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Airway Assessment Of Traffic Policemen Using Spirometry Exposed To Environmental Air Pollution

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ABSTRACT

Background & Aims: Environmental air pollution including vehicular emissions remains a health hazard to those exposed including traffic policemen working in various metro and non-metro cities. The aim of this study is to evaluate the pulmonary functions of the traffic police officers posted at various traffic junctions throughout Pune city in order to ascertain whether prolonged exposure to environmental air pollution including vehicle exhausts have any adverse effects on the traffic police officers' lung functions.

Methods: This cross-sectional study was conducted from July 2020 to July 2022 among 226 traffic police personnel, aged 18–55 years,working in Pune city at various traffic junctions. Measurement of pulmonary function testing was done using portable spirometer. Statistical analysis was carried out and the findings were expressed in the terms of mean, absolute values and percentages.

Results: The study consisted of a total of 226 traffic policeman. The average age of the study participants was found to be 38 years. Majority of the traffic policeman were males, with only 10/226 being females. In the present study, 12.83% had habit of smoking. The average height of the study population was 167.9 cm, and the average weight of the population was 71.63 kg. The average measured and predicted FEV1 was 3.09 and 3.14 respectively. However, the difference between the two groups was not statistically significant. The average measured and predicted FVC was 3.53 and 3.78 respectively. This difference was found to be statistically significant. The average FEV1/FVC was found to be 85.44. On performing spirometry, total 27 out of 226 (12%) traffic policemen were found to have abnormality which includes 9 (4%) were found to have obstruction and 18 (8%) had restriction.

Conclusion: Spirometry in traffic policeman is a unique tool to identify underlying respiratory illnesses. It is a useful screening tool to periodically evaluate their lung health as they are continually exposed to environmental air pollution.

Keywords: Air pollution, Spirometry, Pulmonary function, Traffic police.

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INTRODUCTION

In developed countries the major anthropic pollution sources are essentially represented by vehicular traffic, domestic heaters, industrial activities, urban solid waste incineration plants, coal-fired power plants and nuclear activities. Motor vehicle exhaust emissions are the major source of the many urban air pollutants such as carbon monoxide (CO), nitric oxide (NO), nitrogen dioxide (NO_2) sulphur monoxide (SO), sulphur dioxide (SO_2), particulate matter, benzene, ozone (O3) and many metals (lead, cadmium, arsenic, nickel, etc.).[1-4] There are various harmful effects on human health due to urban pollution and many of these effects are caused by acute or chronic exposure, with the onset of damage on different organs or systems.[5-7]

Air pollution is known to produce deleterious effects on respiratory system.[8] Air pollution due to road traffic is a potential health hazard worldwide wherein vehicular emission is causative for air quality crisis in cities.[9,10] It is very obvious to understand how much would be the exposure to these pollutants to traffic police personnel who are working for a long shift on roadways as a part of their duties. Chronic exposure to the air pollutants generated by motor vehicles, diesel exhaust particles is causative of cough, sputum production, and decremented lung function.[11] Pulmonary disease can be detected by periodic assessment including spirometry at an early stage when preventive or corrective measures are more likely to be beneficial.[12]

The health of persons who are exposed to road traffic pollutants such as volatile organic compounds, suspended particulate matter, sulphur oxides, oxides of nitrogen, and carbon monoxide is negatively impacted.[13,14] Lungs are particularly vulnerable because of their large surface area that is exposed to ventilation, weak respiratory membranes, and substantial pulmonary blood flow. Heart problems, poor lung health, respiratory morbidities, lung cancer, and COPD can all result of exposure to these pollutants over the time.[15,16] Exposure to potentially harmful substances in inspired air can harm the terminal bronchioles and other airways, causing acute and long-term respiratory diseases as well as loss in lung function.

Numerous locations around the country, including Gujarat, Patiala, Jaipur, Hyderabad, and Patiala, have performed studies.[17] Despite significant vulnerability of Pune's traffic police officers, fewer studies have been published on them. Furthermore, early detection of lung illness, when curative or preventive medicines are most likely to be beneficial, may only be possible with routine retesting.

The current study evaluated the pulmonary functions of the traffic police officers posted at various traffic junctions in Pune in order to ascertain whether prolonged exposure to vehicle exhausts had any adverse effects on the traffic police officers' lung functions and to establish a link between the duration of exposure to vehicle exhausts and changes in various lung parameters of traffic police officers.

MATERIALS AND METHODS

The Cross-Sectional Analytical Study was conducted at Tertiary Care centre Pimpri, Pune from July 2020 to July 2022 and Institutional Ethics Committee clearance was obtained before the start of study. Total 226 subjects were included in the study.

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Inclusion Criteria:
1) Age: 18-60
2) Working as traffic policeman for at least 1 year.

Exclusion Criteria:
1) Pregnancy.
2) Traffic Policemen planning to relocate.
3) Visible chest wall bony and muscular deformities
4) All contraindications to spirometry.

Methodology

The individuals working as Traffic policemen at various places in & around pune city were selected from the all the police stations and agreement was made to attend Out Patient Department (OPD) of Department of Respiratory Medicine, of tertiary care center, Pune after fulfilling the inclusion and exclusion criteria and after obtaining informed written consent.

Spirometry was performed in all patients using an electronic spirometer (COSMED Pulmonary Function Equipment – Model Quark PFT 2008). The maneuver was explained to each subject. Height was measured to the nearest centimeter and weight recorded to the nearest kilogram. FEV_1/FVC was recorded to look for obstruction, FEV_1 to grade if obstruction was present and FVC to record whether restriction is present.

All data collected in the pre-formed, pre-tested, semi-structured questionnaire was entered in MS Excel spreadsheet. Statistical analysis was carried out and the findings were expressed in the terms of mean, absolute values and percentages.

RESULTS

TABLE 1: PATIENT CHARACTERISTICS

Patient characteristics	**Number**	**%**
Age Group (Yrs)		
18-20	8	3.5
21-30	20	8.8
31-40	78	34.6
41-50	80	35.4
51-60	40	17.7
Gender		
Male	216	95.57
Female	10	4.25
Smoking		
No	197	87.2
Yes	29	12.8
Co-morbidities		
Diabetes Mellitus	11	4.9

Hypertension	7	3.1
Height & weight		
Average height (cm)	167.9	
Average weight (kg)	71.6	

The study consisted of a total of 226 traffic policeman. The average age of the study participants was found to be 37.75 years. Majority of the traffic policeman were males, with only were females. In the present study, 12.83% had habit of smoking. The average height of the study population was 167.9 cm, and the average weight of the population was 71.63 kg. The average measured and predicted FEV_1 was 3.09 and 3.14 respectively. However, the difference between the two groups was not statistically significant. The average measured and predicted FVC was 3.53 and 3.78 respectively. This difference was found to be statistically significant. The average FEV_1/FVC was found to be 85.44.The results are summarized in Table no-2.

TABLE 2: SPIROMETRY FINDINGS (n=226)

SPIROMETRY FINDINGS	MALES (n=216)	FEMALES (n=10)	TOTAL (n=226)
1. Mean FEV_1 (L)	3.1	2.7	2.9
2. Mean FVC (L)	3.5	3.3	3.4
4.NORMAL SPIROMETRY	194	5	199
5. OBSTRUCTION			
• Mild	8	1	9
• Moderate	0	0	0
• Severe	0	0	0
6. RESTRICTION			
• Mild	14	4	18
• Moderate	0	0	0
• Severe	0	0	0

DISCUSSION

Present study was a community-based observational cross-sectional study among in-service traffic police personnel to measure lung volumes and capacities by computerized spirometry to quantify effect of occupational hazards of air pollution in them.

In this study, we found that the lung functions were declined in traffic policemen. However, we need to keep in mind that age-associated changes in the pulmonary system can also contribute to disparity between actual and predicted value. With aging, there is reduced respiratory muscle strength, stiffness of chest wall with reduce compliance, decreased ciliary and macrophage activity, drier mucus membrane, decreased cough reflex and diminished response to hypoxia and hypercapnea.

The current study measured lung volumes and capacities using computerized spirometry in order to estimate the effects of occupational hazards from air pollution in traffic police officers who were already on the job. In this investigation, we discovered that the lung functions occasionally

deteriorated. But we must remember that differences between actual and projected values can also result from pulmonary system alterations brought on by ageing. Several studies in scientific literature show that exposure to urban air pollution can involve modifications of respiratory functions, such as FVC and FEV_1.[18,19] Van der Lende et al.[20] In Dutch study proved an inverse relationship between the expiratory flow-volume and working near a highway with high traffic density or between FEV_1 and the quantity of motor trucks every day.

Another study[21] shows a variation of spirometric parameters with FEV_1 and FVC decrease in exposed bus drivers and mechanics compared to a control group. The results show that almost all respiratory symptoms are present in both groups of workers exposed for longer than 10 years, compared to workers with shorter exposition. An Indian study shows that exposure to urban pollution longer than 10 years is associated to an FEV_1 and FVC decrease in traffic police officers with effects on their health and respiratory systems.[22] A study on traffic police officers versus a control group of general population shows variation of respiratory functionality and an FEV_1 and FVC significant decrease in the exposed group compared to the group of non-exposed.[19,22]

The decline in lung function parameters may be due to a large number of pollutants such as sulphur dioxide, carbon monoxide, nitric oxide, particulate matter and ozone influence on the body. These pollutants put a burden on the lungs and the resulting oxidative stress is thought to contribute to the genesis of fibrotic lung diseases, chronic bronchitis, emphysema, and lung cancer.[23] Toxic chemicals and gases of vehicular emission produce irritation and allergy in the lungs and airways of subjects who are exposed to them for a long time,[24] like the subjects of our study, traffic policemen. Vehicular exhaust particularly organic extracts of diesel exhaust induce reactive oxygen species in macrophages and bronchial epithelial cells which are key cell type targeted by the particulate matter in the lung.[25]

Reactive oxygen species in turn activate the promoters of cytokines and chemokines leading to allergic inflammation through activator protein-1 and nuclear factor- kappa B signaling pathways. Organic diesel exhaust particle, via a mitochondrial pathway, induce apoptosis and necrosis in bronchial epithelial cells.[25,26] These diesel exhaust particles thought to be made up of carbon core are surrounded by trace metals, such as nickel and salts which adsorb organic hydrocarbons and number of these components do have inflammatory lung effects seen in laboratory animals. Inhalation of hydrocarbons also leads to lung inflammation. These observations indicate that diesel particles themselves can induce airway inflammation.[27,28] We observed that actual value of forced vital capacity (FVC) and forced expiratory volume in 1 second (FEV1) are reduced in traffic police personnel as compared to predicted values. This shows some degree of restriction being present in the respiratory tract of traffic police personnel. The changes might be in the tissue of the lungs due to chronic irritation by pollutants. FEV1 was less in traffic police personnel indicating that there was some obstruction during the expiration.

Simple spirometry cannot completely distinguish between obstructive and restrictive dysfunction; nevertheless, we can distinguish between the two types of lung disorders by visually interpreting the flow volume loop; however, this method is unreliable and is not currently employed. Complete demarcation between obstructive and restrictive dysfunction cannot be achieved by simple spirometry, even though we can demarcate the two varieties of lung diseases by visual interpretation of flow volume loop of spirometry but this is not reliable hence not used.

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CONCLUSION

Spirometry in traffic policeman is a unique tool to identify underlying respiratory illnesses. It can be a useful screening tool as they are continually exposed to respiratory pathogens, such as air pollution. This can be further aggravated if they have habit of smoking. We have a social responsibility to prevent worsening of respiratory illnesses in these groups of individuals.

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