

Effect of air pollution on FVC, FEV₁ and FEV₁/FVC% of the traffic policemen in Dhaka city

Shahriar Ahmed¹, Qazi Shamima Akter², Hossneara Eva³, Mita Bhowmik⁴

Abstract

Background: Due to large number of vehicles, air pollution is increasing day by day in Dhaka city. Automobile exhaust cause acute and chronic respiratory disease in traffic policemen as they are exposed to air pollution for prolong period of time. **Objective:** To observe the effect of long term exposure to air pollution on FVC, FEV₁ and FEV₁/FVC% of traffic policemen. **Methods:** This cross sectional study was conducted in the Department of Physiology, Dhaka Medical College (DMC), Dhaka from July 2014 to June 2015. Fifty apparently healthy traffic policemen with the age 25 to 45 years were selected as study group. Fifty age and BMI matched healthy male subjects were selected as control. The study subjects were selected from different traffic junctions and the control from different offices of Dhaka city. FVC, FEV₁ and FEV₁/FVC% of all the subjects were measured by a digital spirometer. Statistical analysis was done by Independent sample 't' test. **Results:** In this study FVC, FEV₁ and FEV₁/FVC were significantly ($p < 0.001$) lower in the traffic policemen than the control group. **Conclusion:** From the result of this study it can be concluded that prolonged exposure to air pollution may decrease pulmonary function of the traffic policemen in Dhaka city.

Key words: Air pollution, FVC, FEV₁, FEV₁/FVC%.

J Bangladesh Soc Physiol. 2016, December; 11(2): 39-42
For Authors Affiliation, see end of text.

<http://www.banglajol.info/index.php/JBSP>

Introduction

Air pollution is the contamination of the outdoor and indoor environment by any chemical physical or biological agents that modify the natural characteristics of the environment. Motor vehicles, household combustion, industrialization and forest fires are the common sources of air pollution¹. In the developing countries, the concentration of air pollutant is rising with the rapid industrialization and increasing numbers of motor vehicles².

Throughout the world about 7 million people died in 2012 due to air pollution, of which 3.7 million deaths occur due to outdoor air pollution. About 88% of these deaths occur in low and middle-income countries³.

Air Quality Management Project (AQMP), funded by the Government of Bangladesh and World Bank, reported that several million people suffer from pulmonary, respiratory and neurological illness due to this poor air quality and causes about 15,000 early deaths in Dhaka city in each year⁴.

Air pollution can affect respiratory, cardiovascular, nervous and renal system that cause persistent cough, asthma, nasal blockage, respiratory infections, hypertension, eye irritation, drowsiness, headaches and renal damage⁵.

Chronic exposure to air pollution may cause transient reduction in pulmonary function and may produce symptoms of asthma and chronic obstructive lung disease².

Received 20 March 2016; Accepted 4th May 2016

Significant inflammatory reactions occur in the lung of traffic policemen as they are exposed to excessive amounts of vehicular pollutants for prolong period. These reactions can lead to asthma, chronic bronchitis, emphysema, chest infections, pneumonia and lung scarring or fibrosis⁶.

In recent days pulmonary function is assessed by computerized spirometer. The spirometer measures FEV₁ (Forced vital capacity in one second), FVC (Forced vital capacity), FEV₁/FVC% and gives an idea about the lungs functional condition⁷.

Different investigators observed significant decrement of lung function parameters (FVC, FEV₁, FEV₁/FVC%) in traffic policemen^{8,9,10}. Prolonged exposure to vehicular exhaust causes inflammation and oxidative stress in the lung parenchyma that cause asthma, bronchitis, COPD^{11,12}. Exposure to toxic substances such as vehicular gases, smoke and inhaled pollutants (lead, cadmium, manganese) induce inflammation in the lung. This causes epithelial injury and proteolysis of the extracellular matrix and thereby COPD¹³. Studies investigating the effect of vehicular exhaust have reported conflicting results¹⁴.

So this study has been designed to observe the effect of exposure to air pollution on pulmonary function of traffic policemen in Dhaka city.

Methods

This cross-sectional study was conducted in the Department of Physiology in Dhaka Medical College from July 2014 to June 2015. Protocol of this study was approved by Ethical review committee of Dhaka Medical College. For this study 50 traffic policemen, age (25-45 years), working in Dhaka city more than 5 years were selected by random sampling from different traffic junctions of Dhaka city. Fifty age and BMI matched apparently healthy adult male subjects from different offices of Dhaka city were selected as control. All the subjects were free from smoking, chronic obstructive pulmonary disease (COPD), asthma, musculoskeletal abnormality,

anemia, diabetes mellitus, heart disease, liver disease, kidney disease, TB and malignancy. The nature, purpose and benefits of the study were explained to each of the subjects in details. They were encouraged to participate voluntarily. Informed written consent was taken from the participants. Detailed family and medical history were taken. Anthropometric measurement of the subjects was done and blood pressure was measured. All the information were recorded in a prefixed data schedule. Pulmonary function test was done by computerized spirometer in Department of Physiology of Dhaka Medical College, Dhaka. All the parameters were expressed as mean \pm SE of Percentage of predicted values of FVC, FEV₁, FEV₁/FVC. Statistical analysis was done by independent Student's 't' test. P value <0.05 was accepted as level of significance. Statistical analysis was done by using a computer based statistical program SPSS (Statistical package for social science) version 21.

Results

General characteristics are presented in the Table I. Subjects of two groups were similar in respect of age and BMI. Mean percentage of predicted value of forced vital capacity (FVC), forced expiratory volume in 1st second (FEV₁) and FEV₁/FVC% were found significantly lower in the traffic policemen than the control (Table II). Again FEV₁/FVC% <80% were found in 52% of study group (Figure 1).

Table I: General characteristics of study subjects (n=100)

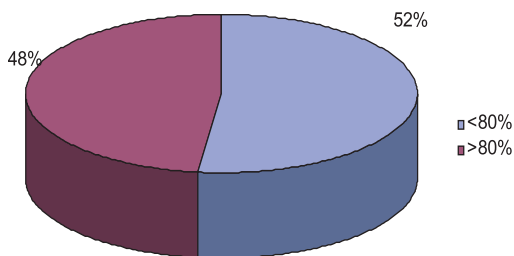
Parameters	Control (n = 50)	Study (n = 50)
Age (years)	36.66 \pm 0.66	36.66 \pm 0.66
BMI (kg/m ²)	24.98 \pm 0.23	26.02 \pm 0.30
SBP (mmHg)	120.00 \pm 1.87	120.16 \pm 1.44
DBP (mmHg)	76.52 \pm 0.94	70.80 \pm 1.06

Results are expressed as Mean \pm SE. Statistical analysis was done by unpaired student's 't' test. n= Number of subjects. Control = Healthy adult subjects, Study = Traffic policemen. BMI= Body mass index, SBP= Systolic blood pressure, DBP= Diastolic blood pressure.

Table II: Mean percentage of predicted value of FVC, FEV₁ and FEV₁/FVC in two groups (n=100)

Parameters	Control (n=50)	Study (n=50)
FVC	73.94 ± 1.27	72.74 ± 1.76***
FEV ₁	78.22 ± 1.44	69.82 ± 2.37***
FEV ₁ /FVC%	89.99 ± 0.82	79.73 ± 1.85***

Results are expressed as Mean ±SE. Statistical analysis was done by unpaired student's 't' test. n= Number of subjects. (***)p < 0.001). Control: Healthy adult subjects, Study: Traffic policemen.

**Figure 1:** Frequency% distribution of FEV₁/FVC% in traffic policemen presenting that majority of the subjects had low FEV₁/FVC%. (n=50). Cut point <80%.

Here 22% traffic policemen have FEV₁/FVC ratio < 0.7 which indicate they are suffering from obstructive lung disease⁷.

Discussion

In this study mean percentage of predicted value of FVC, FEV₁ and FEV₁/FVC were significantly lower in the traffic policemen than the control. This results are similar to other researchers^{9,10,15}. But some studies found no significant changes²⁰.

In this study FEV₁/FVC ratio was less than 0.7 in 22% of the traffic policemen. This findings agree to others^{7,19}.

From the lower values of these parameters in apparently healthy traffic policemen compared

to control, the harmful effect of exposure to air pollution on pulmonary function in the traffic policemen is obvious. Both the traffic police and office goers control subjects are exposed to air pollution from vehicular emission and dust from roadside construction or industrial waste. But comparatively traffic police are chronically exposed for prolonged period to the polluted air than control. From this study the exact reason of reduced lung function due to inhalation of polluted air is not clear. But literature review suggests that. Inhaled noxious particles and gases cause inflammatory response in the lungs that cause activation of proteinase and inactivation of antiproteinase. Inactivation of antiproteinase and activation of proteinases cause destruction of lung parenchyma, hyper secretion of mucous and hyperplasia of epithelial cells¹⁵. The particulate matter of vehicular exhaust can easily enter into the trachea and bronchi and deposit there. Small size particles of less than 2.5 microns (PM_{2.5}) can reach the small airways and the alveoli thus may cause respiratory disease like asthma, bronchitis, COPD and interstitial lung disease¹². Several investigators of different countries have suggested that decrement of pulmonary function is associated with traffic pollution^{17, 18}.

The results of this study suggest that the traffic police have decreased lung function and some of them may have asymptomatic obstructive lung disease.

In the present study, pulmonary function parameters FVC, FEV₁ and FEV₁/FVC% were significantly decreased in the traffic policemen of Dhaka city as a result of air pollution.

Conclusion

From this study, it may be concluded that air pollution has harmful effect on lung function of traffic policemen in Dhaka city

Conflict of interest None

Author affiliation

- *1. Shahriar Ahmed. Assistant Professor. Department of Physiology. CARE Medical College, Dhaka. Email: shahriar_dr80@yahoo.com. Cell no: 01817232181
2. Qazi Shamima Akter. Professor and Head, Department of Physiology, Dhaka Medical College, Dhaka.
3. Hossneara Eva. Assistant Professor. Department of Physiology. Brahmanbaria Medical College, Brahmonbaria. Cell no: 01712467144
4. Mita Bhowmik. Assistant Professor. Department of Physiology. Estern Medical College, Comilla. Cell no: 01711263039

References

1. WHO: Health topics. Geneva: World Health Organization:c2014. Air pollution; [internet]2014; [cited 2014 Nov 27]. Available from http://www.who.in/topics/air_pollution/en.
2. Samet J, Buist S, Bascom R, Garcia J, Lipsett M, Mauderly J, Mannino D, Rand C, Romieu I, Utell M, Wagner G. What constitutes an adverse effect of air pollution? *Am J Respir Crit Care Med*. 2000; 161: 665-673.
3. WHO: Media centre. Geneva: World Health Organization: c2014. 7 million premature deaths annually linked to air pollution; [internet] 2014:[cited 2014 Dec15]. Available from <http://www.who.int/mediacentre/news/releases/2014/air-pollution/en/>.
4. Air pollution in Dhaka. Daily star (Dhaka Ed.);[internet]2009:[cited 2014 Dec21]. Available from:<http://archive.thedailystar.net/newDesign/newsdetails.php?i=1135>
5. Tanvir AKM, Begum DA. Air Pollution Aspects of Dhaka City. International conferences on Environmental Aspects of Bangladesh. ICEAB 2010; Japan: 129-131.
6. Streeton JA. Adelaide: National Environment Protection Council: c2000. A Review of Existing Health Data on Six Polltants. [internet] 2000. [cited: 2015 Jan25]. Available from: <http://www.scew.gov.au/system/files/resources/9947318f-af8c-0b24-d928-04e4d3a4b25c/files/aaq-rpt-review-existing-health-data-6-pollutants>
7. Pal P, Robert J, Dutta TK, Pal GK. Pulmonary Function Test in Traffic Police Persnnel in Pundicherry. *Indian J Physiol Pharmacol* 2010; 54(4): 329-336.
8. Gupta S, Mittal S, Kumar A, Singh KD. Respiratory effects of air pollutants among nonsmoking traffic policemen of Patiala, India. *Lung India*. [internet] 2011; 28(4): 253-256. Available from www.lungindi.com.
9. Ingle ST, Pachpande BG, Wagh ND, Patel VS, Attarde SB. Exposure to Vehicular pollution and respiratory impairment of traffic policemen in Jalgaon city, India. *Industrial Health* 2005; 43: 656–662.
10. Patil P, Thakare G, Patil S. Comparative study of lung function of policemen in traffic control with those in general duty. *Nat J Physiol Pharm Pharmacol* 2013; 3(2):162-166.
11. Barnes PJ. Chronic Obstructive Pulmonary Disease. *N Engl J Med* 2000; 343(4): 269-80.
12. Rickwood P, Knight D. The health impacts of local traffic pollution on primary school age children. 2010; 1-32.
13. Walker BR, Colledge NR, Ralston SH, Penmen ID. Davidson's principles and practice of medicine. 22nd ed. China: Elsevier Limited;© 2014 p.644-731
14. Salvi S, Blomberg A, Rudell B, Kelly F, Sandstorm T, Holgate ST, Frew A. Acute inflammatory responses in the airways and peripheral blood after short-term exposure to diesel exhaust in healthy human volunteers. *Am J Respir Crit Care Med* 1999; 159: 702–709.
15. Pramila T, Girija B. Study of pulmonary function tests in traffic policemen exposed to automobile pollution in Bangalore city. *njbms* 2012; 3(1): 35-38.
16. ATS. COPD Guidelines: For Health Professions: Pathology, Pathogenesis and Pathophysiology [Internet]. Newyork. American Thorasic Society. 2015. c1998-2015. Available from:American%20Thoracic%20SocietyPathophysiology.html
17. Karita K, Yano E, Tamura K, Jinsart W. Effects of working and residential location areas on air pollution related respiratory symptoms in policemen and their wives in Bangkok, Thailand. *Eur J Public Health* 2004 Mar; 14(1): 24-26.
18. Rao NM, Patel TS, Riayani CV, Aggarwal AL, Kulkarni PK, Chatterjee SK, Kashyap SK. Pulmonary function status of shopkeepers of Ahmedabad exposed to automobile exhaust pollutants. *Indian J Physiol Pharmacol* 1992; 36(1): 60-64.
19. Sayyad R, Yadav PK, Sekhar M, Aliyaraj A, Kar SK. Evaluation of pulmonary function tests on non smoking traffic police men at Tirupati, AP, India. *Int J Physiother Res* 2013; 1(5): 279-82.
20. Salvi S, Blomberg A, Rudell B, Kelly F, Sandstrom T, Holgate ST, Frew A. Acute inflammatory responses in the airways and peripheral blood after short-term exposure to diesel exhaust in healthy human volunteers. *Am J Respir Crit Care Med* 1999; 159(3):702–709.