



## STUDY OF PATTERN OF RESPIRATORY IMPAIRMENTS IN FUEL FILLING ATTENDANTS OF BAREILLY, UTTAR PRADESH

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**ABSTRACT** Fuel filling attendants, working in refueling areas are continuously exposed to the organic and inorganic constituents present in the fuel as well as combustion-derived nano particles (CDNPs) as many motorists don't turn down their vehicles. Hence, to justify the toxic effects of fuel in pulmonary functions of petrol-pump workers the study is done in 2015-2016 in the Dept. of Physiology, RMCH. Total 100 male Petrol Pump workers, non-smoker, working for more than 1 year within 20-50 years age were selected by Simple Random Sampling from different petrol stations of Bareilly formed the Study Group. Pulmonary function impairment was observed in 84 petrol pump workers. Among all the workers, 67 subjects had mixed pattern, whereas 11 had restrictive type of impairment and 6 had obstructive type of impairment. It was also observed that 57 workers had shown peripheral airway involvement (PAO). This mixed pattern of impairment was also predominant as the duration of exposure and age of workers increased. Hence, pre-employment checkup and regular monitoring, identification of sensitive workers and vocational rehabilitation, proper supply and usage of safety measures like protective mask, hand gloves etc, are suggested preventive strategies for their optimum health.

**KEYWORDS :** Combustion-derived nano particles, restrictive, obstructive, PAO

### INTRODUCTION :

Petrol and diesel have become an essential commodity to sustain our daily life. Petrol and diesel are very volatile substances. It quickly evaporates during loading and dispensation. In Indian petrol pumps, there is no provision of self-service and the fuel filling attendants are employed for fueling of vehicles. So, the filling attendants, working in refueling areas are continuously exposed to the organic and inorganic constituents present in the fuel.<sup>1</sup> A very important source of benzene emissions is evaporation of petrol from petrol tanks and refueling of vehicles.<sup>2</sup> Additionally, as many motorists usually do not turn down their vehicles at the filling stations while getting refueled, the petrol pump workers are exposed to the emissions liberated from the exhaust pipes of the vehicles in the form of combustion-derived nano particles (CDNPs) along with other vehicular exhaust pollutant gases. These particles remain airborne for longer time periods and penetrate deeper into the lungs.<sup>3</sup> As Petrol-pump attendants do not wear personal protective equipment and personal hygiene is variable in the workplace,<sup>4</sup> noxious substances with high solubility are largely dissolved in the secretions lining the upper respiratory tract, those with low solubility penetrate to the gas exchanging tissues and exert their dominant effect there. However with overwhelming exposures adverse effects will occur at all levels of the respiratory tract and dose becomes a more important determinant of outcome than solubility.<sup>5</sup> So, health problems posed by the pollutants at the work environment of an individual are closely related to the nature and level of exposure to these hazardous chemicals.<sup>6</sup> The pattern of derangement in various pulmonary function parameters varied in different studies. Some studies reported restrictive pattern,<sup>7,8</sup> while others have reported small airway obstructive pattern.<sup>9,10,11</sup> Few studies also found mixed pattern.<sup>12,13,14</sup> and obstructive pattern<sup>15</sup> also. The pattern of derangement also changed according to the duration of exposure.<sup>1</sup> Hence, the present study is undertaken to justify the toxic effects of petroleum in pulmonary functions of petrol-pump workers by means of spirometry.

### MATERIAL AND METHODS:

This was a cross-sectional study carried out in October 2015-September 2016 in the Dept. of Physiology, Rohilkhand Medical College & Hospital after obtaining ethical approval from the Institutional Ethical Committee. Sample size calculated with the formula  $4pq/L^2$ ; where P (Prevalence) = 50%, Q = 100 - P = 50%, L (allowable error) = 20% of prevalence = 10. Total 100 male Petrol Pump workers, non-smoker, working for more than 1 year within 20-50 years age were selected by Simple Random Sampling from different petrol stations of Bareilly formed the Study Group. Those who were not in direct exposure of petroleum fumes; who had any respiratory disease like tuberculosis, bronchial asthma, COPD; any chronic disease like diabetes mellitus, hypertension; history of regular medication like sedative or hypnotics; major abdominal or thoracic surgery in past or inability to perform pulmonary function test were excluded from the study.

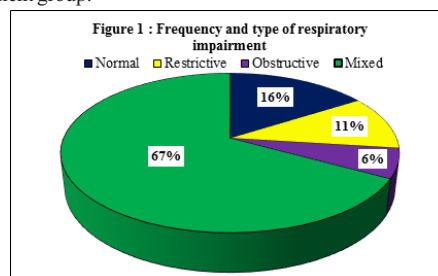
After obtaining the informed consent, basic anthropometric measurements like height, weight etc. were recorded and the subjects

were made familiar with the instrument "Electronic Spirometer Helios 401" and the procedure for performing the test. The subject was made to sit and relax for minimum 5 minutes prior to performing the procedure. The procedure was thoroughly explained to each subject and asked to take full inspiration which was followed by rapid and forceful expiration with closed nostrils in the mouthpiece. The apparatus provided a detailed analysis of predicted value, derived value and percent predicted values of different pulmonary function parameters. The pulmonary function tests were repeated thrice on each occasion for each subject and the best percent predicted reading was selected for analysis as per guidelines of American Thoracic Society.<sup>16</sup> Data analyzed with Microsoft Excel and SPSS (version 17). P value of <0.05 was considered significant. An interpretative result of the FVC maneuver were analyzed and classified according to the values (% Pred) of these parameters as following:<sup>4,17</sup>

- **Restriction :** FVC (<80% predicted) or VC (<70% predicted)
- **Obstruction :** FEV<sub>1</sub>% or FEV<sub>1</sub>/FVC% and PEFR (<80% predicted)
- **Mixed :** VC (<70% predicted), FVC%, FEV<sub>1</sub>%, MMEF% or PEFR (<80% predicted)
- **PAO (peripheral airway obstruction):** MMEF/FEF<sub>25-75%</sub> (<80% predicted).

### RESULTS AND OBSERVATIONS:

Figure 1 shows that respiratory impairment was observed in 84 petrol pump workers. Among all the workers, 16 had normal findings, whereas 11 had restrictive type of impairment and 6 had obstructive type of impairment. Total 67 subjects of Study Group had mixed pattern (combination of restrictive and obstructive) of impairment. It was also observed in this study that, among all the workers 57 had shown small airway involvement (PAO) in lung dysfunction also had less than normal FVC &/or FEV<sub>1</sub>%; hence they were included in mixed impairment group.



Further to find out any change in pattern of impairment with increase in duration of exposure Study group was again divided into three subgroups i.e Group A (exposure >1 year- 3 years), Group B (exposure >3 years- 5 years) & Group C (exposure >5 years- 7 years). In addition, to find out effect of increase in age on pattern of respiratory impairment Study group was again divided into three subgroups i.e Group I (20- <30 years), Group II (30- <40 years) & Group III (40- <50 years).

Groups	Pattern of Pulmonary Function				Total subjects	Pearson Chi-square (Sig. 2 tailed)
	Normal	Restrictive	Obstructive	Mixed		
Group A	12	7	0	19	38	0.002**
Group B	1	3	2	15	32	
Group C	3	1	4	22	30	
Total	16	11	6	67	100	

Table 1 shows that mostly mixed type of respiratory impairment was predominant in all exposure groups. In Group A half (19) subjects has mixed type of impairment, 7 has restrictive impairment and 12 were found normal. Among the 32 subjects of Group B mixed, restrictive, obstructive pattern were found in 15, 3 and 2 subjects respectively. In Group C among 30 subjects mixed, restrictive, obstructive pattern were found in 22, 1 and 4 subjects respectively. This distribution of different patterns of respiratory impairment in duration of exposure groups were significantly associated.

Age Group	Pattern of pulmonary functions				Total subjects	Pearson Chi-square (Sig. 2 tailed)
	Normal	Restrictive	Obstructive	Mixed		
Group I	11	5	0	19	35	0.004**
Group II	2	6	2	15	36	
Group III	3	0	4	22	29	
Total	16	11	6	67	100	

Table 2 shows that mixed type of respiratory impairment was mostly prevalent in all age groups of study population. In Group I, 19 subjects had mixed type of impairment, 5 had restrictive impairment and 11 were found normal. Among the 36 subjects of Group B mixed, restrictive, obstructive pattern were found in 15, 6 and 2 subjects respectively. In Group C among 29 subjects mixed, obstructive and normal pattern were found in 22, 4 and 3 subjects respectively. This distribution of different patterns of respiratory impairment in age groups were significantly associated.

## DISCUSSION :

The prevalence of lung function impairment among the petrol pump workers varied from low to high in different studies: 11.11% (Mukherjee A K et al),<sup>18</sup> 25.71% Anupama et al,<sup>19</sup> 29.0% (Shonga T et al),<sup>20</sup> 36% Tyagi R et al,<sup>21</sup> 57.50% Rahul et al,<sup>22</sup> and 78% Al-Jaddan S A N et al.<sup>15</sup> Prevalence of lung function impairment was found to be high (84%) in this study. This could be due to lack of use of personal protective measures (PPE) during work, poor air quality in the petrol pumps, multitasking (refueling, storing and regular checking of oils, cleaning of workplace), improper location of petrol pumps near busy roads and lack of knowledge about the harmful effects of fuels.

In the present study, overall mixed pattern of respiratory impairment was predominant. This finding is in agreement with other studies.<sup>4,12,13,14</sup> Particles generated from petrol and diesel exhaust are extremely small and are present in the nuclei or accumulation modes with diameter of 0.02  $\mu\text{m}$  and 0.2  $\mu\text{m}$  respectively.<sup>23</sup> Hence chronic exposure to them could culminate into chronic inflammation of respiratory tract and lung parenchyma resulting in restriction of lung movement.<sup>8</sup> Fuel exhaust particles also causes upregulation of the endothelial adhesion molecules ICAM-1 (intercellular cell adhesion molecule-1) and VCAM-1 (vascular cell adhesion molecule-1) in the bronchial tissue which augments the accumulation of particles along the airway<sup>24</sup> and leads to varying degrees of bronchial wall thickening and remodeling of terminal and respiratory bronchioles which may be a probable cause airway obstruction.<sup>25</sup> These pathogenic substances also exert an irritant effect on the bronchial epithelium that affects the clara cells and cilia of the lung which act as sweeper of airway. This also impede natural clearance mechanism of the conducting airway.<sup>26</sup> Immunological destruction of bronchial epithelial cells<sup>7</sup> and a change in receptor sensitivity of ( $\beta_2$ -adenergic receptor mediated airway relaxation) bronchial smooth muscles<sup>28</sup> may also play a significant role in mixed type of respiratory impairment. In contrast, few studies also reported predominance of restrictive pattern<sup>5,22</sup> and obstructive pattern.<sup>15</sup>

In this study, mixed pattern was predominant in less duration of exposure groups and continued to be the predominant pattern as the duration of exposure increased in petrol pump workers. Similar opinion was concluded by other studies also.<sup>4,12,14, 25</sup> Petroleum hydrocarbons may also trigger oxidative stress by consuming the protective free radical scavengers and impairs the type II pneumocytes resulting in a decreased production of surfactant resulting mixed respiratory impairment.<sup>29</sup> In contradiction, study also reported predominance of restrictive pattern continued even duration of exposure increased in groups.<sup>30</sup> Uzma et al also opined that restrictive pattern was observed in less duration of exposure groups but when duration of exposure increased more than 10 years pattern had changed into mixed type of respiratory impairment.<sup>1</sup>

This mixed pattern was also predominant pattern in the younger age group in my study and was also predominant as the age group of the workers increased. Aging is associated with down regulatory immune response which makes the older petrol pump workers prone to the environmental toxic agents that can easily produce inflammation in respiratory tract.<sup>31</sup> These particulate matter by virtue of its ability to induce various cytokines like TNF- $\beta$ , interferon-  $\beta$ , IL-6 and transforming growth factor-  $\beta$  and recruitment of immature neutrophils affects the pulmonary tissues causes inflammation resulting restrictive impairment.<sup>32</sup> Aging also promotes proteolytic and oxidant mediated damage in lungs that hinders in lung expansion and recoiling.<sup>3</sup> Dissimilar to our finding, Priyadarshini et al, reported that with advancement of age, impairment changes from restrictive to obstructive type.<sup>11</sup>

## CONCLUSION :

Petrol pump workers are vulnerable to develop impairment in lung function. They tend to develop mixed type (combination of restrictive and obstructive) of lung disease and this pattern of impairment continued as the duration of exposure increased. Small airways are probably the most crucial site of lung injury among them. Hence, the different preventive strategies like pre-employment checkup during recruitment, regular health check-up and monitoring, identification of sensitive workers and vocational rehabilitation, proper supply and usage of safety measures like protective mask, hand gloves etc, improvement in the engine design, soot filters and fuel modification and vapour recovery system establishment and proper maintenance could be adopted to arrest or decelerate the progress of impairment in petrol pump workers for their optimum health.

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