

Original article

Airway function and mental health status of petrol pump workers of Aurangabad (Maharashtra) city. – An analytical cross-sectional study

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ABSTRACT

Objective: Fumes of petroleum products have an established toxic effect on haematological, respiratory and liver parameters and a definite neurotoxicity. According to study conducted in Italy, the highest concentration of benzene is in the breathing zone of petrol pump workers. This Analytical Cross-sectional study was conducted with the aim and objective to assess the effect of petrol and diesel vapours on the health status (respiratory and mental) of petrol pump workers and comparing the results with non petrol pump workers (controls).

Methods: A sample size of 96 was obtained (study subject- 32, controls - 64). PHQ9 (Patient Health Questionnaire) and PEFR (Peak Expiratory Flow Rate) meter were used as study tools.

Results: The study found a weak negative correlation ($r = -0.233$) between duration of exposure and PEFR. A significant difference between mean PEFR values of the two groups was observed. The PHQ9 values between the two groups were also significantly different ($p = 0.022$). A positive correlation exists between duration of exposure and PHQ9 values ($r = +0.192$).

Conclusion: Thus the study concludes that petrol pump workers are at greater risk of respiratory ailments as well as prone to mental health problems.

1. Background

Environmental condition at work place has been a cause of serious health related issues for the workers. Fast urbanisation trends have resulted in a tremendous rise in number of transports and rapid industrial growth, globalisation and increase in numbers of vehicles. This has thus increased the demand of petroleum products and the related health issues.

Oil and natural gas sector is one of the businesses which has grown up enormously in last few decades, with lot of profit to the

owners and neglecting the health status of the poor workers who serve for more than 8 h per day¹ and 6 days a week on an average.

Literature search from India is restricted scarcely to case-reports^{2,3} and clinic based studies.^{4,5} Lack of availability of sufficient research on occupational aspects of petrol pump workers (PPWs) peculiarly on mental health status motivates us to carry out this study. Although several studies have been done on lung function tests and other biochemical markers none of the studies during literature search comment anything about mental health of petrol pump workers. Keeping in mind that organic vapours can cause severe psychological damage, this study

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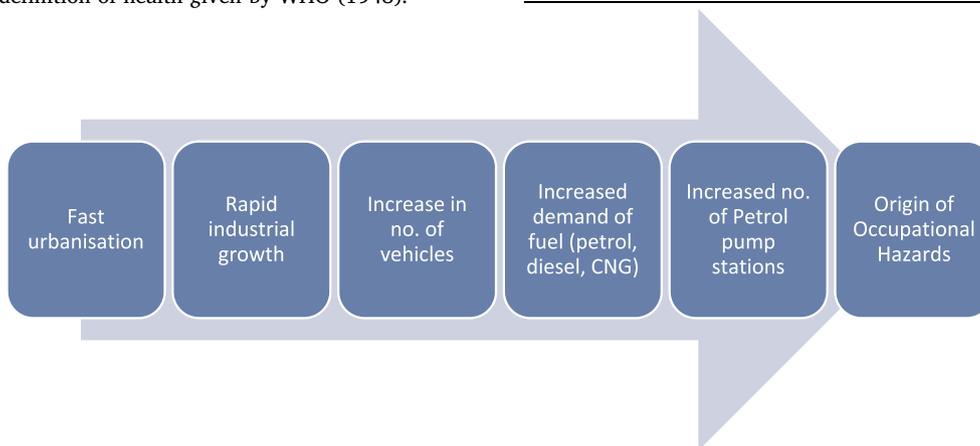
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also emphasizes on mental component of the petrol pump workers in the completeness of definition of health given by WHO (1948).

ahead, keeping this position for the entire time. First, lungs are com-



Petrol and diesel are derived from crude oil which is a mixture of organic hydrocarbons like benzene and toluene which make a person feel ‘high’ when sniffed. The hydrocarbons present in petrol and diesel are quickly absorbed by the body and brain and lead to various short term and long term effects similar to alcohol.⁶ Short-term effects like euphoria, dizziness, numbness, hallucinations, aggression, lack of coordination etc can be seen while long term effects depend upon the duration of time a person is exposed to petrol fumes which includes gradual damage to the brain, lungs, immune system, liver and kidney system. The high level of environmental pollution and exposures to petrol and diesel vapours can impact on lung function, can cause bronchoconstriction, mucosal irritation & alveolar swelling which leads to obstructive disorders of lungs.

The petrol pump workers also experience higher air pollution in their immediate vicinity as compared to general population. Automobile exhaust contains oxides of nitrogen, sulfur dioxide, carbon monoxide, carbon dioxide & unburnt carbon particles etc. Vapour concentration in ppm in air around petrol pump at service station ranges from 2 to 100 ppm.⁷ According to a study conducted in Italy, the highest concentration of benzene is in the breathing zone of petrol pump workers and almost 88% of benzene is emitted while filling of petrol into the tank.⁸ Harmful effects of benzene are toxic effect on haematological parameter, liver toxicity and definite neurotoxicity.⁹ Petrol vapours are irritating to the eyes and respiratory system and high levels for a longer duration leads to range of neurological problems.⁷

1.1. Aim and objectives

To assess the effect of petrol and diesel vapours on the health status of petrol pump workers and comparing the results with healthy controls (non-petrol pump workers).

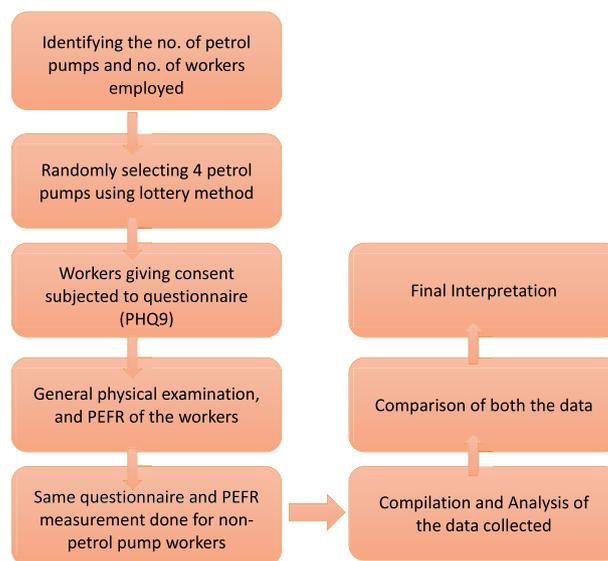
1.2. Materials and Methods

The study was an analytical cross-sectional study^{10,11} using PHQ9 (Patient Health Questionnaire)¹² and PEFR (Peak Expiratory Flow Rate) meter as study tools. A sample size of 96 (study subject- 32, controls - 64) was obtained using difference between two means on Open-Epi sample size calculator version 3.01. This cross-sectional study was carried out on 4 randomly selected petrol pump stations in the city of Aurangabad (Maharashtra). Controls were twice as many as study subjects who were selected from a healthy population of non-petrol pump workers. Workers having any prior (before working at station) respiratory morbidity were excluded from the study.

The PPWs were interviewed, and tested with PEFR meter at their stations. A PEFR meter measures how well a person can blow the air out of his lungs. Before each use, it is made sure that sliding marker is at the bottom of the numbered scale. PEFR can be measured in either standing or sitting posture with chin slightly lifted and eyes looking straight

pletely emptied by blowing out air as much as possible. Then by breathing in deeply to completely fill the lungs with air. Mouthpiece is put between incisor teeth and lips closed tightly. Tongue must not touch the mouthpiece. Air is blown out as hard and fast as a person can through the mouthpiece. The sliding marker will move up the scale. Value of PEFR is noted by looking at the numbered meter where the marker stopped. The steps are repeated three times to measure the peak flow. The highest number is recorded as current value of PEFR. It was made sure to reset the meter to zero and mouthpiece cleansed with liquid betadine before each time it was used on another study subject.

2. Methodology flow chart



3. Results

Total number of study participants were 96 (32 PPW + 64

Table 1 Age of the study participants.

	PPW (N = 32)	Controls (N = 64)	
Age (years) (Mean ± SD)	35.71 ± 8.7	30.08 ± 13.1	p = 0.028

Table 2
Gender-wise distribution.

	PPW (N = 32)	Controls (N = 64)	
Male	32 (100)	61 (95.3)	Fisher Exact value = 0.5832
Female	0 (0)	3 (4.7)	

Table 3
Age-wise distribution

	PPW (N = 32)	Controls (N = 64)	
18-30	8 (25)	18 (28.1)	p = 0.1492
31-40	12 (37.5)	26 (40.6)	
41-50	11 (34.4)	11 (17.2)	
51-60	1 (3.1)	5 (7.8)	
> 60	0 (0)	4 (6.3)	

Table 4
Distribution of addiction among study participants.

	PPW (N = 32)	Controls (N = 64)	
No Addiction	8 (20)	21 (25.3)	p = 0.8931
Smokers	11 (27.5)	24 (28.9)	
Tobacco	14 (35)	26 (31.3)	
Alcohol	07 (17.5)	12 (14.5)	
Total	40 ^a (100)	83 ^a (100)	

^a - Some study subjects had multiple addictions.

Table 5
Duration of exposure to petrol vapours.

	PPW (N = 32)	Controls (N = 64)
0–1 yrs	2 (6.3)	-
> 1–5 yrs	4 (12.5)	-
> 5–10 yrs	10 (31.3)	-
> 10	16 (50.0)	-

Controls). The mean age ± SD (years) of PPWs and controls was 35.71 ± 8.7 years and 30.08 ± 13.1 years respectively (Table 1). All PPWs were male, however out of 64 controls 3 were female (Table 2).

Table 6
Comparison of PHQ 9 values.

	PPW (N = 32)	Control (N = 64)	
0-4 (None)	13 (40.6)	46 (71.9)	p = 0.02295
5-9 (Mild)	10 (31.3)	12 (18.8)	
10-14 (Moderate)	5 (15.6)	4 (6.3)	
15-19 (Moderately Severe)	2 (6.3)	2 (3.1)	
20-27 (Severe)	2 (6.3)	0 (0)	

Table 7
Airway function (PEFR) parameter of two groups.

	PPW (N = 32)	Control (N = 64)	
Mean ± SD (lit/min)	329.6 ± 107.2	407.7 ± 83.2	p = 0.00071

Age distribution is presented in (Table 3) with an insignificant difference between the two groups. Most of the study participants in both the groups were addicted to some or the other substance with an insignificant difference between the two (Table 4). This shows that addiction does not influence the results of our study. Fifty percent (n = 16) of the PPWs had more than 10 years of exposure to organic vapours followed by 31.3% (n = 10) PPWs with an exposure of 5–10 years (Table 5). Duration of exposure to petrol vapours among PPWs had negative correlation (r = −0.233) with PEFR [Fig. 1] and a positive correlation (r = +0.192) with PHQ9 score. The PEFR values of PPWs and healthy controls were subjected to two sample independent t-test and the difference was found to be statistically significant (p < 0.00071) [Table 7]. PHQ9 values can be used as screening tool of depression in the population. A comparison of PHQ9 between the two groups values is shown in Table 6. Mean values of both PEFR and PHQ9 score are shown in Fig. 2. Maximum values (Mean PEFR = 355.75, Mean PHQ9 score = 10.25) of both the parameters was found between 1 and 5 years of exposure to organic vapours with a decreasing trend over a period of time.

4. Discussion

The purpose of the current study was to test a respiratory variable among the PPWs in the study area. Further, the study also aimed to

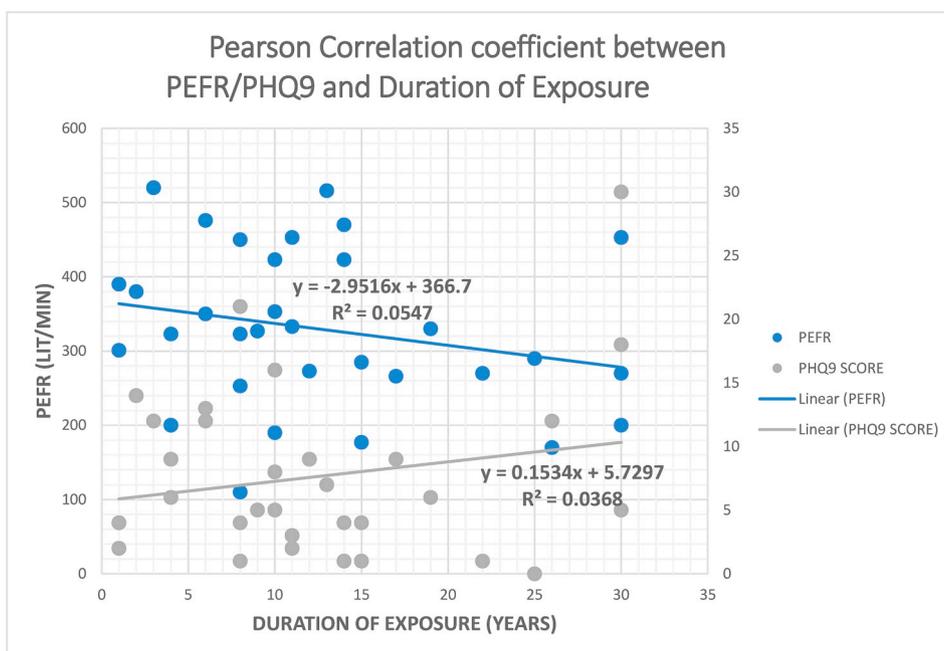


Fig. 1. Pearson Correlation coefficient between PEFR/PHQ9 and Duration of Exposure.

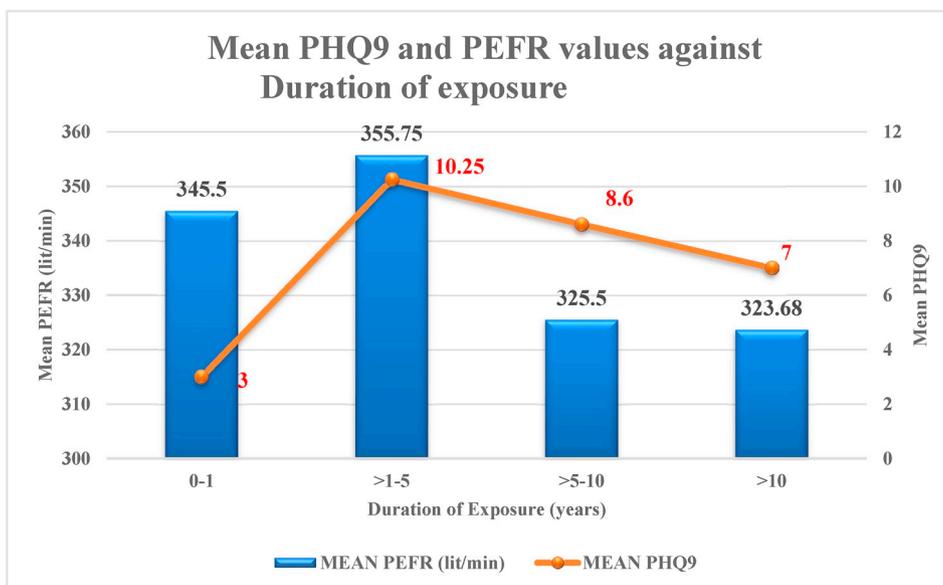


Fig. 2. Mean PHQ9 and PEFR values against Duration of exposure.

correlate the mental health of the PPWs with that of general population so as to analyse the occupational impact of organic vapours on the mental health of the PPWs.

Debashish et al.¹³ have conducted the study with a cases to control ratio of 1:1 whereas in the present study the ratio is 1:2.

5. Airway function

The mean \pm SD PEFR values for PPWs was 329.6 ± 107.2 lit/min, while the controls presented with a far better mean PEFR values of 407.7 ± 83.2 lit/min. After reviewing similar literature on occupational exposure of organic vapours like petrol and diesel a reduction in PEFR values among PPWs was consistent, when compared to the general population^(1, 14–17). Age and cigarette addiction are other factors that influence PEFR in adults. So, these two variables were nullified by equalising their distribution in both the cases and controls, so that only occupation remains the decisive factor influencing the PEFR values. A lower PEFR value in PPWs is suggestive of restrictive lung disorder that must have been caused due to occupational hazards of benzene and other hydrocarbons present in petrol and diesel fumes. Petrol is a complex combination of hydrocarbons which on emission generates particles of diameter - 0.02 nm. Such particulate matter has a propensity to deposit in smaller bronchi such as terminal bronchioles, and cause airway inflammation and a subsequent increase in airway resistance.

The lung damage, caused by such prolonged inhalation of hydrocarbons & particulate matter such as lead (air pollutant), leads to chronic inflammation of the lung parenchyma & fibrosis, resulting in impaired peak expiratory flow rates. The duration of exposure to fumes is also associated with reduced lung function test.

A weak negative correlation ($r = -0.233$) exists between duration of exposure and PEFR. Patil Smita V et al.¹⁸ showed a correlation coefficient of -0.625 which is a strong negative correlation. This can be explained on the basis of strict exclusion and inclusion criteria of the subjects in the study by Patil Smita V et al. According to a study by Santhalingam et al.,¹⁷ a duration of exposure of (> 5 years) shows a significant reduction in PEFR, as compared to those who have less than 5 years of exposure. In such a scenario, a mixed etiology is often found - an obstructive lung pathology super imposed on a restrictive lung pathology.

Majority of studies have correlated the impact of petrol on impaired pulmonary function tests only. And its impact on other bodily systems

remains less studied. Several behavioural studies have been conducted to study the effect of organic vapours on central and peripheral nervous system showing affected immediate and delayed memory as well as intellectual capacity and psychomotor ability.¹⁹

6. Mental health

With respect to PHQ9, the prevalence of depression was significant amongst petrol pump workers as compared to controls. 31.1% of the PPWs were found to have mild depression as against 18.33% of the controls. While 6% of the PPWs were found to have severe depression on PHQ9 scale. A positive correlation ($r = +0.192$) of duration of exposure with PHQ9 score was observed.

Priyanka Gautam et al.² in a case report of a 22 year old male, reported a poor mental status with decreased volume and tone of speech, an increased pressure and reaction time, sad mood and anxious affect in the case who was sniffing petrol, diesel, kerosene from last eight years.

Nurka Pranjic et al.²⁰ of Institute of Occupational Medicine, Tuzla, Bosnia and Herzegovina conducted a prospective cohort study using Minnesota Multiphasic Personality Inventory on gasoline station workers. The mean \pm SD scores for depression among long term exposed workers was 56.8 ± 11.3 which was significant ($p < 0.05$).

A vapour concentration of less than 140 ppm is enough to elicit a mild symptom like cough however no human studies confirm any exact threshold. For CNS symptoms to become apparent a vapour concentration above 900 ppm is reported in Toxicological overview of Health Protection Agency.⁷ In a review by DI Lubman et al.,⁹ it is stated that consistent and chronic exposure leads neurological deficits and dementia.

Hence, the occupational hazards of petrol exist beyond the respiratory system, to have a consequential impact on the psycho-social well-being of the workers. Petrol Pumps are a major tertiary care sector catering to a booming India's automobile economy. Hence, it's imperative for the country's legislation to protect the petrol pump workers by providing safety gears, so as to protect them from the harmful effects of Petrol fumes & hydrocarbons.

7. Conclusion

The study concludes that PEFR, a measure of lung function is impaired in petrol pump workers (PPWs) in comparison to controls. The pattern of respiratory impairment is restrictive as evidenced by the

reduced PEFV values. It is evident from the results of the PHQ9 scale, that the mental health of the PPWs also suffers to a certain degree. Although abundant research is available on the lung function of petrol pump workers, further research is required to estimate the extent of mental health impairment in PPWs in accordance with their physical health.

Disclaimer

The views expressed in the submitted article belong to the authors and not an official position of the institution. The manuscript has been read and approved by both the authors. The requirements for authorship have been met, and each author believes that the manuscript represents honest work.

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Presentation at a meeting

No.

Declaration of competing interest

None to declare.

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