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RESEARCH ARTICLE

Pulmonary function in petrol pump workers in Anand district

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ABSTRACT

Background: Petrol pump workers are exposed to the petrol fumes exhibit a number of effects on the respiratory functions. Health effects of occupational exposure to gasoline and air pollution from vehicular sources are relatively unexplored among petrol-filling workers. It was necessary to carry out detail study on the lung function abnormalities among petrol pump workers as such a study which is lacking in this geographical region. **Aims and Objectives:** To assess and compare the pulmonary functions (forced expiratory volume in the first second [FEV1], FEV6, FEV1/FEV6, and peak expiratory flow rate [PEFR]) of normal healthy individuals with petrol pump workers. **Materials and Methods:** This is a cross-sectional study design in which 100 participants (50 petrol pump workers and 50 normal individuals) with minimum exposure of 3 years in different areas of Anand city were recruited. Every consecutive participant was recruited in the study based on satisfying inclusion and exclusion criteria, and written informed consent was taken for performed for the study. Pulmonary function tests were assessed by (1) measurement of FEV1, FEV6, and FEV1/FEV6 and (2) PEFR. All the values were taken and put for statistical analysis. **Results:** The results of these parameters (FEV1, FEV6, FEV1/FEV6, and PEFR) were statistically significant in study group than the control group ($P < 0.001$). **Conclusion:** The present study demonstrates that exposure to petrol vapors and fumes, hydrocarbons markedly decreased the pulmonary functions FEV1, FEV6, FEV1/FEV6, and PEFR relative to their age-matched controls.

KEY WORDS: Petrol Pump Workers; Pulmonary Functions; Peak Expiratory Flow Rate; Ventilatory Impairment

INTRODUCTION

Air pollution from vehicles emits chemicals such as benzene; lid and carbon monoxide can cause adverse health effects by interacting with molecules, which are crucial for the biochemical or physiological processes of the human body.[1]

Fast urbanization trends have resulted in a tremendous rise in the number of transportation vehicles, thereby resulting in the increased need of petrol. This increase in demand of petrol has led to a steady rise in the number of petrol pumps in the country. The rising number of vehicles has sharply increased the level of air pollution in various cities of India. A health survey done by the Centre for Science and Environment, New Delhi, has shown that 141 (80%) cities in India exceed the PM 10 (pollutants that emit particulate matter of <10 μm in size) standard, 90 cities have a critical level of PM 10, and 26 cities have the most critical level, exceeding thrice the standards.[2] Petrol pump workers (filling attendants) are continuously exposed to the organic and inorganic substances present in the petrol.[3] Petrol pump workers who are exposed to the petrol fumes exhibit a number of clinical signs and symptoms which may be due to benzene toxicity. A long-term exposure of it leads to poisonous effects on the respiratory functions.[4]

The failure to use personal protective equipment poses a great risk for the petrol-filling workers. In India, petrol-filling workers are employed rather than self-serviced,

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increasing the opportunity for exposure. To meet the present day requirement, there are many petrol-filling stations getting established and there is an increased recruitment of workers. Health effects of occupational exposure to gasoline and air pollution from vehicular sources are relatively unexplored among petrol-filling workers.[3]

Currently, air pollution is one of the crucial issues with growing concern. Automobile exhaust consists of mixture of soot, gasses including oxides of sulfur and of nitrogen, carbon monoxide, and liquid aerosols and particles. It leads to various lung disorders, carcinogenesis, and changes in hematological parameters.[5] The high concentration of solvents and pollutants has 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.[6] Pulmonary function test (PFT) is a valuable tool for evaluating the respiratory system, representing an important adjunct to the various lung imaging studies. It also measures the function of lung capacity and chest wall mechanics to determine whether or not the patient has a lung problem. Spirometry gives an important clue in terms of respiratory chronic airway disorders and can predict early damage to the pulmonary system. Occupational exposures to petrol/diesel vapors affect the different systems of the body.[7]

On account of the lack of availability of sufficient international research on the occupational aspects of petrol pump workers, the present study focuses on the occupational health-related issues in this population.[2] It was necessary to carry out detail study on the lung function abnormalities among petrol pump workers as such a study which is lacking in this geographical region. The aim of this study to assess the extent of altered pulmonary functions in petrol pump workers who are exposed to petrol and diesel fumes. Moreover, the effect of the exposure to the petrol/diesel fumes was studied, and these changes in the lung function tests were compared with age-matched healthy controls. Chaugule et al. has used peak expiratory flow rate (PEFR) as a outcome measure in their study evaluation of respiratory morbidity in petrol pump workers in Mumbai and found that it is a reliable tool.[8]

Hence, the present study attempts to evaluate the pulmonary changes in form of FEV_1, FEV_6 and its ratio (FEV_1/FEV_6), and PEFR of petrol-filling workers in Anand city.

The objectives of the study were to assess and compare the pulmonary function of normal healthy individuals with petrol pump workers.

MATERIALS AND METHODS

This is a cross-sectional study in which convenient sampling method was used. The study conducted at the various petrol pumps of Anand city, Gujarat, in December 2012-February 2013, in that 100 participants were taken.

Participant recruitment procedure: Every consecutive individual working at petrol pump with minimum exposure of 3 years in different areas of Anand city was recruited as exposed group, whereas in the control group, the normal healthy individuals were recruited who were not regularly exposed to petrol pump.

The inclusion criteria were age group above 18 years with minimum exposure 3 years to petrol pump while the recent history of any abdominal or chest surgery, history of cardiorespiratory illness, present and past history of smoking, and who were not cooperative were excluded from the study.

Proposal was approved by the Human Research Ethical Committee of H M Patel Center for Medical Care and Education, Karamsad. In the present study, two groups of population were recruited. One group consisted of petrol pump workers and other group was of normal individuals. Every consecutive individual was recruited in the study based on satisfying inclusion and exclusion criteria. Written informed consent was taken after explaining the details of various non-invasive tests to be performed for the study. A person has been interviewed and assessed, and detail examination was done using assessment pro forma.

Procedure

Participants were made aware of purpose of the study before participation in the study. The following PFTs were performed:

1. Measurement of FEV_1, FEV_6, and FEV_1/FEV_6
2. PEFR.

The participants were made to sit in upright position in a plastic chair with arm rest and feet in dependent position. Participants were introduced to the instruments, and procedures were explained. Demonstration, handling, and use of instruments were explained. Before test, trial was given for the instruments.

1. Measurement of FEV_1, FEV_6, and FEV_1/FEV_6
   PFT was performed using following Ferraris piKo 6 m. The piKo-6 allows simple and reliable screening for respiratory assessment.[9] First, the instrument was taken into hand. Participants were asked to press the button and switch on the machine. Then again, that button was pressed and beep was heard when the second beep was heard, participants were asked to tightly seal mouthpiece by the mouth and take deep breath in and expired through mouth until the third beep was heard. After this, values of FEV_1 and FEV_6 were displayed on the machine and they were recorded.[10]
2. PEFR
   Mini-Wright's peak flow meter was used to measure PEFR. Participants were asked to take deep breath in as

much as possible. Then, nose was tightly clamped by non-dominant hand, with the instrument held in the dominant hand and tightly sealed by mouth; the participants were instructed to expire fully in the instrument as fast as possible the same procedure was repeated thrice, and best of three recorded values was considered in the study. The unit of recorded value for peak flow rate is in liters/minute.

RESULTS

Statistical analysis has been done using the SPSS. Analysis started with descriptive statistics, *t*-test to compare mean values of variables between two groups. The statistical significance level for each comparison was considered at 5% level ($P < 0.05$).

In the present study, a total of 100 participants were included 50 in each group. Out of this study group, 50 participants were included as petrol pump workers and 50 were normal healthy individuals as control group. The mean age of study group was 30.62 years and for control group was 29.90 years (Table 1).

Table 2 shows parameters (FEV_1, FEV_6, FEV_1/FEV_6, and PEFR) and its comparison between study group (petrol pump workers) and control group (normal healthy individuals). The results of these parameters were statistically significant in study group than the control group.

FEV_1 and FEV_6 showed statistically significant difference in value as shown in Figure 1 and Table 2 ($P < 0.001$). FEV_1/FEV_6 showed statistically significant difference in value as shown in Table 2 ($P < 0.001$) and Figure 2 as well as PEFR showed statistically significant difference in value as shown in Figure 3 and Table 2 ($P < 0.001$).

Table 1: Age group between the study group and control group

Group	Mean±SD
Study group	30.62±9.714
Control group	29.90±7.212

SD: Standard deviation

Table 2: Comparisons between the study group and control group by independent *t*-test FEV_1, FEV_6, FEV_1/FEV_6, and PEFR by *t*-test ($P<0.005$)

Variable	Mean±SD		*P* valve
	Study group	Control group	
FEV_1	1.3782±0.7769	2.0090±0.5653	<0.001
FEV_6	1.4646±0.6421	2.5880±0.7432	<0.001
FEV_1/FEV_6	0.9526±0.1473	0.7752±0.1463	<0.001
PEFR	246.60±93.167	403.60±69.363	<0.001

SD: Standard deviation, FEV_1: Forced expiratory volume in the first second, PEFR: Peak expiratory flow rate

DISCUSSION

In this study, FEV_1, FEV_6, FEV_1/FEV_6, and PEFR show statistically significant alteration in all these parameters. Along with that, those were exposed to petrol vapors more than 3 years showed a significant reduction in FEV_1, FEV_6, and PEFR relative to their matched controls. These findings are in agreement with the observations of Singhal et al. and Kesavachandrani et al. demonstrated that workers exposed to petrol, diesel, and automative exhaust had increased airway

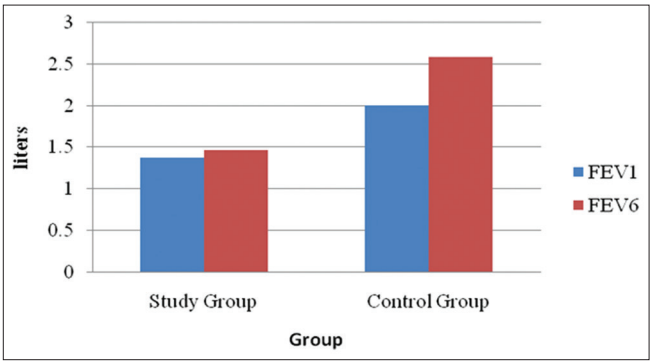

Figure 1: Comparisons of mean between the study group and control group of forced expiratory volume in the first second (FEV1)/FEV6

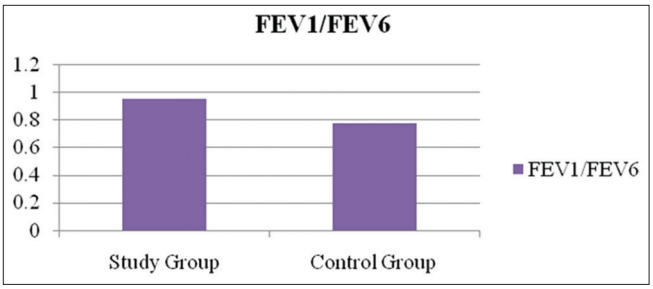

Figure 2: Comparisons of mean between the study group and control group of forced expiratory volume in the first second (FEV_1)/FEV_6

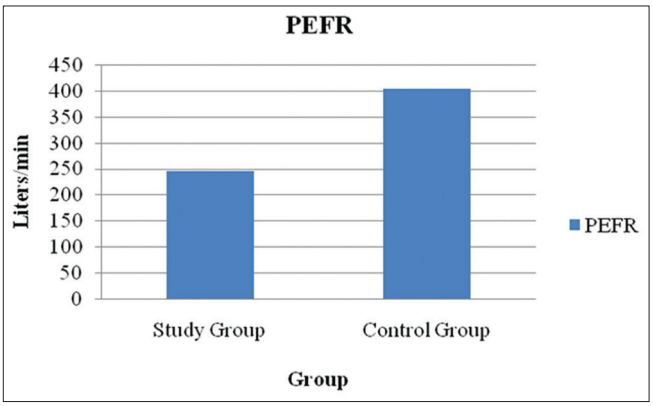

Figure 3: Comparisons of mean between the study group and control group of peak expiratory flow rate

resistance, increasing closing volume and reversible reduction of FVC.[1,4,11,12] The present study demonstrates that exposure to petrol vapors markedly decreased the pulmonary function which indicates the exposure to solvents and air pollutants lead to the restrictive type of lung diseases. The study was designed to quantify resulting abnormalities in lung function in participants exposed to petrol vapors as compared to their matched control. Inhalation of dust is an important cause of interstitial lung disease in India.

Petrol is a mixture of volatile hydrocarbons while diesel is a distillate of petroleum which contains paraffin, alkenes, and aromatics. About 95% of the components in petrol vapor are aliphatic and alicyclic compounds and <2% aromatics. The benzene content of petrol has typically been in range 1-5% but may have risen following the removal of lead additives. Both petrol and diesel undergo combustion in automobile engines and give rise to combustion-derived nanoparticles. These particles are highly respirable and have a large surface area which can carry a larger fraction of toxic, hydrocarbons, and metals on their surface. They can remain airborne for longer periods and can be deposited in greater numbers and deeper into the lungs than the large-sized particles. Petrol evaporates more readily in hot than cold countries.[12] In India, petrol pump attendants are the norm rather than self-service, increasing the opportunity for exposure. Petrol pump attendants do not wear personal protective equipment, and personal hygiene is variable in the workplace. Average daily exposure of petrol pump workers to these chemicals generally exceeds about 10 h/day.[12] The probable cause for the decrease in PFT is the accumulation in peribronchial lymphoid and connective tissues along with varying degrees of wall thickening and remodeling in terminal and respiratory bronchioles arising from each pathway. Bronchiolar walls with marked thickening contained moderate to heavy amounts of carbon and mineral dust, and wall thickening is associated with increase in collagen and interstitial inflammatory cells including dust-laden macrophages.[7] As most of the petrol pumps are on heavy traffic roads, beside petrol and diesel exhaust, these workers are also exposed to heavy air pollution. The petrol and diesel exhaust particle is very small in size about 0.2 nm. Owing to their small size, these particles have large surface area, so they can carry large amount of toxic compounds, such as hydrocarbons and metals on their surface. These particles can remain airborne for longer period and can be deposited deeper in smaller airways of lung.[12,13] The data suggested by Uzma et al. that benzene and air pollutants could account for substantial part of respiratory, hematological, and thyroid dysfunctioning. To prevent these among petrol-filling workers, they suggest that medical observation, including pre-employment and periodic medical checkups, should be performed which include PFTs. Control strategies should adopt to reduce the benzene concentration in the ambient air and evaporation control.[14] The particles generated from petrol exhaust are extremely small and are present in the nuclei or accumulation modes, with diameters of 0.02 nm and 0.2 nm, respectively, and as the surface area is large, they can carry much larger fraction of toxic compounds, such as hydrocarbons and metals on their surfaces. They can remain airborne for longer period and deposit in greater numbers and deeper into the smaller airways and the lungs than large-sized particles. Zuskin et al. and Lee et al. found that the exposure to solvents at workplace had significantly more respiratory symptoms than control group.[15,16]

From the present study, it was suggested that exposure to fuel smell leads to restrictive type of lung disease in petrol pump worker along with that might increase in years of exposure to petrol pump leads more marked changes in pulmonary functioning.[5] It is also suggested that pre-employment and periodical monitoring of pulmonary functions of petrol pump workers. So that, early detection and subsequent treatment of pulmonary diseases will be possible. The use of protective mask at workplace can also decrease morbidity in them. Lack of awareness and protective measures during duty hours by these workers may have led to lung function abnormality and hematological changes among petrol pump workers.[5] The present study has included smokers which has been limitation of study.

CONCLUSION

The present study concluded and demonstrated that exposure to petrol vapors and fumes, hydrocarbons markedly decreased the pulmonary functions FEV_1, FEV_6, FEV_1/FEV_6, and PEFR relative to their age-matched controls.

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