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Monitoring of air pollution and assessment of its risk on traffic policemen

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Abstract: The ambient air quality was monitored at five selected sites in proper Rohtak city. The parameters i.e. sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and suspended particulate matter (SPM) were monitored for eight hours from 9 am to 5 pm once in a week at each of the five sites. Two sites out of five were found to have low pollution, while the other three sites had high level of pollutants, which exceeded the safety limits as per National Ambient Air Quality Standards. The levels of SO_2, NO_2 and SPM were lowest at polluted site 2 (University Gate NO. 2) in the city, which ranged between 4.12 µg/m³ and 40.37 µg/m³, 25.37 µg/m³ and 73.80 µg/m³, 138.0 µg/m³ and 530.7 µg/m³ of the air respectively. Highest levels of SO2, NO2 and SPM were observed at site 5 (Hisar Road) which ranged between 5.30 µg/m³ and 120.0 µg/m³, 68.01 µg/m³ and 197.84 µg/m3, 730.5 µg/m³ and 3319.0 µg/m³ respectively. The concentrations of lead and cadmium were very much below the safety limits at all the sampling sites Health surveillance studies of the traffic policemen revealed that there is a significant excess risk of respiratory problems for traffic policemen as they are exposed to heavy loads of vehicular pollution.

Keywords: SO_2, NO_2, SPM, Traffic policemen

INTRODUCTION

Transport sector is one of the major contributors of pollutants into the atmosphere. The high influx of population to urban areas, increase in the consumption patterns and unplanned urban and industrial development has aggravated the problem of air pollution. It is the dominant source of emissions except SO_2 in Hungary, contributing 57% of oxides of nitrogen (NO_x), 80% of lead (Pb), 81% of carbon monoxide (CO) and 75% of hydrocarbon (HC) emissions (Lehoczki, 2000). Many attempts have already been made for the estimation of various types of air pollutants with the help of emission factors at various source levels in India and outside (Singh *et al.*, 1990; Bose, 1998; Gurjar *et al.*, 2004; Prashar *et al.*, 2005 and Gomez-perales *et al.*, 2007). The worst thing about vehicular pollution is that the pollutants are emitted at the near-ground level where we breathe. Pollution from vehicles gets reflected in increased mortality and morbidity and is revealed through symptoms like cough, headache, irritation of eyes, various bronchial problems etc. Numerous studies have also found effects of long-term and short-term exposure to air pollution on respiratory morbidity (Brunekreef and Holgate, 2002; Gauderman *et al.*, 2007). The present study includes the traffic policemen in the age group of 20-50 yrs in the Rohtak city.

MATERIALS AND METHODS

Monitoring of ambient air quality: To monitor the ambient air quality five sites were selected in proper Rohtak city, which covers the low as well as highly congested areas in terms of number of vehicles as well as population density (Table 1). Site 1: Delhi Bypass, Site 2: University Gate No.2, Site 3: Sonipat Stand, Site 4: Gohana Stand, Site 5: Hisar Road, (near old bus stand).

The ambient air quality monitoring was done during Feb, 2005 to Jan, 2006 by using high volume sampler (Envirotech APM 415-411) at a height of 5ft from the ground where the sampler was placed. The sampling was done continuously from 9am to 5pm, once in a week at each site. SO_2 was analyzed by West and Gaeke method (1956) and NO_2 was analyzed by Jacob-Hochheiser method (1958). The suspended particulate matter was collected by gravity settling method. The concentration of heavy metals viz. lead and cadmium in the SPM were analyzed with the help of Atomic absorption spectrophotometer (Hitachi Z-6100).

Occupational health study : To study the effect of air pollutants, a study based on questionnaire on respiratory health status of sixty traffic policemen was carried out. Sixty healthy young adults (office workers) who are less exposed to vehicular pollution were taken as control subjects. The odds ratio (Gilbert, 2004) was calculated by setting up a simple 2x2 matrix. The odds ratio above 1.0 suggests a relationship between exposure and risk.

RESULTS AND DISCUSSION

The data obtained from monitoring of the air pollutants

Table 1. Number of vehicles (approx.) passing/hr at various sites.

Site	Number of vehicles/hr	Type of vehicles	Population density
1	2100	Heavy, light	Low
2	1500	Light	Low
3	2700	Light	High
4	3060	Light	High
5	3480	Heavy, light	High

at the five selected sites in summer, monsoon and winter season is presented in Fig 1. It was observed that the concentration of oxides of sulphur and nitrogen were very high during summer and winter season. The average concentration of SO_2 and NO_2 were in the range of 11.96 µg/m³ to 35.31 µg/m³ and 42.21 µg/m³ to 135.7 µg/m³ in summer season. While, the average concentration of the same in winter season ranged from 15.38 µg/m³ to 42.23 µg/m³ and 40.27 µg/m³ to 123.43 µg/m³ respectively. It was observed that SPM concentration during the summer season were maximum. The average concentration ranged between 394.63 µg/m³ and 1786.72 µg/m³. The air borne dust increases in the ambient air as a result of speedy wind flows during the summer season of the year. The levels of SO_2, NO_2 and SPM were low in monsoon season due to washing of pollutants with rain water and dispersion in wider area with the winds. Similar trends of air quality parameters and indices were observed by Bishoi *et al.* (2009) and Guttikunda *et al.* (2009) in Delhi and Hyderabad respectively. The average SO_2 levels were below permissible limits of 80µg/m³ at all the five sites in all the seasons while average NO_2 levels were within the permissible limits of 80 µg/m³ at only two sites in summer and three sites in monsoon and winter season. SPM exceeded the permissible limits of 500 µg/m³ at all the sites in all the seasons except site 2. The study revealed that SPM is the major health concern of the city. A similar study on air quality monitoring of various cities revealed that the most prevalent form of air pollution in India is SPM, although at many stations the SO_2 and NO_2 levels also exceeds the safety limits(CPCB, 2000). The concentration of heavy metals in SPM were found to be within safe limits at all sites in all the seasons and cadmium was not at all detected at site 2 in any season. The maximum concentrations of heavy metals were found at site 5. The findings are also supported by a study of Lead concentrations in Delhi (Gajghate and Hasan,1999). Pollution levels in the city have been found to be related to vehicular density at the different sites as indicated by the data in table 1.

Numerous epidemiological studies have demonstrated the association between particle mass concentration in the outside air and the occurrence of health related problems (Fromme *et al.*, 2007). The analysis of health questionnaire data (Table 2) shows that 33% of the subjects were suffering from frequent coughing, 12% from shortness of breath, 23% from irritation of respiratory tract, 35% from chest pain and 3 % suffered from wheezing. Whereas, in control group only 18% subjects were suffered from frequent coughing, 7% from shortness of breath, 3% were suffered from irritation in respiratory tract, 18% suffered from chest pain and 2 % suffered from wheezing problem. This clearly indicates higher prevalence of respiratory problems in traffic policemen in comparison to the control subjects although smoking habits were comparable in both the groups. 68% of the subjects were in traffic police service for more than 10 years. The longer duration of exposure to vehicular pollution may be the reason for prevalence of respiratory symptoms as 68% of the subjects were in traffic police service for more than 10 years. Beside this, these large health effects in traffic policemen might also be attributable to the higher intake fractions and subsequent doses of pollutants at traffic junctions. A study by Dutch researchers demonstrated a near doubling of the

Table 2. General characteristics and symptoms of respiratory problems in traffic policemen.

Sr. No.	Parameter	Traffic Policemen	Control
1	Age (yr)	39 ± 15 (24-50)	40 ± 13 (25-53)
2	Height (cm)	171 ± 5.0 (165-183)	173 ± 7.36 (165-185)
3	Weight (kg)	72 ± 13.2 (50-105)	69 ± 9 (55-98)
4	Smoking habit	63%	57%
5	Duration of exposure		
	< 10 yr	68%	N.A.
	≥ 10 yr	32%	N.A.
6	Symptoms		
	Frequent coughing	33%	18%
	Shortness of breathe	12%	7%
	Irritation in respiratory tract	23%	3%
	Chest pain	35%	18%
	Wheezing	3%	2%

Number of subjects for each data set = 60; values are mean ± SD ; range in parenthesis

Table 3. Comparison of risk of respiratory problems among traffic policemen and control subjects.

Sr. No.	Symptoms	Subjects	Prevalence of symptoms		Odd ratio
			Yes	No	
1	Frequent coughing	T. Police	25	35	3.18 *
		Control	11	49	
2	Shortness of breathe	T. Police	07	53	1.85 *
		Control	04	56	
3	Irritation in respiratory tract	T. Police	14	46	8.2 *
		Control	02	58	
4	Chest pain	T. Police	21	39	1.52 *
		Control	11	49	
5	Wheezing	T. Police	02	58	2.03 *
		Control	01	59	

Number of subjects for each data set = 60; values are significant at $p<0.05$ (*)

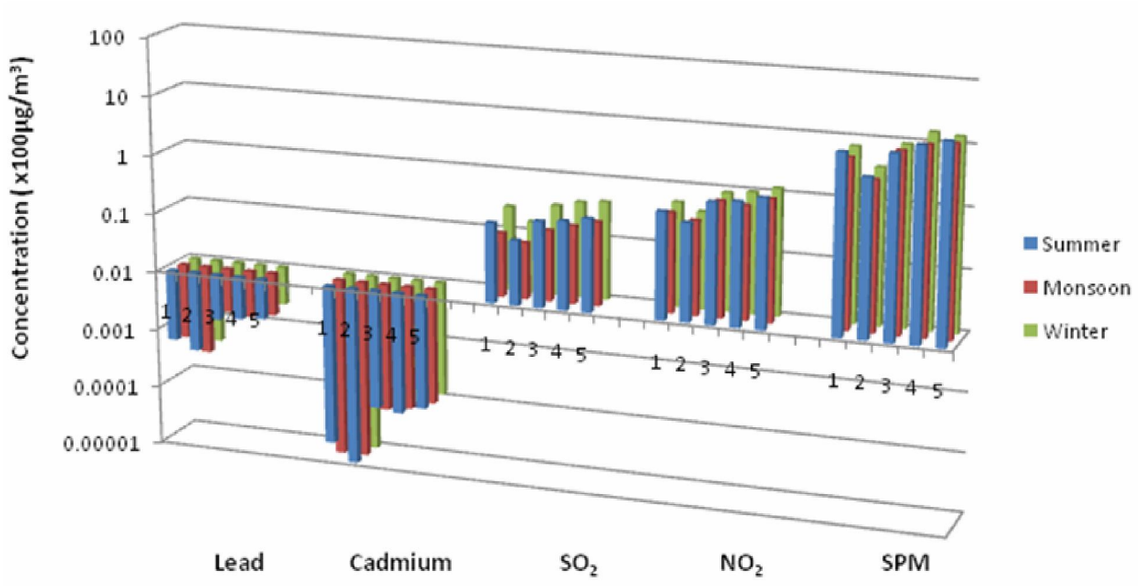

Fig. 1. *Concentration of pollutants at 5 sites(1-5) in different seasons.*

cardiopulmonary mortality for subjects living near major roads (Hoek *et al.*,2002), although a more recent follow up with a larger sample produced generally smaller but elevated risk estimates (Beelen *et al.*, 2007). In the present study, the comparison of risk of respiratory problems among traffic policemen (Table 3) was done by calculating the odd ratio. The odds ratio is one of a range of statistics used to assess the risk of a particular outcome (or disease) if a certain factor (or exposure) is present. It is a relative measure of risk, telling us how much more likely it is that someone who is exposed to the factor under study will develop the outcome as compared to someone who is not exposed. The odd ratio for the symptoms studied was found to be above one, which indicates that there is significant excess risk of respiratory problems for the traffic policemen exposed to the vehicular exhaust and they are highly vulnerable for respiratory impairment due to vehicular pollution at their workplace environment. The regular use of mask, health checkup and awareness on health impacts of pollution needs to be adopted as safety measure for traffic policemen.

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