



## The effect of occupational exposure to petrol on pulmonary function parameters: a cross sectional study in Palestine

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### Abstract

Gas stations are a major source of air pollution in modern and urban areas. Previous studies showed that petrol products have some effect on lung function. So, a cross sectional study aims to determine the effect of exposure of petrol products on lung functions of gas station workers. Lung function is measured by spirometer. A total of 84 workers were screened. Their mean age was 40.6 +/- 14.5 years. According to the type of lung status, 78.57% of workers showed lung disease. 76.19% were restrictive lung disease, 2.38% were obstructive lung disease and 21.43% of workers were normal. The mean of the FEV1 of the sample was  $3.0846 \pm 0.703$  compared with predictive value of  $3.836 \pm 0.645$  (p-value=0.001). On the other hand, the mean of the FVC for the study sample was  $3.491 \pm 0.791$  compared with the normal reference value of  $4.822 \pm 0.724$  (p-value=0.001). The descriptive statistics of the FEV1/FVC ratio of these two parameters was  $88.77 \pm 1.018$  compared with a normal reference of FEV1/FVC ratio of  $79.488 \pm 0.437$  (P-value=0.001). In this study we found that gas station workers suffer from a serious effect on their lungs.

### 1. Introduction

Lung diseases are functionally classified as obstructive or restrictive. Obstructive lung diseases, such as [1], are characterized by the obstruction of airways such that air movement in the lung is hampered. Restrictive diseases, such as idiopathic lung fibrosis [2] are characterized by insufficient lung expansion. Some lung diseases exhibit both obstructive and constructive traits [3].

Gas stations are major source of air pollution in modern and urban areas, and can induce serious health effects on the population especially whom are exposed for long time to chemicals it produces. Gas station workers are considered high risk population due to their continuous occupational exposure where there might be negative impact on their respiratory system [4].

In recent years people are victim of pollution, human exposure to air pollutants has been attributed to cause severe health hazards especially in urban areas where pollution levels often high [4]. For example Petrol pump worker are at risk of accelerated decrease in pulmonary functions due to increase exposure to fuel vapor and auto mobile exhaust comparing to other people, previous studies showed a significant reduction of lung volume of these workers, this indicate a lung dysfunction and impairment with time [4]. Subjects exposed to polluted air showed a significant reduction in Forced Vital Capacity (FVC),

Forced Expiratory Volume in First Second (FEV1) [5]. Many groups in the society are at risk for developing adverse consequences owing to their occupation due to exposure to noxious chemical compounds present in gasoline [6]. Petrol contains significant amounts of monocyclic aromatic hydrocarbons such as benzene, toluene, and xylenes (BTX) [7]. There are many harmful effects seen after exposure to certain chemicals present in gasoline mixture such as benzene, lead, and oxygenates, breathing small amount of these compounds can lead to nose and throat irritation, headaches, dizziness, nausea, vomiting, confusion and breathing difficulties. It may affect skin and cause rash, redness and swelling [8].

Lung function tests (LFTs) are measured using a spirometer, which is an apparatus that is used for measuring the volume and flow rate of inspired and expired air. These tests are used to differentiate between obstructive and restrictive diseases and assess the degree of associated changes [1]. Such parameters include Forced Expiratory Volume in the first second (FEV1) and Forced Vital Capacity (FVC). The specificity and sensitivity of spirometry in diagnosis of obstructive lung disease are reported as 84% and 92%, respectively [2]. While in the diagnosis of restrictive lung disease, it has a sensitivity and specificity of 42.2% and 94.3%, respectively [1]. Cases of lung disease in petrol station workers are reported. However, no studies have been conducted on these workers to detect the prevalence and association between petrol exposure and lung disease in Palestine. Similarly, to our knowledge, in literature no study investigated the effect of exposure to petrol among petrol workers. This study aims to investigate the influence of working in gas stations on selected respiratory parameters, as a reflection of the pulmonary function. It investigated the effect of working in these stations on the FEV1 by comparing the spirometrical readings of both the workers and non-workers. Similar application was done for both FVC and FEV1/FVC.

## **2. Methodology**

### **2.1 Study design:**

This study was a cross sectional study, this study recruited gas station workers; they were selected from Jenin and Nablus. 84 workers who they were tested by spirometer to assess pulmonary function and then a blood samples were taken to do CBC.

### **2.2 Population**

The population of study is in the north of west bank especially from Jenin and Nablus.

### **2.3 Sample size and sample technique:**

The study is a cross sectional study that was used the appropriate sampling.

### **2.4 Study tools**

Pulmonary function tests are measured using a spirometer. The sensitivity and specificity of spirometer in diagnosis of obstructive lung disease are reported as 92% and 84% respectively. While in the diagnosis of restrictive lung disease, it has a sensitivity and specificity of 42.2% and 94.3%, respectively. FEV1 is the maximum air volume exhaled with maximal effort in the first second from a position of full inspiration. This value declines less severely with restrictive diseases than obstructive diseases. FVC is the maximal air volume exhaled with maximal effort from a position of full inspiration (Pellegrino, Veii et al. 2005). When there is a continuous exposure to chemicals and petrol products this led to decline in the lung compliance associated with the presence of partial or diffuse lung fibrosis.

These fibrotic changes render the lung smaller and stiffer, leading to a decrease in the FVC. The FEV1/FVC ratio is reduced in obstructive patterns, but it is normal or increased in restrictive patterns.

### 2.5 The data collection from:

Contained three steps; the first was the demographic, which contained questions (age, gender, education level, health history, smoking status, body mass index, duration of exposure to petrol products) etc. The second step of the data collection form consisted of pulmonary function test by spirometer. The third section of data collection is a blood sample for CBC.

### 2.6 Descriptive analysis:

The data were coded and the Statistical Package for Social Sciences (SPSS) program is used, the p value < 0.001.

## 3. Results and Discussion

The study included 84 gas station workers, who agreed to participate in the study and filled the questionnaire. Table 1 shows social and demographic characteristics of participants. Nearly Two thirds were from Nablus (59.5%) and the rest (40.5%) from Jenin. All of them were males as showed in Table 2. The mean of the age was  $40.65 \pm 14.586$  years.

**Table 1: Socio-demographic characteristics and lung status:**

	Age	Weight	Height	BMI
<b>Mean</b>	40.6548	80.4643	1.7346	26.6821
<b>Median</b>	41.5000	76.5000	1.7500	25.4500
<b>Std. Deviation</b>	14.5863	17.6563	.06610	5.30890
<b>Minimum</b>	17.00	32.00	1.48	10.10
<b>Maximum</b>	73.00	125.00	1.85	39.20

**Table 2: Sex**

	Frequency	Percent
<b>Male</b>	84	100.0
<b>Total</b>	84	100.0

According to the type of lung status, 78.57% of the workers showed lung diseases, 76.19% were restrictive lung disease, 2.38% were obstructive lung disease and 21.43% of workers were normal. The mean of the FEV1 of the sample was  $3.0846 \pm 0.703$  compared with predictive value of  $3.836 \pm 0.645$  (p-value= 0.001). (Figure 1)

On the other hand, the mean of the FVC for the study sample was  $3.491 \pm 0.791$  compared with the normal reference value of  $4.822 \pm 0.724$  (p-value=0.001). The descriptive statistics of the FEV1/FVC ratio of these two parameters was  $88.77 \pm 1.018$  compared with a normal reference of FEV1/FVC ratio of  $79.488 \pm 0.437$  (P-value=0.001). (Figures 2-4) and Table 3.

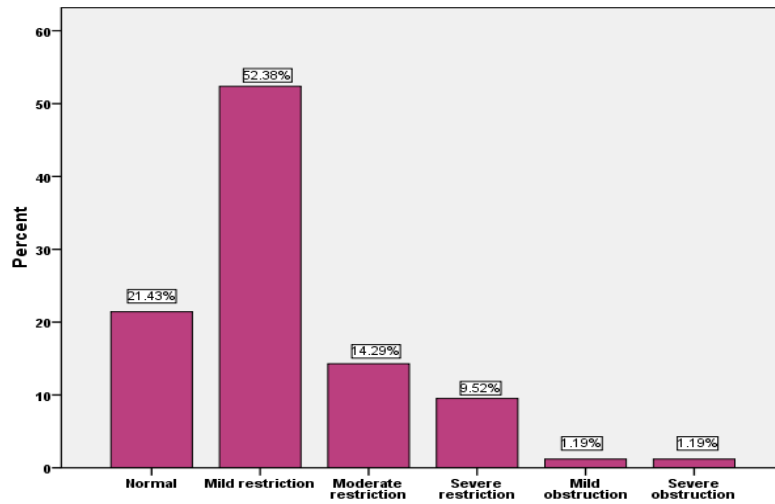


Figure 1: lung status

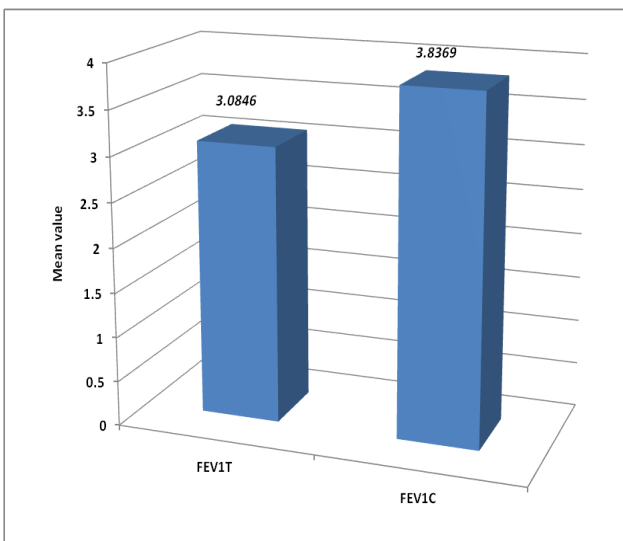


Figure 2: FEV1 Results

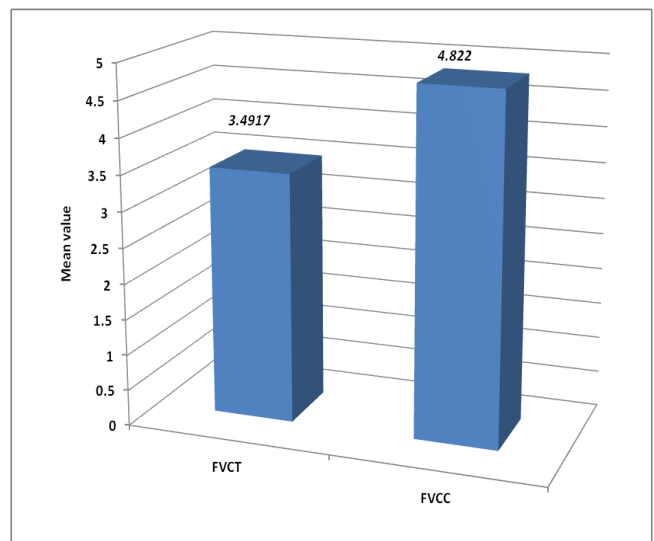


Figure 3: FVC Results

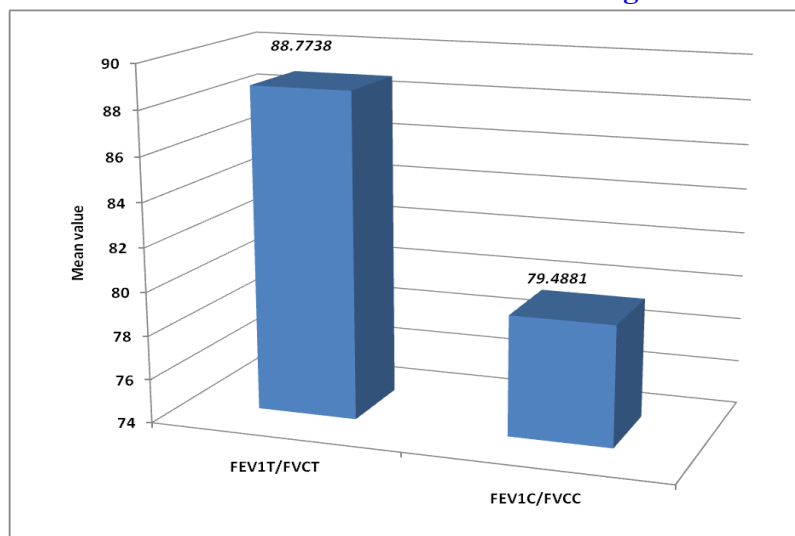


Figure 3: FEV1/FVC ratio Results

**Table3:** The major respiratory parameters; FEV1, FVC and FEV1/FVC ratio.

	<b>Mean (observed)</b>	<b>Mean (expected)</b>	<b>P-value</b>
<b>FEV1</b>	<b>3.08</b>	<b>3.836</b>	<b>&lt;0.001</b>
<b>FVC</b>	<b>3.49</b>	<b>4.82</b>	<b>&lt;0.001</b>
<b>FEV1/FVC</b>	<b>88.77</b>	<b>79.48</b>	<b>&lt;0.001</b>

The purpose of this study was to assess effect of petrol/diesel vapor on the lung function of gas station workers. Petrol is a complex combination of hydrocarbons, which on emission generates particles with a diameter of 0.02 nm. 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 and can deposit them in the small airways on inhalation [9]. Benzene, the major fuel present in gas stations, can be absorbed by lungs after inhalation. It's exaggerating cause of lung impairment in gas station workers [6]. Lung function tests have been of increasing interest in the use for qualitative and quantitative evaluation of pulmonary function in patients with abnormalities of cardiorespiratory system, [10] Increased exposure to fuel vapor and automobile exhaust have resulted in decline in pulmonary function and lung impairment (restrictive pattern) with time in gas station workers compared to other people. Similar findings have been observed in previous studies. The more the duration of exposure the more the effect on pulmonary function [11]. Also, personal protective equipment, such as a face mask, was not used by any of the workers in this study. Studies involving distribution of particulate matter in human lung have shown a major site of impact and injury at the level of the terminal bronchioles and adjacent first generation respiratory bronchioles [12]. Increased risk of pulmonary lung disease is found in gas station workers due to exposure to volatile fuel compounds and motor vehicle exhaust.[4] A study conducted in northern India concluded that alteration of pulmonary function among workers was related to the duration of exposure[9]. Another study conducted in Pakistan showed that respiratory symptoms of cough, shortness of breath, and breathlessness during walking are correlated with pulmonary impairment [13]. Average daily exposure of gas station workers to these chemicals generally exceeds about 10 h/day.

The probable pathologic changes of pulmonary function test is varying degrees of wall thickening and remodeling in terminal and respiratory bronchioles. This is associated with collagen deposition and interstitial inflammatory cells including macrophages [9]. Other than benzene and petrol products in gas stations the exposure of other environmental pollutants may induce airway inflammation [14]. Periodic health checkup, provide air pollutant masks and health education of the workers regarding adverse effects of fuel were shown to reduce the morbidity [15]. Similar findings were reported by Uzma N *et al* [16], Aprajita *et al* [17], Dube S *et al* [18]. Moreover, Miao *et al.* found that life-time summer heat exposure is significantly associated with the reduction of lung function in young adults [19]. On the other hand, in recent years, exposure to air pollution has been studied in rare diseases with interstitial lung involvement such as IPF, rheumatoid arthritis (RA), PHS and sarcoidosis. Several pathogenic mechanisms support the deleterious and possibly fibrosing effect of airborne pollutants. This review focused on the role of exposure to outdoor air pollution in the physiopathological mechanisms possibly involved [20].

## Conclusion

This study has revealed that gas station workers are at greater risk to develop pulmonary impairment with time. Further, this study also sensitizes for the need of regular medical surveillance and implementation of occupational safety programs to prevent work related morbidities. The readings of our study show significant decrease in the FVC and FEV1 values, and an increase in the FEV1/FVC ratio, reflecting the negative effect of Petrol vapor exposure on the lung function. So, safety precautions for workers and restriction of working hours are recommended. Future studies are required to investigate the effects on the diffusion capacity of the lungs and other pulmonary markers in petrol pump workers.

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*Compliance with Ethical Standards:* An-Najah National University was approved the IRB.

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