also high in commercial areas like Aminabad and Charbagh, with 1450

g/m<sup>3</sup> and 1210 g/m<sup>3</sup> respectively. NO<sub>x</sub> is found in Vikas nagar and Charbagh. It ranges from 29.59 g/m<sup>3</sup> to 43.60 g/m<sup>3</sup> there. There was an average concentration of NO<sub>x</sub> in Lucknow city of 35.46 g/m<sup>3</sup> after the rains (Table 1).

### Air Pollution and the Health Effects of It:

In order to find out the main sources of air pollution in Lucknow city, a perception study was done to find out what people thought about the deteriorating air quality and how it affected their health in Lucknow city. More than 800 people were asked about their lives, and 23.5 percent (188) didn't know how to read or write. 76.5 percent (612) were able to read or write. Of the people who answered, 52 percent said that cars were the main source of air pollution, followed by industries (30.5 percent) and pollutants in the air at home or in the office (1.5 percent) (1.5 percent).

"How did air pollution affect you and your family over the last year?" was one of the questions that people in their age group were asked to answer. Table 2 shows that 79 percent of the people who took the survey said that air pollution was one of the main reasons for their poor health. This is because respiratory problems, suffocation, eye irritation, skin problems, and more are common because of air pollution (13.5 percent). A little over 7% of people didn't answer the question. Those who have to travel by bus through crowded areas to get to work are more likely to be affected by outdoor air pollution than those who don't have to travel by bus at all. About 31% of people in the age group 31-60 have long-term health problems like asthma, diabetes, cancer, and so on. 42% have smoke or dust in their air. Because of what they do, how long they travel, or where they live, they may be the reason.

According to the job structure of the people who took part in the study, a question was asked: "What health problems did you have because of outdoor air pollution over the last two years?"

There are more respiratory problems than suffocation (20.5%), eye irritation (19.5%), and skin problems in Table 3, which shows that 44.5% of people have them (5 percent). About 10.5 percent of the people who took the survey said that outdoor air pollution didn't bother them because they work in agriculture. About 58 percent of people who work in business said they had suffocation because they had to stay in crowded commercial areas for a long time. Industrial workers (14.63 percent) also said they had suffocation because of industrial waste (24.39 percent). Respondents who work for the government and businesses (31.46 percent and 34.83 percent) also have respiratory problems. Skin problems are caused by a lot of pesticides, urea, and other things that are used in agriculture a lot.

Occupation	Type of Health Problem					Total
	Suffocation	Eye Irritation	Skin Problem	Respiratory Problem	No Problem	
Govt. Service	4	20	8	112	16	160 (20.0)
Business	96	56	4	124	52	332 (41.5)
Industrial Worker	24	52	0	28	0	104 (13.0)
Agricultural Labour	0	0	28	0	0	28 (3.5)
Others	40	28	0	92	16	176 (22.0)
<b>Total</b>	<b>164 (20.5)</b>	<b>156 (19.5)</b>	<b>40 (5.0)</b>	<b>356 (44.5)</b>	<b>84 (10.5)</b>	<b>800 (100)</b>

**Source: Personal Survey, 2014**

Table 3 Air pollution has caused health problems for people in the last two years, which they have had to deal with

### A rise in the number of airborne diseases:

Following a number of deaths caused by air pollution in the 1930s, the public and scientists began to pay more attention to the health effects. Many epidemiological studies have shown that respiratory diseases are linked to the amount of particulates in the air. People say that a lot of kids in Kolkata die early because of SPM (Ghose, 2005). Gaseous pollutants can cause respiratory problems and have an impact on reproduction and development (Barman, 2010). Perfect solutions to the problem of airborne disease transmission don't yet exist, but the available technologies, such as outside purge air, filtration, and so on, can be used when their characteristics are known and the goals are clear (Kowalski, 1998).

So, it is important to look at what people think about airborne diseases and how often they happen. Table 4 shows the answers to the question, "How common are air-borne diseases among respondents?" A lot of people have high blood pressure because of high levels of Carboxyl Haemoglobin in their blood, according to a survey. This is followed by eye infections and irritation because of exhaust emissions from cars and other things. As a result of the high concentration of airborne allergens, respiratory problems like viral respiratory infections are the most common. Aerosol, SPM, RSPM, NO<sub>2</sub>, SO<sub>2</sub>, and other airborne allergens are to blame. People who lived in crowded and older parts of the city with poor ventilation and a lot of industrial activity near industrial units had a lot of respiratory problems (Table 4).

In order to figure out how common airborne diseases are in six different parts of Lucknow city, the answers to the question "how common are airborne diseases in different parts of Lucknow city?" were looked at. Zone II has the highest rate of asthma (26.4%), followed by Zone I (23.9%). This is because there is a lot of traffic and businesses there (Table 5). The zones that are also in the outer part of the city, like Zone III, are also less likely to have asthma: 19.5 percent, 17.6 percent, 5.0 percent and 7.5%, for example. These zones are also in the outer part of the city: Resident areas have a level of RSPM that ranges from 136.8 to 244.8 g/m. In commercial areas, the level is 183.9 to 252.9 g/m. Sulphur dioxide and nitrogen dioxide, which can cause inflammation of the bronchi (lungs), may also be to blame for the illnesses that the respondents have. They also have bronchitis, tuberculosis, eye infections, and congenial heart diseases. Further, the higher the concentration of gases, particulates, aerosol, and so on, the more likely these diseases are to happen.

Air-borne Disease	Respondents	
	Number	%
Asthma	159	19.9
Bronchitis	24	3
Pneumonia	108	13.5
Tuberculosis	139	17.4
Lung Cancer	31	3.9
Eye Infection	245	30.6
High BP	377	47.1
Congestion Heart	152	19

**Source: Personal Survey, 2014**

Table 4 How Many People in Lucknow City Were Sick with Airborne Diseases

Zone	Air-borne Diseases Among Respondents (%)							
	Asthma	Bronchitis	Pneumonia	Tuberculosis	Lung Cancer	Eye Infection	Blood Pressure	Congenial Heart
I	23.9	33.3	14.8	22.3	12.9	23.3	16.7	26.3
II	26.4	33.3	7.4	15.1	38.7	20	18.6	26.3
III	19.5	16.7	29.6	30.9	35.5	18	22	18.4
IV	17.6	16.7	33.3	10.1	12.9	11.4	11.1	5.3
V	5	0	3.7	13.7	0	12.2	13	5.3
VI	7.5	0	11.1	7.9	0	15.1	18.6	18.4
	100.0							100.0
Total	(159)	100(24)	100 (108)	100 (139)	100.0 (31)	100.0 (245)	100.0 (377)	(152)

**Source: Personal Survey, 2014**

Table 5 Prevalence of Airborne Diseases Among People in Different Areas of Lucknow City

## The Relationship Between Air Pollutants and Diseases Spread through the Air:

RSPM, SO<sub>2</sub>, CO, and NO<sub>x</sub> are some of the air pollutants that are linked to air-borne diseases like Asthma, Bronchitis, TB, Lung Cancer, Eye Infection, and Congenial Heart. This way, it is possible to figure out how bad the air is and how many people are getting sick. It can be seen from Table 6 that there is a positive correlation between them.

The higher the SPM level, the more air-borne diseases like Asthma, Bronchitis, Congenial Heart, Eye Infection, and Lung Cancer are linked to them, as well as many other diseases. RSPM is also found to be positively and significantly linked to Asthma, Bronchitis, Congenial Heart, Eye Infection, Lung Cancer, and TB, while SO<sub>2</sub> is only moderately linked to air-borne diseases. NO<sub>x</sub> and CO are not linked to air-borne diseases in a big way.

The regression analysis says that the dependent variable (disease) is linked to a series of independent variables (air pollutant), which means that more particulate matter (SPM and RSPM) in the air leads to more airborne diseases.

### SPM Vs Asthma:

Table 7 shows how strong the line between SPM and Asthma is. When we look at R<sup>2</sup> (the Coefficient of Determination), we can see that there is a very strong relationship between the two variables. The regression line explains 67.5 percent of y's variation. There is a table called the coefficient table that has the coefficients for the least square (fitted) line as well as other information about the coefficients. There are two things in column B: the constant is the y intercept and the SPM is the slope. The equation of the line that was found from the output is called.

$$Y (\text{Asthma}) = -130.1 + 0.426 (\text{SPM})$$

There are three levels of significance: 1 percent, 2 percent, and 5 percent. The tabulated values of "t" (2.881) at these three levels of significance are 4.60, 3.75, and 2.78 for the 4 degree of freedom (n-2, where n is 6). It is clear that our calculated value is only significant when it is significant at the 5% level of significance. Thus, the data also shows that there is a causal relationship.

### RSPM Vs Asthma:

This means that about 73.3 percent of the variation in Asthma can be explained by the RSPM. This looks like a good way to make predictions because the value of R<sup>2</sup> is closer to 1 than 0 instead of 0. There are two things in column B: the constant is the y intercept and the SPM is the slope. The equation of the line that was found from the output is called.

$$Y (\text{Asthma}) = -64.496 + 0.538 (\text{RSPM})$$

Analyzed data shows that if the level of RSPM goes up by 1 g/m<sup>3</sup> Congenial Heart 100.0 (152), then we predict that the number of cases of Asthma will rise by 0.538. If the level of RSPM is 0 g/m<sup>3</sup> there will be 64.496 cases of Asthma. There are three levels of significance: 1.0%, 2.0%, and 5.0%. The tabulated values of 't' (3.318) at these three levels are 4.60, 3.75, and 2.78. It is clear that our calculated value is only significant when it is significant at the 5% level of significance. Thus, the data show that there is a causal relationship, too.

		SPM	RSPM	SO <sub>2</sub>	CO	NO <sub>x</sub>	Asthma	Bronch Itis	TB	Lung Cancer	Eye Infect.	Cong. Heart
SPM	r	1	.967**	.902*	.608	.362	.821*	.839*	.378	.579	.680	.769
	Sig.		.002	.014	.200	.480	.045	.037	.460	.228	.137	.074
RSPM	r	.967**	1	.795	.562	.441	.856*	.896*	.549	.604	.829*	.859*
	Sig.	.002		.059	.246	.382	.029	.016	.259	.204	.041	.029
SO <sub>2</sub>	r	.902*	.795	1	.526	.283	.664	.674	-.035	.507	.321	.443
	Sig.	.014	.059		.284	.587	.150	.142	.947	.304	.535	.379
CO	r	.608	.562	.526	1	.621	.119	.239	.130	-.253	.381	.521
	Sig.	.200	.246	.284		.188	.822	.649	.806	.629	.456	.289
NO <sub>x</sub>	r	.362	.441	.283	.621	1	-.030	.085	.064	-.006	.435	.532
	Sig.	.480	.382	.587	.188		.955	.873	.904	.991	.388	.278
Asthma	r	.821*	.856*	.664	.119	-.030	1	.975**	.612	.798	.727	.667
	Sig.	.045	.029	.150	.822	.955		.001	.197	.057	.102	.148
Bronchitis	r	.839*	.896*	.674	.239	.085	.975**	1	.639	.684	.774	.680
	Sig.	.037	.016	.142	.649	.873	.001		.172	.134	.071	.137
TB	r	.378	.549	-.035	.130	.064	.612	.639	1	.330	.884*	.742
	Sig.	.460	.259	.947	.806	.904	.197	.172		.523	.019	.091
Lung Cancer	r	.579	.604	.507	-.253	-.006	.798	.684	.330	1	.496	.515
	Sig.	.228	.204	.304	.629	.991	.057	.134	.523		.317	.296
Eye Infect.	r	.680	.829*	.321	.381	.435	.727	.774	.884*	.496	1	.939**
	Sig.	.137	.041	.535	.456	.388	.102	.071	.019	.317		.005
Cong. Heart	r	.769	.859*	.443	.521	.532	.667	.680	.742	.515	.939**	1
	Sig.	.074	.029	.379	.289	.278	.148	.137	.091	.296	.005	

Source: Field Survey and Statistical Analysis, 2014  
Correlation is significant at the 0.01 level (2-tailed)\*\*  
Correlation is significant at the 0.05 level (2-tailed)\*  
List wise N=6

Table 6 Air Quality and Airborne Diseases: A Correlation

Variables		R	R <sup>2</sup>	t	Significant (p)
Independent	Dependent				
SPM	Asthma	.821	.675	2.881	.045
RSPM	Asthma	.856	.733	3.318	.029
SPM	Bronchitis	.839	.703	3.080	.037
RSPM	Bronchitis	.896	.803	4.041	.016
RSPM	Eye Infection	.829a	.688	2.969	.041
RSPM	Congested Heart	.859	.737	3.351	.029

Source: ??

Table 7 Air Pollutants and Diseases: A Linear Regression Analysis, 2014

### Bronchitis vs SPM:

The model summary section offers critical information about how well our regression model fit (or failed to fit) the observed data. As we can see, R equals .839. R is actually equal to the Pearson Product-Moment correlation coefficient between X and Y, as this is a simple linear regression (i.e., there is only one predictor). R Square is defined in the model summary as R to the power of two. That is to say, it equals (.839)<sup>2</sup>. This is the same as 0.703. This parameter specifies the fraction of variance in Y that can be "explained" or "accounted for" by knowledge of X. This suggests that around 70.3 percent of the variance in Y can be explained by knowledge of X in our data.

To begin, we must interpret the constant. It is 37.556. This means that at  $Y = 37.556$ , the least-squares line intersects the ordinate axis. Additionally, it is the expected value for  $Y$  when  $X$  equals 0. Hence,

$$Y = -37.556 + .113(\text{SPM})$$

This indicates that if SPM equals zero (i.e.,  $X$  equals zero), the expected or forecast value for Bronchitis is -37.556 (i.e.,  $Y' = 37.556$ ). The values obtained for  $t'$  are 3.080, which is only statistically significant at the 5% level of significance.

### Bronchitis vs. RSPM:

Study results show that the correlation between RSPM and Bronchitis is very strong (.896). About 80% of the variation in Bronchitis can be explained by R Square, which is  $R$  to the power of 2, which is 0.803. This looks like a good way to make predictions because the value of  $R^2$  is closer to 1 than 0 instead of 0. Our  $y$  intercept is in column B, and the RSPM is our slope. The equation of the line that was found from the output is called.

$$Y (\text{Bronchitis}) = -20.748 + 0.146 (\text{RSPM})$$

At the 1%, 2%, and 5% levels of significance,  $t'$  (4.041) was 4.60, 3.75, and 2.78 respectively. At the 4 degree of freedom ( $n-2$ ), where  $n$  is 6,  $t'$  was 4.41. As soon as you look at our calculations, you can see that they are only significant at the 5% and 2% level of significance. So we can say that the variable  $y$  (Bronchitis) is linked to RSPM in a big way.

### RSPM vs. Infection of the Eye:

It shows that there is a strong relationship (.829) between RSPM and eye infections in the people who took the survey. Some 68% of changes in eye infections can be explained by RSPM, which has a  $R^2$  value of .688. There is a constant that is the  $y$ -intercept, and the RSPM is our slope. The equation of the line that was found from the output is called.

$$Y (\text{Eye Infection}) = -31.294 + 0.426 (\text{RSPM})$$

At the 5% level of significance, the value of  $t'$  (2.969) is important.

### Congested Heart vs SPM:

Study results show that RSPM and a congested heart problem are also very closely linked to each other (.859). About 73% of the variation in congested heart occurrence can be explained by RSPM, which is R Square. This is because R Square is  $R$  to the power of 2. The equation of the line that was found from the output is called.

$$Y (\text{Bronchitis}) = -20.748 + 0.146 (\text{RSPM})$$

Tabulated values of  $t'$  (4.041) are significant at the 5% level of significance for 4 degrees of freedom ( $n-2$ , where  $n$  is 6). The regression analyses show that there is strong and consistent evidence that there is a link between ambient air pollution and health. There are some relationships (positive regression coefficients) that happen. A strong relationship exists between health problems and Air Pollutants, which is a good thing.

### Conclusion:

The paper used a health-oriented model to figure out what was wrong with the air quality in Lucknow and what that meant for people's health. Use data about air quality to figure out how bad the air is and how bad your health is. People of different ages and jobs have different chances of getting airborne diseases. From an environmental justice point of view, remedial action should come from public health, environmental and social policy, and local planning.

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