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Research Paper

Evaluation of Ambient Air Quality at a Sensitive Area of Jaipur, Rajasthan

Environmental Science

KEYWORDS : Ambient air quality, Respirable Particulate matter, Suspended Particulate Matter

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ABSTRACT

Several studies have revealed a link between poor air quality and several diseases like respiratory disorders and cardiovascular diseases. The present study was conducted near one of the major hospital i.e T.B. Hospital at Jaipur city in Rajasthan. Hospitals are categorised as the sensitive areas by the regulatory bodies. The main concern regarding the study areas is the exposure of the patients to poor air quality coming to the hospitals with relatively low immunity. Thus, the major objectives of our study included the monitoring of ambient air quality in the vicinity of the hospital with regard to Respirable Particulate matter (RSPM), Suspended Particulate Matter (SPM), SO2 and NO2. The concentration of all the pollutants was found to exceed the permissible limits prescribed by the CPCB, New Delhi. Concentration of all the pollutants were found to be highest during winters season followed by summers and least during post monsoon season.

INTRODUCTION

Air pollution as the name describes is the introduction of harmful pollutants into the air by means of various natural as well as anthropogenic means, released in the air due to industrial, commercial activities. On an average a person daily inhales about 20,000 litres of air and with every breathe he risks to inhale dangerous chemicals through his respiratory tract. In urban areas and especially metropolitan cities, vehicular pollution has been an in escapable reality faced by every individual. Today cars and trucks operate by using internal combustion engines that use gasoline as fuel. This gasoline burns to ignite engine of cars and trucks and release a variety of pollutants into the atmosphere which has degraded the air quality to a remarkable level. Vehicular pollution has serious irreversible effects on the health of human beings, simultaneously affecting the natural ecosystem. Air pollutants have tendency to travel to long distances and therefore air pollution has become a global issue. Severe air pollution episodes have taken lives of thousands of humans and other living beings in the past with in an unhidden fact. The World Health Organization (2002) has identified ambient air pollution as a high priority in its Global Burden of Disease initiative and estimated that air pollution is responsible for 1.4% of all deaths and 0.8% of disability-adjusted life years globally**.** Of all major air pollutants, the most dangerous and of serious concern are Particulate Matters or Particulates and respirable particulate matter. Increased levels of fine particles in the air are linked to major health hazards such as heart disease, lung cancer and altered lung function. In addition to SPM and RSPM, SO_2 and NO_2 emitted from vehicular exhaust are a cause of several diseases. Exposure to SO_2 and NO_2 causes irritation to the human upper respiratory tract and prolong exposure leads to serious damage to materials such as marble, limestone, and mortar. In Allergy, asthma and dermatitis are known to be caused due to air pollutants affecting children and the elderly the most (Bhattacharya *et al.,* 2007). Ultrafine particles probably are capable of causing much greater tissue damage than larger particles when deposited and may be the greatest source of elevated risk for death from ischemic heart disease or fatal arrhythmia. The lungs provide rapid transport of these potentially damaging particles from inspired air to circulating blood. This is consistent with the significant increase in risk of triggering a myocardial infarction (Johnson 2014).

The ultimate purpose of monitoring is not merely to collect data, but to provide the information necessary for scientists, policy makers and planners to make informed decisions on managing and improving the environment. Monitoring fulfils a central role in this process, providing the necessary and sound scientific basis for policy and strategy development, objective setting, compliance measurement against targets and enforcement action.

Material and method

Study area: The present study was conducted in the vicinity of T.B. Santorium situated at Shastri Nagar in Jaipur city. The hospital is surrounded by shopping complexes and experience heavy traffic all through the day, contributing to the pollution load. The road passing from front of the hospital gate is unpaved which add up to the pollution level in the area. A control site; Kulish smriti van (a maintained forest area), located near OTS, JLN Road, Near Bajaj Nagar, Jaipur was selected for the study to come up with a comparative data.

Sampling: For the purpose of sampling, Respirable Dust Sampler(Envirotech APM 460) with gaseous attachment(APM 411) for sampling gaseous air pollutants was used**.** Sampling was conducted for three seasons winter, post monsoon and summers**.**

Samples were collected twice a week for all the seasons. The sampling for RSPM and SPM was done for 8 hrs (10.00am to 6.00 pm) and analysed gravimetrically whereas sampling for SO_2 and NO_2 was conducted for 4 hours. Sulphur oxides was analysed using Modified West and Gaeke Method and nitrogen oxides with Modified Jacob Hochheiser Method **(**recommended by the Central Pollution Control Board, New Delhi.)

Result and Discussion

Results obtained during the study are shown in the following tables:

Table 1: Concentration of pollutants at T.B. Hospital

Parameters	SPM µg/m³		RSPM µg/m³		SO_2ppm		NO_2ppm	
	T.B. Hospital	Control Site	T.B. Hospital	Control Site	T.B. Hospital	Control Site	T.B. Hospital	Control Site
Summer	250.35	78	888.76	83	103.2	25.3	138.7	21.2
Post monsoon	159.98	62	430.70	49	78.7	17.2	81.1	09.0
Winter	327.60	96	1028.50	88	173.8	29.7	175.2	25.3
Permissible limits(CPCB) for sensitive areas	100		75		30		30	

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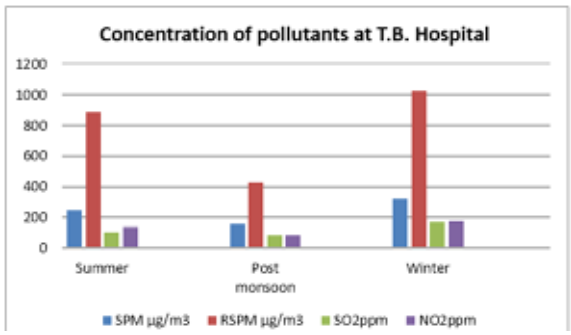


Figure 1: Concentration of pollutants during various seasons

The results obtained during the study show the concentration of all the pollutants above the permissible limits at the T.B. Hospital during all the sampling seasons with highest concentration of all the pollutants during winter season. The reason for higher concentration of pollutants during winter season can be attributed to low temperature, increasing the density of air and reducing the dispersion of pollutants. Temperature inversion also plays a significant role in trapping the pollutants in the lower layer of the atmosphere. The exceeding levels of pollutants at the study site can be because Rajasthan faces seasonal scarce rainfall and thus natural cleansing mechanism is restricted to monsoon season only. The cause of exceeding limits at T.B. hospital can also be due to unpaved roads in the area which is used for traffic movement. The level of SPM, RSPM, SO_2 and NO_2 were found to be lowest during Post monsoon period as rain works as a natural cleanser and washes off all pollutants from air. The concentration of all the pollutants was found to be lower than the permissible limits at the control site, the reason for which can be the absence of vehicular pollution in the area.

Suspended and Respirable Particulate matter

The concentration of SPM obtained in the present study at the study site during winter season (327µg/m^3)(Table1) can be corroborated with the results obtained by Balashanmugam *et al.*,(2012) at Pondicherry where the concentration of SPM ranged between 252.6 to 388.7 µg/m^3

Respirable particulates are known to exacerbate cardiac and respiratory problems among the primary pollutants. The concentration of RSPM during winter season was found to be 1028.5 µg/m^3 which is much higher as compared to the range of levels of RSPM (97.25-282) found by Nandanwar *et al.,* 2015 at various sampling stations at Chandrapur city. The possible reason for this can be higher traffic density and unpaved at the study site.

Sulphur dioxide

The concentration of SO_2 at the study area ranged between 78.7 to 173.8 µg/m^3(Table1) which is higher than the range obtained in the study conducted by Balashanmugam *et al.*,(2012) at Pondicheery where the concentration of SO_2 ranged between 44.14 to 79.9 µg/m^3 at different study areas. This is in contrast to the concentration of SO_2(ranging between 9.0-11.0 ppm) obtained at Salem city, Tamilnadu by Gunasekaran *et al.,* 2014.The major cause of higher levels of SO_2 is vehicular pollution in the area and congested roads with frequent traffic jams.

Nitrogen dioxide

The concentration of NO_2 at the study area ranged between 81.1 to 175.2 µg/m^3)(Table1)which is higher than the range obtained in the study conducted by Balashanmugam *et al.*,(2012) at Pondicheery where the concentration of NO_2 ranged between 84.45 to 124.03µg/m^3 at different study areas. The major cause of higher levels of NO_2 is vehicular pollution in the area . The presence of shopping mall in the area, multiplex, and restaurants close to the hospital area leads to more people coming to the area for amusement purposes which leads to pollution load due to higher population concentration in the area.

The results of present work can be corroborated with the results obtained by Bhuyan *et al.*, (2014) where it was found that the levels of SPM, SO_2 and NO_2 were higher than the permissible levels given by the National Ambient Air Quality Standards (NAAQS). The main reason for the higher levels of pollutants was found to be due to industrial and vehicular emissions, unpaved roads, construction work, burning of municipal wastes and other commercial activities.

The results of present work can also be corroborated with the study done by Afroz *et al.,* (2001) where it was found that Suspended Particulate Matter (SPM) and Nitrogen Dioxide (NO2) are the predominant pollutants in all large cities of Malaysia. The main cause of air pollution is land transportation, along with industrial emissions, and open burning sources.

The solution to this problem is diversion of traffic to other route away from these sensitive areas, also shifting of traffic signal from the entrance point to a distant one and making paved roads can also help to reduce the immediate load of pollutants. Such areas of concern should be kept under continuous monitoring system so as to keep a check on such increasing levels of pollution load in sensitive areas. a wireless sensor network which is a cost efficient, easy setup and real time pollutant data system can be used at such polluted cities(Sirisikar *et al.,* 2015). Plantation of some air pollution tolerant plant species in the study area can prove to be a cost effective method.

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