

Assessment of Lung Function, Exercise Capacity and Quality of Life in Petrol Pump Workers

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ABSTRACT

Introduction: Air pollution from vehicles in a city like Mumbai is an inescapable part of the urban life. Petrol pump workers are continuously exposed to petrol/diesel fumes and a long term exposure to these fumes lead to a deleterious effect on the respiratory system and quality of life. Despite the number of petrol stations in Mumbai, there is paucity of information regarding the cardiorespiratory health and the quality of life of these workers. Hence this study was undertaken to assess lung function, exercise capacity and quality of life in petrol pump workers of Mumbai, India.

Materials and Methods: The study comprised of 217 non-smokers, male petrol pump workers. The lung function was assessed using a Mini Wrights' Peak Flow Meter, the exercise capacity using 3minute step test and the quality of life using SF 12 Questionnaire. The statistical analysis was done using MS Excel and unpaired 't' test.

Results: A significant reduction ($p < 0.0001$) in the mean PEFR was found in the petrol pump workers as compared to the standard normal values. 74% of the petrol attendants were found to have reduced PEFR values. There was mild affection of exercise capacity and poor quality of life among the workers.

Conclusions: This study concludes that the petrol pump workers showed a decline in the mean PEFR value which was statistically significant. There was mild affection of exercise capacity and poor quality of life among these attendants.

Key Words: Petrol pump workers, Peak Expiratory Flow Meter, Exercise capacity Quality of life, petrol/diesel vapours, gasoline vapours.

INTRODUCTION

Air pollution from vehicles in a city like Mumbai is an inescapable part of the urban life. Petrol pump workers are continuously exposed to organic and inorganic substances present in the petrol. [1] Workers who are exposed to petrol and diesel fumes exhibit a number of clinical signs and symptoms which may be due to benzene toxicity and a long term exposure of it leads to poisonous effects on the respiratory functions. [1]

Petrol is a complex combination of hydrocarbons while diesel fuel is a distillate of petroleum which contains paraffins, alkenes and aromatics. [2] Petrol and diesel

undergo combustion in automobile engines and give rise to combustion derived nano-particles. These nono- particles and diesel exhaust particles are the most common in the urban environment. [2] They are highly respirable, can be adsorbed easily and remain air borne for longer period of time and can get deposited deeper into the lungs. [2] Petrol pump workers are coming in contact with the BTEX (Benzene, Toluene, Ethylbenzene, Xylene) compounds through inhalation, ingestion and dermal contacts due to their occupational exposure. [3]

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 [3] and the average daily exposure to these chemicals in India generally exceeds about 10 hours/day. [4]

Patil Smita et al conducted a study on assessment of lung function in petrol pump workers using Peak Expiratory Flow Rate in the West of Maharashtra (2016) and found out that the prevalence of affection of lung function among these workers was 33%. [3]

A study conducted by Ezejindu DN et al in Nigeria (2014) on evaluation of lung function using Mini Wright Peak Flow Meter among the petrol pump workers found that there was 40% reduction in PEFr values compared to control group. [5]

Another study was conducted by Rahul, Sangeeta Vyas et al in 2016 on Spirometric evaluation of the pulmonary functions in the petrol pump workers of Jaipur city and found out that there was 58% affection of lung function of these workers compared to control group. [6]

Aloys Nyagechi et al conducted a study on working environmental factors that affect Quality of Work Life among attendants in Petrol stations of Kenya in 2013 and found that there are several factors affecting the physical and mental health the attendants thus having a negative impact on the quality of life of these petrol attendants. [7]

Numerous epidemiological studies have documented decrements in pulmonary functions with long term air pollution exposure. It has been known for quite sometime that air pollution from petrol/diesel vapour and their exhaust is a major respiratory hazard for workers exposed to it. [8]

The following tools were used for the study: **PEAK EXPIRATORY FLOW RATE (PEFR)** is a sensitive indicator for predicting the magnitude of airway obstruction. PEFR is measured with the help of Mini Wrights Meter. The readings are taken in litres per minute. It is one of the simplest ways of measuring lung function. [9]

3 MINUTE STEP TEST- 1. Purpose: a step test provides a submaximal measure of cardio-respiratory or endurance fitness.⁷ 2. Equipment required: 12 inch (30 cm) step, stopwatch, stethoscope and Pulse-oximeter. Scoring- The total 1 minute post exercise heart rate is the subjects score for the test 3. Advantages: all step tests require minimal equipment and costs, less time consuming and if required the test can be self administered. [10]

SF 12 QUESTIONNAIRE- The SF-12 Health Survey is a multipurpose short form generic measure of health status. It is a subset of the larger SF-36 and monitors physical and mental health in general and in specific populations. It is particularly useful in large population health surveys or applications that combine a generic and disease specific health survey. SF12 is a practical, reliable and valid measure of physical and mental health. [11]

As Mumbai is one of the most polluted cities, petrol pump workers are likely to get exposed to a high level of air pollution along with petrol and diesel vapours and lack of personal protective equipments, both of these factors can affect the respiratory health of petrol pump workers. Studies have been conducted on the evaluation of lung function in petrol pump workers in cities like Delhi, [4] Jaipur, [6] Ahmedabad [13] etc. Despite the number of petrol stations in Mumbai, there is paucity of information regarding the cardiopulmonary health and quality of life of petrol pump workers of Mumbai.

Also this community is neglected by Health care professionals. Hence, the need is felt to conduct the study on these workers. Thus, this study was undertaken to assess lung function using Peak Expiratory Flow Meter, exercise capacity using 3 minute step test and quality of life using SF 12 questionnaire in petrol pump workers.

MATERIALS AND METHODS

This study was conducted in the Department of Physiotherapy, Lokmanya Tilak Municipal Medical College and

General Hospital, Sion, Mumbai, Maharashtra, India after obtaining approval from the ethical committee of our institute.

Materials:

BP Apparatus, Stethoscope, Pulse oximeter, Weighing scale, Peak Expiratory Flow Meter, 12 inch table, Stopwatch, SF12 Questionnaire.

Method:

Permission was taken from the owner and manager of the petrol pumps to conduct the study. After the permission was granted, the study was carried out in 217 non smokers, male petrol pump workers who fulfill the inclusion-exclusion criteria. They were explained about the need of the study and procedure in the language they understand. An informed written consent was taken from all the subjects participating in the study.

Demographic data of the subjects were taken using Subject Evaluation Form. Subjects having a history of acute or chronic respiratory illness, any type of congenital or acquired heart diseases, BMI >30kg/m², any type of known allergic conditions, history of major surgery (Cardiac, pulmonary, abdominal) were excluded from the study.

Breathing maneuvers were explained and made to practice. Each subject was asked to take full inspiration which was followed by as much rapid and forceful expiration as possible in the mouthpiece of the PEFR. Three consecutive readings were taken using Mini Wrights' Meter in Litre/min and the best reading among the

three was considered for statistical analysis.^[5] The obtained value of each subject was compared to the Standard normal values based on individual's age and height.

Then the subjects were explained about the 3-minute test procedure by demonstrating in which the subjects were asked to do alternate step up and step down on a 12 inch step for a total of 3minutes. On completion of the test the subject's heart rate was measured for 1 complete minute. The total 1 minute post-exercise heart rate was the subject's score for the test. The obtained score was compared to its normal value chart (YMCA 3minute step test-Ratings for men).^[10]

Following which the Quality of Life was assessed by giving SF 12 questionnaire to the participants in their preferred language. Scoring of SF 12 – Score >50 indicates Good physical and mental health, Score <50 indicates Poor physical and mental health.^[11]

The data collected was processed with the help of statistical tools.

Statistical Analysis:

The data was analyzed by using the computer software, Microsoft Excel Statistical Package of Social Sciences. The mean and standard deviation (SD) were calculated and reported for the quantitative variables. The statistical difference in the mean values were tested by using unpaired 't' tests. A p-value of <0.0001 was considered as statistically significant.

RESULTS

Table 1: Mean of PEFR values of petrol pump workers and mean of standard normal values (based on individual's age and height)

PEFR Values	Mean
Mean of PEFR values of petrol pump workers	364
Mean of standard normal values (based on individual's age and height)	465

Table 2: Mean and Standard deviation

Mean	Standard deviation	P value	Significance
465	21.9	<0.0001	Significant
364	78.8		

P <0.0001 = Significant

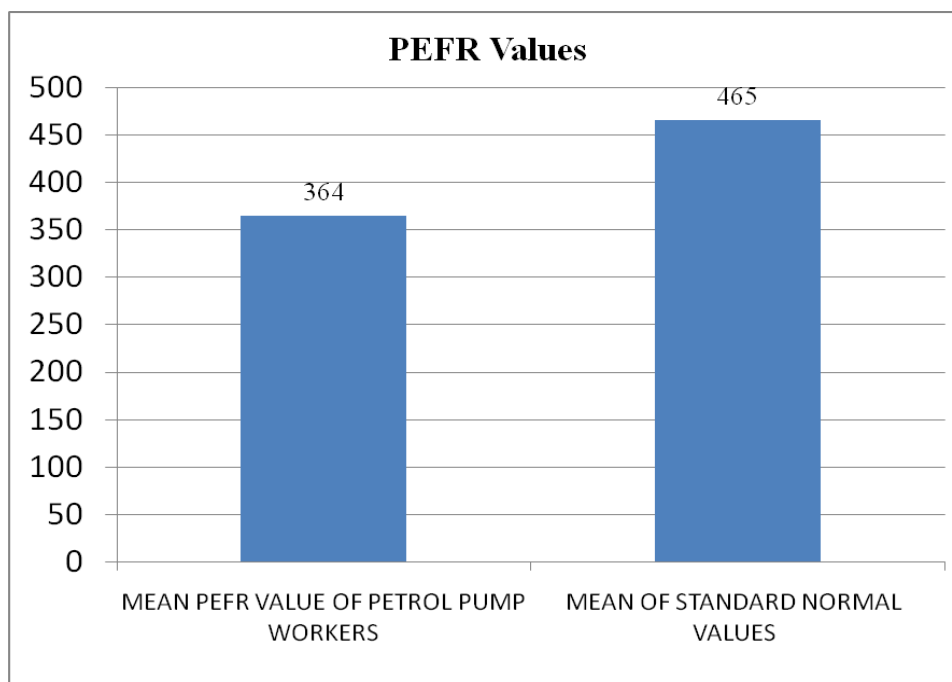


Figure 1

Table 1 and Figure 1 shows a comparison of Peak Expiratory Flow Rates (PEFR) of petrol attendants exposed to gasoline and the Standard Normal values (based on individual's age and height). From the figure, it can be seen that the mean PEFR of the attendants is 364 while the mean of Standard normal values is 465. The result shows that statistically there is a decline in the mean PEFR value of the workers when compared with the Standard normal values. However, the difference is statistically significant (p-value <0.0001).

Table 2: Prevalence of affection of Lung function

PEFR Values	Prevalence of affection of Lung function in %
Reduced PEFR values	74%
Normal PEFR values	26%

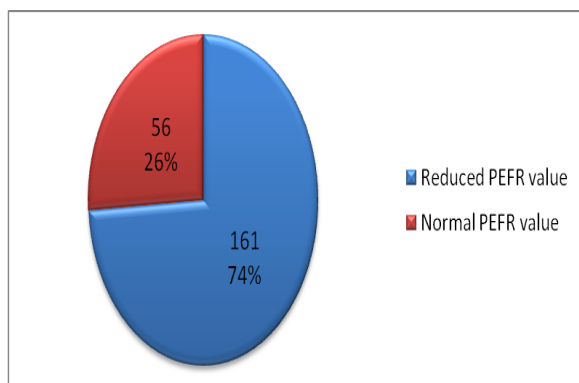


Figure 2

Table 2 and Figure 2 show the prevalence of affection of lung function in petrol pump workers. As seen in the above pie chart, Out of 217 petrol pump workers there are 161 of the workers having reduced PEFR values, thus there is 74% affection of lung function among the petrol attendants.

Table 3: Frequency table

Ratings(based on YMCA 3minute step test)	No. of workers having the response	%
Excellent	0	0%
Good	12	5.50%
Above average	40	18%
Average	69	32%
Below average	73	34%
Poor	19	9%
Very poor	04	1.80%

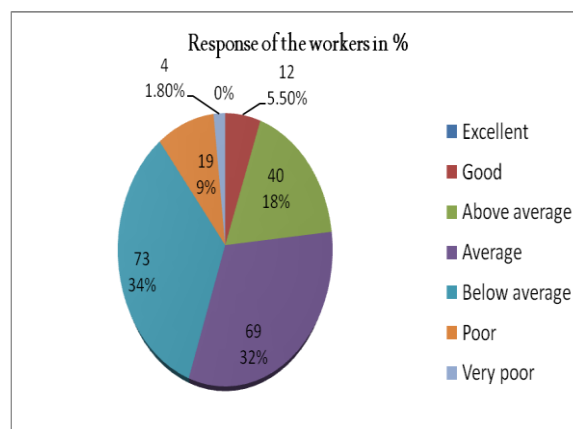


Figure 3

Table 3 and figure 3 shows that that there are 34% of the workers who are below average,9% of them have poor exercise capacity and 1.8% of them have very poor exercise capacity . Thus we can conclude that there is mild affection of exercise capacity among these attendants.

Table 4: Physical health Component of SF-12

Physical component	% of affection
Poor physical health	65%
Good mental health	35%

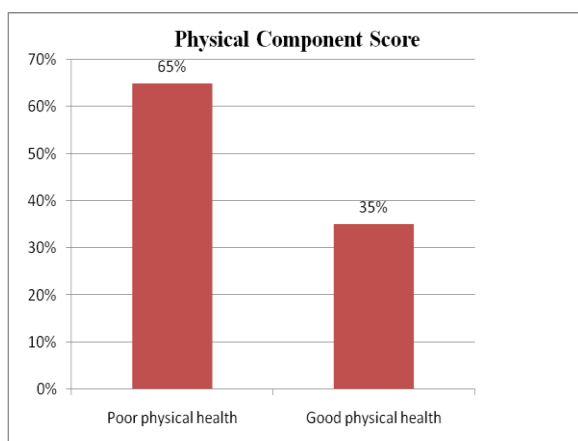


Figure 4

As shown in the above figure 4, 65% of the petrol pump workers that is 142 of them have poor physical health and the remaining 35% of the workers that is 75 of them have good physical health.

Table 5: Mental health Component of SF-12

Mental component	% of affection
Poor mental health	59%
Good mental health	41%

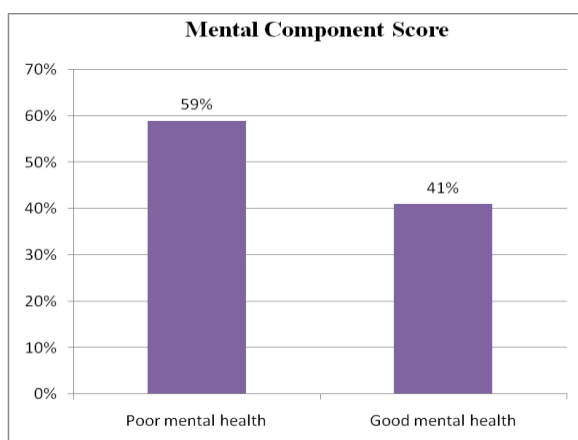


Figure 5

From the above figure 5, it can be seen that 59% of the workers that is 128

workers have poor mental health and 41% of the workers that is 89 of them have good mental health.

From Figure 4 and Figure 5 it can be concluded that the Physical health of the petrol pump workers is affected more than mental health.

DISCUSSION

The present study was conducted to determine the lung function, exercise capacity and quality of life in 217 petrol pump workers of Mumbai, India who by virtue of their occupation are continuously exposed to the gasoline and other chemical vapours.

From our study, we observed that statistically there was a significant difference in the mean PEFR of the petrol pump workers when compared to the Standard Normal values. These findings were in agreement with the studies conducted by Ezejindu et al (2014) and Jigar et al (2018) which described that there was a significant change in the mean PEFR of the test group when compared to the control group. [1,5]

Furthermore, when the PEFR values of the individual subjects in the study group were compared with Standard normal values, 74% of the petrol pump workers were found to have reduced PEFR values. This was in agreement with the study conducted by Rahul et al(2016) on the Spirometric evaluation of Petrol pump attendants in which Spirometric values of the attendants were compared with their own predicted values,57.5% were found to have a pulmonary impairment with obstructive as well as restrictive pattern of lung diseases. [6]

Petrol is a complex combination of hydrocarbons which on emission generate particles. These particles due to their large surface area can carry various toxic compounds that are likely to remain in atmospheric air for a longer period of time and long term exposure to such particles can cause chronic respiratory impairments like obstructive lung diseases (chronic

bronchitis, emphysema, Asthma) or restrictive lung diseases (Interstitial lung disease).^[7] Uzma et al conducted a study in 2008 and found that the ambient air concentration of carbon monoxide is maximum in the area surrounding the petrol stations during peak hours as compared to residential areas.^[12] Thus, a high level of environmental pollution in cities like Mumbai and in area surrounding the petrol stations can have a deleterious impact on the respiratory health of petrol pump workers. Solanki et al found that the workers who work for >8 hours/day are exposed to daily benzene dose of 819ug/day.^[13]

As petrol pump workers in the present study were exposed to petrol and diesel vapours for a long period of time, they are likely to develop obstructive as well as restrictive pattern of lung disease. Our study has been supported by Jigar N Meta et al who conducted a study on Pulmonary functions of petrol pump workers in Anand district (Gujarat) and found that 40% of workers showed obstructive as well as restrictive pattern of lung disease.^[1] In addition, these workers are not wearing any additional protective equipments, this exposes them to have more of lung function abnormalities. In this study, the smokers were excluded, smoking workers are at an even higher risk of developing lung abnormalities as compared to non-smoking petrol attendants.

The present study revealed that there is mild affection of exercise capacity of the petrol pump workers. Due to lack of adequate work tools and their type of work, there is repetitive loading on the heart causing short burst of anaerobic as well as aerobic type of activities for shorter duration leading to extra oxygen demand on the heart. Also they do not have a totally sedentary lifestyle thus there is mild affection of exercise capacity. The affection can be due to long standing job.

Effects of long standing job: (1) Stagnation of blood (pooling of blood) → increased pressure in the veins → reduced blood supply to the heart → reduced stroke

volume, cardiac output and increased oxidative stress → reduced exercise capacity (2) Skeletal muscles work continuously → muscle weakness → reduced blood supply to heart and skeletal muscles → reduced exercise capacity (3) Poor Posture → protracted shoulder and slouched posture → diaphragm is affected → altered biomechanics → restriction of ribcage → reduced mobility of the diaphragm → reduced chest expansion.

The study also revealed poor quality of life among these workers. It has been seen that the physical health (65%) as well as the mental health (59%) of the petrol attendants is affected.

A study by Aloys Nyagechi. K et al in the year 2013(Kenya) found that there are several factors affecting the physical health of the attendants. The above study found that there were 53.5% of the petrol attendants who reported that they were uncomfortable with the safety and health condition of the petrol stations. Also, the workers felt that lack of adequate work tools is another factor that negatively affects the quality of life of the workers. Continuous long standing job at the station exposing to excessive heat causing heat stress (headache and dizziness) and therefore reduced performance, poor posture causing low back pain and knee and pain, lack of protective equipments and the work environment are also the factors affecting the physical health of the workers.^[7]

The common factors affecting the mental health of the attendants are job satisfaction, work environment, stress and work pressure. Aloys.N.K et al found that 69% of the workers agreed that they work under pressure. Also due to double duty shifts, they are not getting enough time to spend with their families thus affecting them emotionally and socially contributing to poor quality of life.^[7]

It therefore shows that safety and health issues, lack of protective equipments, work pressure, stress and provision of inadequate working tools are some of the environmental aspects that bring about poor

quality of life experiences at petrol stations. [7]

Moreover, many of the petrol pump workers engaged in such occupations are largely unaware of the risks related to their tasks. Similarly, the owners and managers are also not aware about the potential hazards resulting in poor implementation of restraint measures and enforcement of laws. [6,16,17]

In order to prevent such occupational hazards, there is a need to spread awareness among these petrol attendants about the cardiorespiratory disorders and the importance and effectiveness of physical therapy.

Recommendations:

1. 6 minute walk test can be carried out to assess the exercise capacity of the workers.
2. Chest expansion of the petrol filling attendants can be done
3. A study can be conducted in Mumbai on knowledge of workers regarding the hazards of their work environment.
4. Chronic exposure to petrol/diesel vapour and their exhaust can lead to chronic inflammation of the respiratory tract and lung parenchyma that future study could be extended to evaluate the status of alveolar-capillary membrane by determining lung diffusion capacities in the workers working in Mumbai.

CONCLUSION

This study concludes that the petrol pump workers showed a decline in the mean PEFV value which was statistically significant and are at a greater risk to develop pulmonary impairment with time. Also there was mild affection of exercise capacity and poor quality of life among these petrol attendants.

So, to prevent these changes in petrol pump workers, we suggest a regular medical observation including pre-employment and periodic medical check-ups and mandatory use of personal protective equipments like masks,

respirators, gloves, shoes at the filling stations for the protection of the workers. Also, health education and training programs should be conducted for the workers, managers and owners regarding safe handling of the chemical instruments. [6,16,17]

Thus, good ergonomic advice, adapting healthy lifestyle along with regular aerobic exercises and relaxation sessions will help them with overall improvement in their working efficiency and thus indirectly improve their socioeconomic status and quality of life.

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