

ORIGINAL ARTICLE

Study of Peak Expiratory Flow Rate as the Assessment of Lung Function in Occupationally Exposed Petrol Pump Workers of Western Maharashtra

Patil Smita V^{1*}, Sumangala Patil¹, Sampada Kanitkar²

¹Department of Physiology, BLDE University's Shri B.M.Patil Medical College, Vijayapur-562135(Karnataka) India, ²Department of Oral Pathology, Bharati Vidyapeeth University Dental College and Hospital, Sangli-416416 (Maharashtra) India,

Abstract:

Background: Fast urbanization trends, rapid industrial growth, globalization, and poor environmental conditions at work places have created a lot of health-related issues. *Aim and Objectives:* The aim of this study is to investigate Peak Expiratory Flow Rate (PEFR) as the assessment of lung function in occupationally exposed petrol pump workers and also check whether PEFR increases or decreases with duration of exposure. *Material and Methods:* The study was conducted on 60 male petrol pump workers between age group of 20-40 years who were working as petrol filling attendants for more than one year from western Maharashtra. 50 normal healthy males with same socioeconomic status were chosen as controls to find out the effect of occupational exposure to petroleum product on PEFR as the assessment of lung function tests. Petrol pump workers were divided into three groups based on their duration of exposure i.e. 1-5 yrs, 6- 10 yrs and more than 11 years. PEFR of petrol pump workers and control was measured by using a Mini Wright peak flow meter which is a portable device for measuring ventilator functions. Comparisons was done using unpaired t-test for 2 groups comparisons and one way ANOVA for multiple groups of exposures. *Results:* The PEFR was significantly lower decrease ($p=0.001$) around petrol pump workers (389.17) as compared to control (534.2). As year of exposure increased mean value of PEFR was significantly decreased from 452.17, 378.00 and 283.64 respectively in petrol pump workers. *Conclusion:* The results suggested that respiratory functions i.e. PEFR of occupationally exposed petrol

pump workers are significantly reduced as compared to controls, also PEFR is significantly reduced with increase in the duration of exposure.

Keywords: Occupational Exposure, Petrol Pump Workers, Peak Expiratory Flow Rate, Year of Exposure

Introduction:

Millions of workers in a variety of occupational settings have the potential to get exposed to hazardous substances. These substances include organic chemicals, intermediates, by-products or end products [1]. Petrol pump workers are exposed to various petroleum products (petrol, diesel). These petroleum products (petrol, diesel) contain various organic compounds such as benzene, toluene, ethylbenzene and xylene (BTEX compound). Petrol pump workers are coming in contact with these BTEX compounds through inhalation, ingestion and dermal contacts. However, the main route of exposure is the respiratory system. The volatile nature of petrol and diesel increases its concentration in air at petrol filling stations, automobile garages and depots. The people working in these areas are continuously coming in contact with these BTEX compounds due to their occupational exposure [2]. Petrol or diesel is mainly used as a fuel for road vehicles e.g. cars, motorbikes, and small van, and also small appliances like lawnmowers, generators, cement mixers, etc.

Peak Expiratory Flow Rate (PEFR) is a sensitive indicator for predicting the magnitude of airway obstruction [3]. Lung reactions to exposure to dust, gases, and fumes at work places have been studied in different populations. The emission level of pollutants that emit particulate matter less than 10 micrometers in size (PM 10) has been found very high in Western Maharashtra. There is a high prevalence of occupational diseases, such as, silicosis, asbestosis, and pneumoconiosis among workers working in different industrial environments in India [4].

Hence, petrol pump workers in western Maharashtra are likely to get exposed to a high level of air pollution along with petrol and diesel vapours, both of these factors can affect the respiratory health of petrol pump workers. Also there is lack of availability of sufficient research on the occupational aspects of petrol pump workers in Western Maharashtra.

Material and Methods:

After the approval by institutional ethics committee, a cross sectional study was carried out on 60 healthy petrol pump workers of Western Maharashtra (Sangli, Satara and Kolhapur Dist). They were further divided in to three groups depending on their duration of exposure as Group I (1-5 years), II (5-10 years) and Group III (more than 10 years). 50 control subjects were chosen from paramedical staff of same socioeconomic status from Bharati Vidyapeeth Medical and Dental College and Hospital Sangli. Written informed consent was obtained from subjects. With prior appointment, petrol pump workers were interviewed with the help of pretested questionnaire. Workers were evaluated as per standard proforma, which included questionnaire regarding health status. The workers with, past or present history suggestive of cardiovascular or respiratory illness or any other systemic illness, any family history of asthma or allergic diseases,

were excluded from the study. Only nonsmoker workers were enrolled. Subjects performing any type of yoga or pranayama and other physical exercises like resistance training, sports and athletics were excluded from the study. 60 workers were eligible to whom the experimental protocol was explained and written informed consent was obtained from them. PEFR was measured with the help of mini wrights peak flow meter which is a portable device for measuring ventilator functions. The readings were taken in liters per minute. Subjects were advised to wear loose fitting clothing over the chest and abdominal area. Breathing maneuvers was explained in detail and demonstrated for the subjects. Subjects were then made to practice breathing into the mouthpiece of flow meter until they could duplicate the maneuvers successfully on three consecutive attempts.

Statistical Analysis:

Results were presented as Mean \pm SD. Unpaired t-test and ANOVA test was used to find the significance of study parameters by using SPSS 16.0 version. $P < 0.001$ was considered as statistically significant.

Results:

Table 1 indicates that age wise distribution of PEFR in petrol pump workers and in control group. The results showed a significant reduction in the PEFR in petrol pump workers, as compared to the control group as shown in Table 2. Table 3 shows that correlation between years of exposure and PEFR. An observed value of PEFR according to duration of exposure in Table 4 indicates linear decrease in mean values with increasing duration of exposure. Table No 5 shows that between group comparison Using post hoc test. Differences between mean values of PEFR in 1-5 years of exposure group with 6- 10 years exposure group and also with 11-15 years exposed group were a found to be statistically significant.

Table 1 Age Wise Distribution of PEFR in Study and Control Group

	Age	N	Mean	SD
Petrol Pump Workers	20 - 30 years	27	397.87	99.10
	30 - 40 years	33	374.07	92.20
Control Group	20 - 30 years	33	545.75	61.39
	30 - 40 years	17	517.05	58.81

Table 2 Showing Mean and SD of PEFR in Petrol Pump Workers and Control Group

Parameters	Group	N	Mean \pm S.D	t test	P value
PEFR (L/min.)	Petrol pump workers	60	389.17 \pm 96.07	-9.298	0.001
	Control group	50	534.29 \pm 60.89		

Table 3 Correlation between Years of Exposure and PEFR among Petrol Pump Workers

	Mean	SD	N	R value	P value
Exposure	1.81	0.74769	60	- 0.651	0.001*
PEFR	387.16	96.07715	60		

*Pearson correlation test. * Significant*

Table 4 showing Mean and SD of PEFR in Petrol Pump Workers according to the Duration of Exposure

Year of Exposure	N	Mean \pm SD	F	P value
1-5 yrs.	23	452.17 \pm 84.151	19.515	0.001
6-10 yrs.	25	378.00 \pm 66.771		
More than 10 yrs.	12	283.64 \pm 69.609		

Table 5 showing between Group Comparison using Post Hoc Tests

Year of exposure		Mean Difference	P value
1-5 yrs.	6-10 yrs	74.174	0.001
	More than 10 yrs	168.538	0.001
6-10 yrs	More than 10 yrs	94.364	0.001

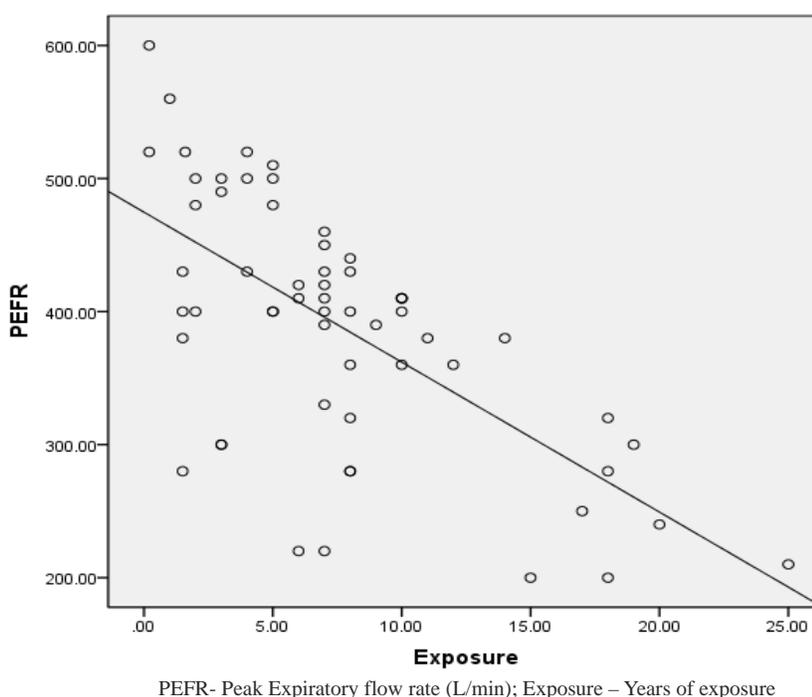


Fig.1: Graph showing Correlation Slope and Decrease in PEFR per Year of Exposure

Discussion:

Rapidly increasing number of vehicles in western Maharashtra is responsible for increase in workload at petrol pumps. It has resulted in increase in the workload of petrol pump workers who are constantly exposed to exhaust fumes and fuel vapors throughout their duty hours. In the present study we have tried to assess dynamic lung function PEFR in petrol pump workers. PEFR was compared between petrol pump workers and

control group. Our study was different from other studies in the aspects that we compared our workers according to the duration of exposure and we found statistically significant change in PEFR with exposure of 5 years, 10 years and more than 10 years.

Effect of Petroleum Fumes on the Peak Expiratory Flow Rates of Petrol Pump Workers and Control Group

From this research finding, there was significant decrease in the mean peak expiratory flow rates of the petrol pump workers as compared to control group (389.17 and 534.29) respectively.

Findings of our study coincide with previous studies of Das *et al* (1991), Tyagi *et al* (2013), Uzma *et al* (2008), Kittad *et al* (2015), Singhal *et al* (2007), Verma *et al* (2001) [5-10]. In these studies, lung function test PEFR was significantly decreased in petrol pump workers and petrol filling workers. Ezejindu *et al* 2014 [11] studied the PEFR of petrol station attendants in Nnewi using a wright peak flow meter, they observed that statistically insignificant decrease in PEFR which could be due to use of small sample size.

Effect of Petroleum Fumes on the Peak Expiratory Flow Rates of the Petrol Pump Workers Based on Years of Exposure to Petroleum Fumes

From the result of this research, there was also a decrease in the mean PEFR of the petrol pump workers according to their years of exposure. The mean value of PEFR decreased with increased years of exposure; this change was found to be statistically significant (P-value 0.001). Our results coincide with Akor-Dewu *et al* (2008), Tyagi *et al* (2013) and Sofoola *et al.* (2005) [12,6,13] who carried a research to assess pulmonary function tests amongst adult male petrol station attendants.

Table 4 and 5 represent the lung function versus duration of exposure of petrol pump workers shows that subjects who had worked for a longer duration at the petrol stations had lower mean values of PEFR. This reduction may be not only due to increasing age of subjects but also because of petrol pumps are located on busy roads, hence these workers in addition to petrol and diesel exhausts it also get exposed to air pollution when vehicles coming to fill up petrol/diesel (Table 1).

The occupational solvents like benzene in petrol and diesel fumes get absorbed into the human body either through the respiratory tract or via epidermal contact. This reduction in PEFR in present study may be due to occupational solvents and air pollutant exerts an irritant effect upon the bronchial epithelium, it also affects the cilia and clara cells of the lungs and release proteolytic enzymes from macrophages [14]. These changes destroy the lung substance and reduce elastic recoil of the lungs. These may cause respiratory symptoms and impaired pulmonary functions resulted in reduced PEFR in petrol pump workers as compared to controls [15]. Accumulation of dust laden macrophages leads to varying degree of wall thickening and remodeling in terminal and respiratory bronchioles [16]. This small airway damage might be the cause of reduced pulmonary functions.

Conclusion:

From the present study it can be concluded that PEFR of petrol pump workers who are continuously exposed to petroleum fumes is significantly reduced as compared to PEFR of age, weight and height matched control groups. Also it was observed that PEFR of petrol pump worker who had exposed for more than 10 years were more affected than those who had worked for less than 5 years. Also it is observed that there is negative correlation between PEFR and years of exposure.

Recommendation:

To minimize the health related issues, periodic health check up along with pulmonary function tests every year should be done every year. Health check-up camps should be arranged frequently. Use of effective personal protection by petrol pumps workers like gloves, apron, long shoes, and appropriate respiratory protective equipments i.e. anti-pollution masks should become mandatory to prevent lung diseases in them.

References

1. Environmental Protection Agency. In brief : The US greenhouse gas inventory. Available: [http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/RAMR5CZKVE/\\$File/ghgbrochure.pdf](http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/RAMR5CZKVE/$File/ghgbrochure.pdf) 2002. [Accessed 18 March 2009].
2. Lewne M, Nise G, Lind ML, Gustavsson P. Exposure to particles and nitrogen dioxide among taxi, bus lorry drivers. *Int Arch Occup Environ Health* 2006 79:220-6.
3. Pal GK, Pravathi Pal. Text book of practical Physiology, 2nd edition, Orient longman private limited, Hyderabad; 2005.157-61.
4. Saiyed HN, Tiwari RR. Occupational health research in India. *Ind Health* 2004. 42:141-8.
5. Das M, Bhargava SK, Kumar A, Khan A, Bharti RS, Pangtey BS, Rao GS, Pandya KP. An investigation of environmental impact on health of workers at retail petrol pumps. *Ann Occup Hyg* 1991; 35:347-52.
6. Rutuja Tyagi, Dvanshi U. Pulmonary function test in petrol pump workers of Ahmedabad. *IJSR* 2013; 2(7): 380-381.
7. Nazia Uzma, Salar BM, Kumar BS, Aziz N, David MA, Reddy VD. Impact of organic solvents and environmental pollutants on the physiological function in petrol filling workers. *Int J Environ Res Public Health* 2008; 5:139-46.
8. Kittad SD *et al.* A study of pulmonary function tests in petrol pump workers. *Int J Rec Tre Sci Techn* 2015; 14(3): 666-9.
9. Singhal M, Khaliq F, Singhal S, Tandon OP. Pulmonary functions in petrol pump workers: a preliminary study. *Indian J Physiol Pharmacol* 2007; 51:244-8.
10. Verma Y, Rana SV. Biological monitoring of exposure to benzene in petrol pumps workers and dry cleaners. *Ind Health* 2001; 39(4):330-33.
11. Ezejindu DN, Ujah Joseph E *et al.* The peak expiratory flow rates of petrol station attendants in nnewi using a wright peak flow meter. *IJPRHS* 2014; 2(3): 231-235.
12. Akor-Dewu, olorunshola KV, Bako IG, Timbuk JA, Suleiman OH. Pulmonary function tests amongst adult male petrol pump workers in Zaria, Kaduna state 2007; 3(1).
13. Sofoola OA, Akintonwa A, Emeka P, Ladipo C, Raji I. Peak expiratory flow rate in petrol depot workers and petrol filling station attendants. *Nig Med Pract* 2005; 47:22-25.
14. Cotes J, Chinn DJ, Miller MR. Lung function – 6th edition. Oxford Blackwell Publishing 2006. Ltd.: 510
15. Sultan Ayoub Meo, Abdul Majeed al Drees *et al.* Effect of duration of exposure to polluted air environment on lung function in subjects exposed to crude oil spill into sea water. *Int J Occup Med Environ Health* 2009; 22(1): 35-41.
16. Madhuri B A, Chandrashekharan M, Ambaresh K *et al.* A study on pulmonary function test in petrol pump workers in Kanchipuram population. *Int J Biol Med Res* 2012; 3(2): 1712-14.

***Author for Correspondence:** Dr. Mrs. Smita V. Patil (Gaikwad), Department of Physiology, Bharati Vidyapeeth Deemed University Dental College and Hospital, Sangli-416416 (Maharashtra) India
Email: mailmesmita.patil@rediffmail.com Cell: 8983020456, 9503628202