STUDY OF PULMONARY FUNCTION TESTS IN TRAFFIC POLICEMEN EXPOSED TO AUTOMOBILE POLLUTION IN BANGALORE CITY

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ABSTRACT

Background: There is a higher risk of developing acute or chronic respiratory disease in individuals who are exposed to automobile pollution. Hence a study was undertaken with a view to investigate the effect of automobile pollution on pulmonary function parameters in Traffic policemen, so that the potential health risks in these subjects can be minimised by early identification of abnormalities in PFT parameters. Periodic retesting can detect pulmonary disease in the earliest stages when corrective measures are more likely to be beneficial.

Methodology: The study involved the traffic policemen who are exposed to automobile pollution and normal healthy controls who are age & gender matched. In both the groups, PFT parameters like Forced Vital Capacity (FVC), Forced Expiratory Volume in first second ($FEV_{1)}$, FEV_1/FVC ratio, Peak Expiratory Flow Rate (PEFR) and Forced Expiratory Flow between 25-75% of Forced Vital Capacity ($FEF_{25-75\%}$) were recorded using Computerised Spiro meter RS 232C.

Results: The pulmonary function parameters were significantly decreased in cases when compared to controls and the decrease in parameters were associated with duration of exposure.

Conclusion: A significant reduction in Forced Expiratory Volume in first second, Peak Expiratory Flow Rate and FEV_1/FVC ratio reflected an obstructive type of abnormality in Traffic policemen and there was a linear relationship between duration of exposure and parameters like Forced Expiratory Volume in first second, Peak Expiratory Flow Rate, Forced Expiratory Flow between 25-75% of Forced Vital Capacity and FEV_1/FVC ratio.

KEY WORDS: Automobile pollution, Flow parameters, Pulmonary Function Tests, Traffic policemen

LIST OF ABBREVIATIONS

ANOVA	Analysis Of Variance
BALF	Broncho Alveolar Lavage Fluid
BSA	Body Surface Area
Cm	Centimetre
DEP	Diesel Exhaust Particulates
FEV_1	Forced Expiratory Volume in first second
$FEF_{25-75\%}$	Forced Expiratory Flow between 25-75% of Forced Vital Capacity
FVC	Forced Vital Capacity
Kg	Kilogram
PEFR	Peak Expiratory Flow Rate
PFT	Pulmonary Function Test
SD	Standard Deviation
TNF-a	Tumour Necrosis Factor-alpha

INTRODUCTION

Bangalore is one of the rapidly growing cities of India. The growth is associated with an enormous increase in vehicular traffic emitting exhausts and polluting the atmosphere.

Airborne dust plays a major part in the overall atmospheric pollution and Motor vehicle emissions constitute the most significant source of ultra particle in an urban environment[1, 2]. Road traffic produce volatile organic compounds, suspended particulate matter, oxides of sulphur, oxides of nitrogen, and carbon monoxide which makes adverse health effects on the exposed population[3].

Traffic related air pollution is an occupational health hazard to individuals who work close to traffic[4]. Traffic police personnel are posted at various traffic junctions through which maximum numbers of vehicles pass and they are more prone to develop health hazards of automobile exhaust on respiratory system.

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When inhaled, air pollutants cause damage to the airways and the lungs. The prevalence of the obstructive, restrictive and mixed type of functional impairment of the lung has been found to have direct relationship with the dust concentration and duration of exposure[3, 5, 6]. Prolonged exposure to dust can result in chronic bronchial problems[7-10].

Investigations of the respiratory health effects from vehicular pollution are necessary in order to predict the risk factors that may cause an asthmatic response[11-13].

Since exposure to automobile pollution is a cause for development of acute or chronic respiratory disease, the potential health risks in traffic policemen can be minimised by providing them with the information about hazards of automobile pollution and about the protective measures like provision of mask/protective device at individual level or change of work atmosphere when feasible at higher level. Periodic retesting can detect pulmonary disease in the earliest stages when corrective measures are more likely to be beneficial.

METHODS

The current study was done by taking hundred traffic policemen who are exposed to automobile exhaust and hundred healthy controls. The subjects were selected from the general population randomly according to following inclusion and exclusion criteria.

Inclusion criteria:-

- Healthy non smoker traffic policemen in the age group of 20–55 years who are working in traffic junctions for more than 1 year are included in the study.
- Healthy non smoker control population of the same age, sex and BSA are selected from general population and included for the study.
- Informed consent is taken from all the subjects those who are willing to participate in the study.

Exclusion criteria:-

- Any evidence of chronic obstructive pulmonary disease, asthma, musculoskeletal abnormality, heart disease, anaemia, obesity and history of smoking.
- Any history of angina or chest pain, diabetes or hypertension.
- Non cooperation or inability to perform pulmonary function tests.

Study design:

Traffic policemen were selected as per the inclusion criteria laid down. The controls were selected as per the criteria laid down. Their written consent was taken. The screening of the subjects was done for exclusion criteria. The Anthropometric measurements like height (cm), weight (kg) and Body surface area (square meter) were measured. PFT by computerised spirometer measuring FVC, FEV_1, FEV_1/FVC, PEFR and $FEF_{25-75\%}$ were recorded. The subjects were explained about the actual procedure and purpose of the study before they were put to test. PFT measurements are done by using Kit micro RS 232 C, Computerised spirometer recording, a minimum of 3 readings on each occasion at 15 minute interval and maximum values were taken.

Statistical analysis:

Results are presented in Mean $\pm$ SD (Min-Max) for each of the parameter. The two groups were compared by using unpaired t test. Analysis of variance (ANOVA) has been used to find the significance of the study parameters between the 3 or more groups of patients.

RESULTS

Both the subjects and controls were well matched with respect to age, weight, height and body surface area (BSA) respectively.

Table 1 shows the comparison of pulmonary function tests in cases and control groups. It can be seen that there is decline in pulmonary function parameters like FVC, FEV_1, PEFR, FEV_1/FVC, $FEF_{25-75\%}$ in cases when compared to controls which is statistically significant.

This study is in agreement with Wongsurakiat P, Maranetrea KN et al[14], Kim SM, Cheon GR et al[15], Jafary ZA, Faridi I et al[1], Binawara BK, Gahlot S et al[16] and Ingle ST, Pachpande BG[3] et al who also found the same results.

Table 3 shows the comparison of pulmonary function tests with respect to duration of exposure. It shows a linear relationship in pulmonary function parameters in traffic policemen with respect to duration of exposure . This study is in agreement with Uzma NB, Khaja Mohinnuddin Salar BM, et al[17] who also found the same results.

Table 1: Comparison of Pulmonary Function tests in study and Control group

Pulmonary Function test	Study group	Control group	t value	P value
FVC	...	4.09±0.39	10.159	<0.001**
FEV_1	2.62±0.54	3.48±0.39	12.953	<0.001**
PEFR	7.62±1.32	8.92±0.86	8.294	<0.001**
FEV_1/FVC	0.76±0.07	0.84±0.06	8.486	<0.001**
$FEF_{25-75\%}$	3.59±0.63	4.37±0.49	9.652	<0.001**

** Significant at 1% level of significance

Table 2: Comparison of pulmonary function tests according to duration of exposure

Pulmonary Function test	1-5 years	6-10 years	11-15 years	>15 years	Control Group	F value	P value
FVC	3.91± 0.42	3.32 ±0.46	3.41± 0.63	3.02± 0.37	4.09± 0.39	46.261	<0.001**
FEV_1	3.23± 0.46	2.56 ±0.37	2.55± 0.54	2.22± 0.26	3.48± 0.39	79.989	<0.001**
PEFR	9.03± 0.61	7.43 ±1.19	7.19± 1.27	6.87± 1.06	8.92± 0.86	40.270	<0.001**
FEV_1/FVC	0.83± 0.05	0.77 ±0.07	0.74± 0.06	0.72± 0.06	0.84± 0.06	33.088	<0.001**
$FEF_{25-75\%}$	4.22± 0.58	3.66 ±0.45	3.58± 0.44	3.03± 0.44	4.37± 0.49	51.076	<0.001**

Significant at 1% level of significance

DISCUSSION

In the present to see the effect of automobile exhaust, PFT was recorded in the Traffic policemen. The dynamic parameters like FVC, FEV_1, PEFR, FEV_1/FVC, $FEF_{25-75\%}$were reduced in traffic policemen exposed to automobile exhaust when compared to control group.

Diesel exhaust organic extracts induce reactive oxygen species in macrophages and bronchial epithelial cells, two key cell types targeted by particulate matter in the lung. Reactive oxygen species activate the promoters of cytokines and chemokines involved in allergic inflammation through activator protein-1 and nuclear factor- kappa B signalling pathways. Organic diesel exhaust particle chemicals also induce apoptosis and necrosis in bronchial epithelial cells via a mitochondrial pathway[18,19].

Laboratory studies in humans and animals have shown that particulate toxic pollutants particularly diesel exhaust particles can enhance allergic inflammation and can induce allergic immune responses. Most of these immune responses are mediated by the carbon core of diesel exhaust particle. Poly aromatic hydrocarbons are major chemical components of diesel exhaust particulates, and they have enhanced the production of immunoglobulin E[20].

Diesel exhaust particles (DEP) are thought to consist of a carbon core surrounded by trace metals, such as nickel, and salts to which are adsorbed organic hydrocarbons. A number of these components have inflammatory effects in the lungs of laboratory animals. For example, intratracheal instillation of ultrafine carbon particles in rats leads to neutrophil influx into the lungs, and increase in bronchoalveolar lavage fluid (BALF) concentrations of tumour necrosis factor- (TNF) - alpha. Intratracheal instillation of nickel in rats causes severe and sustained inflammation, with generation of free radicals. Inhalation of hydrocarbons also leads to lung inflammation. The foregoing observations indicate that diesel particles themselves can induce airway inflammation[21,22].

This may be the reason for decreased FVC and FEV_1 and PEFR in traffic policemen.

$FEF_{25-75\%}$ indicates flow rates in small airways i.e. those with internal diameters of less than 2 mm. Decrease in $FEF_{25-75\%}$ suggest greater involvement of small airways. Particles generated from diesel exhaust are extremely small and are present in the nuclei or accumulation modes, with diameters of 0.02 nm and 0.2 nm respectively. These small sized particles, by virtue of their greater surface area to mass ratio, can carry a much larger fraction of toxic compounds, such as hydrocarbons and metals on their surface. Hence chronic exposure to them can lead to chronic inflammation of respiratory tract and lung parenchyma[23,24].

The FEV_1/FVC ratio was also reduced in the current study suggesting an obstructive type of respiratory involvement.

The pulmonary function parameters recorded using Kit micro RS 232 C, Computerised spirometer reflected an obstructive type of respiratory involvement in Traffic policemen.

Recording of Slow Vital Capacity would have revealed restrictive abnormality more accurately. Post Bronchodilator test along with FEV_1/FVC would have supported obstructive type of abnormality.

The PFT parameters in the Traffic policemen showed a linear relationship with respect to duration of exposure in the present study.

The chronic inflammation of respiratory tract may be the reason for decreased pulmonary function parameters in traffic policemen with respect to duration of exposure.

CONCLUSIONS

The results of this study have shown a significant fall in pulmonary function parameters like FVC, FEV_1, PEFR, FEV_1/FVC and $FEF_{25-75\%}$ in traffic policemen and the fall in pulmonary function parameters is also associated with respect to duration of exposure indicating a reduction in lung function efficiency of the traffic policemen exposed to automobile pollution.

The significant reduction in PEFR and FEV_1/FVC indicate warning symptoms of asthma among Traffic policemen.

This study concludes that the Traffic policemen are highly vulnerable for respiratory impairment due to vehicular exhaust at workplace environment. The protective measures like use of mask, regular health check up and also awareness on health impacts of pollution need to be adopted for protection of Traffic policemen working on the heavy traffic roads.

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