

## Impact of Air Pollution on Human Health in Dehradun City

A. Gautam, M. Mahajan, and S. Garg

People's Science Institute,  
252/1, Vasant Vihar, Dehra Doon - 248006: (eqmg@rediffmail.com)

### Abstract

The Doon valley is an 'Ecologically Fragile Zone' under Environmental (Protection) Act, 1986. Major source of air pollution in Dehra Doon is vehicular traffic. The present study was to study the adverse health effects of ambient air pollution in different areas of Dehra Doon and examine the relationship between levels of air pollution and health effects.

Air quality monitoring and a questionnaire-based health survey were adopted as the techniques for this study, which was conducted in four areas of Dehra Doon - two commercial areas, and two residential areas. Twenty-four hours sampling was done. From the analysis of data collected, it was found that RPM concentrations exceeded prescribed national standards in commercial areas and were just tolerable in residential areas. The Average Percentage Disease Occurrence was found to commensurate with the pollution level.

**Keywords:** vehicular pollution, particulate matter, coefficient of correlation, average percentage disease occurrence

### Introduction

Air quality affects human health. Nearly 1.4 billion urban residents in the world breathe air that fails the WHO air quality standards (World Resource Institute, 2000). At the global level, mortality due to exposure to outdoor air pollution is estimated to range from 200,000 to 570,000 (CPCB, 2001). In Indian cities, among the most polluted in the world, available mortality and morbidity statistics indicate that respiratory infections and chronic conditions are widespread (Nath, 1999).

Dehra Doon city is situated in a valley, located between the outer Himalayas and Shivalik ranges. Very little air circulates in or out of this region and the pollutants remain trapped near the ground level. Owing to its unique physiography, Doon valley has been declared as an 'Ecologically Fragile Zone' under the provisions of the Environmental (Protection) Act, 1986 and Uttar Pradesh Special Area Development Act, 1986 (People's Science Institute, 1995)

Looking at the special status of Dehra Doon, a study of air pollution has been made. Major source of air pollution in Dehra Doon is vehicular traffic. Vehicles emit particulate matter, sulphur dioxide, nitrogen oxides, carbon monoxide, hydrocarbons, etc. Particulate matter, the main atmospheric pollutant, can have severe health effects. Air pollution episodes in Muese Valley (1930), Donora (1948) and the London fog of 1952 resulted in heavy mortality (CPCB, 2001). These events indicate that short term elevated levels of particulate matter and sulphur dioxide can lead to a variety of pulmonary disorders including mortality. Sulphur dioxide (SO<sub>2</sub>) and nitrogen oxides (NO<sub>x</sub>) can have adverse effects on human health as well. Exposure to even low levels of SO<sub>2</sub> is known to affect breathing.

The objectives of the present study were:

- To study the adverse health effects of exposure to ambient air pollution in different areas of Dehra Doon.
- To examine the relationship between the levels of air pollution and the percentage of affected people in the selected area of Dehra Doon city.

### Study Area and Methodology

Air quality monitoring and a questionnaire-based health survey in four areas of Dehra Doon were conducted during January and February 2003. The selected areas included two commercial areas, Lakhi Bagh and Clock Tower, both with highly congested vehicular traffic, and two comparatively clean residential areas, Vasant Vihar and Kedarapuram. Kedarapuram is less urbanised and medium density area compared to Vasant Vihar.

Monitoring of air pollutants in the present study was undertaken at 4 stations, two primarily commercial and two residential. Twenty-four hours sampling was done. At each sampling site, two samples were collected every month in the first and the second half of the month. Sampling was done in three months of winter (2002 - 03). The parameters measured were (i) RPM (Respirable Particulate Matter), (ii) TSPM (Total Suspended Particulate Matter), (iii) NO<sub>x</sub> and (iv) SO<sub>2</sub> through analysis as per IS: 5182 guidelines.

Health survey of 519 individuals was conducted in the selected areas through a questionnaire. Local residents, shopkeepers, hawkers, auto-rickshaw drivers, etc., were asked to list the occurrence of respiratory problems like cough, dry cough, cold, runny nose, nose block, bronchitis, wheezing, pneumonia and asthma along with eye problems, skin diseases and heart diseases. Information regarding respondent's age, sex, occupation, income, residence, food habits, etc. was also collected for subsequent analysis. The number of respondents in the four sites is given in Table 1.

**Table 1: No. of Respondents in Different Study Sites**

S. No.	Study site	No. of respondents
1	Lakhi Bagh	148
2	Clock Tower	125
3	Kedar Puram	119
4	Vasant Vihar	127

## Results and Discussion

### Air Quality

Air quality data are presented in Table 2. It shows the average concentrations of RPM, TSPM, NO<sub>x</sub> and SO<sub>2</sub>. It may be seen that the RPM concentrations exceed the CPCB prescribed standards in both the commercial areas of Lakhi Bagh and Clock Tower, where it is alarmingly high, and are just tolerable in the residential areas of Kedar Puram and Vasant Vihar.

**Table 2: Ambient Air Quality in Different Areas of Dehra Doon in Winter (2002 – 03)**

S. No.	Stations	Pollutants in $\mu\text{g}/\text{m}^3$			
		RPM	TSPM	NO <sub>x</sub>	SO <sub>2</sub>
1.	Lakhi Bagh	217	608	78	31
2.	Clock Tower	148	444	58	25
3.	Kedar Puram	96	182	24	13
4.	Vasant Vihar	77	148	20	9
CPCB Standard*		100	200	80	80

\* Source: CPCB, National Ambient Air Quality Monitoring Series, NAAQMS/22/2001-02.

### Health Effects

Information was collected from the respondents about the incidence of eye problems, acute and chronic respiratory diseases and skin diseases. In many cases incidence of multiple diseases in a single respondent was reported. Table 3 presents an account of the percentage occurrence of various diseases in respondents interviewed at the different study locations.

**Table 3: Percentage of Respondents Reporting Specific Ailments**

S. No.	Disease	Lakhi Bagh	Clock Tower	Kedar Puram	Vasant Vihar
1.	Eye Problems	46.6	38.4	12	15
2.	Cough	46.6	42.4	26	34
3.	Dry Cough	13.5	12	1.7	3.9
4.	Sneezing	26.7	24.8	12	15
5.	Nose Block	22.3	18.4	13	11
6.	Running Nose	11.5	13.6	5	9.4
7.	Wheezing	20.9	16	12.5	11.1
8.	Bronchitis	8.1	7.2	3.3	6.3
9.	Asthma	4.1	1.6	2.5	1.6
10.	Skin Disease	4.7	10	1.7	0.6
Total Number of Respondents		148	125	119	127

A comparison of the average percentage disease occurrence (APDO) in the commercial areas (with high concentrations of air pollutants) and the residential areas (with low concentrations of air pollutants) is presented in Table 4. It shows that for every ailment, except the chronic ones – bronchitis and asthma, the APDO is significantly higher in the commercial areas, with higher concentrations of air pollutants, than in the residential areas. Since the main source of the pollutants in the commercial areas is motor vehicular traffic, there is a clear need to decongest such traffic in these areas.

**Table 4: Comparison between Commercial and Residential Areas' Disease Patterns**

S. No.	Diseases	APDO* in Commercial Areas with high level of Air Pollution(%)	APDO* in Residential Areas with low level of Air Pollution (%)
1	Eye Problems	43	14
2	Cough	45	30
3	Sneezing	26	14
4	Nose Block	20	12
5	Wheezing	19	12
6	Dry Cough	13	3
7	Running Nose	13	7
8	Bronchitis	8	5
9	Asthma	3	2
10	Skin Diseases	7	1

\*APDO – Average Percentage Disease Occurrence

A survey of exposure to air pollution and its consequent health effects done in Mumbai in 1996 by IIT-Bombay and CPCB have also reported findings of a similar nature (Ghosh 2001). The maximum number of respondents suffering from chronic cough (18.4%) were from high pollution areas, it was followed by those (10.2%) living in medium pollution zones and finally those (6.9%) low pollution zones.

Table 5 shows the association between the concentrations of different air pollutants and the percent incidence of diseases in terms of the value of the coefficients (R) between them. The degree of association between the different air pollutants and the occurrence of the disease on the basis of the value of the coefficient of correlation (R) is presented in Table 6.

**Table 5: Coefficient of Correlation (R) between Specific Air Pollutants and Illnesses.**

S. No.	Diseases	Ambient Air Pollutants			
		RPM	SPM	NO <sub>x</sub>	SO <sub>2</sub>
1.	Eye Problems	0.94	0.98	0.99	0.97
2.	Cough	0.85	0.90	0.91	0.86
3.	Dry Cough	0.90	0.96	0.96	0.94
4.	Sneezing	0.87	0.94	0.94	0.92
5.	Nose Block	0.98	0.99	0.99	0.99
6.	Running Nose	0.58	0.70	0.71	0.67
7.	Wheezing	0.99	0.98	0.98	0.97
8.	Bronchitis	0.71	0.77	0.77	0.71
9.	Asthma	0.77	0.66	0.65	0.63
10.	Skin Disease	0.54	0.66	0.67	0.71

Tables 5 and 6 clearly show that eye and acute respiratory ailments, except runny nose, correlate strongly with all the air pollutants studied. Chronic ailments like bronchitis, asthma and skin diseases, however, have a lower correlation with motor vehicular air pollutants. This is not surprising since the longer-term diseases most likely are also influenced by other factors.

**Table 6: Categorization of the Values of Coefficient of Correlation (R) between Air Pollutants and Illnesses.**

S. No.	Degree of Association (R)	Diseases Associated with RPM	Diseases Associated with TSPM	Diseases Associated with NO <sub>x</sub>	Diseases Associated with SO <sub>2</sub>
1	Excellent (R > 0.9)	Eye Problem Nose Block Wheezing	Eye Problem Dry Cough Sneezing Nose Block Wheezing	Eye Problem Cough Dry Cough Sneezing Nose Block Wheezing	Eye Problem Dry Cough Sneezing Nose Block Wheezing
2	Very Good (0.8 ≤ R ≤ 0.9)	Cough Dry Cough Sneezing	Cough	-	Cough
3	Good (0.7 ≤ R ≤ 0.8)	Bronchitis Asthma	Bronchitis Runny Nose	Bronchitis Runny Nose	Bronchitis Skin Disease
4	Fair (R < 0.7)	Runny Nose Skin Disease	Asthma Skin Disease	Asthma Skin Disease	Runny Nose Asthma

## Conclusions

The results of the epidemiological study indicate that air pollution in Dehra Doon city is seriously affecting the health of the people, especially in Lakhi Bagh and Clock Tower, which are the most polluted areas. The source of pollution is motor vehicular traffic. Eye diseases and acute respiratory illnesses correlate strongly with air pollution levels. Chronic diseases have a lower correlation coefficient than acute illnesses with the extent of air pollution in Dehra Doon. There is thus a serious need to reduce traffic congestion in Dehra Doon's commercial areas.

## Acknowledgements

Financial support for this project was provided by The Ford Foundation, New Delhi. The guidance provided by Drs. G D Agrawal and R H Siddiqui, Honorary Advisors to the Environmental Quality Monitoring Group at PSI, is gratefully acknowledged.

## References

1. CPCB, September 2001: Air Pollution and Human Health, *Parivesh*, CPCB, New Delhi.
2. Ghosh C., September 2001: Clear as Air, Down to Earth, Vol.10, No.8.
3. Nath K.J., 1999: Environmental Health Monitoring and Management Action Plan, Proceedings of the Workshop on 'Environmental Epidemiology Training Course', Lucknow, Industrial Toxicology Research Centre.
4. Nath S., 1999: Prevention and Control of Health Hazards due to Industrial Pollution, Proceedings of the Workshop on Environmental Epidemiology Training Course, Lucknow, Industrial Toxicology Research Centre.
5. Peoples Science Institute, 1995: Ambient Air Quality Monitoring of Dehra Doon, People's Science Institute, Dehra Doon.
6. World Resource Institute, 2000: Health Effects of Air Pollution, Washington (DC), World Resource Institute.