A cross-sectional study of pulmonary function test in traffic policemen of Gangtok, East Sikkim, North East India

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ABSTRACT

Background: Vehicular or automobile emission constitutes a significant health injury to traffic policemen posted at the numerous traffic junctions. Aim and Objectives: Evaluating the spirometric lung function test parameters of traffic policemen posted in Gangtok town and to compare and measure the findings with general police personnel and also to study the effect of exposure to long-term automobile pollution. Materials and Methods: In this study, after matching for anthropometric variables such as weight, height, and body mass index, 40 traffic policemen were taken as case and 40 general duty policemen were taken as control groups. The exclusion criteria were duly screened, and only those subject who fulfilled the inclusion criteria were included after which the spirometric pulmonary function tests (PFT)’s evaluation was done. The indices measured in the study included (1) Forced vital capacity (FVC) (2) Forced expiratory volume in 1 s (FEV₁) (3) FEV₁/FVC ratio (4) Peak expiratory flow rate (PEFR) (5) Forced mid expiratory flow (FEF 25–75%). Spirometric indices of the subjects and controls were statistically analyzed using the student’s t test and p value computed against the degree of freedom. Results: The traffic policemen showed decline in various PFT indices as compared to controls in terms of FVC(L), FEV₁(L), FEV₁/FVC, FEF 25–75%, PEFR, although it was not statistically significant. Conclusion: The traffic policemen working in Gangtok town had decreased PFT, although it was not statistically significant in this study. Even then, we strongly recommend for the adoption and practice of various preventive measure from vehicular pollution and conduction of further studies on larger samples.

KEY WORDS: Traffic Policemen; Spirometric Pulmonary Function Tests; Automobile Pollution

INTRODUCTION

The occupational environment also known as working conditions significantly affects the man’s total wellbeing and health. Among the vast array of occupational health hazards, vehicular borne air emissions pose a significant health injury to people working in the various traffic junctions.[¹] Airborne dust and emissions from motor vehicles are the most significant source of atmospheric pollution.[²,³] Vehicular pollution produce suspended particulate matter, oxides of Sulphur, volatile organic compounds, oxides of nitrogen, and carbon monoxide which are known to have major unfavorable effects on the respiratory health of the traffic policemen.[⁴]

These Traffic policemen are vulnerable to the harmful effects of vehicular emissions on their respiratory health. As these traffic policemen work in the traffic signal for years together, the severity of these health hazards increases as the duration of exposure increases.
The Traffic police personnel have to work for a long duration in an atmosphere polluted by automobile exhaust and fumes. These aforementioned factors pose as a significant health hazard. Vehicular emissions releasing toxic chemical and gases cause allergic reaction and irritation in the lungs and air passages of the exposed individuals.

The incidence of various restrictive, obstructive and mixed type of functional impairment of the lung has strong association with the total time of exposure to automobile pollutants and dust concentration. Continuous exposure to dust and pollutants can cause chronic bronchial problems. The changes in lung parameters can be assessed and observed by detailed assessment of the pulmonary function tests (PFTs), even before the changes or disease become symptomatic. The respiratory health parameters or the pulmonary function of an individual can be fairly assessed using a computerized spirometer. PFTs provide reproducible and accurate assessment of the functionality of the respiratory system and allow quantification of the severity of disease helping in early detection as well as assessment to the response to therapy.

PFT’s are physiological test, that is, they are test of function. The PFT’s are employed to assess the three basic processes of lungs-Ventilation, Diffusion and Perfusion. The most important aspects of spirometry are the Forced vital capacity (FVC), Forced expiratory volume in 1 s (FEV1) to FVC ratio, which are obtained from recording spirometer and correlated with predicted values based on height, age, sex and ethnic groups. Typical patterns of abnormalities such as obstructive and restrictive ventilatory defects are obtained from the ratio.

The present study was conducted at Gangtok, a growing town with an increasing number of vehicles. This present study aimed at assessing the PFT parameters in traffic policemen of Gangtok, Sikkim, North East, India, to evaluate the lung function parameters and to compare and analyze the findings with general police personnel and also to estimate the effect of exposure to long-term vehicular pollution on respiratory function.

**MATERIALS AND METHODS**

The present cross-sectional study was conducted in the department of Physiology, Sikkim Manipal Institute of Medical Sciences, Gangtok, East Sikkim, over a period of 12 months. The sample size consists of 40 traffic policemen as cases and 40 general duty policemen as control matched for age, height and body mass index (BMI).

After obtaining ethical clearance and permission from the institutional ethics and research council, written informed consent was taken and submitted. General and systemic examinations were performed and subjects were recruited on the basis of inclusion and exclusion criteria.

**Selection of the Subjects**

**Study population**

The study population comprised of traffic policemen and general police personnel of Gangtok town who were willing to participate in the study.

- **Cases**: The traffic policemen posted at several traffic points in and around Gangtok town.
- **Controls**: The general police personnel who have never been posted for traffic duty and thus are not exposed to traffic-related air pollution.

**Inclusion Criteria**

1. Healthy nonsmoker traffic policemen in the age group of 25–55 years.
2. Duration of working in traffic junctions for more than 2 years.
3. Willingness to participate in the study.
4. Control population of same age, sex and BMI were selected from general duty policemen who work in office and have never been posted for traffic duty.

**Exclusion Criteria**

1. Subjects with gross clinical abnormalities of the vertebral column, cage and neuromuscular diseases.
2. Those with past history or clinical evidence of pulmonary or heart disease not related to occupational hazards (congenital heart disease, coronary heart disease, rheumatic heart disease, tuberculosis, asthma, chronic obstructive pulmonary disease, diabetes mellitus).
3. Subject with history of smoking.

**Evaluation of Subjects**

After obtaining the informed consents in the pre-printed informed consent form and after screening the subjects by exclusion criteria based on history and examination, details of subjects were recorded as follows.

The traffic policemen were administered a pre-printed data sheet, that is, case record format, to enter the required data.

- The method for asking the questions and the conducting the examination were as per the instructions given along with the case record format.
- The case-record format had a section, which included details of the subject such as age, sex and address.
- The presence or absence of respiratory symptoms of cough, sputum production, shortness of breath, wheezing, and past chest illness were recorded in each subject.

**Examination**

**General physical examination**

Anthropometric measurements (height in centimeters, weight in kilograms) general appearance pallor, lymphadenopathy,
blood pressure, pulse rate, and respiratory rate were recorded.

**Systemic**

Detailed systemic examination including respiratory and cardiovascular examination was done.

**Control**

After screening for exclusion criteria, the details pertaining to the history, general physical examination and systemic examination similar to the subject were recorded.

**Investigations**

1. Spirometric PFT’s evaluation was done after recording all baseline parameters. The pulmonary function testing was done using an electronic portable PC based Spirometer with printer (MODEL-HELICOS 702 SPIROMETER) RMS HELICOS 702 is a battery operated device and works on 12V, 1.3AH battery. The device has a hand piece which houses a removable flow turbine inducer and Graphical LCD of 320 × 240 pixels. The transducers incorporate an axially mounted, flat, two branded rotor vane driven by induced swirl and readout for the volume. Air is breathed by the patient against the frictionless rotating vane. The air inhaled or exhaled by the patient is converted into electrical signals by the transducers. These electrical signals are picked up by IR optical sensors mounted in hand piece. These signals are processed to produce relevant plots for calculation, real time display and printing

The subjects were instructed and demonstrated on how to perform the tests. The subject was made to sit and relax for approximately fifteen minutes before recording.

2. The subject was asked to perform the test in standing upright posture. They were instructed to take maximum inhalation and blow into the instrument rapidly and maximally followed by re inhalation from the mouthpiece. The subject was asked to maintain a tight seal is maintained between the lips and the mouthpiece of the device, nose clips was not used. However, subjects were asked for manual occlusion of their nares to avoid air leak. The spirometric parameters were recorded

3. At least three spirometric readings were taken and the highest reading at any testing session was used in the statistical analysis.

4. Spirometric data was recorded as
   - Absolute measures
   - Percent of those predicted for age, sex, and height.

5. The indices which were measured in the study included
   - FVC
   - FEV₁
   - FEV₁/FVC
   - Peak expiratory flow rate (PEFR)
   - Forced mid expiratory flow (FEF 25–75%).

**Statistical Analysis of Data**

The data were compiled on excel spreadsheet of Microsoft office 2007 and was statistically analyzed. Spirometric PFT results of the subjects and controls were compared using student’s *t*-test and the *P* value computed against the degree of freedom. *P* < 0.01 was considered significant.

**RESULTS**

The present cross-sectional study included 40 male nonsmoker traffic policemen of Gangtok in the age group 25–55 years as subjects of the study. For comparison, another group of nonsmoker 40 general duty policemen were enrolled as controls. The anthropometric measurements of the exposed traffic policemen (cases) and non-exposed general duty policemen (controls) are given in Table 1. The two groups did not differ significantly on these parameters viz age, height and weight.

The observed values of various PFT’s measured were compared between the exposed traffic policemen and the non-exposed controls.

Table 2 shows the mean of absolute measured values of the PFT’s of the two groups. It was observed that though the various PFTs parameters were decreased in the traffic as compared to the controls, although this did not statistical significance. To study the effect of duration of exposure on the traffic policemen, the traffic policemen were further subdivided into two groups:

- Group A: with duration of exposure 8 years or less;
- Group B: with duration of exposure more than 8 years.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Traffic policemen (Mean±SD)</th>
<th>Controls (Mean±SD)</th>
<th><em>P</em>-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of subjects</td>
<td>40</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Age in years</td>
<td>32.19 (±8.92)</td>
<td>32.63 (±8.62)</td>
<td>0.891</td>
</tr>
<tr>
<td>Height in cm</td>
<td>165.42 (±7.150)</td>
<td>167.16 (±6.237)</td>
<td>0.068</td>
</tr>
<tr>
<td>Weight in kgs</td>
<td>58.80 (±6.470)</td>
<td>62.45 (±8.201)</td>
<td>0.06</td>
</tr>
<tr>
<td>Residence</td>
<td>Urban</td>
<td>Urban</td>
<td></td>
</tr>
</tbody>
</table>

*P*<0.05 was considered significant, SD: Standard deviation
It was observed that though the various PFT’s were decreased in Group B (with duration of exposure more than 8 years) as compared to Group A, although this did not reach statistical significance [Table 1].

**DISCUSSION**

In this comparative cross-sectional study, we investigated spirometric lung function tests in 40 traffic police personnel and assessed and compared the pulmonary function between the traffic police personnel and general duty policemen with the aim to bring awareness about the respiratory effect of vehicular pollution as well as to advocate proper precautionary methods and measures against it. Traffic policemen working in various traffic posts in and around Gangtok with history of long duration of posting of more than 8 years were investigated. As we know cigarette smoking is significantly correlated with decline in lung health, only subjects who did not smoke were recruited for the study. The present investigation revealed that traffic policemen had decreased FVC, FEV₁, FEV₁/FVC, PEFR and FEF 25–75% as compared to controls, although it was not statistically significant [Table 1].

Furthermore, as shown in Table 2, we found that traffic policemen with duration of exposure more than 8 years did not reveal any notable impairment of the PFT as compared to the controls. This could be due to low levels of air pollution with low traffic load and significant green forest cover and agricultural plantation in the hilly northeastern state of Sikkim. In Sikkim, the environment pollution measurements are within the Indian ambient air pollution levels. Furthermore, data released by the environment sustainable index has placed Sikkim as an environmentally viable region in the country, with air pollution contamination levels well below the Indian ambient air quality standards.

In a similar study Attfield et al. noticed, no significant variance between the PFT parameter FVC among the smoker mine workers and nonsmoker mineworkers. Similarly, Proietti et al. assessed the lung function of 484 traffic policemen which showed that alterations of the respiratory function tests were more common in the nonexposed control group (14.3%) as compared to the exposed group of traffic policemen (9.6%). The respiratory symptoms of dyspnea, wheezing, and cough were reported at a higher prevalent rate among the smokers as compared to non-smokers and ex-smokers within each group. Their results also showed that respiratory symptoms and allergic sensitization were more commonly reported among the exposed traffic police as compared with non-exposed police, although this did not reach statistical significance. Govindaraju et al. evaluated the consequence of exposure to sea salt aerosol on respiratory function in seafarers and found no significant changes in the parameters FVC, FEV₁, FEV₁/FVC. The reason being inspiration of sea salt aerosols containing sodium chloride helped stabilize alveoli.

However, several studies show findings contradictory to the present study results. Singh et al. described a notable dissimilarity in FEV₁ parameter of subjects who did not smoke but where exposed to vehicular emissions as compared to those subjects who were not exposed to such emissions. The FEV₁ value in nonsmoking exposed subjects was 87.8 ± 9.5% of the expected value, whereas in non-exposed subjects, FEV₁ was 95.3 ± 13.6% of the expected value.

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**Table 2: Comparison of the PFTs of the traffic policemen and controls**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Traffic policemen (Mean±SD)</th>
<th>Control (Mean±SD)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC (L)</td>
<td>3.26 (±0.45)</td>
<td>3.33 (±0.32)</td>
<td>0.42</td>
</tr>
<tr>
<td>FEV₁ (L)</td>
<td>2.61 (±0.39)</td>
<td>2.73 (±0.35)</td>
<td>0.15</td>
</tr>
<tr>
<td>FEV₁/FVC</td>
<td>80.06 (±3.15)</td>
<td>81.84 (±3.68)</td>
<td>0.12</td>
</tr>
<tr>
<td>FEF25–75%</td>
<td>3.27 (±0.67)</td>
<td>3.35 (±1.14)</td>
<td>0.35</td>
</tr>
<tr>
<td>PEFR (L/s)</td>
<td>5.14 (±1.59)</td>
<td>5.20 (±1.98)</td>
<td>0.72</td>
</tr>
</tbody>
</table>

*P<0.05 was considered significant, FVC: Forced vital capacity, FEV₁: Forced expiratory volume in 1 s, FEF: Forced mid expiratory flow, PEFR: Peak expiratory flow rate, SD: Standard deviation. PFTs: Pulmonary function tests*

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**Table 3: Comparison of pulmonary function test according to duration of exposure**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Group A traffic (Mean±SD)</th>
<th>Group B traffic (Mean±SD)</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC</td>
<td>3.53 (±0.71)</td>
<td>3.16 (±0.42)</td>
<td>0.20</td>
</tr>
<tr>
<td>FEV₁</td>
<td>2.88 (±0.46)</td>
<td>2.68 (±0.32)</td>
<td>0.54</td>
</tr>
<tr>
<td>FEV₁%</td>
<td>81.5% (±8.04)</td>
<td>84.81% (±8.26)</td>
<td>0.28</td>
</tr>
<tr>
<td>FEF25–75%</td>
<td>3.97 (±0.92)</td>
<td>3.73 (±0.67)</td>
<td>0.52</td>
</tr>
<tr>
<td>PEFR (L/s)</td>
<td>4.16 (±1.3)</td>
<td>3.60 (±1.2)</td>
<td>0.31</td>
</tr>
</tbody>
</table>

*P<0.005 was considered significant, FVC: Forced vital capacity, FEV₁: Forced expiratory volume in 1 s, FEF: Forced mid expiratory flow, PEFR: Peak expiratory flow rate, SD: Standard deviation*
Similarly, Amit et al.[16] evaluated the pulmonary function of Gujarar traffic police personnel and reported a decrease in the pulmonary function. The decrease in the same was attributed to the effect of automobile pollution on lung function. Wongsurakiat et al.[17] noted a notable decrease of mean values of FEV₁ and FVC of traffic policemen in Thornburi, Thailand, as measured to the normal Thai population (3.29 ± 0.5 L vs. 3.43 ± 0.5 L, P = 0.01 for FEV₁ and 3.86 ± 0.5 L vs. 3.98 ± 0.6 L, P = 0.047 for FVC.[17] Even among the traffic police personnel, the Spirometric values were significantly decreased among those who did not advocate the use of protective gears as contrasted to those who used them. The results of research have established that significant duration of exposure to vehicular pollution is directly correlated with unfavorable outcome on lung health.

Awareness on health aspects of pollution with periodic health checkups and advocating the use of protective gears, mask, can help improve situation. There is a need to conduct such studies on a larger population to greater understand the role of traffic pollution.

Strength and Limitations

In this present study, a detailed assessment of PFT of the traffic police personnel was done. The lung function indices included in the study were FVC, FEV₁, FEV₁/FVC which are the most reliable parameters.

The constraint of the study was the sample size. Hence, conduction of similar studies on a greater sample size will help to better understand the effect of vehicular pollution.

CONCLUSION

The results of the present study show various spirometric test parameters of traffic policemen working in the town of Gangtok have decreased as compared to the controls over the years, although it was not statistically significant in this study. Even then, we firmly assert for the use of various protective and preventive policy measure such as periodic health check-up of traffic police personnel and conduction of such studies on a larger scale.

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REFERENCES


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