PULMONARY FUNCTIONS IN PETROL PUMP WORKERS: A PRELIMINARY STUDY

MAYANK SINGHAL, FARAH KHALIQ*, SIDDARTH SINGHAL AND O. P. TANDON

Department of Physiology, University College of Medical Sciences & GTB Hospital, Delhi – 110 095

Abstract: Occupational exposures to petrol/diesel vapors have been shown to affect functioning of different systems of the body. The present study was planned to assess the pulmonary functions in petrol pump workers (filling attendants) who are continuously exposed to petrol/diesel vapors during duty hours. Thirty healthy non-smoker males working in petrol pump for more than one year formed the study group, while thirty healthy non-smoker males from hospital staff served as control group. The pulmonary functions were assessed using computerized spirometer. The FVC and FEV₁ were decreased in the study group while their ratio did not differ much. Both the inspiratory and expiratory flow rates were also decreased in the study group. These findings point towards adverse effects of petrol/diesel fumes mainly on lower airways with restrictive pattern of disease.

Key words: pulmonary functions petrol/diesel vapors occupational exposures

INTRODUCTION

Numerous epidemiological studies have documented decrements in pulmonary function and various other health problems associated with long-term air pollution exposure (1–4). Health problems posed by the pollutants at the work environment of an individual are closely linked to the nature and level of exposure to these hazardous chemicals. It has been known for quite sometime that air pollution from diesel exhaust is a major respiratory hazard for workers exposed to it in enclosed space (5). Diesel exhaust, in addition to generating pollutants like hydrocarbons, oxides of nitrogen and carbon is a major contributor to particulate matter in most places of the world. Symptoms like chronic cough, wheezing and breathlessness have been reported on exposure to these pollutants (2, 4). At high ambient concentrations, well-defined and marked systemic pulmonary inflammatory response is also observed (6). Various occupational exposures to petrol/diesel products have been shown to affect

*Corresponding Author: Phone No.: 0-9868350022, 011-22029877; E-mail: farahphysio@yahoo.com
different systems of body (7–10). Several animal studies have also demonstrated a consistent association between the air pollutants and the altered lung function (11–13). Petrol pump workers (filling attendants) are continuously exposed to the organic and inorganic substances present in the petrol. The average daily exposure to these chemicals in India generally exceeds about 10 h/day. Some of them are working for more than ten years now. Hence, the present study aims to evaluate the respiratory functions in subjects continuously exposed to petrol/diesel vapor for more than one year.

MATERIAL AND METHODS

The study was carried out in the environmental physiology laboratory of the department. The study group (group I) consisted of thirty healthy non-smoker males in the age group of 20–40 years working in petrol pump for more than one year. They were selected from the petrol pumps located in the vicinity of the institution which are located in the lower pollution zones (3) and were brought to the laboratory for the test. While thirty age matched healthy male non-smokers, working as Laboratory attendants in our hospital served as controls (group II). None of the subjects had a history of asthma, respiratory or other illness or were taking any medication. The ethical committee clearance was taken and an informed written consent was taken after explaining the procedure to the subjects.

The pulmonary function tests were carried out using computerized spirometer (Spiro 232 of P. K. Morgan, London) using the standard laboratory methods. The spirometer was calibrated regularly and the values were corrected to DTPS. The questionnaire was filled up and relevant data (name, age, sex, height, weight, occupation, and smoker/nonsmoker) was entered in the computer. The test module was activated and the subject was given proper instructions about the procedure to be performed. All the pulmonary function tests were done on the subjects comfortably seated in an upright position. The subject was connected to the mouthpiece and was asked to breathe in and out to familiarize himself with the equipment. During the test the subject was adequately encouraged to perform their optimum level and also a nose clip was applied during the entire maneuver. Tests were repeated three times and the best matching results were considered for analysis. The predicted values for above parameters were calculated from standard equation derived for Indian subjects (14, 15).

The flow volume curve was recorded and the parameters measured by the apparatus were the peak expiratory flow rate (PEFR), forced expiratory flow in 25–75% of vital capacity (FEF25–75), peak inspiratory flow rate (PIFR) and forced inspiratory flow at 50% of vital capacity (FIF50), forced vital capacity (FVC) and forced expiratory volume at one second (FEV1), forced inspiratory vital capacity (FIVC), inspiratory capacity (IC) and expiratory reserve volume (ERV).

Statistical analysis

The data of pulmonary function tests were presented as the Mean ± Standard Deviation for each of the parameter. The two groups were compared by using unpaired ‘t’ test and p value of less than 0.05 was considered significant.
RESULTS

The anthropometric parameters of study group were age 26.40 ± 8.15 years, weight 60.93 ± 10.13 kg, height 168.07 ± 8.72 cms while that of controls were age 24.13 ± 4.74 years, weight 62.67 ± 8.52 kg, height 172.67 ± 6.26 cms. The two groups did not differ significantly on these parameters. The observed values of various lung functions were compared between the two groups.

Table I shows the values of flow rates in the two groups. The peak expiratory flow rate (PEFR), forced expiratory flow in 25–75% of vital capacity (FEF25–75), peak inspiratory flow rate (PIFR) and forced inspiratory flow at 50% of vital capacity (FIF50) were found to be significantly decreased (P<0.05) in petrol pump workers as compared to controls.

The ambient air quality data as reported by central pollution control Board (21) in the vicinity of petrol pump showed the levels of suspended particulate matter (SPM) levels 301 ± 71 µg/m 3 (upper limit 200), respirable suspended particulate matter (RSPM) levels 135 ± 46 µg/m 3 (upper limit 100), both being above the permissible upper limits. While SO 2 9 ± 2 (upper limit 80) and NO 2 36 ± 5 (upper limit 80) within the normal standards.

DISCUSSION

In the present study most of the parameters were decreased significantly in petrol pump workers as compared to controls. Although FEV1 and FVC both decreased in petrol pump workers their ratio did not differ between the two groups. This finding indicates the restrictive nature of pulmonary involvement in the study group (16). Similar findings were observed in cats following long-term exposure to diesel exhaust (12). However previous work involving animal exposures to diesel exhaust and pulmonary function tests has shown

<table>
<thead>
<tr>
<th>TABLE I: Flow rates in the two groups.</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>PEFR (L/min)</td>
</tr>
<tr>
<td>FEF25–75 (L/min)</td>
</tr>
<tr>
<td>PIFR (L/min)</td>
</tr>
<tr>
<td>FIF50 (L/min)</td>
</tr>
</tbody>
</table>

*P<0.05 as compared to controls.

The values of lung volumes and capacities are shown in Table II. Both forced vital capacity (FVC) and forced expiratory volume at first second (FEV1) were decreased significantly while their ratio did not differ much between the two groups. Expiratory reserve volume (ERV) is also lowered in the study group. Forced inspiratory vital capacity (FIVC) and inspiratory capacity (IC) were not significantly different in the two groups.

The ambient air quality data as reported by central pollution control Board (21) in the vicinity of petrol pump showed the levels of suspended particulate matter (SPM) levels 301 ± 71 µg/m 3 (upper limit 200), respirable suspended particulate matter (RSPM) levels 135 ± 46 µg/m 3 (upper limit 100), both being above the permissible upper limits. While SO 2 9 ± 2 (upper limit 80) and NO 2 36 ± 5 (upper limit 80) within the normal standards.

<table>
<thead>
<tr>
<th>TABLE II: Lung volumes and capacities in the two groups.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petrol pump workers</td>
</tr>
<tr>
<td>----------------------</td>
</tr>
<tr>
<td>FVC (Litres)</td>
</tr>
<tr>
<td>FEV1 (Litres)</td>
</tr>
<tr>
<td>FEV1/FVC (%)</td>
</tr>
<tr>
<td>FIVC (Litres)</td>
</tr>
<tr>
<td>IC (Litres)</td>
</tr>
<tr>
<td>ERV (Litres)</td>
</tr>
</tbody>
</table>

*P<0.05 as compared to controls.
varying results (17–20). While short term exposure to diesel exhaust in healthy human volunteers have demonstrated marked systemic and pulmonary inflammatory response but lung function measurements did not show a significant change (6). These volunteers were exposed to diluted diesel exhaust under controlled conditions for 1 hour with intermittent exercise. Such low exposure could be one of the reasons for normal lung function parameters in their study. Since our subjects are exposed to these exhausts for longer period of time (more than a year, for at least 10 hrs/day), they have more chances of chronic inflammatory involvement of lungs as indicated by the results of our study. Moreover, the ambient air quality monitored in the vicinity of petrol pumps by central pollution control Board (21) also showed increase in the levels of SPM (301 ± 71 µg/m³ and RSPM (135 ± 46 µg/m³). These values were 35% to 50% greater as compared to maximal permissible levels (21). Another important pollutant which may have contributed to our findings is lead. Inhalation of lead from leaded petrol emissions is an important source of lead exposure. Few studies have related lead to structural damage or impaired functions of the lungs (22, 23). In the present study expiratory and inspiratory flow rates i.e. PEFR, PIFR, FEF25–75 and FIF50 are also decreased in the study group. PEFR was also decreased in the experimental study of cats which otherwise showed a classic pattern of restrictive lung disease (12). Since petrol pumps are located on busy roads, hence, these workers in addition to diesel exhaust are exposed to other air pollutants. The flow rates at low volumes i.e. FEF25–75 and FIF50 indicates flow rates in small airways i.e. those with internal diameters of less than 2 mm. These are reduced at low lung volumes both in restrictive and obstructive diseases (24). Thus findings 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 (25). 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 (25). Importantly, they can remain airborne for long periods of time and deposit in greater numbers and deeper into the lungs than larger sized particle (26). Hence chronic exposure to them can lead to chronic inflammation of respiratory tract and lung parenchyma. Therefore future study could be extended to evaluate status of alveolo-capillary membrane, by determining lung diffusion capacities in these workers.

REFERENCES


