Original Article

Assessment of pulmonary functions among traffic police personnel in Chennai city - A comparative cross-sectional study

Sasikumar S[1], Maheshkumar K[2], Dilara K[3], Padmavathi R[3]

[1]Department of Physiology, Sree Balaji Medical College and Hospital, Chennai, Tamil Nadu, [2]Department of Physiology and Biochemistry, Government Yoga and Naturopathy Medical College and Hospital, Tamil Nadu, [3]Department of Physiology, Sri Ramachandra Medical College and Research Institute, Sri Ramachandra Institute of Higher Education and Research (SRIHER), Chennai, Tamil Nadu, India

Abstract

Background: Air pollution due to road traffic is a solemn health hazard and vehicular emissions due to huge population in the cities are the main reason for the air quality crisis. The study was conducted to assess the degree of impairment in lung function in traffic police personnel exposed to traffic pollution compared to less-exposed healthy subjects. **Materials and Methods:** This comparative cross-sectional study was conducted among 250 traffic police personnel, aged 20–55 years, working in Chennai city, as compared to a matched control group, consisting of 250 less-exposed subjects. Measurement of pulmonary function testing was done with an RMS Helio 401. Statistical analysis was carried out with R statistical software. **Results:** The traffic police personnel had significantly ($P < 0.05$) declined FEV1 and FEV1/FVC ratio and FEF 25–75% (L/s) as compared to controls. Traffic personnel with longer duration of exposure showed significantly ($P < 0.05$) reduced lung functions than those with shorter duration. We have found a significant negative correlation with all pulmonary function parameters such as FVC, FEV1, FEV1/FVC, PEFR, and FVC 25%–75% among the traffic police personnel. **Conclusion:** The impairment of pulmonary function among the traffic police personnel might be due to the effect of pollution by vehicular exhausts and they should be offered personal protective or preventive measures.

Keywords: Air pollution, health hazards, pulmonary function, traffic police

Introduction

Air pollution is a continuously increasing environmental degradation due to overexploitation of natural fuel resources, industrialization, rapid urbanization an economic development. Emission from vehicular traffic is one of the biggest sources of air pollution that affect people who live or work in cities.[1] Vehicular traffic contributes to almost 30% of air pollution in cities. Road traffic generates volatile organic compounds, suspended particulate matter, sulfur oxides, oxides of nitrogen, and carbon monoxide which impose adverse health effects on the exposed population.[2] Deterioration in air quality due to vehicular emissions has shown to produce significant morbidity and mortality by affecting multiple organs and systems.[3] The respiratory system bears the direct brunt of pollutants in the inhaled air. The lungs are vulnerable due to their large surface area exposed to ventilation, thin respiratory membranes, and massive quantity of pulmonary blood flow. These pollutants cause respiratory morbidities, reduced lung function, and even cause cardiac problems and upon chronic exposure it may even cause lung cancers and COPD.[4,5] Inhalation of toxic substances in the inspired air can result in injury to airways including the

Address for correspondence: Dr. Dilara K, Department of Physiology, Sri Ramachandra Medical College and Research Institute, Sri Ramachandra Institute of Higher Education and Research (SRIHER), Chennai, Tamil Nadu, India.
E-mail: dilarakamaldeen@gmail.com

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terminal bronchioles, leading to acute and chronic respiratory diseases, exhibiting as a decrease in lung function.[6,7] The various occupational groups exposed to air pollution include drivers, hawkers, toll booth workers, traffic police personnel, road side vendors, and street sweepers. The traffic police personnel of metropolitan cities, particularly from densely populated countries like India, who work in the traffic for hours together for many years are highly vulnerable to the respiratory morbidities.[8] Hence, it is essential 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. There have been some studies done in different cities of the country like Hyderabad,[9] Patiala,[10] Jaipur,[11] Puducherry,[12,13] and Gujarat.[14] But no studies could be traced out from the Chennai city. In spite of the high vulnerability of the traffic police personnel of the Chennai city, there are hardly any studies that have been done on them. Moreover, there is a possibility to detect pulmonary disease only by periodic retesting in the earliest stages when preventive or corrective measures are more likely to be beneficial. So, the present study was aimed at assessing the pulmonary functions among the traffic police personnel posted at various traffic junctions of the Chennai city so as to note whether prolonged exposure to vehicular exhausts had any detrimental effect on their lung functions and also by way of this study we have tried to establish a link between the duration of exposure to vehicular exhausts and decrements in various lung parameters of traffic police personnel.

Methodology

This comparative cross-sectional study was conducted in Chennai city West zone which includes Porur, Poonamalli, Ambattur, Mathuravayil, and Tiruverkadu. Totally, 500 subjects were included; among them, 250 subjects were traffic police personnel (exposure group) and 250 subjects were control (less exposure) group. Clearance from the Institutional Ethical Committee was obtained prior to the conduct of the study. Permission from the Deputy Commissioner of Police, Chennai city was obtained after explaining the protocol and benefits to them. Healthy nonsmoker traffic police personnel in the age group of 20–55 years who are working in traffic junctions for >1 year are included in the study. Healthy non-smoker control population of the same age group residing >2 years were selected in the study. Subjects with the history of smoking, known case of COPD/Asthma/TB and those who have recent had abdominal/thoracic surgery were excluded from the current study. Information about demographic details, socioeconomic status, and history of respiratory illnesses were obtained by using a standard questionnaire. General examination followed with detailed respiratory system examination was performed and clinical examination findings were noted. Pulmonary function test was conducted as per the ATS criteria[15] and the parameters such as forced vital capacity (FVC), forced expiratory volume in one second (FEV1), forced expiratory flow rate 25–75% (FEV 25–27%), and peak expiratory flow rate (PEFR) were measured using a portable spirometer (RMS Helios 401).

Results

There was no significant difference with regard to the anthropometric parameters between the control group and exposed group [Table 1].

Out of five traffic police stations, 33% (n-80) were from ambattur, 20% (n-47) in porur, 18% (n-43) in mathuravoyal, 16% (n-39) poonamalle, and 13% (n-31) [Figure 1] in thiruvertkaatu station.

The pulmonary function parameters of the exposed traffic policemen have significantly ($p < 0.001$) lower FEV1 (2.79 ± 0.51), FEV1/FVC (78.40 ± 7.67), and FEV 25-75% (2.66 ± 0.83) than the control groups with less exposure [Table 2]. There was no significant change with regard to the other parameters such as FVC (L) and PEFR (L).

As shown in Table 3, we found that as the years of experience increase all the pulmonary function parameters decrease significantly in traffic police personnel. Traffic policemen having more than 20 years of experience suffer a significant decline in pulmonary function parameters.

As shown in Table 4, the Pearson correlation test between the duration of exposure and pulmonary function shows that there was a significant negative correlation between the pulmonary function parameters such as FVC, FEV1, FEV1/FVC, PEFR and FVC 25%-75% among the traffic police personnel. This would clearly explain that as the year of exposure increases the pulmonary function declines significantly in traffic police personnel.

Discussion

This comparative cross-sectional study was designed to look for differences in the respiratory function between traffic police

Table 1: Anthropometric parameter of exposed (traffic police personnel) group and less-exposed (control) group

VARIABLE	Less Exposed (control) *n*=250	Exposed (Traffic police) *n*=250
Age (yrs.)	38.03±10.95	39.43±13.87
Height (cm)	171.14±6.96	173.34±4.33
Weight (kg)	76.18±8.56	79.29±13.40
BMI (Kg/m^2)	25.91±4.48	26.40±4.90

Table 2: Lung function parameters of exposed (traffic police personnel) group and less-exposed (control) group

Variables	Less Exposed (control) *n*=250	Exposed (Traffic police) *n*=250	*p*
FVC (L)	3.61±0.76	3.55±0.58	0.41
FEV1 (L)	2.98±0.62	2.79±0.51	0.002
FEV1/FVC (%)	82.80±5.53	78.40±7.67	<0.001
PEFR (L)	8.01±1.2	8.16±1.5	0.27
FEF25-75% (L/s)	3.22±0.94	2.66±0.83	<0.001

Values were expressed Mean±SD. Unpaired T test was done to compare between the groups. *P*<0.05 set as significant. FVC-Forced vital capacity, FEV1-Forced expiratory volume in one second, PEFR-Peak expiratory flow rate, FEF25-75 -Forced expiratory flow rate 25-75

Table 3: Spirometric parameters among the traffic police personnel according to years of exposure

variables	Year of exposure				*P*
	<5 yrs. (*n*-39)	5-10 yrs. (*n*-79)	10-20 yrs. (*n*-89)	>20 yrs. (41)	
FVC (L)	3.99±0.68	3.63±0.52	3.51±0.55	3.30±0.53	0.001
FEV1 (L)	3.84±0.66	3.57±0.47	3.56±0.51	3.35±0.58	0.01
FEV1/FVC (%)	80.99±6.98	79.06±4.95	78.42±7.41	75.80±11.04	0.001
PEFR (L/sec)	8.41±1.20	8.23±1.23	8.40±1.62	7.52±1.68	0.05
FVC25-75% (L)	3.45±0.89	2.69±0.61	2.65±0.85	2.22±0.73	0.001

Values were expressed Mean±SD. One way Anova was done followed by Tukey HSD post hoc test. *P*<0.05 set as significant

Table 4: Correlation between the pulmonary function and duration of exposure among traffic police personnel

	Correlation coefficient (*r*)	*P*
FVC (L)	-0.38	<0.001
FEV1 (L)	-0.34	<0.001
FEV1/FVC (%)	-0.2	0.001
PEFR (L/s)	-0.12	0.04
FVC 25%-75% (L)	-0.34	<0.001

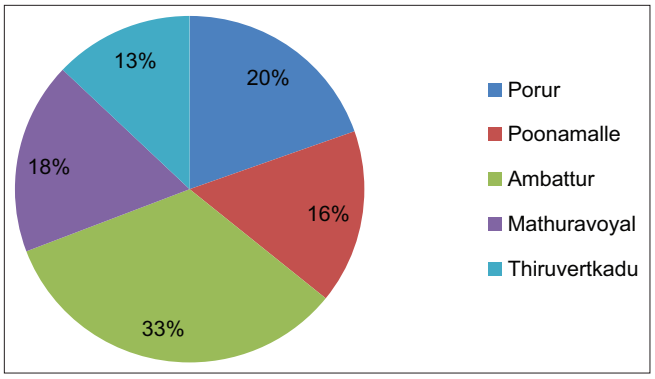

Figure 1: Distribution of traffic police personnel (Exposed group)

personnel and to sensitize them about their respiratory health as well as about the preventive care. Traffic police personnel were chosen as a representative group with long-term exposure to air pollution in Chennai. Since smoking has been documented to have significant effects on respiratory health and is a major confounding factor on studies of pulmonary function,[16] only non-smoking subjects were chosen for the analysis. This study shows that traffic police personnel have significantly lower FEV1, FEV1/FVC, and FEF 25%-75% than the less-exposed control subjects. FEV1 is a lung function parameter that is easy to measure and has very good reproducibility. It is the most widely used and quoted lung function test in clinical practice. Chronically reduced FEV1 is a predictor of increased risk of mortality.[17] Hence, a statistically significant increase in the number of persons with FEV1 below normal limits indicates an increase in the number of persons with respiratory impairment in the traffic police personnel population. In the guidelines of the American Thoracic Society, this is considered to be an adverse respiratory health effect of air pollution.[18] The FEV1/FVC ratio is a better indicator of the condition of the bronchial musculatures. FEV1percentage of FVC in both the groups was found statistically significant. In this study, there was no significant decrease in the PEFR value between the exposed and less-exposed groups. Peak expiratory flow rate (PEFR), which is also termed maximal expiratory flow occurs shortly after the onset of expiration. The PEFR, more than the other measures, is dependent on participant's effort, thus signifying the capacity of expiratory muscles. In the present study, the FEF25%-75% of traffic police personnel (which suggests conditions of smaller airways) was also significantly lower, which suggests that the airways, in general, are narrowed preventing the free flow of air during respiration. Similar results were reported by Pal *et al.* and Singh *et al.*, 2009 who reported a significant difference in the FEV1 data of nonsmoking subjects exposed to traffic-generated pollution and those not exposed.[11,13] Another study done among traffic police personnel in Bangkok found that a 18.6% prevalence of cough and phlegm.[19]

A similar recent study by Amit *et al.*, 2015 on Gujarat traffic police personnel also documents decreased pulmonary function and correlates the decline in the same to the effect of pollution by vehicular exhausts.[14] The comparison of PFT parameters among traffic police personnel with the duration of exposure has revealed a negative correlation. The magnitude of decline in many PFT parameters has been shown to be directly proportional to the duration of traffic duty. This suggests that increase in the duration of traffic duty (in years) has an increasingly harmful effect on the lung function of traffic police personnel. This decline in lung function parameters may be due to a large number of pollutants such as sulfur dioxide, carbon monoxide, nitric oxide, particulate matter, and ozone influence on the body.[20] 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.[1] 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.[21] Traffic police are particularly prone to this occupational hazard. Vehicular exhaust, particularly, organic extracts of diesel exhaust induce reactive oxygen species in macrophages and bronchial epithelial cells which are the key cell types targeted by the particulate matter in the lung.[22] 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 particles, via a mitochondrial pathway, induce apoptosis and necrosis in bronchial epithelial cells.[23,24] 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 a number of these components do have inflammatory lung effects seen in laboratory animals.[25] Inhalation of hydrocarbons also leads to lung inflammation. These observations indicate that diesel particles themselves can induce airway inflammation.[26] We observed that the actual value of forced expiratory volume in 1 second (FEV1) and FEV1/FVC were reduced in traffic police personnel as compared to predicted values. This shows some degree of obstruction being present in the respiratory tract of traffic police personnel. The changes might be in the tissue of the lungs due to the chronic irritation by vehicular pollutants.

Conclusion

The findings of this study show that the FEV and FEC of the traffic police personnel have decreased over the years, thus confirming the significant adverse health impacts of automobile pollution. The prolonged exposure to vehicular pollution might cause airway obstruction by inducing chronic airway irritation and increased mucus production leading to obstructive kind of lung diseases. Thus, we strongly vouch for the adoption of various strategies for the protection/preventive measure of traffic police personnel from vehicular pollution.

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Conflicts of interest

There are no conflicts of interest.

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