ORIGINAL ARTICLE

PULMONARY FUNCTION TESTS IN PETROL FILLING WORKERS IN MYSORE CITY

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Background: With urbanisation and rapidly increasing number of automobiles, there is increasing establishment of petrol filling stations. Occupational exposure to petroleum vapours have been shown to affect functioning of different systems of the body. The present study was taken up to assess the Pulmonary Function Tests (PFT) in petrol filling workers in Mysore city. **Methods:** Twenty-eight non-smoker males in the age group of 18–30 year working in petrol filling station as petrol filling workers for more than 2 years formed the study group. Age and sex matched individuals not exposed to fuel vapour served the control group. Pulmonary function parameters FEV_1, FVC, PEFR, MVV, and FEV_1/FVC were assessed using computerised Spirometer during their working hours and were statistically analysed. **Results:** There was a statistically significant decrease in FEV_1 and FVC in study group compared to control group with normal FEV_1%. The decrease in PEFR, and MVV was statistically non-significant. **Conclusion:** The above findings point towards adverse effects of petroleum vapours on lung function, mainly on lower airways with restrictive pattern of disease.

Keywords: Petroleum vapour, Petrol filling workers, Pulmonary function tests

INTRODUCTION

With urbanisation and rapidly increasing number of automobiles in most of the towns and cities, there is an increase in the air pollution. Numerous epidemiological studies have documented decrements in pulmonary function and various other health problems associated with long term air pollution exposure.[1–4] There is also a convincing evidence for an association between air pollution and cardiovascular disease.[5,6] Health effects of occupational exposure to petroleum vapours and air pollution from vehicular sources is relatively unexplored among petrol filling workers.

Petrol, also called gasoline is a complex combination of hydrocarbons. About 95% of components in petrol vapour are aliphatic and acyclic compounds and less than 2% is aromatics.[7] The benzene content of petrol has typically been in range 1–5%. Typical 8 hour benzene exposure concentrations in distribution and retail operations average less than 1 parts per million (ppm), although exposures can reach 2–3 ppm for shorter periods. India still does not have an air quality standard for benzene. Petrol filling station is a place where workers are exposed to both petroleum vapours and the vehicular exhaust. The combined effects of the two may result in accelerated decline in lung functions.

In India, petrol filling workers are employed rather than self serviced, increasing the opportunity for exposure. Long-term exposure to petrol vapour has shown to affect the different physiological systems in the body.[8]

To meet the present day requirement, there are many petrol filling stations getting established and there is an increased recruitment of workers. Because of the predominant role of petrol (gasoline) as a motor vehicle fuel, the effects of gasoline engine emissions are potentially even greater problems. Hence, the present study attempts to evaluate the changes in Pulmonary Function Tests (PFTs) like Forced Vital Capacity (FVC), Forced Expiratory Volume in the first second (FEV_1), FEV_1/FVC ratio, Peak Expiratory Flow Rate (PEFR), Maximum Voluntary Ventilation (MVV) of petrol filling workers in Mysore City.

MATERIAL AND METHODS

The present study was conducted in various petrol filling stations of Mysore City with due permission of the managers. Ethical clearance was taken from the Institutional Ethical Committee and each subject gave the consent.

The study group consisted of 28 males in the age group of 20–35 year, who were working in various petrol filling stations as petrol filling attendants, 8 hours per day for more than 2 years in Mysore city. The control group consisted of 28 males of same age group, who were not exposed to petroleum vapour, from the preclinical and paraclinical departments of JSS Medical College, Mysore.

The subjects chosen in the study and the control group had no history of allergic disorders, respiratory disorders like asthma, or any systemic disease and no history of smoking, chewing tobacco, intake of alcohol and no history of previous exposure to petroleum vapour.

Age, height, and weight were recorded. Pulmonary functions were tested during work shift using Medspiror® (a self-calibrating computerised spirometer that fulfils the criteria for standardised lung function tests). The parameters studied were, Forced

Vital Capacity (FVC), Forced Expiratory Volume in first second (FEV_1), FEV_1/FVC (FEV_1%), Peak Expiratory Flow Rate (PEFR), and Maximum Voluntary Ventilation (MVV).

The subjects were familiarised with the setup and detailed instructions were given. All the tests were carried out at the same time of the day, between 8.30 AM to 9.30 AM to avoid possible diurnal variations. Tests were performed using the acceptability standards outlined by the American Thoracic Society (ATS) with subjects in a standing position and wearing nose clips.[9] The subjects were asked to breathe forcefully following deep inspiration into the mouthpiece attached to the pneumatachometer. Expiration was maintained for a minimum period of 3–4 seconds, 3 to 4 trails of maximal inspiratory and expiratory efforts were made and the highest reading was taken for statistical analysis.

Statistical methods employed in the present study were Mean and Standard Deviation, Independent sample *t*-test using SPSS-16. The *p* value less than 0.05 was considered statistically significant.

RESULTS

The results are summarised in Table-1. There was statistically significant decrease in FVC, and FEV_1 in the study group when compared to the control group. In addition, there was a decrease in PEFR, MVV, and FEV_1%, but it was not statistically significant.

Table-1: Comparison of pulmonary function parameters between study and control groups

Parameter	Mean±SD		*t*-Test	*p*-value
	Study group (n=28)	Control group (n=28)		
FVC (L)	2.86±0.37	3.33±0.50	-4.096	0.000*
FEV_1 (L)	2.58±0.46	3.01±0.33	-4.115	0.000*
PEFR (L/sec)	7.47±1.40	8.05±1.59	-1.479	0.145
MVV (L/min)	119.80±18.63	130.16±22.89	-1.923	0.059
FEV_1%	88.13±8.44	90.80±10.69	-1.072	0.053

*Significant

DISCUSSION

Occupational health has been gaining importance for the fact that long term exposure can lead to a permanent morbidity. There are health hazards involved in handling and use of petrol as documented by various studies. The acute health risks involved are minimal, provided that the products are used in accordance with appropriate health and safety practices.

Statistically significant decrease in FVC and FEV_1 was observed in petrol pump workers when compared to their controls, but their ratio (FEV_1%) did not differ between the two groups. This finding indicates the restrictive pattern of pulmonary involvement in the study group.

Petrol filling workers are at risk of petrol vapour inhalation and also inhalation of automobile exhaust for a longer period of time (at least 8 hours per day for more than one year) and they have more chances of chronic involvement of lungs as indicated by the results in the present study.

Petrol is a complex mixture of aliphatic and aromatic hydrocarbons with high volatility. There is no definitive ADME (Absorption, Distribution, Metabolism and Excretion) data available. Pulmonary sequels following inhalation of petrol vapour or secondary to pulmonary elimination (following ingestion or dermal absorption) include persistent atelectasis and petechial haemorrhages.

The benzene content of petrol has typically been in the range 1–5%. Benzene in petroleum vapour may be an exacerbating factor for the lung function abnormalities observed as the study groups were non-smokers. Smoking as an independent variable was found to affect FEV_1 significantly and smoking has shown to accelerate the decline in lung function in a time dependent manner.[10]

As petrol pumps are located on busy roads, the workers in addition to automobile exhaust are exposed to other air pollutants. Automobile exhaust is a complex mixture of different gases like Sulphur dioxide (SO_2), Carbon dioxide, Carbon monoxide (CO), Nitrogen dioxide (NO_2) and particulate matter. Animal studies have demonstrated that exposure to particulate matter combined with exposure to an irritant gas such as NO_2, results in greater damage to the lung than when exposed to either substances individually.[11]

In combination with particulate pollutants, SO_2 and NO_2 have a greater chance to reach the deeper parts of the lungs. The gaseous pollutants may also alter the properties and concentration of surfactant and may thus contribute to the early closure of small airways. Much of the terminal bronchioles may be compromised before other pulmonary function tests such as FEV_1 are affected.[12] Histopathological studies have provided evidence that the small airways are the site of damage in people living in areas of high air pollution.[13]

Particles generated from diesel exhaust are extremely small and are present in the nuclei or accumulation modes with diameter of 0.02 ηm and 0.2 ηm 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. Importantly they can remain airborne for long periods of time and deposit in greater numbers and deeper into the lungs than large sized particles. Hence chronic exposure to them can lead to chronic inflammation of respiratory tract and lung parenchyma. These would contribute to the substantial decrease in lung functions in the form of restrictive pattern as indicated in the present study.

This finding is consistent to that reported in a study carried out in Delhi where both inspiratory and

expiratory flow rates were decreased. Moreover, the ambient air quality monitored in the vicinity of petrol pumps by Central Pollution Control Board also showed increase in the levels of Suspended Particulate Matter (SPM).[14]

In a study, altered lung function in petrol pump workers related to duration of exposure showed overall prevalence of mixed Peripheral Airway Obstruction (PAO) type of respiratory impairment. Reduced mechanical properties of breathing were attributed to exposure to benzene in the vapours of petrol.[15] Exercise and regular physical activity could increase the strength of the skeletal muscles including respiratory muscles.[16]

CONCLUSION

Our findings point towards adverse effects of petroleum vapours on lung function, mainly on lower airways with restrictive pattern of disease. Test group are exposed to benzene present in the petrol vapour and NO_2 and SO_2 of automobile exhaust from the vehicles.

Small airways probably bear the brunt of air pollution and fuel vapour related lung injury. As benzene in the main component of vapour, an ambient air quality guideline for safe standard level for benzene is the need of the hour along with the control strategies for air pollution.

RECOMMENDATIONS

In order to prevent this respiratory dysfunction among petrol filling workers, medical observation including pre-employment and periodic check-ups for pulmonary function tests should be performed. Control strategies should be adopted to reduce the vapour concentration in the air, like catalytic converters, vapour adsorbants and to reduce the benzene concentration in the ambient air.

Further long term perspective studies of petrol filling workers will help in getting a comprehensive picture of long term effects.

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