

Proceeding Paper

Air Pollution, Its Health Effects on Residents of Patna and Air Quality Forecasting of The City[†]

Krishna Neeti¹, Mohammad Minhaj Faisal¹ and Reena Singh^{2, *}

¹Research Scholar, Department of Civil Engineering, National Institute of Technology Patna, Patna, Bihar 800005, India; mohammadf.pg21.ce@nitp.ac.in (M.M.F); krishnan.phd19.ce@nitp.ac.in (K.N.)

²Assistant Professor, Department of Civil Engineering, National Institute of Technology Patna, Patna, Bihar 800005, India;

* Correspondence: reena@nitp.ac.in; Tel.: +91-9006463991

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Abstract: Air pollution is a serious issue in most parts of Bihar, especially in its capital city, Patna. The air quality in Patna has significantly worsened due to factors like rapid urbanization, increased traffic, and various natural and human-related causes. This decline in air quality has led to several negative health effects. In light of this, the aim of this study was to examine how air pollution affects the long-term health of Patna's residents, taking into account age and exposure time as important factors. We gathered data from one busy intersection in Patna, specifically Danapur. Health effects from air pollution was collected from the residents by a formatted questionnaire. To analyse the relationship between age, exposure time, and the health effects reported by the participants, we used a statistical test called the chi-square test of independence. The findings of the study revealed a clear link between age, exposure time, and the health status of the participants. We concluded that older individuals and those with longer exposure times faced a higher risk associated with the increasing air pollution levels. This study provides a foundation for raising awareness among both authorities and the general public of the adverse health impacts associated with declining air quality, emphasizing the urgency in taking appropriate measures to counter this challenge.

Keywords: Air Pollution; Short Term effects; Long Term Effects; Chi Square Test; Extrapolation; Air Quality Forecasting

1. Introduction

Bihar's capital city Patna, India particularly, bears the brunt of air pollution, a burgeoning concern across numerous regions worldwide [1]. Several factors, including rapid urbanization, an increase in vehicular traffic, and a blend of natural and anthropogenic sources, have resulted in significant deterioration of Patna's air quality [2]. Multifaceted challenges have been posed as a result of deteriorating air quality, especially in the context of public health. The purpose of this study was to examine the complex relationship between air pollution and well-being in Patna, especially regarding the effects over long periods of time, taking age and exposure period into account [3]. The ambient air conditions were reflected in the data collected from the bustling district of Danapur Cant. within Patna. Through a meticulously designed questionnaire, we obtained firsthand accounts from the local population regarding the health effects associated with air pollution, in addition to objective data. A rigorous statistical framework was used to explore the intricate relationship between age, exposure duration, and health implications [4]. Among the analytical tools available, the chi-square test of independence proved most effective in establishing patterns and correlations within the dataset. Based on the results of this comprehensive analysis, it was revealed that extended periods of exposure to high

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pollution levels are connected to advancing age of individuals, further exposing their heightened vulnerability to health problems. There is an imperative need for strategic intervention, highlighting an imperative step towards resolving this complex challenge and enhancing Patna's well-being.

2. Method

The area selected for our study was Marshall Bazaar at Danapur cantt. The area was so chosen as they usually had high vehicular density and had markets in and around it. A structured questionnaire was prepared which was then used to collect data from individuals like auto rickshaw drivers, shop owners, vendors etc. to assess the short term and long-term effects of air pollution on their health.

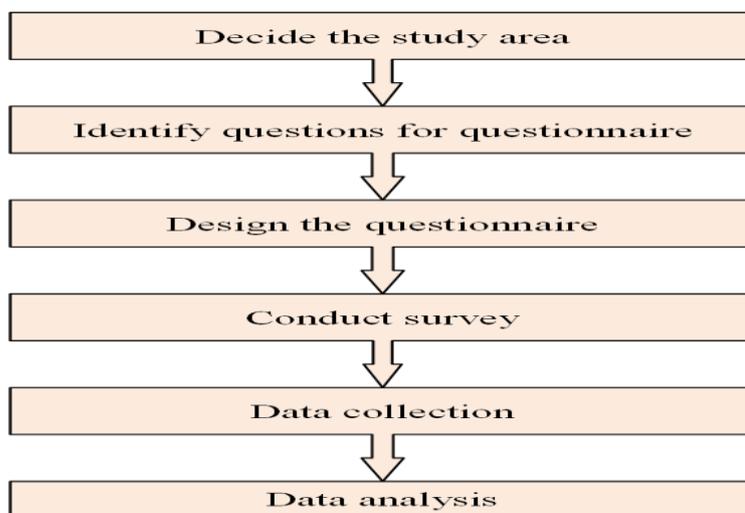


Figure 1. Flowchart used in the study.

3. Survey Data

Survey data is collected using face to face interview method. The questionnaire is based on asking age, exposure time and the health problems they are facing. Health problems are of 2 types – Short term diseases which include Headache, coughing, sneezing, ENT irritation etc. while long term diseases include Asthma, Bronchitis, Lung Cancer and other respiratory problems.

Table 1. Occurrences of diseases in people owing to Air pollution with their age as variable.

Headache						
Age Group	Never	Rare	Often	Frequent	Always	Total People surveyed
15-30	4	6	7	6	8	31
31-45	9	5	3	8	7	32
46-60	3	2	2	10	8	25
>60	1	3	6	8	11	29
Total	17	16	18	32	34	117

ENT						
Age Group	Never	Rare	Often	Frequent	Always	Total People surveyed
15-30	5	6	5	9	6	31
31-45	7	4	6	8	7	32
46-60	6	4	2	4	9	25
>60	6	2	5	6	10	29
Total	24	16	18	27	32	117

Respiratory Problem						
Age Group	Never	Rare	Often	Frequent	Always	Total People surveyed
15-30	4	4	7	8	8	31
31-45	6	6	4	7	9	32
46-60	6	2	3	6	8	25
>60	3	4	5	9	8	29
Total	19	16	19	30	33	117

Asthma						
Age Group	Never	Rare	Often	Frequent	Always	Total People surveyed
15-30	4	4	5	10	8	31
31-45	6	7	6	9	4	32
46-60	5	5	3	6	6	25
>60	5	3	5	7	9	29
Total	20	19	19	32	27	117

Bronchitis						
Age Group	Never	Rare	Often	Frequent	Always	Total People surveyed
15-30	14	11	4	2	0	31
31-45	15	9	5	3	0	32
46-60	6	5	7	7	0	25
>60	10	8	6	5	0	29
Total	45	33	22	17	0	117

Lung's cancer						
Age Group	Never	Rare	Often	Frequent	Always	Total People surveyed
15-30	31	0	0	0	0	31
31-45	32	0	0	0	0	32
46-60	25	0	0	0	0	25
>60	29	0	0	0	0	29
Total	117	0	0	0	0	117

Table 2. Occurrences of diseases in people owing to Air pollution with their exposure time as variable.

Lung's cancer						
Exposure Time	Never	Rare	Often	Frequent	Always	Total People surveyed
0-30 Mins	3	9	5	6	1	24
30-60 Mins	6	7	4	5	3	25
1-2 Hrs.	5	5	2	8	6	26
2-4 Hrs.	2	4	3	6	5	20
>4 Hrs.	2	3	4	7	6	22
Total	18	28	18	32	21	117

ENT						
Exposure Time	Never	Rare	Often	Frequent	Always	Total People surveyed
0-30 Mins	5	2	5	5	7	24
30-60 Mins	6	6	2	6	5	25
1-2 Hrs.	2	5	4	7	8	26
2-4 Hrs.	4	2	3	5	6	20
>4 Hrs.	3	4	4	7	5	22
Total	20	18	18	30	31	117

Respiratory problems						
Exposure Time	Never	Rare	Often	Frequent	Always	Total People surveyed

0-30 Mins	4	6	2	7	5	24
30-60 Mins	4	4	4	7	6	25
1-2 Hrs.	4	3	4	6	3	20
2-4 Hrs.	5	4	6	7	4	26
>4 Hrs.	3	6	3	6	4	22
Total	20	23	19	33	22	117

Asthma

Exposure Time	Never	Rare	Often	Frequent	Always	Total People surveyed
0-30 Mins	5	5	2	6	6	24
30-60 Mins	5	3	4	7	6	25
1-2 Hrs.	4	3	2	5	6	20
2-4 Hrs.	2	4	8	5	7	26
>4 Hrs.	3	2	4	6	7	22
Total	19	17	20	29	32	117

Bronchitis

Exposure Time	Never	Rare	Often	Frequent	Always	Total People surveyed
0-30 Mins	5	6	5	1	7	24
30-60 Mins	8	7	2	2	6	25
1-2 Hrs.	6	3	0	4	7	20
2-4 Hrs.	5	3	7	6	5	26
>4 Hrs.	4	2	1	6	9	22
Total	28	21	15	19	34	117

Lung's Cancer

Exposure Time	Never	Rare	Often	Frequent	Always	Total People surveyed
0-30 Mins	24	0	0	0	0	24
30-60 Mins	25	0	0	0	0	25
1-2 Hrs.	20	0	0	0	0	20
2-4 Hrs.	26	0	0	0	0	26
>4 Hrs.	22	0	0	0	0	22
Total	117	0	0	0	0	117

3. Results and Discussions

In this, effect of air pollutants on human health is studied. For this purpose, initially the air quality parameter of the busy business location of Patna is observed. The commonly observed diseases owing to Air pollution is taken from literature & health of people affected due to their exposure to environment is studied through a structured questionnaire.

3.1. Long Term Diseases

Chi square test of independency is adopted to check the dependency of long-term disease with age [5]. When the frequencies of the two data are known, chi square test is best suited method to check the dependency between the given data.

To check the dependency of long-term disease with age, two hypotheses are assumed

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- H0 – There is no relationship between health of people and age.
- H1 – There is a relationship between health of people and age

Table 3. Diseased (Long term) and healthy people in different age group as per survey.

Age (in yrs.)	Diseased	Healthy
15-30	47	14

31-45	42	22
46-60	32	20
>60	41	17

Now, using Chi square test of independence, p value = 0.2924, As p value > 0.05, the null hypothesis is rejected. Thus, occurrence of long-term diseases is dependent on the age group of individuals.

4. Conclusions

In all cases, p value using chi square test of independency is > 0.05. As a result, null hypothesis is rejected. Thus, occurrence of both short terms and long-term diseases is dependent on the age as well as exposure time of individuals.

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