



## Dynamic Lung Function Tests in Occupationally Exposed Petrol Pump Workers of Western Maharashtra

PatilSmita V.\*<sup>1</sup>, Gaikwad Pandurang B<sup>2</sup>, Sampada Kanitkar<sup>3</sup>, Suvarna T. Jadhav<sup>4</sup>, Ulhas S. Mali<sup>5</sup>, Sudhir Sase<sup>6</sup>

<sup>1</sup>Assistant Professor, Dept of Physiology, BharatiVidyapeeth University, Dental College & Hospital, Sangli-(Maharashtra), India.

<sup>2</sup>Assistant Professor. Dept. of Physiology, Prakash Institute of Medical Science and Research Islampur. Dist. Sangli (MS), India.

<sup>3</sup>Professor and HOD, Department of Oral Pathology B.V.D.U.D.C. & H. Sangli, India.

<sup>4</sup>Assistant Professor. Dept. of Biochemistry, B.V.D.U.D.C. & H. Sangli (Maharashtra), India.

<sup>5</sup>Associate Professor, Department of General Pathology B.V.D.U.D.C. & H. Sangli, India.

<sup>6</sup>Assistant Professor. Dept. of Biochemistry, B.V.D.U.D.C. & H. Sangli., India.

\*Corresponding author's E-mail: [mailmesmita.patil@rediffmail.com](mailto:mailmesmita.patil@rediffmail.com)

Accepted on: 02-09-2016; Finalized on: 30-11-2016.

### ABSTRACT

Fast Globalization trends, rapid industrial growth, and poor environmental conditions at work places have created a lot of health-related issues and complications. The main aim of this study is to study the dynamic lung function tests in occupationally exposed petrol pump workers of western Maharashtra. The study was conducted on 70 male petrol pump workers & 70 normal controls to find out the effect of occupational exposure to petroleum product on dynamic lung function tests. PFT were studied by using computerized spirometer. Parameters of PFT are FEV<sub>1</sub>, FVC, FEV<sub>1</sub>/FVC ratio, PEFR, FEF 25%, FEF 50 %, FEF 75 % FEF 25-75, MVV was recorded and compared with normal predicted value. Analysis was done using unpaired t-test. There was a statistically significant decrease in FEV<sub>1</sub>, FVC, PEFR, FEV<sub>1</sub>/FVC ratio, PEFR, FEF 25%, FEF 50 %, FEF 75 % and FEF 25-75 in petrol pump workers as compared to control. MVV was decreased in petrol pump workers but it was not found to be statistically significant. It was concluded that dynamic lung function tests of petrol pump workers were significantly decreased. Our findings suggest that the adverse effects of petroleum vapors on lung function with mixed pattern of lung diseases.

**Keywords:** FEV<sub>1</sub> (forced expiratory volume in first second of FVC), FVC (forced vital capacity), FEV<sub>1</sub>/FVC ratio, PEFR (peak expiratory flow rate in liters/sec), FEF 25-75% (forced expiratory flow rate during 25 % to 75 % of expiration) and MVV (maximum voluntary ventilation).

### INTRODUCTION

In rapidly developing country like India automobiles plying on roads are increasing each day. Exposure of petrol pump workers to petroleum fumes and gases from exhaust of automobiles is also increased<sup>1</sup>. Petrol is a complex combination of hydrocarbons which contain 95% aliphatic and acyclic compounds and less than 2% are aromatics<sup>2</sup>. These petroleum products (petrol, diesel) contain various organic compounds such as benzene, toluene, ethylbenzene and xylene (BTEX compound). Benzene is one of the active compounds in petrol & it is responsible for the physiological dysfunction in respiratory, hematological and thyroid function in petrol pump workers.

Millions of workers working in different occupational settings. They are get exposed to hazardous substances due to their occupation. Hazardous substances include organic chemicals, intermediates, by-products or end products. Different experimental studies showed that airborne contaminants lead to injury to airways and lung parenchyma in subjects who are exposed to it<sup>3,4</sup>. Long term exposure to air pollution and petroleum vapors causes bronchoconstriction<sup>5</sup>.

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.

Petrol pump workers in western Maharashtra get exposed to a high level of air pollution along with petrol and diesel vapors. Both these factors can affect the respiratory health of petrol pump workers. Also there is lack of availability of sufficient data international research on the occupational aspects of petrol pump workers in Western Maharashtra. Therefore we are undertaking the present research.

### MATERIALS AND METHODS

After the approval by institutional ethical committee, a cross sectional study was carried out on 70 petrol pump workers of Western Maharashtra (Sangli, Satara & Kolhapur Dist). 70 control subjects were chosen from paramedical staff of same socioeconomic status from Bharati Vidyapeeth Medical & Dental College and Hospital Sangli. Workers were evaluated as per standard proforma, which included a 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. 70 workers were eligible to whom the experimental protocol was explained and written informed consent was obtained from them.



Dynamic PFT was done by using electronic computerized portable spirometer (Spiro Excel PC based, recorder system, Chandigarh, India). All the subjects were made familiar with the instrument and the procedure for performing the test. The most useful measures of dynamic lung function parameters included were FEV<sub>1</sub> (forced expiratory volume in first second of FVC), FVC (forced vital capacity), FEV<sub>1</sub>/FVC ratio, PEFR (peak expiratory flow rate in liters/sec), FEF<sub>25%</sub> (forced expiratory flow rate during 25% of expiration), FEF<sub>50%</sub> (forced expiratory flow rate during 50% of expiration), FEF<sub>75%</sub> (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) were recorded. Subjects were then made to practice breathing into the mouthpiece of spirometer until they can duplicate the maneuvers successfully on three consecutive attempts.

### Statistical analysis

Results were presented as Mean  $\pm$  SD. Unpaired t-test was used to find the significance of study parameters by using SPSS 16.0 version. P value of less than 0.05 was considered significant.

### RESULTS

The purpose of the present study is to find out impact of petrol/diesel fumes and environmental pollution on the dynamic lung functions of occupationally exposed petrol pump workers. The results are summarized in table No- 1. There was statistically significant decrease in FVC, FEV<sub>1</sub>, PEFR, FEV<sub>1</sub>/FVC ratio, PEFR, FEF 25%, FEF 50 %, FEF 75 % and FEF 25-75 in petrol pump workers. In addition, there was a decrease in MVV but it was not statistically significant.

**Table 1:** Mean  $\pm$ SD of dynamic lung functions in Petrol Pump Workers & Control Group

Parameters	Mean $\pm$ SD of Petrol pump workers (n= 70)	Mean $\pm$ SD of Control group (n= 70)	t – test	P value
FVC (Itrs)	3.499 $\pm$ 1.152	5.126 $\pm$ 1.930	-6.059	0.001*
FEV1 (Itrs)	2.705 $\pm$ 0.879	3.572 $\pm$ 0.732	-6.341	0.001*
FEV1/FVC (%)	83.701 $\pm$ 15.768	89.236 $\pm$ 9.403	-2.522	0.013 *
PEFR (L/s)	7.502 $\pm$ 2.321	9.191 $\pm$ 2.326	-4.301	0.001 *
FEF 25% (L/s)	6.860 $\pm$ 1.7637	8.115 $\pm$ 1.8184	-4.145	0.001 *
FEF 50% (L/s)	6.287 $\pm$ 1.946	8.148 $\pm$ 2.416	-5.021	0.001*
FEF 75%	4.737 $\pm$ 2.517	6.342 $\pm$ 2.057	-4.133	0.001*
FEF 25-75 (L/s)	4.835 $\pm$ 1.483	6.445 $\pm$ 1.509	138	0.001*
MVV (L/min)	48.39 $\pm$ 28.380	52.34 $\pm$ 43.287	-639	0.524 NS

\* = Significant, NS= Not significant

**Table 2:** Mean  $\pm$  SD of Dynamic PFT in petrol pump workers according to the duration of exposure

Parameters	1-5 yrs Exposure. (n=29)	6-10 yrs. Exposure (n=31)	More than 10 yrs Exposure (n=10)	F value	P value
FVC (Itrs)	4.3328 $\pm$ 1.13382	3.1255 $\pm$ 0.66975	2.2390 $\pm$ 0.43250	26.441	0.000*
FEV1 (Itrs)	3.0455 $\pm$ 0.82405	2.6987 $\pm$ 0.75991	1.7350 $\pm$ 0.68758	10.541	0.000*
FEV1/FVC (%)	86.744 $\pm$ 13.70788	82.3252 $\pm$ 17.1165	79.1410 $\pm$ 16.8993	1.079	0.346NS
PEFR (L/s)	8.0431 $\pm$ 2.06874	7.5352 $\pm$ 2.44747	5.8290 $\pm$ 1.98686	3.651	0.031*
FEF 25% (L/s)	7.020 $\pm$ 1.5998	6.799 $\pm$ 1.9180	6.588 $\pm$ 1.8562	0.251	0.779NS
FEF 50% (L/s)	7.1717 $\pm$ 1.55780	5.7988 $\pm$ 1.97157	5.2310 $\pm$ 1.98376	6.280	0.003*
FEF 75%	6.7552 $\pm$ 2.37752	3.6787 $\pm$ 1.33895	2.1620 $\pm$ 0.81565	33.669	.000*
FEF 25-75 (L/s)	4.9352 $\pm$ 1.38485	4.9320 $\pm$ 1.39187	4.7090 $\pm$ 1.63054	0.195	0.824 NS
MVV (L/min)	70.21 $\pm$ 27.379	36.23 $\pm$ 15.060	22.76 $\pm$ 17.721	27.304	0.000*

\* = Significant, NS= Not significant.

### DISCUSSION

Occupational health has been getting importance for the fact that long term exposure to petroleum products can lead to a permanent morbidity. There are health hazards involved in handling and use of petrol/diesel as

documented by various studies. Inhalation of environmental pollutants and petroleum fumes is an important cause of interstitial lung disease in India

In present study we found that, there was significant decrease in the mean value of FVC, FEV<sub>1</sub>, PEFR, FEV<sub>1</sub>/FVC



ratio, PEFr, FEF 25%, FEF 50 % , FEF 75 % and FEF 25-75 amongst the petrol pump workers as compared to control group as shown in table no 1.

In the present study, significant reduction was seen in the FEV<sub>1</sub> (Forced expiratory volume in 1 sec), FVC (forced vital capacity), PEFr, FEF 50 %, FEF 75 % & MVV in petrol pump workers who were exposed to more than 5 years. Flow rates i.e. FEF 25%, FEF-25-75%, FEV<sub>1</sub>/FVC ratio also decreased in the workers exposed more than 5 & 10 years but the change was not statistically significant as shown in Table No. II.

Our study coincides with previous studies done by Singhal M et al.<sup>6</sup>, Nazia Uzma et al.<sup>7</sup>, Meo SA et al.<sup>8</sup>, Chawla A et al.<sup>9</sup>, Madhuri B A et al.<sup>10</sup>, Dr. Rajula Tyagi et al.<sup>11</sup>, Savita D. Kittad et al.<sup>12</sup>, Batta M et al.<sup>13</sup>, & Patil Smita V. et al.<sup>14</sup>

In these studies, FVC, FEV<sub>1</sub>, PEFr, FEF 25-75 were significantly decreased in petrol pump workers .

In our study, forced expiratory flow (FEF<sub>25-75%</sub>) also known as the maximum mid expiratory flow rate also showed significant decrease. FEF (25-75%) is one of the sensitive indicator of small airway disease<sup>15</sup>. This parameter of our study coincides with previous studies done by Hulke, S. M., et al.<sup>16</sup> & Solanki RB<sup>17</sup>.

In our study MVV was decreased, but it was not found to be statistically significant. Our findings coincide with Sadiqua begum et al.<sup>15</sup> & J.E Cotes et al.<sup>18</sup>.

Petrol and diesel fumes get absorbed into the human body either through the respiratory tract or via epidermal contact. In present study reduction in dynamic lung function tests such as FVC, FEV<sub>1</sub>, PEFr, FEV<sub>1</sub>/FVC ratio, PEFr, FEF 25%, FEF 50 % , FEF 75 % and FEF 25-75 & MVV may be due to, occupational solvents and air pollutants that exert an irritant effect upon the bronchial epithelium. It affects the clara cells and cilia of the lungs and releases proteolytic enzymes from macrophages. These changes destroy the lung substance such as surfactant and reduce elastic recoil of the lungs. These may cause respiratory symptoms and impaired pulmonary functions in petrol pump workers as compared to controls. Also due to Accumulation of peri-bronchial lymphoid and connective tissues along with dust laden macrophages leads to wall thickening and remodeling in terminal and respiratory bronchioles. Wall thickening is associated with increase in collagen and interstitial inflammatory cells. This small airway damage might be cause of reduced pulmonary functions in petrol pump workers.

Our findings suggest that petrol pump workers have mixed pattern of restrictive & obstructive lung disease.

## CONCLUSION

From the present study it was concluded that dynamic lung function tests (FVC, FEV<sub>1</sub>, FEV<sub>3</sub>, PEFr, FEF<sub>25%</sub>, FEF<sub>50%</sub>, FEF<sub>75%</sub>, FEF 25-75% of petrol pump workers who are continuously exposed to petroleum fumes were

significantly reduced. Our findings point towards adverse effects of petroleum vapors on lung function with mixed pattern of restrictive and obstructive lung diseases.

## Recommendation

To minimize the health related issues, periodic health check up along with pulmonary function tests every year should be done. Use of effective personal protection by petrol pumps workers like gloves, apron, long shoes. An appropriate respiratory protective equipments i.e. anti-pollution mask is mandatory to prevent lung diseases in them. Workers who have lung function impairment during the study were advised to practice yoga exercises related lung functions like pranayama & yogasana.

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**Source of Support: Nil, Conflict of Interest: None.**

