

Impact of Local Traffic Pollution on the Health Status of Secondary School Students in Karachi

Riaz Ahmed Bhutto¹, Syed M. Maqsood¹, Zeba Saeed¹, Muneer Sadiq², Shahid Kamran¹
and Irfan Khan³

ABSTRACT

Objective: The aim of this study was to see how secondary school students were influenced by vehicle exhaust emissions and dust. The health impact of local traffic pollution on the secondary school age children is evaluated in this report.

Study Design: Randomized Study

Place and Duration of Study: This study was conducted at Community Medicine, Al-Tibri Medical College, Karachi. from December, 2020 to March, 2020.

Materials and Methods: 210 secondary school students were selected of age 12 to 16 years for study. Oxygen saturation (SPO₂) changes were measured by Wireless Fingertip Pulse Oximeter and Peak Expiratory Flow Rate was taken by Digital Peak Flow Meter of secondary school going students attending schools at main Saddar area, Gulshan-e-Iqbal and in DHA Karachi city. Statistical analysis was carried out by SPSS.

Results: Oxygen saturation, (SPO₂) changes were normal in students of every area but were remarkably low in students attending school in Saddar area ($p < 0.001$) to compare with other areas students. Peak Expiratory Flow Rate was lower (431.00 ± 10.98 L/min) in students going schools at Saddar area than students attending school in Gulshan-e-Iqbal area (436.00 ± 13.19 L/min) and Defense Housing Authority area (450.40 ± 12.92 L/min).

Conclusion: Effect of automobile exhaust emissions and dusts on secondary school students inside centres of city seed more health threat to young students than the students attending schools in other parts of city.

Key Words: Secondary school students, Automobiles air pollution, Environmental dust pollution, Oxygen Saturation, Peak Expiratory Flow Rate

Citation of article: Bhutto RA, Maqsood SM, Saeed Z, Sadiq M, Kamran S, Khan I. Impact of Local Traffic Pollution on the Health Status of Secondary School Students in Karachi. Med Forum 2021; 32(9):65-68.

INTRODUCTION

Karachi is the 10th largest city of the world. Karachi has grown nearly 25 times since 1947 and is growing at the rate of about 5.4 percent per annum, making it one of the fastest growing cities of the world. Apart from the spurt in population that it has experienced, the intra-urban distribution of population has also changed phenomenally. Its average annual growth, 2006 to 2019, was 3.19%. Its Pollution Index rate 2019 at mid-year is 89.32¹.

The city has seen an extraordinary advancement in most recent decade.

¹. Department of Community Medicine / Medicine² / Forensic Medicine³, Al-Tibri Medical College, Karachi.

Correspondence: Dr. Riaz Ahmed Bhutto, Associate Professor, Department of Community Medicine, Al-Tibri Medical College, Karachi.
Contact No: 0345-2751689
Email: drrkb@hotmail.com

Received: April, 2021
Accepted: July, 2021
Printed: September, 2021

Recent census revealed Karachi population has grown at around 6% per annum while the average growth rate of registered vehicles was recorded 40%².

Motor vehicle exhaust is made up of a combination of gases, liquid droplets, and solid particles. In humans, several of these compounds have been linked to disease³. Automobile emissions cause encompassing levels of air toxics contain carcinogens. Exposure to air toxins even causes noncancerous effects such as cardiovascular, neurological, reproductive and respiratory diseases.

Engine vehicles exhaust fumes discharge has a lot of negative impact on the human wellbeing and the climate. Internal combustion engines emit carbon monoxide, carbon dioxide, hydrogen vapors, water, hydrogen isocyanides, sulfur oxides, nitrogen oxides, and various metals like lead, cadmium, nickel, sodium, potassium, phosphorus, zinc, manganese, iron, copper, barium, and so on while the evaporative outflows are the fumes of fuel which are delivered into the environment⁴. Diesel exhaust from vehicles and air pollution is harmful and interrupts with the proper functioning of human body organ systems. After acute and long term exposure to particulate matter, vehicle fume exhaust can disrupt normal physiology. Systemic

disease processes in the central nervous, ocular, hematologic, respiratory, cardiovascular, and renal systems may occur as a result of exposure⁵. Dust and smoke are visible examples of PM 10, but more than 90 percent of particulate matter isn't visible to the naked eye. Particulate matter contains microscopic solids or liquid droplets that are so small that they can be inhaled and cause serious health problems. Some particles less than 10 micrometers in diameter can get deep into human lungs and some may even get into bloodstream. The high surface-to-mass ratio of very small particles less than 0.1 microns increases their toxic capacity⁶. PM 2.5 concentration in Karachi air is currently 4 times above WHO exposure recommendation⁷.

The current investigation was subsequently manifest the impact of toxic waste such as auto exhaust fumes, gases, and so forth on secondary school going students by estimating their peak expiratory flow rate and oxygen saturation.

MATERIALS AND METHODS

This study was carried out from 1st week of December 2019 to 2nd week of March 2020. Schools are chosen using a stratified random sample of secondary schools from the Karachi city area's major school regions: Saddar, Gulshan-e-Iqbal and Defense housing authority (DHA). Twenty-one secondary schools were chosen at random from a list of secondary schools collected from the Department of Education. For each of the schools we selected, we calculated the distance between the school's central and the nearest major road. At least average three hundred automobile vehicles movements in twenty-four hours in all the areas in study were recorded. 210 students were conveniently selected. Only healthy students with same anthropometric measurements, and at least two years of duration of exposure were included in the study. Students with history of allergies or respiratory illnesses were not included in study. Their identity was kept secret. Study was conducted in all three selected sites of Karachi, at the entrance of the school, in the open parking area of the school, and inside the school building respectively. Before testing all selected students were given a complete explanation of the purposes, procedures and potential risks and benefits involved in the study and their school administration consent was taken in this regard. A detailed history including the history of diet and lifestyle was taken and general physical and systemic examination was done. Weight was taken on a weighing scale with standard minimum clothing to the nearest 1/2 kg. Height was recorded in cm without shoes. The study was approved by the local institutional ethical committee.

The Wireless Fingertip Pulse Oximeter was used to calculate the Oxygen saturation. Students were asked to sit for ten minutes before taking three measurements on their left index finger at one-minute intervals. The

highest pulse oximetry-measured blood oxygen saturation value was held. In the event of a broken nail, other digit from the same hand was used. It was also tested to see whether the subjects were wearing nail polish or ink, which was removed if they were. After spending ten minutes in warm rooms, measurements were taken. A Digital Peak Flow Meter was used to calculate the peak expiratory flow rate. The test was carried out while standing, with the peak flow meter kept horizontally. In the inlet nozzle, a tight-fitting disposable cardboard mouthpiece was inserted. Following proper rest, the subject was instructed to take a deep breath and exhale as vigorously as possible into the instrument in one single blow. The experiment was carried out three times, with the best of the three results being documented.

Statistical analysis was carried out by SPSS. The unpaired 't' test was used for statistical procedure and analysis. We compared the means of two independent groups to determine if there is a significant difference between the two. The findings were expressed as Mean $\pm$ SD, with a p value of < 0.001 considered relatively significant.

RESULTS

This study looked at whether or not exposure to vehicular contaminants is linked to children's respiratory health. In most cases, according to a WHO technical report, vehicle exhaust is a significant irritant that affects the respiratory tract. To avoid permanent damage, it is important to detect and treat respiratory obstruction at an early and reversible stage. At present in Karachi airborne particles concentration is less than 2.5 microns (PM 2.5) which is four times higher than the WHO's recommended exposure level⁷. Pulmonary function tests are used as screening tests to ascertain the effects of these contaminants in populations exposed to them⁸. One such parameter that can be easily measured is the peak expiratory flow rate.

Table No.1: Oxygen Saturation (SPO2)

Location	Oxygen Saturation %	Values
School located at Saddar Karachi	98.90 $\pm$ 0.59	in Mean $\pm$ SD
School located at Gulshan-e-Iqbal Karachi	98.60 $\pm$ 0.60	in Mean $\pm$ SD
School located at DHA Karachi	97.94 $\pm$ 1.29	in Mean $\pm$ SD

In our study, school students in Saddar area who were constantly exposed to exhaust and fumes had a lower peak expiratory flow rate than Students of Gulshan-e-Iqbal area and DHA Schools. The PEFR is useful for determining the degree and rate of growth of a disease⁹. Within 100-120 m of the start of forced expiration, the PEFR emerges from the broad airways as an effort-

dependent parameter. It stays at its highest point for around 10 meters^{10, 11}.

Table No.2: Peak Expiratory Flow Rate (PEFR)

Location	Peak Expiratory Flow Rate (L/min)	Values
School located at Saddar Karachi	431.00 ± 10.98	in Mean ± SD
School located at Gulshan-e-Iqbal Karachi	436.00 ± 13.19	in Mean ± SD
School located at DHA Karachi	450.40 ± 12.92	in Mean ± SD

Table No.3: Comparative relation of Oxygen Saturation

Location	T-value	P-value	Statistical Significance
Students of Saddar area School Vs Students of Gulshan-e-Iqbal area School	3.66	0.01-0.001	Significant
Students of Gulshan-e-Iqbal area School Vs Students of DHA area School	1.71	>0.10	Non-Significant
Students of Saddar area School Vs Students of DHA area School	3.99	<0.001	Highly Significant

Table No.4: Comparative relation of Peak Expiratory Flow Rate

Location	T-value	P-value	Statistical Significance
Students of Saddar area School Vs Students of Gulshan-e-Iqbal area School	4.69	0.01-0.001	Significant
Students of Gulshan-e-Iqbal area School Vs Students of DHA area School	1.31	>0.10	Non-Significant
Students of Saddar area School Vs Students of DHA area School	5.95	<0.001	Highly Significant

DISCUSSION

Motor vehicles release a mixture of solid and liquid particles into the atmosphere. Primary particles are made up of unburned diesel or petrol droplets combined with solid fuel (smudge) from engine emissions¹². Traffic pollution has been linked to a number of illnesses as well as risk of death. Over the previous two

decades, the concentrations of main air pollutants such as O₃, NO_x, and SO₂ have also increased dramatically in Pakistan. According to the World Bank, the annual burden of disease caused by outdoor air pollution in Pakistan leads in about 22,000 premature adult deaths and 163,432 disability-adjusted life years (DALYs) lost. Increased mortality in children as a result of pollution, on the other hand, is difficult to estimate since increased mortality occurs later in life. Early exposure to local traffic pollution has been linked to lung function problems later in life¹³. In a study performed by Yasar et al. in 2013, vehicle emissions were reported to be significantly depending on the type of fuels utilized. Diesel vehicles and buses produced five times more SO₂ and fourteen times more HC emissions than CNG vans and buses, which produced two to twenty times more CO emissions. According to Hussain et al. (2018), one of the main causes of inferior civic air quality in Pakistan's major cities is increasing number of vehicles. The average yearly growth rate for on-road cars in Pakistan was more than 8.5 percent, and an average vehicle in Pakistan produces 25, 20, 8, and 3.6 times more lead, hydrocarbons, carbon, and NO_x per kilo metre than a vehicle in the United States, according to this report¹⁴. The peak expiratory flow rates of students inside school building were lower than those of students in open parking area or students near entrance in school in Saddar. Our findings back up previous studies that found men working in underpasses and bus garages had decreased lung capacity¹⁵. Students at DHA school inside in school building had significantly lower Peak Expiratory Flow Rates due to the localized concentration of exhaust fumes and dust in the building and the lack of access to outside fresh air. A lack of proper ventilation and humidity in side building exposes student to dust mites and air borne spores, in addition to exhaust and dust. Many studies have linked dampness and mould in buildings to negative respiratory health effects^{16,17}. All of the students seemed to have normal oxygen saturation (SPO₂) levels in all places of studies. This clearly indicates that their oxygen saturation was not affected despite the apparent drop in PEFR. Since our research was conducted on a younger age group, this may be reason for normal oxygen saturation SPO₂ with pollutants exposure. Students inside school building, on the other hand, had significantly lower oxygen saturation than those whom tests were taken outside school buildings. Various studies have found several examples of air quality constantly exceeding national guidelines in Pakistan's major cities. During the year 2019, PM 2.5 concentrations in the city of Karachi and Lahore exceeded the WHO and national air quality guidelines on virtually every single day. Although a few studies have reported on the significant effects of rising pollution concentration in Pakistan, the full

scope, nature of contributing causes, and consequences are unknown.

CONCLUSION

Because of the growing health and socioeconomic consequences, in recent years, air pollution and particle matter have merged to create a global problem. These dangers have grown in intensity and impact, particularly in developing nations Pakistan, for example, is a developing country with inadequate warning, protection, and control mechanisms. Poor air quality has been linked to a number of health issues, as well as growing death rates, according to several epidemiological studies. As a result of high levels of air pollution, mainly particulate matter, death rates in Pakistan are alarmingly high. Exhaust gases and dust have a negative impact on student's health. Students are at risk due to the additional effects of indoor pollution. Regular health tests for the students should be performed to identify any respiratory problems as soon as possible and to follow proper management procedures. Ventilation should be carefully considered, and generators and other air-polluting devices should not be placed in basements.

Author's Contribution:

Concept & Design of Study:	Riaz Ahmed Bhutto
Drafting:	Shahid Kamran
Data Analysis:	Zeba Saeed, Irfan Khan
Revisiting Critically:	Riaz Ahmed Bhutto, Muneer Sadiq Syed M. Maqsood
Final Approval of version:	Riaz Ahmed Bhutto

Conflict of Interest: The study has no conflict of interest to declare by any author.

REFERENCES

1. Anjum MS, Ali SM, Imad-ud-din M, Subhani MA, et al. An Emerged Challenge of Air Pollution and Ever-Increasing Particulate Matter in Pakistan; A Critical Review. *J Hazardous Materials* 2021;402: 123943.
2. The News International: 'Over 6,000 cars, 22,000 motorbikes registered in city every month', [online] 2018 February 1 [cited 2020 April 15]. Available from: URL: <https://www.thenews.com.pk/print/275413.html>
3. Reis H, Reis C, Sharip A, Reis W, Zhao Y, Sinclair R, Lawrence Beeson. Diesel exhaust exposure, its multi-system effects, and the effect of new technology diesel exhaust. *Environment Int* 2018; 114:252-265.
4. Amato F, Cassee FR, van der Gon HD, Gehrig R, Gustafsson M, et al. Urban air quality: The challenge of traffic non-exhaust emissions. *J Hazardous Materials* 2014;6:275: 31-36.
5. Reis H, Reis C, Sharip A, Reis W, Zhao Y, Sinclair R, et al. Diesel exhaust exposure, its multi-system effects, and the effect of new technology diesel exhaust. *Environment Int* 2018;114:252-265.
6. Heberle SM, da Costa GM, Barros N, Rosa M. The Effects of Atmospheric Pollution in Respiratory Health. In: Hussain C, editor. *Handbook of Environmental Materials Management*. Springer, Cham: 2018 https://doi.org/10.1007/978-3-319-58538-3_171-1.
7. Air quality in Pakistan: [online] 2020 [cited 2020 April 10]. Available from: URL: <https://www.iqair.com/us/pakistan/sindh/karachi>
8. Reshmarani, Shilpa N, Veena HC. Peak flow meter and digital spirometer: A comparative study of peak expiratory flow rate values. *Natl J Physiol Pharm Pharmacol* 2020;10.
9. Tiwari VK, Bansal S, Sood S, Kumar A, Shukla R. Comparative evaluation of peak expiratory flow rate between computerized spirometry and peak flow meter. *Int J Adv Integr Med Sci* 2016;1:93-4.
10. Tomar S. Comparison of PEF measurements using peak flow meter and digital spirometer among people of Udupi District; a cross sectional study. *Ind J Sci Res* 2014;9:102-4.
11. Moore VC. Spirometry: Step by step. *Breathe* 2012;8:232-40.
12. Madaniyazi L, Xerxes S. Outdoor air pollution and the onset and exacerbation of asthma. *Chronic Diseases and Translational Med* 2021;7:100e106.
13. Anjum MS, Ali SM, Imad-ud-din M, Subhani MA, et al. An Emerged Challenge of Air Pollution and Ever-Increasing Particulate Matter in Pakistan; A Critical Review. *J Hazardous Materials* 2021; 402(1): 0304-3894.
14. Khreis H, Alotaibi R, Horney J, McConnell R. The impact of baseline incidence rates on burden of disease assessment of air pollution and onset childhood asthma: analysis of data from the contiguous United States. *Annals Epidemiol* 2021; 53:76-88.e10.
15. Franklin B, Cascio W, Hong Y, Howard G, Lipsett M, Luepker R, et al. Air pollution and cardiovascular disease: a statement for healthcare professionals from the Expert Panel on Population and Prevention Science of the American Heart Association. *Circulation* 2018;114:252-265.
16. Arbak P, Balbay O, Annakkaya AN, Bilgin C, Ozshin SL. Annual Changes in Forced Expiratory Flows in Toll Collectors: Results from a Four Years Observation. *Industrial Health* 2009; 10.2486/indhealth.47.160, 47, 2, (160-165).
17. Ahmad U, Balkhyour MA. Occupational exposure and respiratory health of workers at small scale industries. *Saudi J Biological Sci* 2020;10. 1016/j.sjbs.2020.01.019.