AIR POLLUTION BY ROADSIDE DUST AND AUTOMOBILE EXHAUST AT BUSY ROAD-CROSSINGS OF LAHORE

Zafar Altaf Jafary, Ilyas Ahmed Faridi*

Assistant Professor, Department of Physiology, Services Institute of Medical Sciences, Lahore, *Head of Faculty of Environment & Occupational Health, Institute of Public Health, Lahore.

Background: Lahore is one of the most polluted metropolis of Pakistan and only a few studies have been conducted in this country so far, for the assessment of pollution levels prevalent in relation to the ever increasing roadside automobile traffic. This study was carried out to assess the roadside dust and autoexhaust gaseous levels at 23 busy road-crossings of Lahore. **Methods:** The roadside dust levels were determined by using 'High volume portable dust sampler' and autoexhaust gaseous levels were estimated by using 'Drager tubes' for Carbon monoxide, Sulphur dioxide and Nitrogen dioxide gases with 'Drager suction pump'. **Results:** Twenty three sites were sampled for dust and gaseous level estimation. Out of all these; dust concentration was <1.5 mg/m^3/hr at 8 (35%) sites, between 1.5-3.0 mg/m^3/hr at 9 (39%) sites and >3.0 mg/m^3/hr at 6 (26%) sites. Regarding gaseous levels, more than 7 (30%) sites had Carbon monoxide level in excess of 9ppm, whereas 7 (30%) sites had sulphur dioxide level of 20ppm. Nitrogen dioxide levels were hardly above 0.20ppm or below detection limits, due to being lower than the minimum detection limit of the available nitrogen dioxide testing Drager tubes. **Conclusion:** The levels of roadside dust and autoexhaust gaseous pollutants present in the tested areas are quite high and this is by all means a health hazard to the public at large and inhabitants of these areas in particular. Some sort of preventive/ protective measures need to be taken to safeguard the health of the people at risk.

Keywords: Air pollution, roadside dust, autoexhaust gases

INTRODUCTION

Air pollution is a major part of the overall atmospheric pollution and the motor vehicle emissions usually constitute the most significant source of ultrafine particles in an urban environment.[1] Important chemical pollutants emitted by land vehicles are Carbon monoxide (CO), Sulphur dioxide (SO_2), Nitrogen dioxide (NO_2) and Total suspended particules (TSP).[2] The smoke is a mixture of particles and gaseous chemicals of varying physical and chemical properties. When inhaled, these cause damage to the airways and the lungs. The particles increase the toxicity of chemicals present in the smoke.[3] Air pollution generated by motor vehicular exhaust has become a major cause of scientific and public concern worldwide. The rapid and the marked increase in motor vehiclular traffic and its associated gaseous pollutants in the urban areas have caused a sharp increase in the prevalence of respiratory allergies.[4] The potential association between long-term exposure to air pollution and histopathologic evidence of damage to human lungs was evaluated by Souza and his associates. The results of this study suggested that long-term exposure to air pollution may contribute to the pathogenesis of airway disease, and that the urban levels of air pollution have adverse effects on respiratory tract.[5] Pope and colleagues found that respirable particulate air pollution is likely an important contributing factor to respiratory diseases.[6] The American Conference of Governmental Industrial Hygienists (ACGIH) has established threshold limit values (TLVs) which refer to the level of toxic air contaminant to which nearly all the workers may be repeatedly exposed without adverse effects.[7]

The contribution of motorized traffic to air pollution is widely recognized but relatively few studies have been conducted in Pakistan to estimate the levels of different pollutants. In this study, the concentration of total suspended particulate (TSP) dust and automobile exhaust gases (CO, SO_2 and NO_2) at busy road-crossings of Lahore were estimated for comparison with minimum acceptable levels and other international studies.

MATERIALS AND METHODS

Environmental air sampling was done for the estimation of air-borne dust concentration and autoexhaust gaseous concentrations. A 'walk through survey' of different areas of Lahore was carried out and on the basis of assessment of traffic density (vehicle count) and the amount of visible autoexhaust fumes/ smoke and roadside dust 23 busy road-crossings of Lahore were selected for quantitative assessment of Total Suspended Particulates (TSP) and gases of autoexhaust origin i.e. CO, SO_2 and NO_2. Thereafter, air sampling was carried out for 2 hours at each study site for TSP and spot sampling was done for autoexhaust gaseous concentration at the peak busy hours of maximum traffic density; excluding dust storm and rainy days.

Dust estimation was done by 'Gravimetric method' using 'High volume portable dust sampler' (Model: L 30, MK III NO. 3374, 230V, 0.8A, Rotheroe & Mitchell Ltd. Middlesex), Glass-fiber filtration discs (6.0cm, WCN type Cat. # 7184003, Whatman Ltd., Maidstone, England) and Analytical micro-balance (Chyo, JL-900, 0.1mg-200g) for measuring weight after sample collection.

Autoexhaust gaseous concentrations were estimated by using Direct reading colorimetric Drager tubes for CO, SO_2 and NO_2 (Dragerwerk AG, Germany) and Drager suction pump (Model: Accuro® 2000, Dragerwerk AG, Germany).

Data recorded included TSP dust concentration ($mg/m^3/hr$) and concentrations of CO, SO_2 and NO_2 in parts per million (ppm) at each site.

RESULTS

Twenty three busy road-crossings of Lahore were sampled for air-borne dust concentration and autoexhaust gaseous levels of CO, SO_2 and NO_2 and are presented in Table-1.

The air-borne dust concentrations ranged from 0.760 $mg/m^3/hr$ at Lahore Hotel chowk to a maximum of 5.044 $mg/m^3/hr$ at Kanchee crossing. Whereas, a very different trend was observed in case of autoexhaust gases. Carbon monoxide concentrations were maximum at Scheme More (11ppm), Samanabad More (10ppm) and Naulakha chowk (10ppm); the areas with highest traffic density.

But maximum levels of SO_2 (20ppm) were recorded at Chauburji, Ghazi chowk, Kalma chowk, Lohari Gate and Naulakha chowk, Railway station and Samanabad More as shown in Table-1.

Table-1: Air pollution levels at 23 road crossings of Lahore

S. No	Name of Site	Air-Borne dust Concentrations ($mg/m^3/hr$)	Auto exhaust Gaseous Concentrations (ppm)		
			CO	SO_2	NO_2
1	Chauburji	2.760	5	20	0.10
2	Chowk Yaadgar	2.365	8	16	0.08
3	Chungi Amer Sidhu	2.723	6	11	0.15
4	Club Chowk	1.075	5	11	*BDL
5	Ghazi Chowk	1.677	6	20	0.13
6	General Bus Stand	3.070	5	17	0.13
7	Kalma Chowk	0.817	5	20	*BDL
8	Kanchee Crossing	5.044	8	18	*BDL
9	Lahore Hotel Chowk	0.760	7	17	0.17
10	Lakshami Chowk	1.111	7	12	0.20
11	Liberty Market Chowk	2.208	6	12	0.15
12	Lohari Gate	3.420	9	20	0.17
13	Mochi Gate	4.532	5	10	0.10
14	Moon Market Chowk	1.333	9	13	0.18
15	Muslim Town More	1.428	7	15	0.15
16	Naulakha Chowk	4.515	10	20	0.25
17	Qartaba Chowk	1.505	7	18	0.20
18	Railway Station	2.891	7.5	20	0.18
19	Regal Chowk	1.385	9	18	0.20
20	Samanabad More	1.930	10	20	0.18
21	Scheme More	2.381	11	18	0.22
22	Shadman Chowk	1.040	7	18	0.15
23	Yateem Khana Chowk	3.607	9	15	0.17

* BDL= Below detection limits

DISCUSSION

It is a common observation that the roads in our daily use are flooded not only with the automobile traffic but also pollution caused by its gaseous exhaust fumes and the dust, which is a respiratory health hazard to the people exposed thereof.[8]

Total suspended particulates (TSP), CO, SO_2 and NO_2 levels were recorded in the present study. These parameters are good indicators of combustion products from traffic related sources[9-12] and were much higher in our study as compared to other regional and international studies (Table-2), thereby showing an alarming situation in our country.

The TSP ranged from 0.760-5.044 mg/m^3/hr in the present study whereas, the Threshold limit value (TLV) for mixed organic dust is 5mg/m^3.[13] The mixed dust consists of soil dust (organic carbon, chloride and sulfate), roadside dust (organic carbon and Iron), solid waste/ animal excreta, fossil fuel combustion products and tyre wear.[14] Different international studies[15-20] have documented far less TSP levels than those of our study because of non-uniform mixing conditions in urban areas, resuspension of roadside and soil dust by automobile traffic.[21] Secondly, temporal (daytime/ nighttime) and seasonal variations in air sampling for dust levels also result in observed variability in the TSP levels obtained.[22]

The maximum permissible level of CO is 25.8ppm (30mg/m^3)[23] and the level found in our study ranged from 5-11ppm (8.1-12.8mg/m^3), whereas CO level reported by other studies are 7ppm (8.1mg/m^3)[24] upto 117ppm (135mg/m^3).[25] The major sources of CO in air are mainly incomplete internal combustion in automobile engines and nearby industrial emissions.[2] The TLVs of SO_2 and NO_2 are 5ppm (8.1mg/m^3)[26] and 25ppm (48mg/m^3)[27], respectively. The level of SO_2 ranged from 10-20ppm (26.6-53.2mg/m^3) and for NO_2 0.08-0.22ppm (0.15-0.44mg/m^3). These values of SO_2 are much more than reported in international studies[24,28] (0.4ppm & 6-9µg/m^3), possibly due to high traffic density and improper maintenance/ poor engine condition of motor vehicles in our cities. It is however recommended[25] that allowable limits for CO and NO_2 be established/ redefined as 20ppm and 0.25ppm (250ppb), respectively.

In relation to TLV for NO_2 the values recorded in other and our study are similar and far less. It has been reported[2] that usually there is a low background level of NO_2 which increases only during busy hours on congested roads and even then reaches measurable level for a very shot time. The airborne dust/ TSP remains suspended in air for couple of hours and is dispersed less rapidly unlike gaseous exhaust. So a 2 hours sampling for roadside dust gives a fairly accurate estimate of the prevalent dust level.

The observed level of gases of autoexhaust origin (CO & SO_2) was much higher in our study in comparison to other studies. The possible reasons being; large number of plying vehicles (high traffic load), road conditions, repeated traffic jams, poor engine condition, weather conditions, less rainfall, sparse vegetation and water bodies/ canals & fountains alongside the roads and variation in levels also depend on days of the week (weekend or mid-week days), time of the day (busy or non-busy hours), which also play an important role in overall distribution of air pollutants.

Table-2: Comparison of TSP levels in different studies

No.	Studies	Total suspended particulate levels (mg/m^3)
1	Xu et al (1995)[15]	0.388-1.255
2	Najeeba and Saleem (1997)[2]	0.147-1.293
3	Peters et al (1997)[16]	0.098
4	Xu and Wang (1998)[17]	0.261-0.449
5	Meijer et al (1998)[18]	2.000
6	Raza et al (1999)[19]	1.980
7	Savrin et al (1999)[20]	0.120-0.390
8	The Present study (2002)	0.760-5.044

CONCLUSION

It is concluded that the values of TSP, CO and SO_2 found in this study are significantly more than those reported by other national and international studies. Air pollutant levels need to be assessed in other parts of Pakistan as well, and timely imperative steps are required to be taken to improve the present situation; which may include; plantation, strict implementation of laws for vehicle fitness, improvement and widening of roads to sustain traffic pressure and prevent traffic jams. Steps for promotion of CNG vehicles instead of gasoline and diesel engines can also go a long way in reducing air pollution due to automobiles.

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Address for Correspondence:
Dr. Zafar Altaf Jafary, Assistant Professor, Physiology Department, Services Institute of Medical Sciences, 6-Birdwood Road, Lahore, Pakistan. Mobile: 0333-4279338
E.mail: drzafaraltaf@hotmail.com, zafaraj@yahoo.com