Forced Vital Capacity (FVC), Forced Expiratory Volume in 1st Second (FEV_1) and Forced Expiratory Ratio (FEV_1/FVC) In Petrol Pump Workers at Jhalawar and Jhalarapatan (Rajasthan)

Himanshu Sharma[1,*], Shashikant Agarwal[2]

[1]Demonstrator, [2]Associate Professor, Department of Physiology, Jhalawar Medical College, Jhalawar (Raj.)

***Corresponding Author**:
E-mail: dr.himanshusharma@ymail.com

ABSTRACT

Background and Objective: *In India, petrol filling workers are employed rather than self employed, increasing the potential danger for exposure to harmful vapours during fuel fillings. Long-term exposure to petrol vapour has been blamed to affect the different physiological systems in the body adversely. The present study is carried out to assess the dynamic ventilatory lung function in petrol pump workers so as to comment on the long-term effects of work environment on lung function.*

Material and Method: *The present study was conducted on 30 males of 20-40 years age, who were working in various petrol filling stations as petrol filling attendants, working 8 hours per day for more than 2 years in Jhalawar and Jhalrapatan city. For comparison 30, age and BSA matched apparently healthy control group, who were not exposed to petroleum vapours, from the preclinical and para clinical departments of Jhalawar Medical College, Jhalawar were studied simultaneously. Spirometry was performed with an electronic spirometer Helios-401. The parameters studied were Forced vital capacity (FVC), Forced expiratory volume in 1st second (FEV_1) and Forced expiratory ratio (FEV_1/FVC)*

Results and Interpretation: *The two groups did not differ significantly on physical parameters. Both forced vital capacity (FVC) and forced expiratory volume at first second (FEV1) were decreased significantly while their ratio did not differ much between the two groups.*

Conclusion: *Our findings point towards adverse effects of petroleum vapours on lung function, mainly on lower airways with restrictive pattern of disease.*

Keywords and Abbreviations: *Forced vital capacity(FVC), Forced expiratory volume in 1st second (FEV_1) and Forced expiratory ratio (FEV_1/FVC)*

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INTRODUCTION

Lung function tests have been of increasing interest in the use for qualitative and quantitative evaluation of pulmonary function in patients with abnormalities of cardio respiratory system[1]. Numerous epidemiological studies have documented decrements in pulmonary function and various other health problems associated with long-term air pollution exposure[2,3,4,5]. It has been known for quite some time that air pollution from diesel exhaust is a major respiratory hazard for workers exposed to it in enclosed space[6].

Petroleum refining products are constituted by cycloalkanes, straight and branched chain alkenes which are continued source of pollution in various occupational settings[7]. With the increasing use of petroleum and petroleum products, there is greater opportunity for human ingestion and addiction of these toxic substances[8]. Benzene and toluene are major monocyclic hydrocarbons in petrol with nitropyrene in diesel exhaust emission[7]. Benzene is a highly volatile and the most usual route of exposure is through inhalation of vapour[9]. A small percentage of benzene can be detected in the expired air after being absorbed through the lungs[10].

Diesel exhaust, in addition to generating pollutants like hydrocarbons, oxides of nitrogen and carbon is a major contributor to particulate matter in most places of the world. Symptoms like chronic cough, wheezing and breathlessness have been reported on exposure to these pollutants[11].

In India, petrol filling workers are employed rather than self employed increasing the opportunity for exposure. Long-term exposure to petrol vapour has shown to affect the different physiological systems in the body[12]. Petrol pump workers (filling attendants) are continuously exposed to the organic and inorganic substances present in the petrol. The average daily exposure to these chemicals in India generally exceeds about 10 h/day. Some of them are working for more than ten years now. Studies on health condition in petrol pump workers have concentrated more on clinical symptoms with limited reports on lung function. The present study is carried out to assess the dynamic ventilatory lung function in

petrol pump workers so as to comment on the long-term effects of work environment on lung function.

MATERIALS AND METHODS

The present study was conducted on 30 males of 20-40 years age, who were working in various petrol filling stations as petrol filling attendants, 8 hours per day for more than 2 years in Jhalawar and Jhalrapatan city. For comparison 30, age and BSA matched apparently healthy control group, who were not exposed to petroleum vapor, from the preclinical and para clinical departments of Jhalawar Medical College, Jhalawar will also be studied. The exposed subjects were also be matched with control subjects in terms of socioeconomic status.

After selecting of the subjects, the purpose of the study was explained to each subject with a cordial attitude giving emphasis on the benefits they would obtain from this study. They were encouraged for voluntary participation. They were also be allowed to withdraw themselves when they need to do so. Before examination an informed written consent was taken from each subject. A detailed personal, medical, family, socio economic, occupational and drug history was recorded in a preformed performa. Thorough physical examinations were done. Height and weight of the subjects were measured for calculation of BSA.

Exclusion Criteria: Subjects were gross abnormalities of the vertebral column or thoracic cage, known history of acute or chronic respiratory infections, allergic disorders, neuromuscular disease, malignancy, cardiopulmonary disease, or a history of major abdominal or chest surgery were be excluded from the study. In addition, subjects with current or previous drug or tobacco (smoked or chewed) addictions were excluded.

Spirometry: Spirometry was performed with an electronic spirometer Helios-401. All pulmonary function tests were carried out at a fixed time of the day (10 am–2pm hours) to minimize diurnal variation. The apparatus was operated within the ambient temperature range of 20–25° C. The precise technique in executing various lung function tests for the present study was based on the operating manual of the instrument with reference to the official statement of the American Thoracic Society of Standardization of Spirometry (1987). Subjects were trained about the entire maneuver and encouraged to practice this maneuver before doing the pulmonary function tests. The tests was performed (with each subject in the sitting position) by using a nose clip. The tests were repeated three times after adequate rest. The subject was told to take 2 or 3 normal tidal breaths and then to inspire as deeply as possible. After a complete inhalation, the subject was instructed to place the mouthpiece in his mouth and then to blast out the air as quickly & completely as possible, followed by a deep & forceful inspiration with his maximum efforts. The parameters studied were Forced vital capacity (FVC), Forced expiratory volume in 1st second (FEV_1) and Forced expiratory ratio (FEV_1/FVC),

STATISTICAL ANALYSIS: Statistical analysis was conducted using a Mean, Standard Deviation and Student's t test for independent groups (two tailed). The level of significance was taken as p value < 0.05.

RESULTS AND OBSERVATIONS

Table No. I shows the physical parameters of the control subjects and petrol pump workers. The two groups did not differ significantly on these parameters. The values of lung volumes and capacities are shown in Table II. Both forced vital capacity (FVC) and forced expiratory volume at first second (FEV1) were decreased significantly while their ratio did not differ much between the two groups.

The ambient air quality data as reported by central pollution control Board[4] in the vicinity of petrol pump showed the levels of suspended particulate matter (SPM) levels 301 ± 71 µg/m3 (upper limit 200), respirable suspended particulate matter (RSPM) levels 135 ± 46 µg/m3 (upper limit 100), both being above the permissible upper limits. While SO_2 9 ± 2 (upper limit 80) and NO_2 36 ± 5 (upper limit 80) within the normal standards.

Table No. I: Comparison of Physical Parameters of Control Subjects and Petrol Pump Workers

Groups	Age in Years (Mean ± SD)	Weight in kg (Mean ± SD)	Height in cm (Mean ± SD)	Body Surface Area m^2 (Mean ± SD)
Control (30)	31.77 ± 4.20	65.42 ±10.23	171.11 ± 5.12	1.76 ± 0.12
Subjects (30)	31.82 ± 4.35	64.97 ± 4.35	169.14 ± 5.34	1.74 ± 0.17

Table II: Lung volumes and capacities in the two groups

Parameters	Subjects (30)	Control (30)	p Value
FVC (Lit.)	2.52 ± 0.68	3.12 ± 0.30	0.001*
FEV_1 (Lit.)	2.17 ± 0.71	2.85 ± 0.23	0.02*
FEV_1/FVC (%)	86.11 ± 12.32	91.34 ± 8.34	0.145

DISCUSSION

In the present study most of the parameters were decreased significantly in petrol pump workers as compared to controls. The mean FVC value in petrol pump workers was lower than that of control subjects and the difference in the mean value was statistically significant (p = 0.001). These findings are in agreement with the observations of Singhal *et al.*[13], Meo *et al.*[14], Kesavachandrani *et al.*[15] and Ayres *et al.*[16].Ayres *et al.*[16] demonstrated that workers exposed to diesel and automative exhaust had increased airway resistance, increasing closing volume and reversible reduction of FVC.

In the present study, FEV_1 was lower in petrol pump workers as compared to control subjects and the difference in the mean FEV_1 between the two groups was statistically significant (p = 0.001). This observation is in agreement with the observations of Kesavachandrani *et al.*[15] and Skyberg *et al.*[17], who reported decline in FEV1 with years of work exposure.

Although FEVl and FVC both decreased in petrol pump workers their ratio did not differ between the two groups. This finding indicates the restrictive nature of pulmonary involvement in the study group[18]. While short term exposure to diesel exhaust in healthy human volunteers have demonstrated marked systemic and pulmonary inflammatory response but lung function measurements did not show a significant change[19]. These volunteers were exposed to diluted diesel exhaust under controlled conditions for one hour with intermittent exercise. Such low exposure could be one of the reasons for normal lung function parameters in their study. Since our subjects are exposed to these exhausts for longer period of time (more than two year, for at least 8 hrs/day), they have more chances of chronic inflammatory involvement of lungs as indicated by the results of our study.

This study demonstrates that certain physiological dysfunctioning effects are constantly observed in occupationally exposed petrol pump workers. This study indicates that exposure to petrol fuel vapours, diesel exhausts and airborne particulate matter at petrol pumps leads to restrictive type of lung impairment in petrol pump workers as compared to control.

Moreover, the ambient air quality monitored in the vicinity of petrol pumps by central pollution control Board[20] also showed increase in the levels of SPM (301 ± 71 µg/ m3 and RSPM (135 ± 46 µg/m3). These values were 35% to 50% greater as compared to maximal permissible levels[20]. Another important pollutant which may have contributed to our findings is lead. Inhalation of lead from leaded petrol emissions is an important source of lead exposure. Few studies have related lead to structural damage or impaired functions of the lungs[21,22].

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.

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[23]. Histopathological studies have provided evidence that the small airways are the site of damage in people living in areas of high air pollution[26].

CONCLUSION AND RECOMMENDATION

Our findings point towards adverse effects of petroleum vapours on lung function, mainly on lower airways with restrictive pattern of disease. 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 adsorbents and to reduce the benzene concentration in the ambient air. Early recognition and removal of sensitive workers from working place before chronic impairment develops will help. Development of appropriate equipment for

monitoring and testing for environmental pollutants in the community and in workers would be beneficial.

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