Comparison of Peak Expiratory Flow Rate and Forced Vital Capacity between Petrol Pump Workers and Automobile Repair Workers

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ABSTRACT

Urbanization has led to enormous increase in number of automobiles and in order to cater them petrol filling stations and workshops for repairing the vehicles had also increased accordingly. Workers engaged in these places are continuously exposed to petrol and diesel fumes which can take a toll on their health. Respiratory system is the most affected one as the fumes are volatile. The present study has focused on measuring peak expiratory flow rate (PEFR) and forced vital capacity (FVC) in sixty male petrol pump workers, sixty male automobile repair workers and sixty normal healthy male controls. Results showed that PEFR was reduced in petrol pump workers as compared to the automobile repair workers. PEFR was significantly reduced in smokers of petrol pump workers and automobile repair workers as compared to non-smokers of those groups. The results suggest that respiratory functions are significantly compromised in petrol pump workers as compared to automobile repair workers, as they are exposed to traffic vehicle exhaust apart from environmental pollutants.

1. Introduction

The city of Pondicherry has seen a rise in number of automobiles in both two wheelers and four wheelers. With growing global needs there had been rise in number of petrol pumps and automobile workshops. This has led to health risks, particularly rise in respiratory morbidity in petrol pump workers and automobile repair workers due to occupational exposure to benzene and other hydrocarbons.

Exposure assessment have indicated that important microenvironment for benzene exposure for those associated with petrol and diesel are due to: driving, working or visiting a service station, having attachment to automobile workshop or living close to waste sites petroleum refinery or chemical manufacturing plant[1]. Moreover those individuals involved in these occupation related to automobile repairs and petrol filling will have a profound exposure to benzene and other hydrocarbons.

Occupational exposures to petrol/diesel vapors have been shown to affect the effective functioning of body systems. Petrol is a complex combination of hydrocarbons and about 95% of its components are aliphatic and acyclic compounds[2]. Benzene is highly volatile and the most usual route of exposure is through inhalation of vapor[3]. Sulphur dioxide is formed during combustion of sulphur present in petroleum products. Nitrogen dioxide is a constituent of tobacco smoke, forest fires, and urban air pollution, particularly fumes from vehicle exhaust[4]. Diesel exhaust in addition to generating pollutants like hydrocarbons, oxides of nitrogen and carbon is a major contributor of particulate matter worldwide[5]. All the above molecules are known to impair lung functions. Automobile repair workers exposed to metal working fluids, have increased respiratory morbidity[6]. Since the petrol pump workers and automobile repair workers are exposed to petrol fumes and diesel exhaust at high ambient concentrations of solvents and air pollutants, well defined and marked pulmonary inflammatory response is also observed[7,8].

A study on pulmonary functions in petrol pump workers by MayankSinghal showed that both peak expiratory flow rate and forced vital capacity were significantly reduced in petrol pump workers exposed to exhausts for a longer duration[9]. O.Chattopadhyay observed compromised lung functions in 25.8% of automobile repair workers, out of which 21.1% had restrictive lung disease[10].
The present study is planned to assess the PEFR and FVC of petrol pump workers and automobile repair workers who are continuously exposed to petrol fumes and vehicle exhaust during duty hours and to compare the results of both the groups and find the more vulnerable group amongst them. We also decided to have comparative analysis for the PEFR and FVC amongst the smokers of petrol pump workers and automobile repair workers.

2. Materials and methods:

The present study was carried out in department of physiology at Indira Gandhi Medical College and Research Institute, Puducherry. The present project was approved by Institutional Ethical Committee. We planned to assess the Peak Expiratory Flow Rate and Forced Vital Capacity in sixty petrol pump workers, sixty automobile workshop workers and sixty healthy control in the age group of 25 to 40 years. All the cases and controls selected for study were males.

All workers (petrol pump and automobile repair workers) and controls selected for study were from same socio-economic status, included both smokers and non-smokers and all the cases and control were nonalcoholic having no clinical evidence of any illness or neither were on any drug or therapy. Those excluded from the study were cases and control having complaints of any respiratory ailments, history of any other occupational hazards, female workers and male workers below 20 years and above 45 years.

The volunteers for this study reported to the department of Physiology between 10am to 12noon. The informed consent was obtained from the patient. After recording the health profile and detailed clinical examination, the anthropometric measurements which included height and weight were recorded. BMI was calculated and vitals like pulse rate and blood pressure were recorded. The procedure and maneuver for FVC and PEFR was explained to the participants and was done as per the American Thoracic society guidelines [22].

Peak Expiratory Flow rate was measured using a wright peak flow meter. PEFR was recorded in standing posture, without flexing the neck. The participants of this study were asked to take a maximum inspiration and immediately expire forcefully with maximum effort for recording the PEFR. Three readings were taken and the best reading was noted. The normal value of PEFR is 400-600 liters per minute.

Forced vital capacity was recorded in standing position and the person was asked to take a maximum inspiration and then expire forcefully and completely. Three readings were taken and the best reading was noted. The normal value of FVC is 4.5-4.8 liters.

Statistical analysis was done using Anova test for comparing the values of parameters between the three groups. The sub-group statistical analysis between the smokers and non-smokers was carried out using unpaired t-test.

3. Results

Petrol pump workers had the least PEFR values among three groups and FVC was almost equal in both petrol pump workers and automobile repair workers. The subgroup analysis on comparison of PEFR of smokers and nonsmokers petrol pump workers revealed significantly (p=0.02) reduced PEFR in the smokers (309.21±89.484). FVC was reduced in the smokers’ petrol pump workers (2226.33±582.02).

The analysis of PEFR and FVC between smokers and nonsmokers automobile repair worker showed significantly (p=0.006) reduced PEFR in the smokers. No significant change was seen in FVC

The comparison between smokers among petrol pump workers and automobile repair workers revealed reduced PEFR in smokers petrol pump workers (309.21±89.482) than smokers automobile repair workers (341±122.072).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group</th>
<th>Mean±sd</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEFR in liters/min</td>
<td>Petrol pump workers</td>
<td>340±99.49</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>Automobile repair workers</td>
<td>350.33±85.904</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Automobile repair workers</td>
<td>350.33±85.904</td>
<td>0.49</td>
</tr>
<tr>
<td></td>
<td>Controls</td>
<td>372.17±127.28</td>
<td>0.22</td>
</tr>
<tr>
<td></td>
<td>Petrol pump workers</td>
<td>340±99.49</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Controls</td>
<td>372.17±127.28</td>
<td></td>
</tr>
<tr>
<td>FVC in ml</td>
<td>Petrol pump workers</td>
<td>2226.33±582.021</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Automobile repair workers</td>
<td>2345.45±621.616</td>
<td>0.486</td>
</tr>
<tr>
<td></td>
<td>Automobile repair workers</td>
<td>2226.33±582.021</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Controls</td>
<td>2345.45±621.616</td>
<td></td>
</tr>
</tbody>
</table>

*p value < 0.05 is significant

<table>
<thead>
<tr>
<th>Variable</th>
<th>Smokers (n=22)</th>
<th>Non-Smokers (n=38)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEFR (MEAN±SD) in liters/min</td>
<td>309.21±89.484</td>
<td>393.18±94.988</td>
<td>0.02**</td>
</tr>
<tr>
<td>FVC (MEAN±SD) in ml</td>
<td>2226.33±582.021</td>
<td>2345.45±621.616</td>
<td></td>
</tr>
</tbody>
</table>

*p value < 0.05 is significant and denoted by **
Table 3: PEFR and FVC in smokers & non-smokers automobile repair workers

<table>
<thead>
<tr>
<th>Variable</th>
<th>Smokers (n = 20)</th>
<th>Non-smokers (n = 40)</th>
<th>p value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEFR (mean±SD) in liters/min</td>
<td>341±122.072</td>
<td>434.5±116.55</td>
<td>0.006**</td>
</tr>
<tr>
<td>FVC (mean±SD) in ml</td>
<td>2127.5±578.5</td>
<td>2322.20±542.509</td>
<td>0.546</td>
</tr>
</tbody>
</table>

*p value < 0.05 is significant and denoted by **

Table 4: PEFR and FVC between smokers & non-smokers controls

<table>
<thead>
<tr>
<th>Variable</th>
<th>Smokers (N = 20)</th>
<th>Non-smokers (N = 40)</th>
<th>p value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEFR (mean±SD) in liters/min</td>
<td>336±69.992</td>
<td>357.5±92.84</td>
<td>0.321</td>
</tr>
<tr>
<td>FVC (mean±SD) in ml</td>
<td>2205±498.92</td>
<td>2207.5±541.786</td>
<td>0.986</td>
</tr>
</tbody>
</table>

*p value < 0.05 is significant

4. Discussion

In the present study Peak Expiratory Flow Rate and Forced Vital Capacity were compared between petrol pump workers and automobile repair workers. The workers of both the groups are exposed to hydrocarbons. The only difference between the exposures is that the petrol pump workers work in an environment on the roadside and automobile repair workers in a closed space.

The mean Peak Expiratory Flow rates and Forced Vital Capacity were reduced in petrol pump workers and automobile repair workers when compared to controls and these findings are similar to that observed by Neena Sharma et al[18]. Similarly Madhuri BA et al in their study stated that the mean FVC values and the mean PEFR were lower than the controls in petrol pump workers and the differences were statistically significant[8]. Mayank Singhal et al, in their study have demonstrated that FEV1 and FVC both were decreased in petrol pump workers and their ratio did not differ between the two groups. PEFR was also decreased in the petrol pump workers, when compared to the controls[9].

The occupational solvents like benzene in petrol and diesel fumes get absorbed into the human body either through the respiratory tract or via epidermal contact. These may cause respiratory symptoms and impaired pulmonary functions and has resulted in reduced Peak Expiratory Flow rates and Forced Vital Capacity in petrol pump workers as compared to control[1,15].

Petrol pump workers are exposed to hydrocarbons and toxic metal like lead and these are responsible for structural damage of lung parenchyma. Particles generated from diesel fumes are extremely small having a diameter between 0.02nm to 0.2nm, by virtue of their greater surface area to mass ratio it leads to hydrocarbon deposition on the lung tissue and this may further impair lung tissue[6] and thereby its function as observed in our study.

Among the automobile workers, those involved in repairing batteries and spray painters are exposed to isocyanate containing spray paints. As the concentration range from below the limit of detection to 0.06 parts per million, these particles are likely to damage the pulmonary alveoli and thereby reduce function capacity. Similar to petrol pump workers, automobile workers are also exposed to hydrocarbons, lead, benzene; sulphur etc. pulmonary functions are likely to be compromised in them also[10]. Chattopadhyay, Parker et al and Cullen et al in their studies observed both obstructive pattern and restrictive pattern of damage in those who were exposed to the automobile repair works. Chronic exposure to petrol and diesel fumes leads to chronic inflammation of respiratory tract and lung parenchyma[7].
In our study the Peak Expiratory Flow rates were reduced in automobile repair workers when compared to that of the controls while Forced Vital Capacity remained unaffected. The intergroup comparison between petrol pump workers and automobile repair workers revealed reduced Peak Expiratory Flow rates in petrol pump workers while Forced Vital Capacity was reduced in automobile repair workers. As the petrol pumps included in our study were located on the busy roads, and the workers were exposed to more vehicle exhaust fumes in addition to the petrol and diesel fumes. There are not enough evidence of comparing lung functions between petrol pump workers and automobile repair workers.

In this present study, PEFR in smokers of the petrol pump workers and automobile repair workers were compared and was found to be reduced and the reduction was statistically significant when compared to their counterpart non-smokers. FVC was also reduced in smokers of both petrol pump workers and automobile repair workers. The aerosol in tobacco smoke stimulates the lung airways to cause bronchoconstriction. CO present in tobacco smoke impairs respiratory function by combining with hemoglobin and reduces the lung capacity. Tar, superoxides, ozone and oxides of sulphur exert an irritant effect upon the bronchial epithelium, it also affects the dilla and clara cells and release proteolytic enzymes from macrophages[4]. These changes destroy the lung substance and reduce elastic recoil of the lungs.

Outdoor NO₂ concentration is greatest in the zones situated within 0-20metres from the main road[19] and there was a tendency for outdoor NO₂ concentration to decrease with distance from the roadside[23].

PEFR when compared between smokers group of petrol pump workers and Automobile repair workers, smokers of petrol pump workers had more decline in PEFR values. The ill effects of smoking on respiratory function and the working environment in the zone very near to the main roads has made the petrol pump smokers to have a more compromised lung functions.

5.CONCLUSION

The present study concluded that both the petrol pump workers and automobile repair workers are vulnerable to hydrocarbon and particulate matter induced pulmonary function morbidity. But since petrol pumps are situated on the road sides the workers are more exposed to vehicle exhaust fumes and particulate matter in addition to petrol and diesel fumes which makes them a more vulnerable group. The effects are more prominent in smokers the petrol pump workers and automobile repair workers. Taking into consideration the health of the workers; protective measures should be made mandatory. Making them to work in shifts can also reduce the exposure duration. We recommend periodic medical check-up and health awareness amongst the petrol pump workers and automobile repair workers.

Acknowledgement

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References

1. Wallace L. 'Environmental exposure to Benzene: an update'. Environmental Health perspective. 1996; vol 10 pp1129-1136