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Impact of Air Pollution on the Lung Function of Traffic Policemen in Mangalore

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ABSTRACT

Aims and objectives: Air pollution is one of the major concerns of the civilized world, which has a serious toxicological impact on human health and the environment. The traffic police personnel of crowded metropolitan cities, especially from a densely populated country such as India, who work in the traffic for hours together for many years are highly vulnerable to the respiratory morbidities. Present study was aimed at measurement of lung volumes and capacities in traffic police personnel who were posted at various traffic junctions in Mangalore city, so as to note whether prolonged exposure to vehicular exhausts had any detrimental effect on their lung functions.

Materials and Methods: A cross sectional study was conducted among 100 traffic policemen and 100 controls. Lung function parameters were measured using a portable spirometer. The spirometric parameters were compared in both groups by independent Student's 't' test and the effect of duration of exposure was compared by ANOVA test. Statistical significance was indicated by *P* value < 0.05.

Results: The pulmonary function parameters of the exposed traffic policemen have significantly ($p < 0.05$) lower FVC (3.27±0.55), FEV1 (2.76±0.47) and PEFR (7.77±1.69) and higher FEV1/FVC (84.57±4.33) than the control groups with less exposure. There was no significant change with regard to FEF 25-75% (3.29±0.87). We found that as the years of experience increase the pulmonary function parameters such as FVC and FEV1 decrease significantly in traffic police personnel.

Conclusion: Computerized spirometry-based evaluation of pulmonary functions in traffic police personnel as compared to age-matched controls reveals overall decline in the lung function parameters in traffic police personnel.

Keywords: Air pollution, lung function, lung volume, lung capacity, traffic policemen

INTRODUCTION

Air pollution is one of the major concerns of the civilized world, which has a serious toxicological impact on human health and the environment. It has a number of different emission sources, but motor vehicles and industrial processes contribute the major part of air pollution. 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.[1] The presence of various particles and gases from vehicular emission like carbon dioxide, carbon monoxide, sulphur, benzene, lead, nitrogen dioxide, nitric oxide and black smoke etc. may play a role in the pathogenesis respiratory diseases. The above mentioned pollutants can cause respiratory morbidities, reduced lung function, and can even cause cardiac problems. Also upon chronic exposure it may even cause lung cancers and COPD [2]. Respiratory diseases are commonly detected by periodic retesting

during the early stages when preventive or corrective measures are more likely to be beneficial [3].

Air quality index (AQI) is a measure of air quality which shows how polluted the air is and the impact it can have on us. The current AQI of Mangaluru is 110.The various groups of people exposed to air pollution include drivers, street vendors, toll booth workers, traffic police personnel, road side vendors, and street sweepers.

The traffic police personnel of crowded metropolitan cities, especially from a densely populated country such as India, who work in the traffic for hours together for many years are highly vulnerable to the respiratory morbidities.[4]

Thus, it is important to understand how much the exposure would be to these pollutants to traffic police personnel who are working for long shifts on roadways as a part of their duties. There have been some studies done in different cities of the country like Hyderabad, [5] Patiala, [6] Jaipur, [7] Puducherry, [8,9] and Gujarat. [10] Present study was aimed at measurement of lung volumes and capacities in traffic police personnel who were posted at various traffic junctions in Mangalore 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

Study subjects

The present study was carried out at Department of Pulmonology, Fr. Muller Medical College Hospital, Mangalore, Karnataka and at Pandeshwar Police Station and Kadri Police Station in Mangalore. The study was conducted in 100non smoker traffic policemen of Pandeshwar and Kadri Police Stations in Mangalore and 100 age and sex matched non-teaching staff of Fr. Muller Medical College Hospital.

The 100 non-teaching staff who were less exposed to traffic related pollution were taken as controls. The control group was comparable in age, gender, region and physical activity to study group.

Inclusion and exclusion criteria

We included traffic police personnel working at traffic signals, aged 30-60 years, with minimum 4 years of service. We excluded traffic police personnel working at office, aged >55 years, with the history of smoking, known case of COPD/Asthma/TB and those who have underwent recent abdominal/thoracic surgery were excluded from the current study.

Statistical analysis:

A cross sectional study was conducted among 100 traffic policemen and 100 controls. The spirometric parameters were compared in both groups by independent Student's ‘t’ test and the effect of duration of exposure was compared by ANOVA test. Statistical significance was indicated by P value < 0.05.

Information regarding 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 American Thoracic Society(ATS) criteria[11] and the parameters such as forced vital capacity (FVC), forced expiratory volume in one second (FEV1), FEV1/FVC, forced expiratory flow rate 25–75% (FEV25–27%), and peak expiratory flow rate (PEFR) were measured using a portable spirometer (EasyOne^{TM} DIAGNOSTIC 6.7).

All the subjects were physically healthy on basis of clinical examination, without any symptoms of any acute respiratory illness. The approval of institutional ethical committee was obtained prior to the initiation of the study. Permission from the Assistant

Commissioner of Police, Mangalore city was obtained after explaining the protocol and benefits to them.

Statistical analysis:

A cross sectional study was conducted among 100 traffic policemen and 100 controls. The spirometric parameters were compared in both groups by Student's 't' test and the effect of duration of exposure was compared by ANOVA. Statistical significance was indicated by *P* value < 0.05.

RESULTS

The study included 100 traffic policemen as cases out of which 51% belonged to the age group 30-40yrs, 27% belonged to the age group 41-50yrs and 22% belonged to the age group 51-60yrs. (TABLE 1)

TABLE 1

Age group	frequency	percentage
30-40	31	51%
41-50	16	27%
51-60	13	22%

The pulmonary function parameters of the exposed traffic policemen have significantly ($p < 0.05$) lower FVC (3.27±0.55), FEV1 (2.76±0.47) and PEFR (7.77±1.69) and higher FEV1/FVC (84.57±4.33) than the control groups with less exposure [Table 2]. There was no significant change with regard to FEF 25-75% (3.29±0.87).

TABLE 2

Variables	Less exposed (control)	Exposed (traffic police)	P value
FVC(L)	3.61±0.76	3.27±0.55	0.0007
FEV1(L)	2.98±0.62	2.76±0.47	0.0030
FEV1/FVC(%)	82.80±5.53	84.57±4.33	0.0076
PEFR(L/s)	8.01±1.2	7.77±1.69	0.0004
FEF 25-75%(L)	3.22±0.94	3.29±0.87	0.2202

As shown in Table 3, we found that as the years of experience increase the pulmonary function parameters such as FVC and FEV1 decrease significantly in traffic police personnel. Traffic policemen having more than 10 years of experience suffer a decline in pulmonary function parameters.

TABLE 3:

VARIABLES	YEARS OF EXPOSURE			P Value
	<5yrs	6-10yrs	>10yrs	
FVC(L)	3.56±0.37	3.43±0.48	2.86±0.48	<0.05
FEV1(L)	3.01±0.37	2.9±0.42	2.44±0.41	<0.05
FEV1/FVC(%)	84.63±6	84.23±4.34	85.09±3.97	0.798
PEFR(L/s)	7.96±2.09	8.16±1.64	7.12±1.53	0.357
FEF 25-75%(L)	3.43 ± 0.99	3.39±0.9	3.06±0.82	0.106

DISCUSSION

This comparative cross-sectional study was designed to find the differences in the pulmonary function between traffic police personnel and to sensitize them about their respiratory health as well as about the preventive measures. Traffic police personnel were chosen to represent a population with long term exposure to air pollution in Mangalore. Since smoking has been documented to be a factor with significant effects on respiratory health and is a major confounding factor on studies of pulmonary function,[12] only non-smoking subjects were chosen for the study.

Our study shows that traffic police personnel have significantly lower FVC, FEV1 and PEFR and higher FEV1/FVC, than the less-exposed control group. FEV1 is a lung function parameter that has good reproducibility and is easy to measure. It is one of the most widely used and quoted lung function test in clinical practice. Chronically reduced FEV1 is a predictor of increased risk of mortality.[13]

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 that there is some degree of restriction 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. The FEV1/FVC ratio is a better indicator of the condition of the bronchial musculatures. In our study FEV1/FVC was statistically significantly increased in traffic police personnel as compared to control. FVC, FEV1 and FEV1/FVC ratio are parameters which are used in differentiating an obstructive pattern from a restrictive pattern. In obstructive lung diseases FEV1 is disproportionately reduced more than FVC, hence FEV1/FVC ratio is also reduced. In the case of restrictive lung diseases, FEV1 is not disproportionately reduced than FVC, so FEV1/FVC ratio is comparatively increased.[14]

As it is shown in our study that reduction of FEV1 is more than that of FVC with FEV1/FVC ratio being more indicates a restrictive pattern of lung diseases in the exposed group.

In a similar study done in Jaipur showed that there were prominent respiratory symptoms and reduced FEV1 in traffic police personnel as compared to controls.[7]

In a study done by Binawara BK et al in Gujarat in 2015 in it was found that Traffic police personnel had significantly declined FVC,FEV 1, slow vital capacity (SVC) and maximum voluntary ventilation (MVV) when compared with predictive normal values.[15]

Our current study also supports the findings of a few older studies.[16][6][17] suggests that respiratory function impairment in traffic police personnel is secondary to the exposure to vehicular pollution for multiple hours everyday for many years causing decreased functional capacity of the lungs.

FEV1/FVC was more with decreased FVC and decreased FEV1 in majority indicating restrictive nature of pulmonary dysfunction as against obstructive.[18] These may be due to exposure to vehicular pollution for several hours in a day for many years causing decreased functional capacity of the lungs and chronic smoking worsens the condition.

Lung function test parameters when compared among traffic police personnel with the years of service has revealed a negative correlation. The decline in the lung function test parameters has been shown to be directly proportional to the duration of exposure i.e. years of service which suggests that as the duration of traffic duty (in years) increases the harmful effect of air pollution on the lung function also increases. This worsening of the pulmonary function parameters could be due to a large number of pollutants such as sulfur dioxide, carbon monoxide, nitric oxide, particulate matter, and ozone influence on the body.[19]

As a result of vehicular emission certain toxic chemicals and other pollutant gases affect the lungs and airways by producing irritation and allergy in subjects who are exposed to them for a long time.[20]

Traffic police are particularly prone to this occupational hazard. Certain gases especially exhaust from diesel fueled vehicles, such as the 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.[21]

Reactive oxygen species in turn activate the promoters of cytokines and chemokines leading to allergic inflammation through activator protein 1and nuclear factor kappa B signaling pathways and via a mitochondrial pathway, induce apoptosis and necrosis in bronchial epithelial cells.[22,23]

We observed that the forced vital capacity (FVC) and forced expiratory

volume in 1 second (FEV1) in traffic policemen were reduced and FEV1/FVC was increased compared to the control group and was found to be significant. This shows some degree of restrictive disease present in the respiratory tract of traffic police personnel. The changes in the tissue of the lungs might be due to the chronic irritation by vehicular pollutants.

CONCLUSION

Computerized spirometry-based evaluation of pulmonary functions in traffic police personnel as compared to age-matched controls reveals overall decline in the lung function parameters in traffic police personnel. The prolonged exposure to vehicular pollution might cause restrictive airway disease by inducing chronic airway irritation and parenchymal involvement. Thus, we strongly recommend for the adoption of strategies such as the use personal protective equipment, interrupted duty hours and awareness among exposed people for the protection/prevention of traffic police personnel from vehicular pollution.

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