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CHEMICAL COMPOSITION OF TRAFFIC GENERATED DUST AND ITS IMPACT ON HUMAN HEALTH WITH ASSOCIATED PROBLEMS IN QUETTA

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Abstract

Rate of dust fall in urban areas of Quetta was estimated during two consecutive years (2010 and 2011) through recommended methods using standard size and shape containers. Collection of dust fall was made from January 2010 to December 2011. The levels of dust fall in Quetta during both years remained the highest (38.67 and 42.02g/m^2/month), respectively, with high traffic density. Among the locations, Shahrah-e-Iqbal showed with the highest rate of dust fall while Liaqat Bazar showed the lowest. Statistical analysis using a t-test revealed that all the locations showed significant ($P<0.001$) high rate of dust fall during 2011 than 2010. Percentage of dust fall which increased from 2010 to 2011 was noted 5.43-11.94% with Mechangi road having the largest increasing percentage and Liaqat bazar showing the least. Metallic analysis of dust fall in Quetta was made through Atomic Absorption Spectrophotometer. All the investigated metals except Ni were found high in all the dust fall samples of all the locations and dust samples collected during 2011 showed high contents of heavy metals than 2010. Data regarding impact of air pollution on human health exhibited that the percentage of pulmonary diseases, eye irritation and headaches in the urban area of Quetta was found the highest than any other and 55% of effected people were those who practiced trade while being directly exposed to the pollutants without any protective measures.

Keywords: Quetta, Dust fall, Heavy metals, Traffic density, Human health.

Introduction

Air pollution deteriorates ecological condition and can be defined as the fluctuation in any atmospheric constituent from the value that would have existed without human activity (Tripathi and Gautam, 2007). Environmental degradation exerts significant pressure on human health. Unfortunately, these aspects are closely associated with the hazards to the environment and human health caused by transport, particularly, road transport (Dora and Phillips, 2000). One of the leading concern about the impact of air pollution on health and the economy have resulted in measures to mitigate emissions of the most harmful pollutants, such as, particle pollution (acids, organic chemicals, metals, and soil or dust particles) and ozone, which affects the respiratory system. Despite national and international interventions and decreases in major pollutant emissions, the health impacts of air pollution are not likely to decrease in the years ahead, unless appropriate action is taken. Health problems linked to air pollution range from minor eye irritation to upper respiratory symptoms, chronic respiratory diseases, such as, asthma, cardiovascular diseases and lung cancer. The atmospheric dust loading has been increasing over the last years due to global warming, increasing desertification and human activities (Derbyshire, 2007). Dust in the atmosphere can have major effects on environmental systems and on human health. Environmental effects including the influence on biogeochemical cycles of the earth, influence on earth's radiation balance and influence on atmospheric chemistry (Tegen, 2006).

The study area (Quetta) is located in the mountainous region of Pakistan and is the capital

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of the province of Balochistan. It lies approximately 30° 10′ latitude and 67° 1′ longitude. The present municipal limits encompass an area of approximately 21 km^2; towards the North, there is a large military cantonment, and the Quetta valley slopes are generally towards the Northwest, at a fairly uniform rate of 12.5m/km and this valley is surrounded by five mountain ranges. The Zarghun ranges northeast-wards, Sor ranges to the east, Murdar ranges to the southeast, Chilton ranges to the west and Takatu ranges to the north (see Fig. 1).

In Pakistan, very little attention has been paid to the atmospheric pollution in general and dust fall in particular. Some limited data is available for some cities of Pakistan, like, Karachi, Islamabad and Lahore (Beg et al., 1991; Khan et al., 1996). The aim of this study was to evaluate the rate of dust fall in mountainous urban area, its potential cause and metal composition.

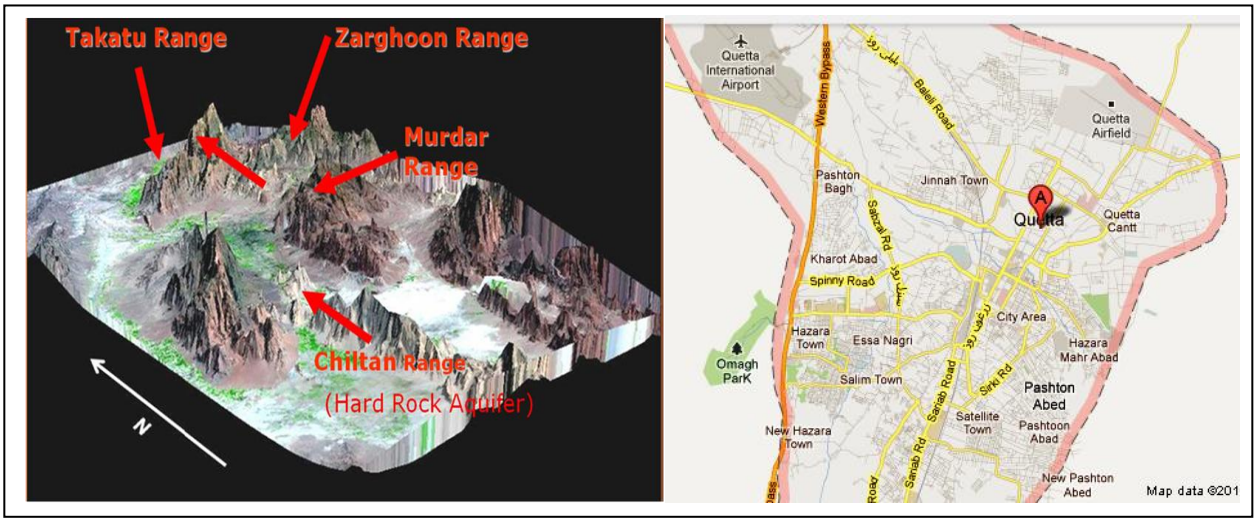


Fig 1. Satellite view of Quetta valley and details of the study sites in Quetta

Materials and Methods

Dust fall collection and Metallic analysis:

Dust fall measurement was carried out for two complete years (2010 and 2011) by a recommended standard method (Robert, 1986). Dust fall containers/collectors of standard size and shape, i.e., 22-24cm mouth diameter jars, 20cm base diameter and 25cm height were used and heavy traffic roads were chosen for the sampling. Dust fall containers were installed at three locations on Shahrah-e-Iqbal near Mezan chowk, Jinnah road near Manan chowk, Liaqat bazar, Sariab road near Choungi, Mechangi road, Prince road, Mesjid road, Zarghun road, Patail road and Double road up tile bus stand. After a period of one calendar month, the collectors were taken off, covered with plastic lid and brought to the laboratory analysis (Farid et al., 2002). The samples were analysed for heavy metals through Atomic Absorption Spectrophotometer (Model 2380 PERKIN ELMER).

Traffic Counting:

The vehicles passing along the selected roads were counted for 12 peak hours from 8 am to 8 pm for three consecutive days of every month and average was taken from 10 busiest roads of the Quetta for the period of two years (2010 and 2011). Buses, trucks, wagons, cars, motorbikes and rickshaws were counted separately (Khan, 1996; Hamidullah et al., 1998).

Impact on Human Health

For the determination of pollutants impact on human, a questionnaire was prepared and distributed among those who were directly exposed to the pollutants on the selected roads, using random sampling method. Data was also collected from different hospitals of Quetta about different cases registered in different disease categories, like, cardiac diseases, ENT cases, blood pressure, pulmonary diseases, eye irritation and headaches. Data was collected on monthly basis and then an average was calculated (data of

the adult male patients was only taken). Dust fall affects not only the air quality of cities but also public health (Harrison et al., 1997). Dusts and dust fall can lead to diseases, such as, tonsillitis, allergy, daily pneumonia, asthma and eye irritation (Cheng et al., 2008, De Longueville et al., 2010 and Chung et al., 2003). Dust events have been seen as a risk factor for daily hospitalisation for respiratory and cardiovascular diseases (De Longueville et al., 2010; Tao et al., 2012; Meng and Lu, 2007).

Statistical Analysis:

Standard deviation, values of the means, maximum and minimum values were calculated for a comparison of site categories. To determine the significance of the samples, a paired t-test was performed for the comparison of dust fall collected over two years. Relationship among the two variables was assessed, using correlation coefficient and linear relationship (Steel and Torrie, 1980).

Results and Discussion

Total 72 samples from each sampling station were collected and studied on monthly basis from January 2010 to December 2011. The annual average rate of dust fall, average traffic density and increasing percentage of dust fall per annum are shown in Table 1 and Figs. 2-5. Heavy metals composition of dust fall and its impact on human health were shown in Tables 2-3 and Figs. 6-9.

Table 1. Average rate of dust fall (g/m^2/month) during two consecutive years on different locations of Quetta

Locations	Total dust fall in 2010		Total dust fall in 2011		t
	Ave	S.D.	Ave	S.D.	
Shahrah-e-Iqbal	46.19	0.29	49.67	2.66	29.91***
Jinnah Road	44.65	0.34	47.74	2.30	22.26***
Double Road	41.32	0.60	45.03	1.69	15.29***
Sariab Road	39.82	0.37	42.98	2.55	21.25***
Mechangi Road	37.74	0.42	42.86	1.92	29.84***
Zarghun Road	37.04	0.28	41.39	1.85	38.03***
Masjid Road	36.97	0.24	40.01	1.47	31.06***
Prince Road	36.20	0.48	38.64	1.52	12.47***
Patail Road	35.12	0.64	38.36	1.95	12.51***
Liaqat Bazar	31.68	0.10	33.50	1.94	46.91***

Ave = Average, S.D = Standard deviation

During 2010, average rate of dust fall (fine and large particles) was in the range of 31.68 - 46.19g/m^2/month, and during 2011, it changed to 33.50-49.67g/m^2/month, with Shahrah-e-Iqbal having the largest average rate of dust fall and Liaqat Bazar showing the least. Statistical analysis using a t-test indicated that all the locations showed significant ($P<0.001$) high rate of dust fall during 2011 than 2010 (Table 1). Overall, average rate of dust fall on different locations of the city during both the year was found 32.59-47.93g/m^2/month lowest to highest, respectively, whereas Shahrah-e-Iqbal standing with the highest dust fall and Liaqat Bazar with the lowest (Fig 2). The higher amount of dust fall at Shahrah-e-Iqbal was attributed to the high traffic mobility and population density as it is the busiest road of the city. Other factors, like, construction of roads, lack of proper arrangement of the vehicles parking, presence of goods stores, lack of awareness about air pollution and dusty weather condition of the area, are adding more dust pollution to the atmosphere of Quetta. Due to above facts and figures the site was expected to be the most polluted area as compared to the other sites. The findings of Beg et al. (1987), and Khan et al. (2002), also supported the above mentioned facts. Moreover, average rate of dust fall on all the locations during 2010 and 2011 was found to be 38.67 and 42.02g/m^2/month respectively (Fig 3), which might be due to climate change, global warming, increasing population, increasing rate of bomb blast and fires in the city or increasing rate of traffic density. Unfortunately, these aspects are closely associated with the hazards to the environment and human health caused by transport, particularly, road transport; the above views were

also supported by Dora and Phillips (2000). Furthermore, the rate of dust fall positively correlated with the number of vehicles passing along different roads of the city; as the number of vehicles increased, the rate of dust fall also increased (Fig. 5). Similar observation was reported by Dora and Phillips, (2000). Data also exhibited that percentage of dust fall increasing from 2010 to 2011 was 5.43 to 11.94% at Mechangi road, having the largest increasing percentage and Liaqat bazar showing the least (Fig 4). The lowest rate of dust fall at Liaquat bazar during the study period might be due to the lowest and the slowest moving traffic. Liaquat bazar is the main market of Quetta due to rush of pedestrians people walk and shops on the road due to which no clear space for driving is available. Furthermore, the shopkeepers also wash and clean the road in front of their shops thus keeping the area clean. Therefore, least dust fall was observed at Liaquat bazar. The findings of Khan et al. (2001) and Khan et al. (2002) support this observation.

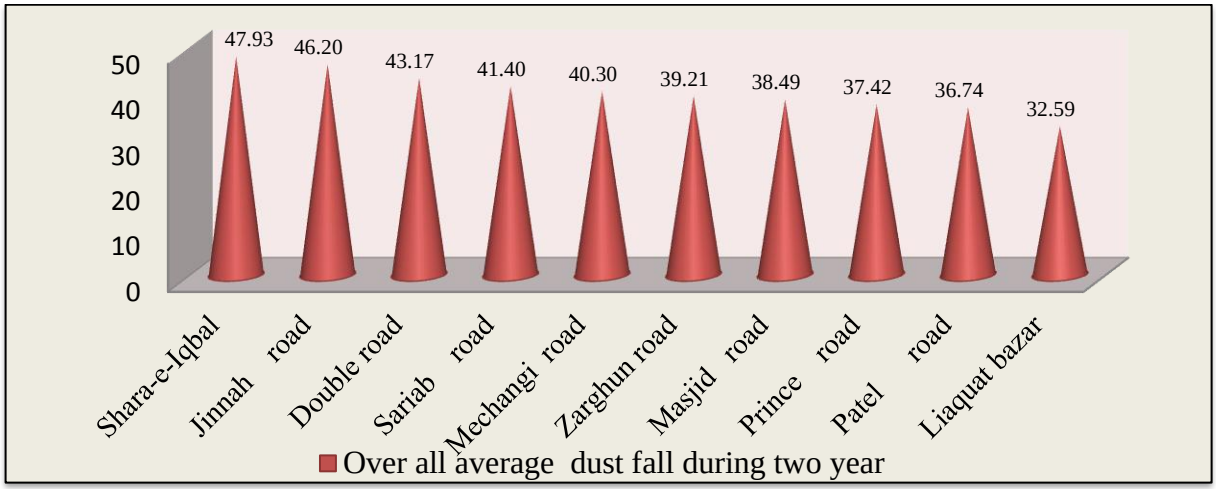


Fig. 2. Average rate of dust fall (g/m^2/month) on different locations of Quetta during two consecutive years (2010-2011).

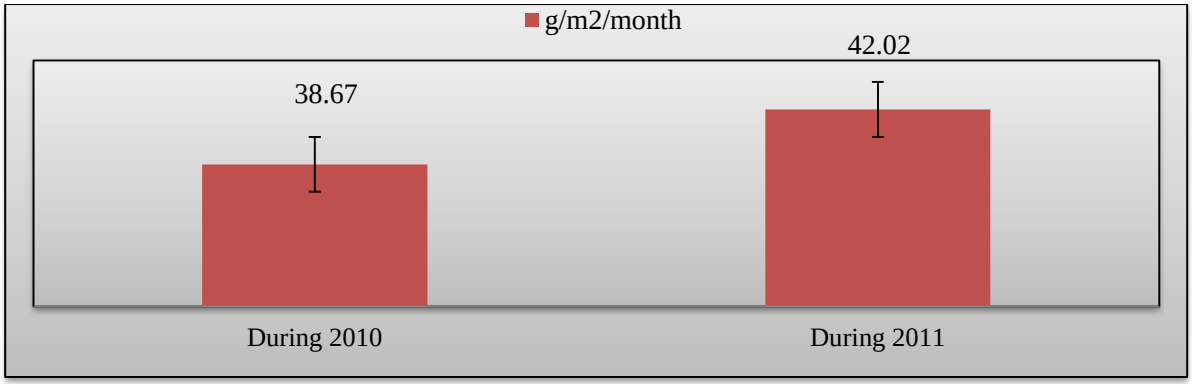


Fig. 3. Overall average rate of dust fall (g/m^2/month) on all the locations during 2010 and 2011

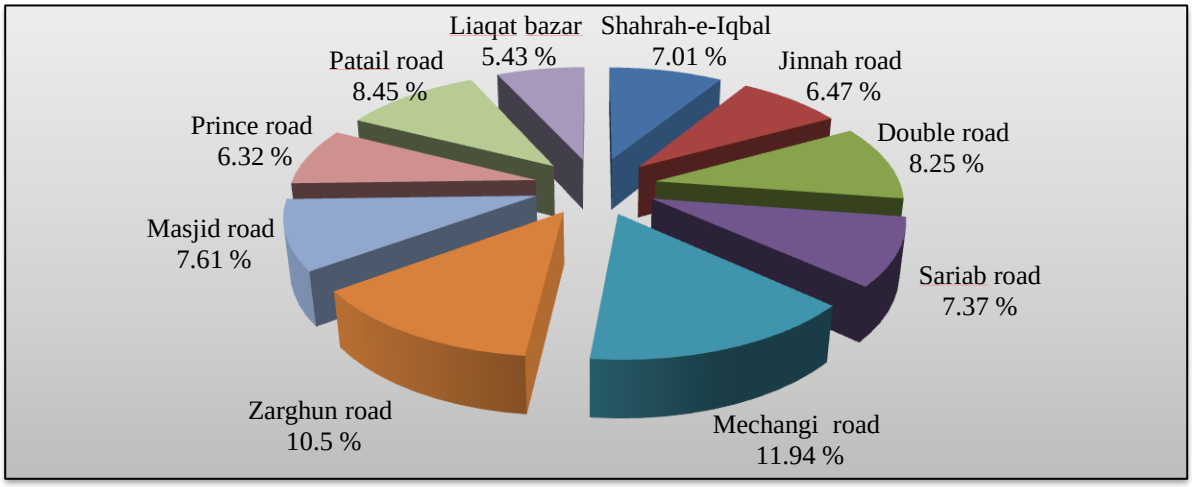
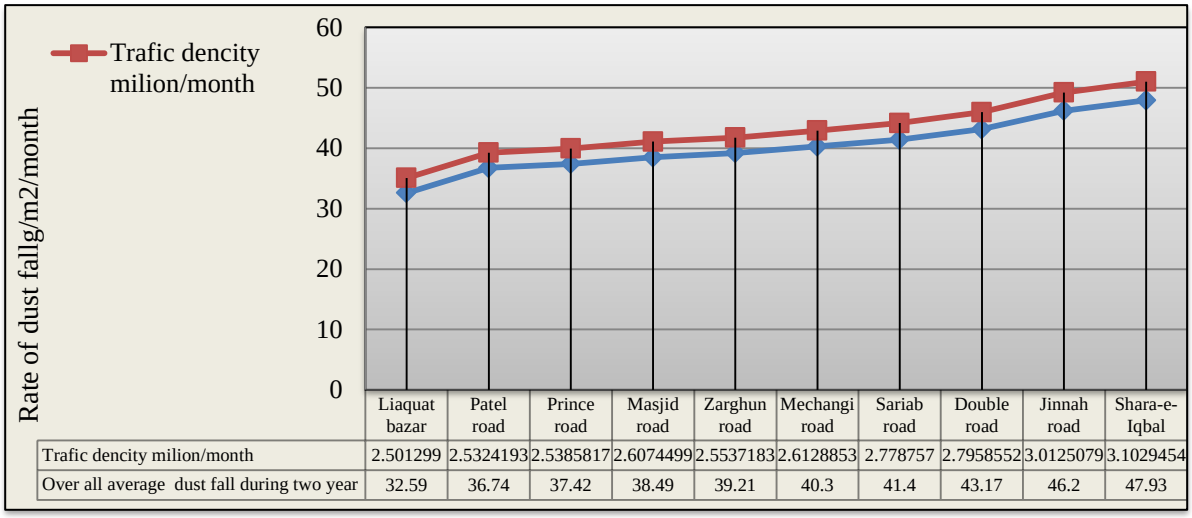


Fig. 4. Increasing rate of dust fall per year 2010-2011 on different locations of Quetta.



	Liaquat bazar	Patel road	Prince road	Masjid road	Zarghun road	Mechangi road	Sariab road	Double road	Jinnah road	Shara-e-Iqbal
Trafic dencity milion/month	2.501299	2.5324193	2.5385817	2.6074499	2.5537183	2.6128853	2.778757	2.7958552	3.0125079	3.1029454
Over all average dust fall during two year	32.59	36.74	37.42	38.49	39.21	40.3	41.4	43.17	46.2	47.93

Fig. 5. Traffic density and dust fall relation.

The average contents of Mn in traffic generated dust collected during 2010 and 2011 was found 9.1 to 15.3mg/g with Patail Road having the largest contents and Liaqat bazar showing the least (Table 2). The mean values of Mn in dust fall were observed higher than the critical level of 5mg/g (Rhue and Kidder, 1983). The overall average concentration of Mn was found to be 11.9mg/g, which was the highest among all the observed metals (Table 2). This spurious variation of Mn is difficult to explain but it might be due to contamination of road dust/soil of the area. The high concentration of Mn was noticed by Malik et al., (2002) in the soil of Rawalakot, Azad Jamu and Kashmir. The high concentration of Mn was also reported by Tejada et al. 1987 and Tiffany (1998) Tiffany et al., 1999, 2001), in the road dust of Guatemala and in the Soil of Florida.

The fourth abundant metal copper (Cu) also showed its presence in all the dust samples of Quetta with small variation 2.4 to 5.3mg/g, at Jinnah Road, having the highest value and at Zarghun Road, showing the lowest. Total average concentration at all the locations was recorded (2.4mg/g) (Table 2). According to the classification with reference to available Cu content in the dust, the Cu status of dust fall under the study was medium to high (Rashid and Ahmed, 1994). The addition of sewage in the road dust due to rested sewage system might be considered as the main source of increasing concentration of copper in the dust fall of Quetta. It also enters in to the atmosphere by the

automobile radiator and wilding apportion. The finding of Ara et al. (1996) supports this fact.

The toxic metal lead (Pb) was present (3.0 to 6.8mg/g) in all the dust samples of Quetta. The highest contents of Pb were recorded from Jinnah road, Patail road and Shahrah-e-Iqbal, while minimum was found at Sariab road (Table 2). The high concentration of lead was correlated with high traffic density. Finding of Kamal et al. (1998) support this observation. A high content of lead was also noticed by Leghari et al. (2003) in the road side dust of Jinnah road of Quetta. Lead may enter the atmosphere by different human activities, such as, mining, melting, refining and manufacturing processes; by the use of lead containing products and by the vehicular emission. Open sewage system also contributes to heavy metals of dust fall and soil (Qureshi, 2000, Agrawal, 1999). Petrol contains tetra ethyl lead to check engine knock and it enters air through fumes of burnt fuel (Gautam, 1990; Benneth, 1981).

Table 2. Average contents of heavy metals (mg/g) in dust fall collected from Quetta.

Location	Mn	S.D	Cu	S.D	Pb	S.D	Ni	S.D	Zn	S.D
Prince Road	12.2	1.7	3.6	0.2	4.8	0.4	2.3	0.0	8.8	0.3
Patail Road	15.3	0.7	3.5	1.1	5.9	1.3	3.1	0.7	8.7	0.0
Double Road	14.0	0.4	4.3	0.1	4.7	0.4	2.3	0.1	10.5	0.1
Jinnah Road	9.8	0.5	5.3	0.6	6.8	0.1	2.1	0.1	7.8	0.1
Shahrah-e-iqbal	11.8	1.0	3.5	0.9	5.3	1.1	1.4	0.1	9.8	0.1
Mechangi Road	12.6	0.3	4.6	0.1	3.1	0.1	2.7	0.1	11.6	0.1
Zarghun Road	9.4	0.1	2.4	0.1	3.4	0.1	2.7	0.1	10.6	0.1
Sariab Road	10.8	0.2	3.1	0.1	3.0	0.1	2.3	0.1	9.4	0.8
Masjed Road	13.6	0.1	3.0	0.1	4.6	0.1	2.9	0.1	10.5	0.1
Liaqat bazar	9.1	0.2	4.1	0.2	4.3	0.1	2.6	0.2	11.1	0.1
Total mean	11.9	2.0	3.7	0.8	4.6	1.2	2.4	0.5	09.9	1.1

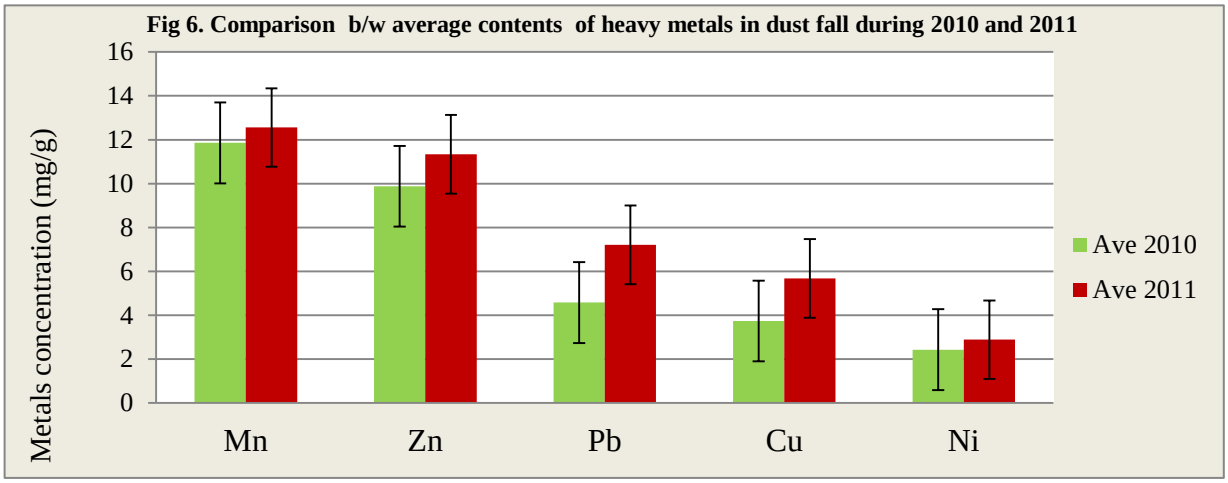
Data is the mean of three replicates S.D = Standard deviation

The Ni concentration was found to be low (between 1.44 and 3.06 mg/g) in all selected sites' dust samples and among all the observed metals with small variation. Ara et al., (1996) also noticed the low level of Ni in the dust of roadsides from Karachi. The maximum value was observed at Patail road, followed by Masjid road, Zarghun road, Mechangi road, Liaquat bazar, Double road and Sariab road, respectively (Table 2) and minimum was observed at Shahrah-e-Iqbal that showed an inverse relationship with traffic density. The variation of Ni concentration is difficult to explain but it might be due to contamination of road dust/soil and addition of sewage on the roads by the overflow of sewage system.

Zinc, an essential and beneficial element for man in low concentrations, was present in all the dust samples collected from Quetta but with large variation (7.8 to 11.6mg/g) from place to place. Generally, among all the observed metals, it was the second highest metal and total average contents at all the location remained high (9.9mg/g, Table 2). High concentration of Zn has also been reported by Prabowo et al. (1991) in Indonesia, which might be due to deterioration of galvanised iron, viz., pipes, sheets, etc. and when the protective coating is damaged (Gautam, 1990).

The level of all the investigated metals were found high, during 2011, with respect to 2010 (Fig 6). The level of all these metals except Ni remains higher at all the locations. The positive correlations of some metals with the number of vehicles may indicate the exhausts of the vehicles as the emanating sources. However, with the exception of Pb, other metals are not normally found in gasoline and diesel; the sources of these metals are both mobile and stationary, including rusted vehicles, rusted bridges and fences along the roads, construction projects, metal-based businesses, auto workshops, printing presses, metal made utensil shops and metal polishing shops and broken and flooded sewerage system. Petrol vehicles, auto-workshops and printing presses may be, however, considered the major sources of air pollution, as also stated by Saifullah (1998) and Hamidullah et al., (1998).

Questionnaires survey indicated that the percentage of people suffering from cardiac diseases was 15 and 20%, ENT-diseases, 42 and 46%; blood pressure, 54 and 58%; pulmonary diseases, 56 and 60%; eye irritation 60 and 65% and headache 64 and 68% during 2010 and 2011, respectively (Fig.7). Total average data taken from different hospitals of Quetta, during 2010 and 2011, for different cases registered, gave the following distribution: 1.38% cardiac cases, 7.33% ENT-cases, 21.33% blood pressure cases, 21.50% eye irritation cases, 22.33% of the cases were for chest diseases and 25.67% complaints were related to headaches (Fig. 8).



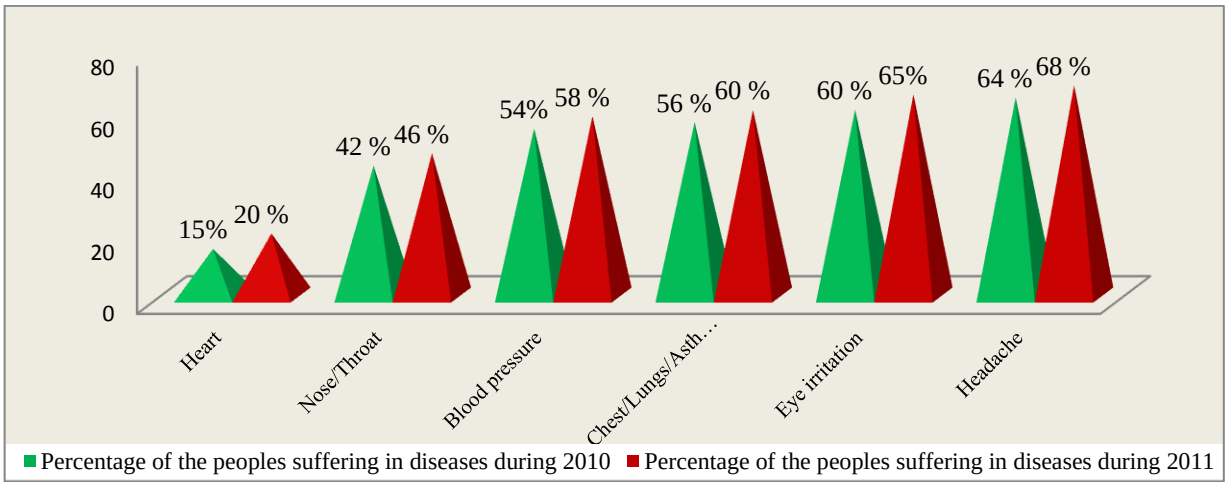


Fig. 7. Percentage of people suffering in different diseases during two consecutive years (2010 and 2011)

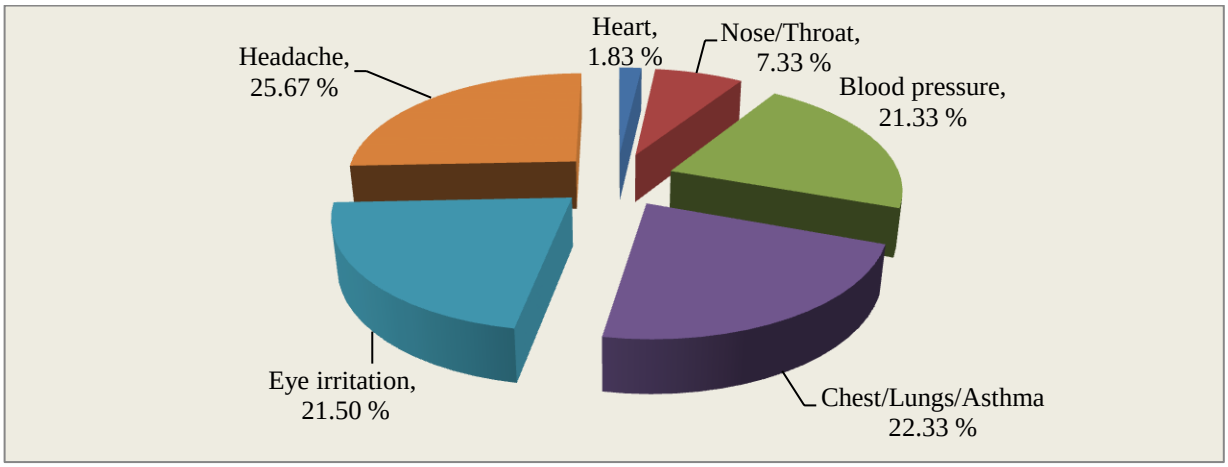


Fig. 8. Total average percentage of registered cases in all the hospitals of the Quetta (2010 and 2011).

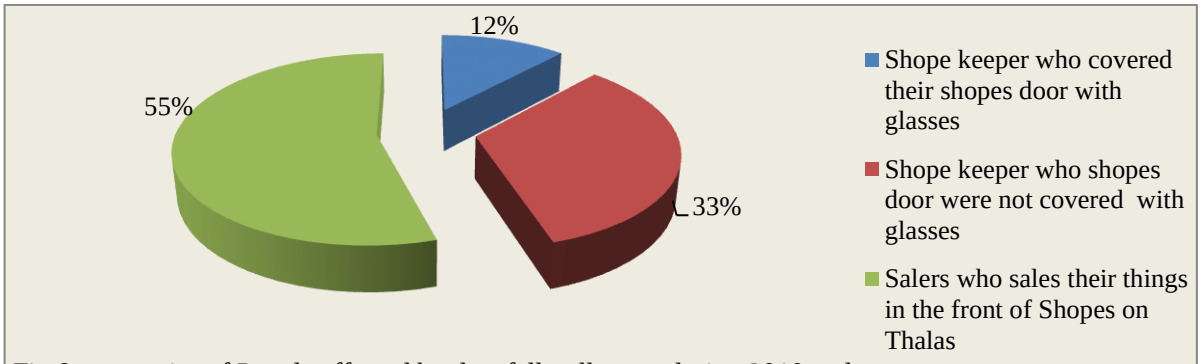


Fig 9: categories of People effected by dust fall pollutants during 2010 and 2011 in Quetta city

Table 3. Correlation coefficient between data collected from different hospitals of Quetta and questionnaire about different diseases categories

Heart Patients	Nose/Throat Patients	Blood pressure Patients	Chest/Lungs/ Asthma Patients	Eye irritation Patients	Headache Patients
***	***	*	**	ns	**
0.94	**0.89**	**0.53**	**0.77**	**0.36**	**0.67**

***, **, *** and ns = slightly, highly, very highly significant and non-significant, respectively**

Correlation coefficient between the data collected from different hospitals of Quetta and questionnaire about different diseases categories (Table 3) indicated that cardiac patients and ENT patients showed significant relationship, pulmonary patients and headache patients indicated highly significantly. Blood pressure complaints reported a slightly less significant relationship, while eye irritation cases exhibited non-significant relationship. The highest percentage of reported pulmonary patients, eye irritation and headaches in the urban area of Quetta, might be due to different factors, like, high traffic density, use of Iranian diesel and petrol oils, improper cleaning of roads and emissions from tyres, which are the main causes of air pollution, particularly dust fall and its heavy metals contamination. Several studies have

demonstrated higher rates of respiratory illness and symptoms and reduced lung function in people living near major roadways (Brunekreef, 1997; Hoek et al., 2002; Livingstone et al., 1996; Venn et al., 2001). WHO (2000) reported that about 30% of the respiratory diseases are related to personal exposure to high level ambient PM concentrations. At global scale, more than 0.5 million deaths per year are due to exposure to ambient PM concentrations (AQEG, 2005). In developed countries, PM emissions are mainly responsible for respiratory health problems (Yang, 2002; Shendell and Naeher, 2002; Wang et al., 2003). They also indicated that the main sources for ambient PM concentrations at urban roadways are vehicle exhausts, emissions from tyres, brake wear and re-suspension of road dust.

Data regarding categories of people suffering from different diseases, during 2010 and 2011, in Quetta, was found as follows: 55% of the total were those shopkeepers who practiced trade while being directly exposed to air pollution; whereas 33% were those practiced trade by being not directly exposed to the dust fall. Only 12% had their shops covered with glasses (Fig. 9). Similar observation was also reported by Cacciola et al. (2002); they revealed that at present, over 600 million people living in urban areas worldwide are being exposed to dangerous levels of traffic-generated air pollutants.

Conclusion

In this study, it has been concluded that atmosphere of the Quetta city is highly polluted because of high rate of traffic generated dust. It was also noticed that main causes of dust fall pollution are the vehicles movement and winds. Results reported that rate of dust fall significantly increase from 2010 to 2011. Results also exhibited that majority of the people of Quetta city (particularly those who were directly exposed to the dust fall pollutants) are badly affected due to traffic generated pollutants and they were mostly suffering from different diseases. This is in agreement with the reports of public health in connection with the degrading air environment of Quetta.

References

Agrawal, S.K. 1999. Studies on the effect of the auto-exhaust emission on the *Mitragymapatriflora*. M. Phil thesis. M.D.S. University, Ajmeer, India.

AQEG, 2005. *Particulate Matter in the UK: Summary*. Defra, London.

Ara, F., Z.M. Iqbal and M.S. Qureshi. 1996. Determination of heavy metals contaminations of trees and soil due to vehicular emission in Karachi city, *Kar. Univ. J. Sci*., 24(1): 80-84.

Beg, M.A.A., A.H.K. Yousufzai and S.N. Mahmood. 1987. Air pollution in Karachi *Pak. J. Sci. Ind. Res*. 30: 60-70.

Beg, M.A.A., S.N. Mahmood and A.H.K Yousfzai. 1991. Environmental problems of Karachi. *Pak. J. Sci. Ind. Res*., 34: 52.

Benneth, B.G. 1981. Exposure commitment assessment of environmental pollution. Monitoring and Assessment Research Center, London. *Brit. Med. Journ*. (1): 454-58.

Brunekreef, B. 1997. Air pollution from lorry traffic and lung function in children living near motorways. *Epidemiology*,8(3):298-303.

Cacciola, R.R., M. Sarva and R. Polosa. 2002. Adverse respiratory effects and allergic susceptibility in relation to particulate air pollution: flirting with disaster. *Allergy*, 57: 281–286.

Cheng, M.F., S.C. Ho, H.F. Chiu, T.N. Wu, P.S. Chen and C.Y. Yang. 2008. Consequences of exposure to Asian dust storm events on daily pneumonia hospital admissions in Taipei, Taiwan. *J Toxicol. Environ Health A.* 71(19):1295-9.

Chung, Y.S., H.S Kim, J. Dulam and J. Harris. 2003. On heavy dust fall observed with explosives and storms in Chongwon-Chongju, Korea in 2002. *Atmos. Env.*, 37:3425-33.

De Longueville, F., Y.C. Hountondji, S. Henry and P. Ozer. 2010. What do we know about effects of desert dust on air quality and human health in West Africa compared to other regions? *Sci. Total Environ.* 409(1):1-8.

Derbyshire, E., 2007. Natural minerogenic dust and human health. Ambio 36, 73-77.

Dora, C. and M. Phillips eds. 2000. *Transport, environment and health*. Copenhagen, WHO Regional Office for Europe (WHO Regional Publications, European Series, No. 89.

Farid, U.K., B. Shakila, G.G. Ejaz and M. Ahmad. 2002. Air pollution in Peshawar (Rate of dust fall). *Pak.J. Sci. Ind. Res*,45:1-6.

Gautam, A. 1990. Ecology and Pollution of Mountain waters. "A case study of Bhagirathi River, Ashish Publishing House, New Delhi-110026 ISBN 81-7024341-6, pp 68-128.

Hamidullah, S., S. M. Khan and S. Tahir. 1998. Heavy metal pollution in the western part of Peshawar metropolis, North Pakistan. *Journal of Nepal Geological Society*, 18: 379 - 394.

Harrison R.M, D.J. Smith, C.A. Pio and L.M. Castro. 1997. Comparative receptor modeling study of airborne particulate pollutants in Birmingham (UK), Coimbra (Portugal) and Lahore (Pakistan). *Atmos. Env.* 31(20): 309-321.

Hoek G., B. Brunkreef and S. Goldbohm. 2002. Association between mortality and indicators of traffic-related air pollution in the Netherlands: a cohort study. *Lancet*, 360:1203–1209.

Qurashi, I.H. 2000. Air pollution and Human health. Proc. Pakistan Acad. Sci., 37: 109-117.

Kamal, L., M.I. Zaidi, A. Asrar, and S.A. Saddiqi. 1998. Effects of hazardous elements on community health of Quetta city. *Pak. J. Sci. Ind. Tech.* 20: 21-27.

Khan, F.U., B. Shakila, G.E Ghori and M. Ahmad. 2002. Air pollution in Peshawar (rate of dust fall). *Pak. J. Sci. and. Res.*, 45: 1-6.

Khan, K.H., N. Ahmad, J.K. Sial and M.I. Khan. 1996. Ground water pollution by heavy metals: A Case Study of Faisalabad [Pakistan]. *Sci. Technol. Develop*., 15: 1-5.

Khan, M.S. 1996. Heavy and trace metal-related pollution in the western part of Peshawar metropolis. M.Phil thesis, Univ. Peshawar, 89p.

Khan, Z.A., K. Faridullah, G.M. Khan and M. Ahmad. 2001. Rate of dust fall at Islamabad during 1989-90. Sci and Tech in the Islamic World, 9: 1-3.

Leghari. S.K., M.A. Zaidi, and S. Rehman. 2003. Tempo-Spatial study of the deposition of lead on "*Pinushalepensis* Mill, around roadside of Quetta. *Res. J. U.O. B.*, 3: 29-39.

Livingstone A.E., G. Shaddick, C. Grundy and P. Elliott. 1996. Do people living near inner city main roads have more asthma needing treatment? Case control study. *British Medical Journal*, 312: 676–677.

Malik, S. M., M A. Kaleem and R. Nasir. 2002. Laboratory study of physical and chemical characteristics and the nutrient status of soils collected from Rawalakot Azad Jammu and Kashmir, Pak. J. of Biological Sciences., 3: 2082- 2086.

Meng Z. and B. Lu. 2007. Dust events as a risk factor for daily hospitalization for respiratory and cardiovascular diseases in Minqin, China. *Atmos. Env.* 41(33):7048-58.

Prabowo, A., L.R. McDowell, N.S. Wilkinson, C.J. Wilcox and J.H. Conrad 1991. Mineral Status of grazing cattle in South Sulawasi, Indonesia. Z-Microminerals Anim. Sci., 4:121-130.

Rashid, A. and N. Ahmed. 1994. Soil testing in Pakistan. Proceedings of FADINAP regional workshop on cooperation in soil testing for Asia and the pacific, held in Bangkok. Thailand, August, 16 to 18, 1993.

Rhue E.D and G. Kidder. 1983. Analytical procedures used by the IFAS extension soil testing Laboratory and the interpretation of results. Soil Science department, University of Florida, Gainesville.

Robert, A.H.T.R. 1986. Air pollution measurement committee. *J. Air Pollut Control Associ*. 16: 372p.

Saifullah. 1998. Heavy and trace metal- related pollution in the eastern part of Peshawar metropolis. *M.Phil thesis*, Uni. Peshawar, 133 p.

Shendell, D.G. and L.P. Naeher. 2002. A pilot study to assess ground-level ambient air concentrations of fine particles and carbon monoxide in urban Guatemala. *Environment International.*, 28: 375–382.

Steel. R.G.D and J.H Torrie. 1980. Principles and procedure of statistics. McGraw Hill Book Co. Inc. New York., 507p.

Tao, Y., X. An, Z. Sun, Q. Hou and Y. Wang. 2012. Association between dust weather and number of admissions for patients with

respiratory diseases in spring in Lanzhou. *Sci Total Environ.* 423:8-11.

Tejada, R., L.R McDowell, F.G Martin and L.H. Conrad. 1987. Evaluation of the macro-mineral and crude protein status of cattle in specific regions in Guatemala. *Nutr. Rep. Int*., 35: 989-998.

Tegen, I., 2006. Effects of atmospheric dust. In Encyclopedia of Quaternary Science. Elsevier, Netherlands.

Tiffany, M.E. 1998. Effects of Biosolids application to pasture on performance of grazing cattle and mineral status of forages and soils in North Florida. M.S. Thesis, Univ. of Florida. Gainesville, FL

Tiffany, M.E., L.R. McDowell, G.A.O Connor, F.G. Martin and N.S. Wilkinson. 1999. Variation of forage and extractable soil minerals over two grazing seasons in North Florida. *Commun. Soil Sci. Plant Anal*., 30: 2743-2754.

Tiffany, M.E., L.R., McDowell, G.A.O. Connor, H. Nguyen, F.G. Martin, N.S. Wilkinson and N.A. Katzowitz. 2001. Effects of residual and reapplied biosolids on forage and soil concentrations over a grazing season in North-Florida.11. *Microminerals. Commun. Soil Sci. Plant Anal*., 32: 2211-2226.

Tripathi, A.K. and M. Gautam, 2007. Biochemical parameters of plants as indicators of air pollution. *Journal of Environmental Biology*, 28: 127-132.

Venn, A.J., S.A. Lewis and M. Cooper. 2001. Living near a main road and the risk of wheezing illness in children. *American Journal of Respiratory and Critical Care Medicine*, 164: 2177–2180.

Wang, G., H. Wang, Y. Yu, S. Gao, J. Feng, S. Gao and L. Wang. 2003. Chemical characterization of water-soluble components of PM10 and PM2.5 atmospheric aerosols in five locations of Nanjing, China. *Atmospheric Environment* 37: 2893–2902.

World Health Organization (WHO), 2000. Air Quality Guidelines for Europe. WHO Regional Publications, European Series No. 91, WHO Regional Office for Europe, Copenhagen.

Yang, K.L. 2002. Spatial and seasonal variation of PM10 mass concentrations in Taiwan. *Atmospheric Environment* 36, 3403–3411.