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Pulmonary function test in petrol pump workers and garage workers: A long drawn peril

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ABSTRACT

A cross-sectional study on occupational exposure to petrol vapours, diesel and automobile exhaust on pulmonary function tests was conducted. Parameters like FEV1, FVC and FEF25-75% of petrol pump workers and garage workers were compared with healthy subjects and analyzed .90 subjects (30 controls and 60 workers from above two groups) with median age 35 years. A significant difference was observed in study group when compared with control group. The petrol pump workers were found to have significantly low ($p<0.001$) levels of FVC and FEF25-75% as compared to controls as well as with the garage workers. These working sector groups are definitely at risk of developing respiratory disease due to exposure of fuel vapours and air pollutants. Therefore it points out that there is more of restrictive disease and small airway disease.

Keywords: Pulmonary Function Test, Petrol pump workers, Garage workers, Airway disease.

INTRODUCTION

Occupational health hazard is of great concern for workers, be it biological, chemical, psychosocial, etc. Particularly the automobile exhaust derived air pollutants have become a major health hazard which occurs in different fuel handlers such as petrol pump workers, garage mechanics and traffic police[1],[2],[3].India being a rapidly developing country and automobiles plying on roads are increasing each day. This has led to an increase in petrol pump stations and exposure of petrol pump workers to vapours of petrol and gases from exhaust of automobiles [4]. In India, petrol-pump attendants are the norm rather than self-service, increasing the opportunity for exposure. Average daily exposure of petrol pump workers to these chemicals generally exceeds about 10 hr/day. Some of them are working for more than ten years. Prolonged exposure to air pollution and petroleum vapors causes broncho constriction [5].While every day, auto shops use chemicals and

equipment that can cause serious health problems, environmental pollution, and disabling injuries [6]. Upcoming garages are good and clean ones but still there do exists old garages where proper maintenance & proper safety measures are not there which makes them prone to various diseases. Therefore the study was designed to evaluate the risk of occupational exposure to different fuel vapours and automobile exhaust on pulmonary function tests.

MATERIALS AND METHODS

The subjects for the present cross-sectional study were randomly selected from the population in and around Pune city. Male, age group 20 to 40 years, exposed to petrol vapours and air dust and chemicals for minimum six hours of a day (at least 5 days per week for more than 1 year).Smokers, tobacco chewers, underlying cardio-respiratory condition, severe or uncontrolled hypertension and malignancy were excluded. We selected 30 petrol pump workers from 10 petrol pumps across the city and nearby highways in a circle of 30 kilometers from our college. While 30 garage workers were selected.

Detailed history of each subject and their duration of exposure were noted. Study group comprised of (n=60 subjects, 30 in each group) petrol pump workers (PPW) and garage workers (GW).90 subjects with median age (35 years) were studied. The study group was compared with healthy controls age and sex matched. Written informed consent was taken from each subject. Anthropometric measurements like height and weight was recorded which was followed by pulmonary function tests.

The pulmonary function tests was carried out by handheld spirometer using the standard laboratory methods[7].The subject was made to sit comfortable and was asked to remove or loosen all restricting clothing. The nose clip was applied gently press to test for leaks. The subject was then handed the device and asked to place the mouthpiece in the mouth and was allowed to get accustomed to breathing into the apparatus. Once reached the end of a normal expiration, he was instructed to perform forced vital capacity maneuver. This maneuver entailed two steps: a full inspiration, followed by a rapid, forceful, maximal expiration into spirometer for 6 seconds or more. After recording nose clip was also removed. Following parameters are assessed by this maneuver [8].

1. Forced vital capacity **(FVC)** -The maximum volume of air that can be expired (or inspired) during a manoeuvre using maximal effort.
2. Volume of air that can be forcefully expired in the first second of the maximal expiration **(FEV1**)-A reduced FEV_1 is only suggestive of obstructive disease. While reduced FEV_1 and FVC are only suggestive of restrictive disease.
3. Forced expiratory flow during the middle half of the FVC manoeuvre **(FEF25-75%) -** It is regarded as more sensitive but more variable measure of narrowing of smaller airways than provided by FEV1.Data was expressed as Mean ± SD. Statistical analysis was done by using Student's unpaired't' test in Microsoft excel , and $p<0.001$ was considered as highly significant.

   Ethical clearance was obtained from the Institutional Ethical Committee. Period of study was between April 2014 to October 2014.

RESULT

The present study was carried out to observe the pulmonary functions of petrol pump workers and garage workers and how their working environment affected their health. The demographic features and work related characteristics of the study population are given in the Table1.

Table 1: Demographic Features and Working characteristics of study population

Groups	Age (Yrs) Mean ±SD	Height (cms) Mean ±SD	Weight (Kgs) Mean ±SD	Working Hours (per/day) Mean ±SD
Control	32 ± 5.71	165.9 ± 8.0	70.7 ± 11.5	8.21 ± 0.48
PPW	31.7± 4.50	167.5 ± 7.44	67.4 ± 7.46	9.46 ± 1.30
GW	29.7 ± 5.84	170.7 ± 9.15	70.5 ± 7.65	7.71 ± 0.46
Statistical analysis:	P value			

PPW Vs Control	0.19	0.55	0.42
GW Vs Control	0.07	1.0	0.94

p<0.05 significant, SD – Standard Deviation
***** PPW – Petrol pump workers, GW- Garage workers

In our study lower levels of FVC, FEV1 and FEF25-75% values were found in study groups (Table 2) as compared to controls.

Table 2: Comparison of FVC, FEV1, FEF25-75% in control group and study group

Groups	**FVC(L) Mean ±SD**	**FEV1(L) Mean ±SD**	**FEF 25-75%(Lit/sec) Mean ±SD**
Control	4.01 ± 0.82	7.38 ± 27.5	4.28 ± 0.81
PPW	2.06 ± 0.66	3.78 ± 0.32	1.67 ± 0.40
GW	2.42 ± 0.46	2.22 ± 0.19	2.56 ± 0.66
Statistical analysis: p value			
PPW Vs Control	0.000	0.000	0.000
GW Vs Control	0.000	0.000	0.000

p<0.001 highly significant, SD – Standard Deviation

When PFT was compared between both study groups, it was observed that FVC and FEF25-75% was significantly less in PPW as shown in Table 3.

Table 3: Comparison of FVC, FEV1, FEF25-75% in traffic police personnel & garage workers

Parameters	**Petrol pump workers**	**Garage workers**	**P Value**
FVC(L) Mean ±SD	2.06 ± 0.66	2.42 ± 0.46	0.021
FEV1(L) Mean ±SD	3.78 ± 0.32	2.22 ± 0.19	0.363
FEF 25-75%(Lit/sec) Mean ±SD	1.67 ± 0.40	2.56 ± 0.66	0.001

p<0.05 significant; p<0.001 highly significant, SD – Standard Deviation
While only FEV1 was found to be not significant. The difference between the groups was statistically significant.

DISCUSSION

According to the surveys in the environmental status report 2014, Pune being one of the most rapidly growing metropolitan cities of the country with increasing number of vehicles, adding to more pollution and crowding. More vehicular population adds to more number of petrol filling stations and garages[9].The present study was therefore undertaken to identify the changes in lung functions in petrol pump workers and garage workers.

In Table 1 demographic features and working characteristics of study population were matched. Mean working hours were more in the petrol pump workers (9.46 ± 1.30) than garage workers (7.71 ± 0.46).

In our study there was a significant reduction in FVC, FEV1 and FEF25-75% in petrol pump workers and garage workers (Table 2) as compared to their matched controls. A study conducted by Meo SA et al the subjects were exposed to crude oil spill into sea water, significant reduction was found in forced vital capacity (FVC), forced expiratory volume in first second (FEV1), forced expiratory flow (FEF (25-75%) and maximum voluntary ventilation (MVV) however this impairment was reversible and lung functions parameters were

improved when the subjects were withdrawn from the polluted air environment [10].

Similarly Aparjita et al also found statistically decrease in FVC, FEV1, PEFR in petrol pump workers [5]. Kesavachandran et al also found that high prevalence of respiratory symptoms was primarily a consequence of exposure to the petrol vapors found in the work place in the petrol filling stations [11].

Many previous studies have shed a light on the occupational exposure to automobile combustion & solvent and found significant change in lung function test. Petrol and diesel fumes causes bronchoconstriction in the smooth muscles of lungs and hence the need arises to examine the evidence for the occurrence of physiological changes in the respiratory functions in a population of male fuel filling workers occupationally exposed to the solvent in petrol for long duration [12].Most of the petrol pumps are located on the busy roads so therefore there are chances of exposure to air pollutants as well. Airborne contaminants include nitric oxide (NO2), carbon monoxide (CO), carbon dioxide (CO2), ozone (O3) sulphur dioxide (SO2), hydrocarbons and suspended particulate matters (SPM).They cause harmful effect on airways and lung parenchyma causing bronchoconstriction, increased mucous secretion and increased alveolar swelling [13]. The toxic effects of petroleum hydrocarbon are exerted on variety of organs of living systems such as the lungs, liver and kidney [14].

The probable cause for the decrease in pulmonary function test is the accumulation in peri-bronchial lymphoid and connective tissues along with varying degrees of wall thickening and remodeling in terminal and respiratory bronchioles arising from each pathway[15].In another rare parallel automobile mechanics are also continuously exposed to the airborne substances present in the petrol, diesel and other chemicals we included them too in our study .As they provide services like maintenance and repair which includes battery work, bodywork, painting, tire retreading and wheel alignment. Nowadays garages are well organized but still many are typical old ones near road side and no fixed hours of work so this makes them prone to respiratory and other harmful effects on health and they also do not come under the provision of Employees State Insurance Corporation (ESIC).Oxides of nitrogen present in garage air causes injury in the terminal bronchioles, decrease the pulmonary compliance, and reduce vital capacity [1]. Diesel exhaust is a major respiratory hazard for workers exposed to it in enclosed space [16].

Our study also compared pulmonary function between petrol pump workers (PPW) and garage workers (GW) and found significant reduction of FVC and FEF25-75 %(as shown in Table 3) in petrol pump workers, suggestive of restrictive and small airway diseases developing in them.

In this respect, many researchers indicated nearly 36.4% of the automobile garage workers had some form of pulmonary function impairment; obstructive and/or restrictive [17]. Speizer and Ferris found a significant association between automobile exposure and the development of chronic non-specific respiratory diseases. The flow rates measured at different levels showed greater changes in FVC, FEV1 & FEF25-75% on exposure to exhaust fumes [18]. In a study conducted on automobile mechanics and compared with their controls pulmonary function tests most of the parameters were significantly reduced [4].

Pulmonary Function Testing (PFTs) is a valuable tool for evaluating the respiratory system appropriate monitoring and testing for environmental elements in the community and in workers would be beneficial.

It is also prudent to recommend a regular check-up of the workers working in these environments which initially may show subtle symptoms which goes unnoticed. Prevention measures need to be encouraged. Thus regular monitoring of lung function is desirable. We suggest pre-employment and periodic medical check-up like pulmonary function tests. Early recognition and removal of susceptible workers from working place before deterioration develops. Safety measures should be included. Use of protective mask at work place can also decrease morbidity in them.

CONCLUSION

The present study concluded that the parameters like FVC, FEV1 and FEF25-75% was adversely affected in the petrol pump workers and garage workers and resulting in impairment of their lung function. It was found that petrol pump workers are prone for developing restrictive disease and small airway disease. While the garage workers are likely

to remain asymptomatic till significant pulmonary damage results or may present with subtle symptoms and are prone for obstructive disease in future. The impairment in lung functions is proportionate to the extent of exposure or the severity of exposure rather than duration of exposure. Early recognition is advisable.

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