

Correlation between Air Pollution and associated Respiratory Morbidity in Delhi

Girija Jayaraman and Nidhi



**Centre for Atmospheric Sciences
Indian Institute of Technology, New Delhi**



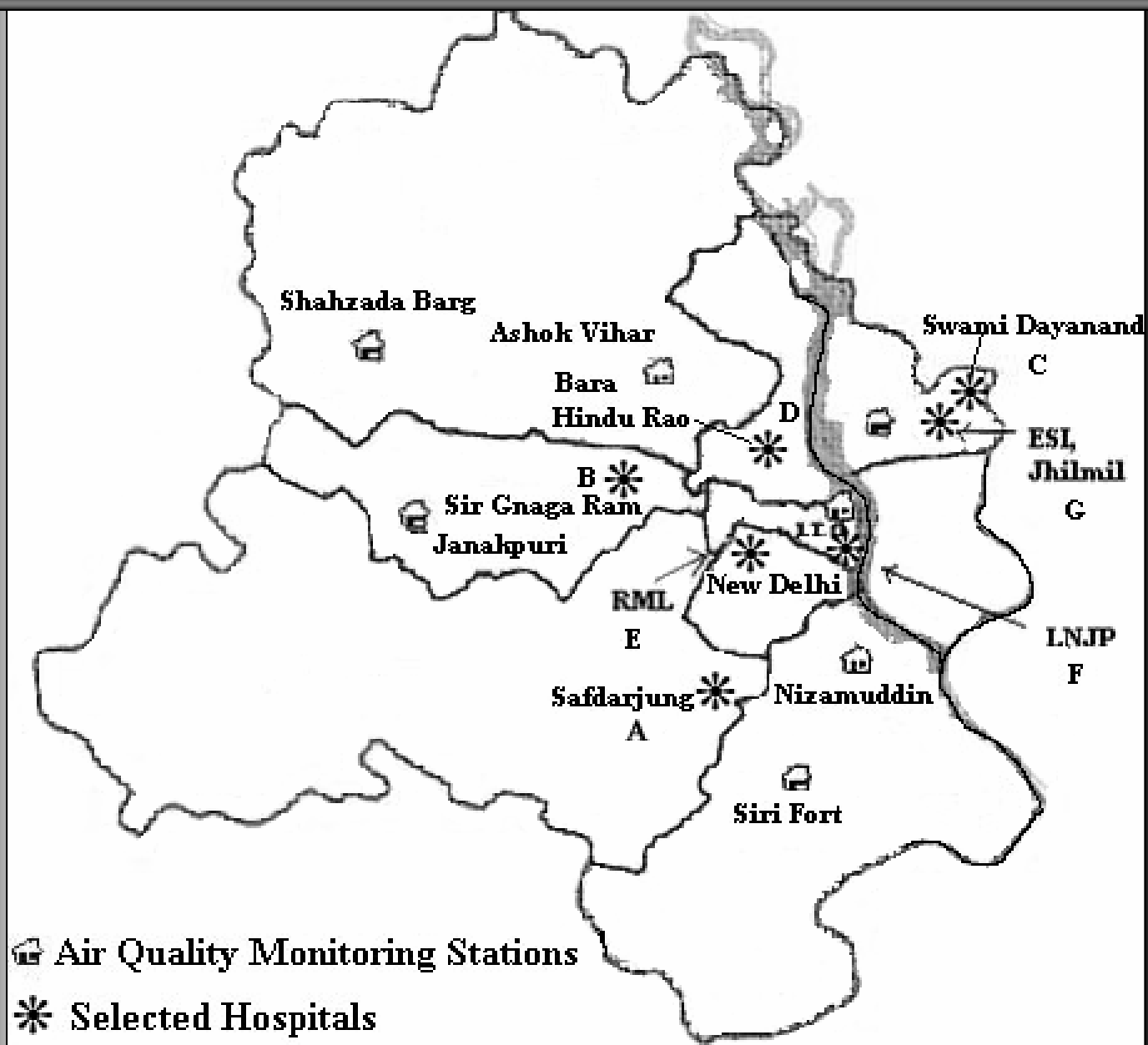
Context and Objectives

Context

- Rates of respiratory illness and symptoms are elevated (?) due to increase in the mean levels of SO_2 , NO_x , ozone and TSPM
- Broad variation in the air quality of Delhi in different seasons offers the opportunity to investigate health effects.

Objectives

- To assess simultaneously
 - i) air quality (SO_2 , NO_2 , OZONE, PM and RSPM levels)(CPCB data)
 - ii) meteorological conditions (IMD data) (temperature, relative humidity)
 - iii) hospital visits/admissions on account of respiratory illness.
- To answer the question: Is there a definite link between hospital visits/admissions and pollution level?



Map of Delhi showing hospitals selected and respective air quality monitoring stations.

Methodology

● Outcome Assessment

Hospital admissions on account of respiratory diseases.

● Exposure Assessment

Measurements of different air pollutants from fixed site monitors.

● Statistical Approach

Juxtaposition of a time series of morbidity with a time series of air pollution.

DATA COLLECTION

I. Hospital Admission

a) Monthly Admissions (Jan'98 to Dec'05):

- Safdarjung (South Delhi)
- Swami Dayanand (East Delhi)
- Ram Manohar Lohia (Central Delhi)
- E.S.I. Jhilmil Colony (East Delhi)
- Ganga Ram (West Delhi)
- Hindu Rao (North Delhi)
- LNJP (Central Delhi)

b) Daily Admissions (Jan'04 to Jun'05): Respiratory Unit of Safdarjung

II. Pollutants Under Study: SO₂, NO₂, SPM, RSPM (CPCB) CO, Ozone (Only for daily data analysis)

III. Meteorological Parameters : Temperature, Relative Humidity, Wind Speed (India Meteorological Data)

Data Classification

Variables Classification

Dependent variable:	No. of monthly admissions/daily visits (respiratory illness)
Independent Variables:	Monthly/daily average concentrations of pollutants
Covariates:	Monthly/daily average of meteorological parameters

Seasonal Classification

Summer:	March – June
Monsoon:	July – September
Winter:	October - February

Statistical Models Used

Poisson Regression Model – expresses hospital admissions as a function of pollution and weather variables.

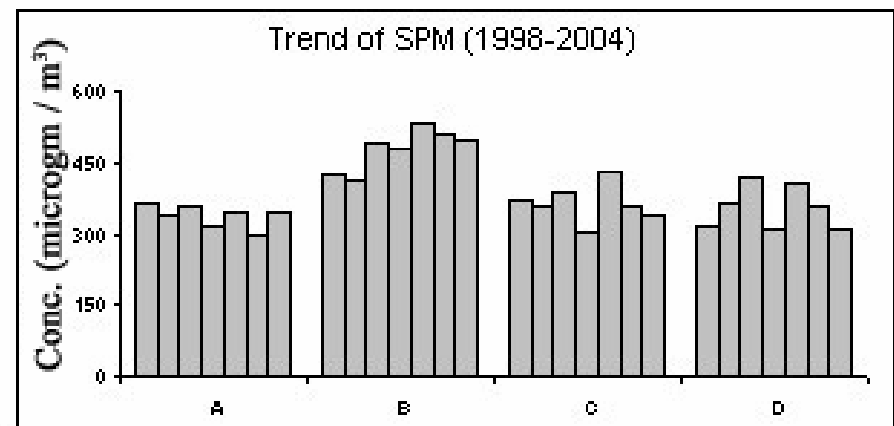
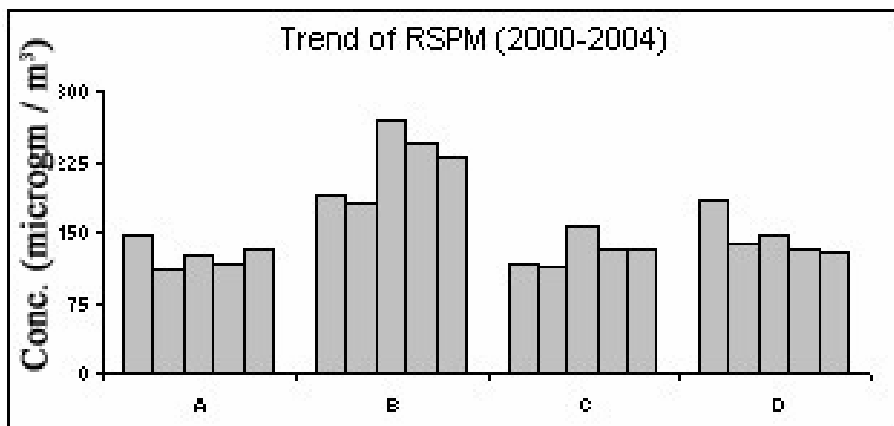
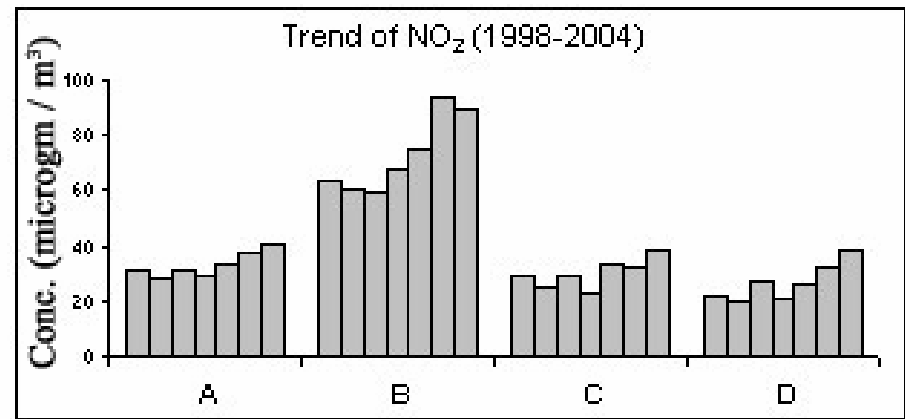
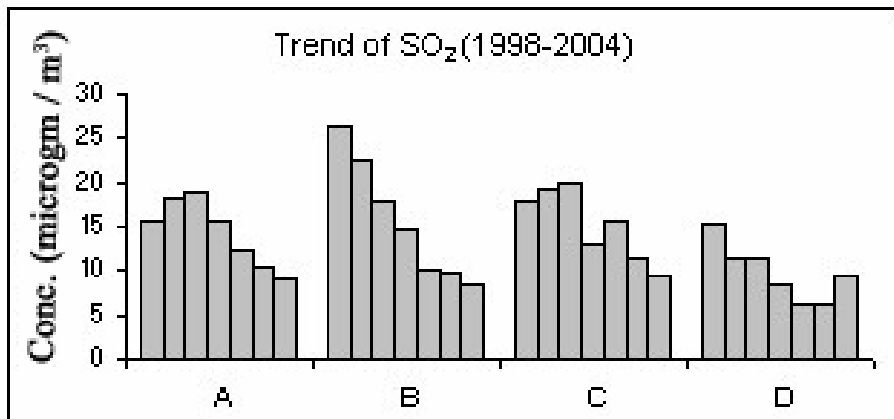
- ❑ **Monthly Data:** Generalized Linear model (GLM)
- ❑ **Daily Data:** Generalized Additive Model (GAM) using Lowess smoothing.

Relative risks (RRs): Proportionate increase in number of admissions/visits due to unit increase in the concentration of different pollutants.

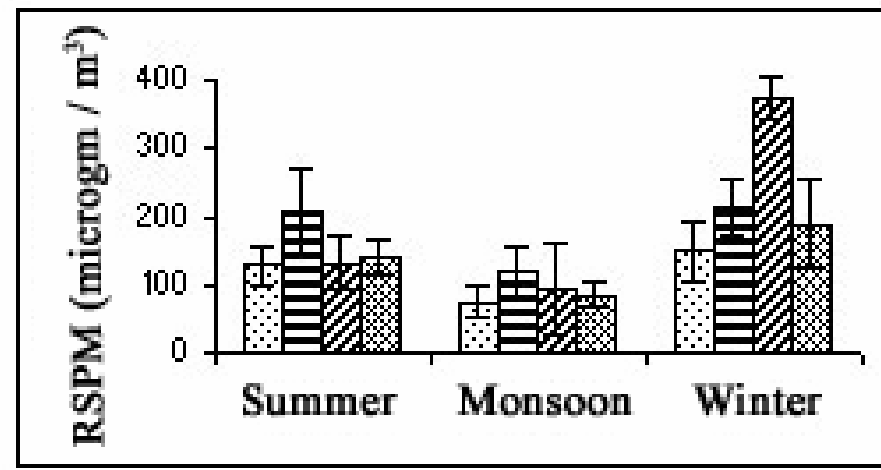
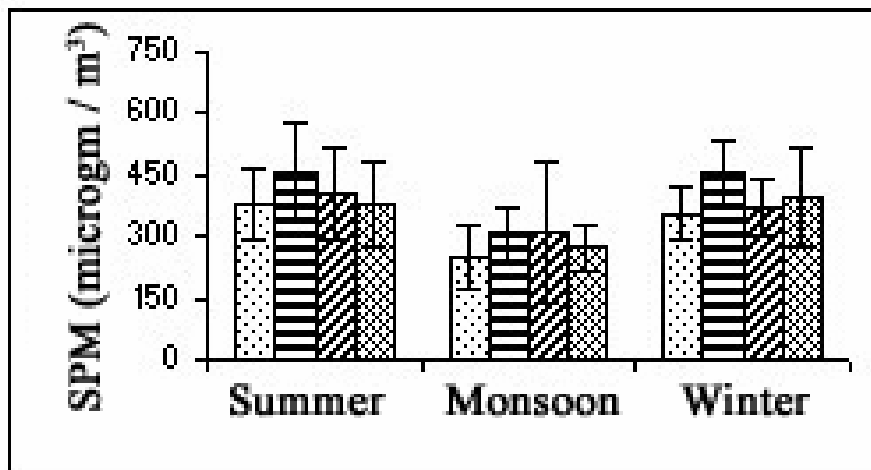
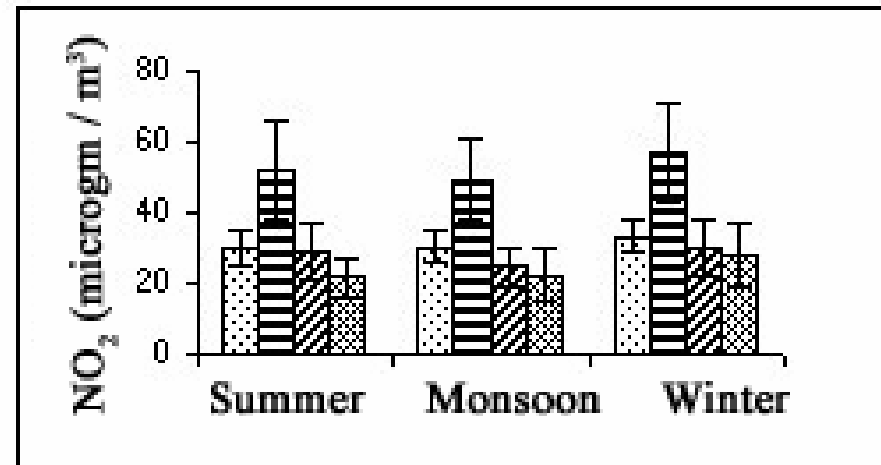
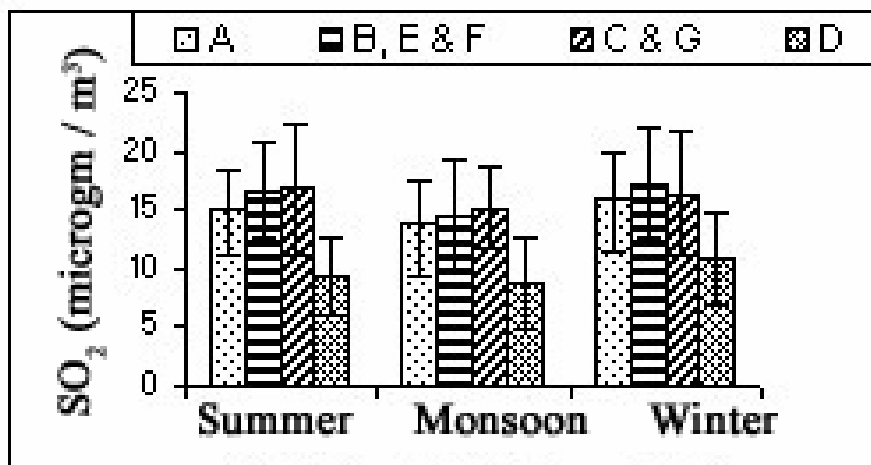
**Trend of Monthly Count of Admissions in different
Hospitals over the study period (1998 to 2004)**

Significant seasonal / yearly impact of pollutants on monthly hospital admissions

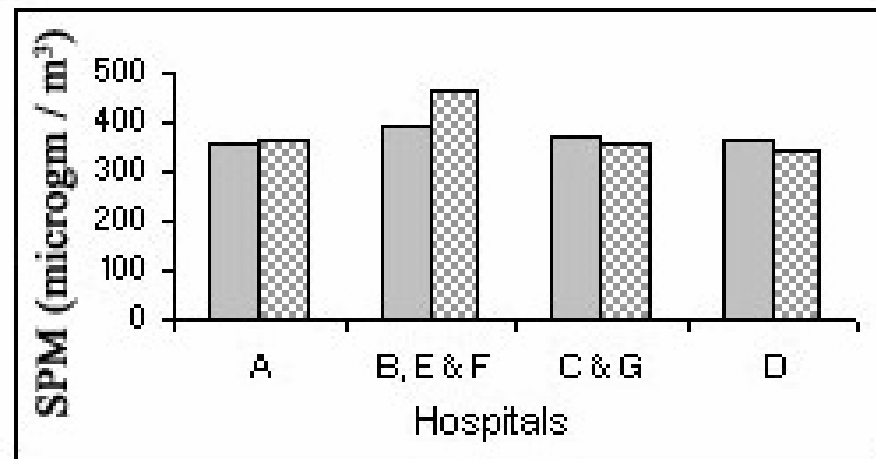
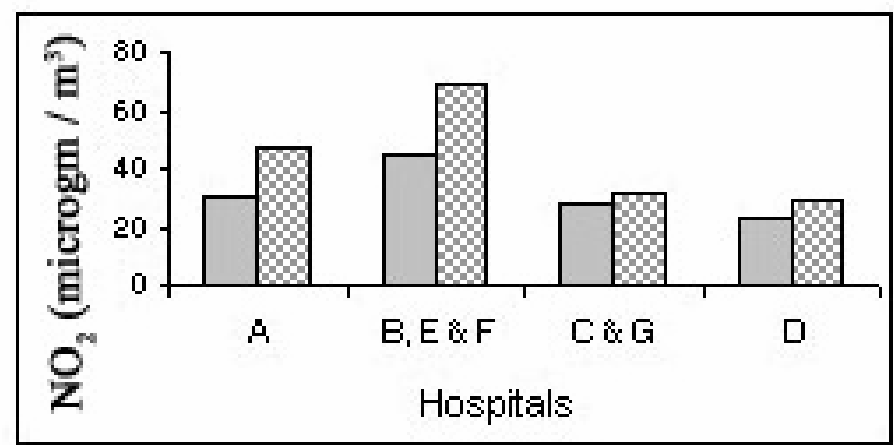
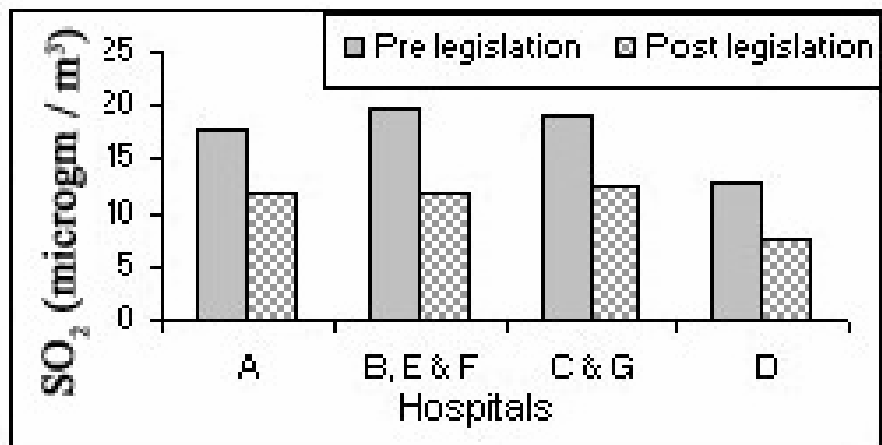
Hospitals	Summer	Monsoon	Winter	Whole study period
A	RSPM	---	SO ₂ & SPM	SPM
B	---	SO ₂	SO ₂	---
C	---	---	---	---
D	SO ₂ & SPM	SO ₂ & SPM	SO ₂ , NO ₂ & RSPM	SO ₂ & NO ₂
E	NO ₂	---	SO ₂	SPM
F	RSPM	NO ₂	---	NO ₂
G	SO ₂ & SPM	SO ₂ & SPM	---	---



Air Quality near all the hospitals (1998 – 2004)



Air quality near seven hospitals in different seasons.

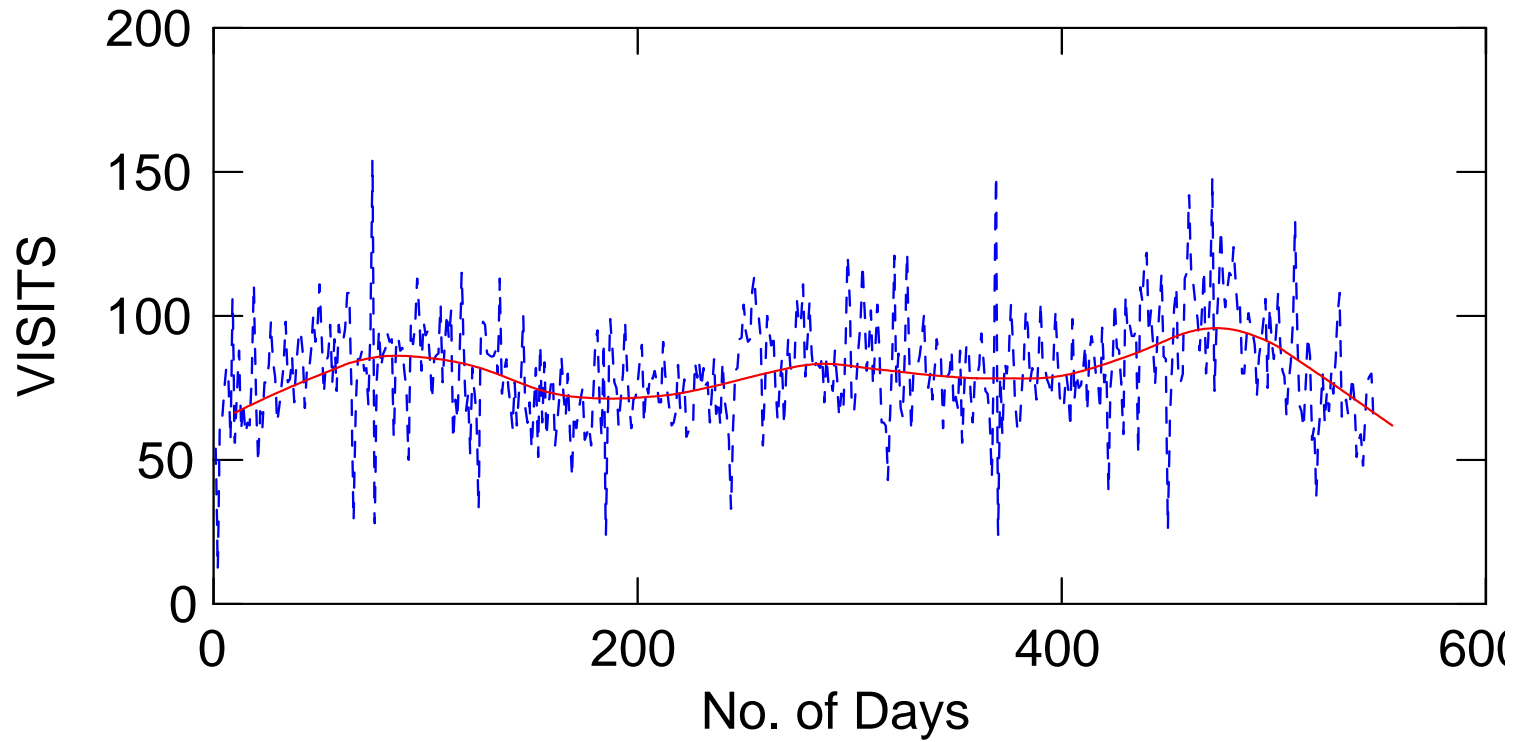


Average concentration of pollutants in pre and post legislations periods.

Daily Data
(Safdarjung Hospital)

Lowess Smooth of Hospital Patients

Series Plot



Assumptions

- Comparison by time rather than place.
- Confounders are factors that vary on short time scales and are associated with daily visits, e.g., weather patterns, pollutants.
- Time invariant characteristic such as gender is not a potential confounder.
- Smoking is not a confounder unless consumption patterns change on scale of days.
- Indoor air pollution, such as that derived from cooking, cannot be considered as a confounder.
- There is no complete thermal isolation between outdoor and indoor air.

Significant seasonal / yearly impact of pollutants on daily hospital visits in Safdarjung Hospital

Whole Study Period	NO ₂ , RSPM & Ozone
Summer	NO ₂ & RSPM
Monsoon	-----
Winter	CO & Ozone

Results

For entire study period:

- Hospital visits were observed to be significantly associated with some of the pollutants.
- Single pollutant model predicted significant associations with all the pollutants except NO₂ and CO but they were closer to baseline (RRs " 1).
- Only RSPM and ozone were not affected by controlling other pollutants in the model, however, the RRs increased in magnitude (ozone: 3.3% → 24.4% & RSPM: 0.6% → 3%.)
- In all the adult age groups, Ozone, NO₂ & RSPM, in that order, were observed to have significant association with the hospital visits.

Conclusions

Monthly Admissions:

- Respiratory disease admissions were related to the pollution but these associations were not consistent in different hospitals.
- Winter effect of SO₂ was apparent near every hospital which may be due to the fact that its emission is high from burning of fossil fuels.

Daily Visits:

- Our studies to assess the association between air pollution and health suggest that the usual air pollution levels in Delhi, specifically of O₃,NO₂ and RSPM are associated with an increase (**24%,13%,3% respectively**) in respiratory diseases related hospital visits.
- The estimated values of relative risks for the above three pollutants were remarkably stable in different age groups.
- Unlike other pollutants, particulate matter is not a single pollutant, rather a class of pollutants. Therefore, it is advisable to identify its one or more of the most harmful components.

LIMITATIONS OF STUDY

- ❑ Non uniformity in the maintenance of records in the hospitals monitored.
- ❑ Non uniformity in the classification of diseases in different hospitals.
- ❑ Further sub classification of respiratory diseases is missing.
- ❑ Location wise identification of patients visiting non MCD hospitals, i.e., Safdarjung, Sir Ganga Ram, LNJP, RML etc. is difficult.
- ❑ Data not available on required time scale (hospital admissions as well as pollutants concentration)
- ❑ The pollutants like Ozone and carbon monoxide are not measured at all the sites of Delhi.

Recommendations

Apart from providing health services, there is a need to place emphasis to be given to maintain the records properly in all the hospitals.

All the hospitals should follow uniform classification of diseases, say as per International Classification of Diseases (ICD).

To study daily variation in the admissions/visits along with the variation in pollution and meteorological variables, the hospitals simply need to mention date while maintaining the records.

If the data is available, the hospitals authorities need to cooperate in providing the data. Usually a lot of time goes in ice-breaking procedures.