Original Article

Effect of Automobile Exhaust on Pulmonary Function Tests in Petrol Pump Workers

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Abstract

Background: Inhalation of automobile exhaust and fuel vapours predisposes petrol pump workers to respiratory disorders leading to pulmonary function impairment. This study was undertaken to evaluate the effect of automobile exhaust and fuel vapours on the pulmonary functions of petrol pump workers in a city of Punjab, India. **Material and Methods**: This study was an observational case control study comprising of 200 subjects. The pulmonary function tests were analysed using Medspiror™ among one hundred adult petrol pump workers who were working since one year at the filling station and were being exposed to the automobile exhaust and fuel vapours. Age matched controls were taken from the healthy paramedical staff working in the medical college. The data was statistically analysed by student t-test and Mann-Whitney U test. The mean and standard deviation were calculated and reported for the quantitative variables. P value of less than 0.05 was considered significant. **Results**: The baseline variables did not differ in the cases and controls. The FVC, FEV1, FEV3, PEFR, FEF25%, FEF50%, FEF75%, FEF25-75% and MVV were found to be significantly decreased in cases as compared to controls (p value <0.001 in all of them). There was statistically insignificant difference in the FEV1/FVC% and FEV3/FVC% between the two groups. **Conclusion:** The exposure to automobile exhaust in petrol pump workers leads to the deterioration of the pulmonary functions. Strategies should be planned at various levels to protect the exposed persons from their deleterious effects.

Keywords: Automobile exhaust; Fuel vapours; Pulmonary function tests; Petrol pump workers

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INTRODUCTION

Air pollution is increasing day by day and this increment is significantly contributed by vehicles. The inhalation of automobile exhaust and fuel vapours leads to significant pulmonary function impairment. Petrol is a complex combination of hydrocarbons and about 95% of components in petrol fumes are aliphatic and acyclic compounds.[1] Benzene, one of the active ingredients has been shown to be responsible for the physiological dysfunction in respiratory, haematological and thyroid function in petrol pump workers. The petrol and diesel fumes do affect the functioning of

different systems of the body directly.[2] The high concentration of solvents and pollutants have been found to produce marked pulmonary inflammatory response leading to decreased forced vital capacity (FVC), forced expiratory volume in the first second (FEV1), inspiratory and expiratory flow rates. In the developed countries the staff is not employed at the petrol pumps but in India the petrol pump workers are hired to fuel the vehicles. This practice predisposes petrol pump workers to respiratory system morbidity by the inhaled automobile exhaust and vapours of the fuel. The effects of chronic exposure of toxic fumes are relatively less studied among petrol pump workers. This study was undertaken to evaluate the effect of automobile exhaust and fuel vapours on the pulmonary functions of petrol pump workers in a city of Punjab, India.

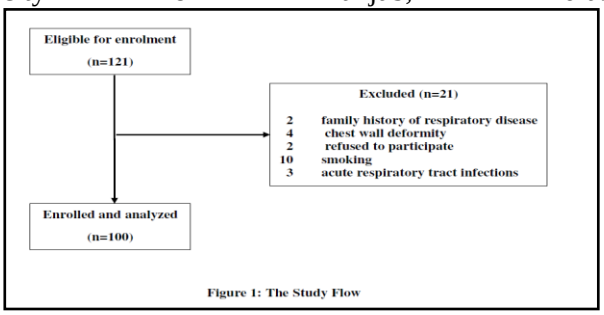

Figure 1: The Study Flow

MATERIAL AND METHODS

The present study was an observational case control study conducted in the Physiology department of a government medical college in northern India. This study comprised of two hundred subjects of which one hundred cases were enrolled for the study and age matched controls were taken from the medical college and hospital staff. Written informed consent was taken from enrolled subjects. They were provided with written and verbal information involved in the research. Confidentiality of the subjects was maintained. Adult petrol pump workers working continuously from one year at the filling station and exposed to the automobile exhaust were eligible for enrolment. The petrol pump workers who were suffering from any kind of chronic respiratory disease, chest wall or spinal deformities, and acute respiratory tract infections in last two weeks were excluded from the study. The subjects who had family history of respiratory diseases, indulged in smoking were excluded from the study. The petrol pump workers (e.g. clerks) who sit inside the closed cabins and are directly not exposed to the exhaust were also not included. Similar number of age matched controls was taken from the healthy paramedical staff working in the medical college and hospital after ruling out any of the exclusion criteria. The pulmonary function tests were performed in the research laboratory of physiology department of a government medical college in northern India. Pulmonary functions were measured using Medspiror™ (Recorders and Medicare System, Chandigarh, India). Detailed clinical examination was done to rule out any existing pulmonary disease. Procedure was explained and demonstrated prior to the test to each subject till full familiarity was achieved. The subject was asked to take deep breath, place lips tightly on the mouth piece and blow into the instrument and values were recorded by the instrument. Such three readings were taken and best of these three readings was considered for study. Height, weight, age and temperature were also noted prior to test. The lung function parameters included were FVC (forced vital capacity), FEV1 (forced expiratory volume in first second of FVC), FEV3 (forced expiratory volume in third second of FVC), PEFR (peak expiratory flow rate in liters/sec), FEF25% (forced expiratory flow rate during 25% of expiration), FEF50% (forced expiratory flow rate during 50% of expiration), FEF75% (forced expiratory flow rate during 75% of expiration), FEF 25-75% (forced expiratory flow rate during 25 % to 75 % of expiration) and MVV (maximum voluntary ventilation). The data were filled in a predesigned structured proforma.

Statistical analysis

Data was collected by the investigators, compiled and analyzed using Microsoft Excel™ and appropriate statistical tests. Continuous data with normal distribution was analyzed by student t-test and non-normally distributed data by Mann-Whitney U test. The mean and standard deviation were calculated and reported for the quantitative variables. P value of less than 0.05 was considered significant.

RESULTS

A total of 121 petrol pump workers were enrolled during the study period out of them 19 were excluded because of various reasons and two for not giving consent. Remaining 100 subjects were taken as cases. Age matched healthy paramedical workers form the medical college and hospital college were taken as control. The details of the recruitment of the subjects are shown in Figure 1.

The mean age of the subjects in years was 28.36 ± 2.85 in study group and 29.02 ± 2.61 in control group. The mean height, weight, and baseline variables of cases and controls are shown in the Table1. The comparison of various parameters of pulmonary function tests in the cases and controls are shown in Table 2.

Table 1: Baseline variables

Variable		**Cases (n=100)**	**Controls (n=100)**
Age in years		28.36 ± 2.85	29.02 ± 2.61
Height in cm		170.36± 17.27	169.56 ± 16.95
Weight in kg		64.99 ± 5.86	65.62 ± 5.73
Background	Rural	28(28%)	27(27)%
	Urban	72(72%)	73(73)%
Religion	Hindu	15(15%)	18(18%)
	Sikh	85(85%)	15(15%)

Values indicate mean ± standard deviation and values in parenthesis indicate percentages

Table 2: Pulmonary function tests in petrol pump workers

Parameter	Cases (N=100)	Controls (N=100)	Significance
FVC in L	2.88 ± 0.27	3.77 ± 0.33	HS
FEV1 in L	2.67 ± 0.23	3.19 ± 0.30	HS
FEV3 in L	2.89 ± 0.27	3.56 ± 0.33	HS
PEFR in L/sec	5.98 ± 0.58	7.89 ± 0.74	HS
FEF25-75% in L/sec	3.66 ± 0.35	4.86 ± 0.46	HS
FEF 25% in L/sec	4.67 ± 0.39	6.59 ± 0.64	HS
FEF 50% in L/sec	3.36 ± 0.32	5.09 ± 0.49	HS
FEF 75% in L/sec	1.86 ± 0.17	3.09 ± 0.28	HS
FEV 1/FVC%	89.89 ± 0.87	90.19 ± 0.90	NS
FEV3 /FVC%	98.88 ± 0.96	99.89 ± 0.98	NS
MVV in L/min	100.38 ± 9.98	127.85± 12.52	HS

Values represent mean ± standard deviation.
HS(Highly significant)=p <0.001, NS(Not significant)=p >0.05

The FVC, FEV1, FEV3, PEFR, FEF25%, FEF50%, FEF75%, FEF25-75% and MVV were found to be significantly decreased in cases as compared to controls (p value <0.001 in all prameters). There was statistically insignificant difference in the FEV1/FVC% and FEV3/FVC% between the two groups.

DISCUSSION

The present study was designed to observe the effect of automobile exhaust in subjects exposed to them as compared to the age matched control group. This study demonstrated that prolonged exposure to automobile exhaust markedly decreased the pulmonary functions in the exposed group relative to their matched controls. Various authors also reported decrease in parameters of pulmonary functions in petrol pump workers.[2-6] In the present study there was restrictive as well as dynamic type of respiratory dysfunction. The reduction in the dynamic parameters of the lung functions evident by decreases FEV1 was also reported by Singhal M et al,[3] Meo SA et al[7] and Chawla A et al,[8] however, Chaugule SS et al[9] did not find any reduction in dynamic parameters. The restrictive type of dysfunction shown by decreased FVC has also been reported in previous studies.[8,10] The petrol and diesel on combustion produces particulate matter smaller than the respiratory particulate matter, and a mixture of gases like sulphur dioxide, carbon dioxide, carbon monoxide, and nitrogen oxide. It has been proven in animal studies that together these constituents of automobile exhaust do much more damage than acting alone.[11] The particulate matter by virtue of its ability to induce various cytokines like TNF-β, interferon- β, IL-6 and transforming growth factor-β, and recruitment of immature neutrophils affects the pulmonary tissues.[12] The petrol pump workers are continuously exposed to these pollutants because the location of their pumps is usually on busy roads and their duty hours are long. The practice of not using any protective device during the duty further compounds this problem. So this group of workers is likely to have grave ill effects on their health. The limitation of the present study was that the petrol pump workers were not divided into subgroups on the basis of their total duration of exposure to the automobile exhausts. We did not sort petrol pumps located at busy roads having high traffic from others located in relatively less congested areas. The pulmonary function tests were done only at a single point of time. Further studies are required with adequate sample size along with stratification of various degrees of exposure to the automobile exhaust. The pulmonary function tests should be carried out among petrol pump workers repetedlly so as to ascertain the reversibility of the changes acquired

during the exposure phase. Stratification can also be done on the basis of inflow of a particular quantum of traffic. Multi-centric studies can also be planned to get more generalised results.

CONCLUSION

The exposure to automobile exhaust in petrol pump workers leads to the deterioration of the pulmonary functions. Such air pollutants do adversely affect the respiratory system and strategies should be planned at the individual, policy makers, community, and employer's level to protect the exposed persons from their deleterious effects.

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