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Effects of Occupational Exposure on Lung Function Tests in Old Process Plant Units workers, North Oil Company, Iraq

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Abstract

Occupational exposure to petroleum vapors has been shown to affect functioning of different systems of the body. The present study was taken up to assess the Pulmonary Function Tests. **Method:** A total of 356 male old process plant units' workers in north oil company, Kirkuk, Iraq, were assessed for lung function status. Respiratory function test was according to the American Thoracic Society (ATS) recommendations, Questionnaire performed and respiratory functions viz. (FVC, FEV1, FEV1/FVC% and PEF) were recorded by a portable electronic spirometer. **Results:** There was a statistically significant decrease in FEV1, FVC, and PEF in this study of exposured state compared to the normal state which was normal. FEV1/FVC% ratio was within normal limit. **Conclusion:** Most findings point towards adverse effects of petroleum vapors on lung function, mainly on lower airways with restrictive pattern of disease.

Keywords: Petroleum vapour, old process plant units workers, Pulmonary function tests.

Introduction

The prevalence of occupational diseases shows the quality of working conditions and health of working environment [1]. Respiratory system is affected by changes in environmental conditions [2, 3]. Employees in the Petroleum industry are exposed to dust, fumes, and gases of various compositions that may be harmful to the respiratory tract [4]. Airborne contaminants occur in the gaseous form (gases and vapors) or as aerosols. Aerosols may exist in the form of airborne dusts, sprays, mists, smokes and fumes. In the

occupational setting, all these forms may be important because they relate to a wide range of occupational diseases [5]. North Oil Company contains a large number of oil wells [6]. Multiple etiologies no doubt exist for both its inception and symptom exacerbation once the disease is established. Factors underlying inception can range from viral respiratory tract infections in infancy [6, 7]. To occupational exposures in adults [8]. Chronic respiratory diseases cause approximately 7% of all deaths worldwide and represent 4% of the global burden of disease [9]. This study was carried out on old process plant units employees. Petrol, also called gasoline is a complex combination of hydrocarbons. About 95% of components in petrol vapour are aliphatic and acyclic compounds and less than 2% is aromatics [10]. Spirometry is the most comprehensive screening method for chronic lung diseases, including those of occupational an etiology. FVC, FEV1 and FEV1/FVC are the most important indicators in the diagnosis of obstructive and restrictive functional changes [9, 10]. Spirometry was performed according to the American Thoracic Society (ATS) recommendations [11]. A written protocol was created describing spirometric procedures and interpretation of the spirometric results [12, 13]. Regular follow-up courses for evaluation were conducted, with the importance of calibration and technique particularly stressed [15]. If the temperature changed by more than 2^0C during a day of examination, calibration was repeated [14]. The development of occupational respiratory disease is dependent on several factors including the chemical nature and physical state of the inhaled substance, the size and concentration of the dust particles, the duration of exposure, and individual susceptibility [15]. Petroleum product and its exhaust are causing significant health problem symptoms like chronic cough, breathlessness and wheezing, in high concentration they cause marked systemic pulmonary inflammatory response [16]. Chest radiographs and arterial blood gas analysis are unable to detect any significant airway obstruction in the early stages of respiratory disease. Spirometry is a valuable tool to assess lung function in the initial asymptomatic stages of respiratory dysfunction, as compared to other tools. It has been documented that only spirometry enables the detection of chronic obstructive pulmonary disease five to ten years before shortness of breath develops. Petrol workers, who are asymptomatic, may have abnormal lung function [17].

The data suggested that background benzene and air pollutants accounted for substantial part of respiratory, hematological, and thyroid dysfunctioning [18]. The aim of the study was to assess the pulmonary function of workers in old process plant units who are exposed to gases and pollutions resulted from petrol processing.

Method

This study was carried out in Kirkuk city in North Oil Company (N.O.C.), which is a state company within the Ministry of Oil of Iraq. The number of workers in this company is about 12000 workers [18], the study was done during the period of February 2016 – August 2016, whose the workers age between 20-63 years (n=356 male) have been selected from old process plant units employees only, cross section study using spirometry (BTL-08, SN 08MTS 0735501) tool, lung function test which classify the subjects into two group and four states depending spirometery tool, the states were; normal lung function (Control Group) and abnormal lung function as mild, moderate and severe states (Abnormal Group) according to spirometry results. Full instructions and illustrations were done regarding the test, the participant was asked to take full inspiration followed by rapid and forceful expiration into the spirometry for three times, three consecutive readings were recorded, the best result was selected, nose clip was used, tight clothes were removed and the test was performed between 10 and 12 am to avoid diurnal variation and sitting position (according to the guidelines of American Thoracic Society). Parameters used were forced vital capacity (FVC), forced expiratory volume in one second (FEV1), peak expiratory flow (PEF) and FEV1/FVC ratio. Respiratory impairment was considered as FVC < 80%, FEV1< 80%, standard height was measured by centimeters using measuring tape, weight was recorded in kg using portable weighing machine, body mass index (BMI) was calculated using Queteletes index, smoking status and disease history Were recorded, significant diseases and drugs that interfere with the test. Such as asthma, allergy, antihistamin and pneumonia were excluded (recent abdominal, thoracic and eye surgery, recent myocardial infarction or unstable angina), the aim of the study was to assess the pulmonary function of workers in old process plant units who are exposed to gases and

pollutions resulted from petrol processing. Statistical methods used were; mean standard deviation and P-value of <0.05 was regarded as statistically significant.

Results

The purpose of this study is to assess the impact of petrol vapors and environmental pollutions on lung function in old process plant units of north oil company workers in Kirkuk city. Figure (1) show the degrees of affection and percentage of the workers affected, which classify them into four states depending on Spirometric tool; normal, mild, moderate and severe, 51 workers of them were normal 15.3%, while results of 305 workers of them were abnormal (mild 56.1%, moderate 17.3% and severe 11.3%).

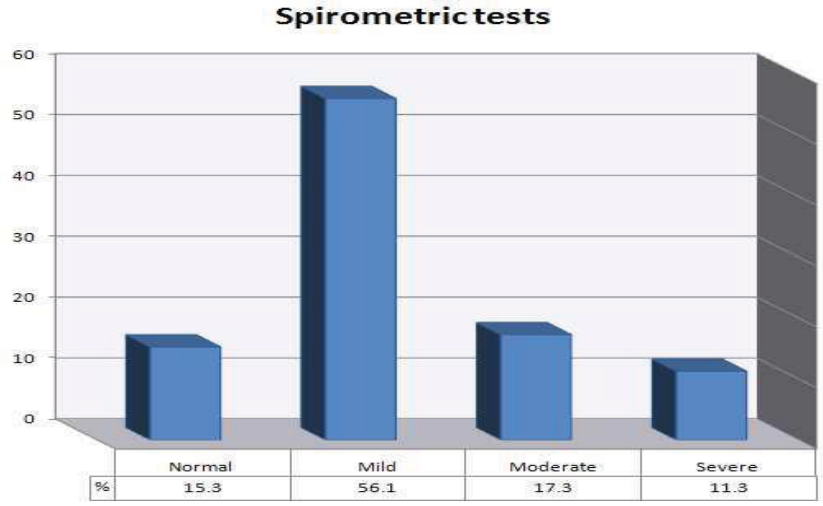

Fig. (1) Percentage Results was Depending Spirometric tests.

Also see table (1) which shows spirometric parameters of the states; FVC, FEV1, PEF and FEV1/FVC ratio. Parameters result show reduction in all abnormal states (mild, moderate and severe) when compared with normal state, there is a statistically significant difference (P = <0.001).

Table (1) groups according to Spirometric Parameters (Mean±SD)

State N (%)	Spiromtery Parameters (Mean±SD)			
	FVC	FEV1	PEF	FEV1/FVC
Normal	4.6±0.39*	4.6±0.54*	9.3±1.64*	100±6.2*
Mild	3.25±0.62	3.1±0.69	6.64±1.8	95.57±8.1
Moderate	2.94±0.38	2.73±0.46	6.22±2.4	93.3±14.6
Severe	2.13±0.8	1.89±0.9	5.70±3.1	88.8±21.7

(*) Statistically significant difference at (P = <0.001) between normal state with other states.

All parameters of normal state show no statistically significant difference between exposure subjects as showen in table (2), while the mean value of parameters of mild State FVC, FEV1 and **PEF** was maximum in Group 1 (4±0.42),(3.9±0.69) and (7.6±1.6) respectively, minimum in Group 4 (2.6±0.42), (2.58±0.69) and (6.14±1.1) respectively, the decline from Group 1 till group 4 was gradual according to years of exposure, statistical significance was observed in the decline between the groups were highly statistically significant ($p < 0.001$).In FEV1/FVC ratio there is no statistically significant difference between exposure groups. The decline in Spirometric Parameters from Group 1 till group 4 was also gradually decreased progressively according to years of exposure in moderate and severe states with high statistically significant difference between exposure groups as showen in table (2).

Table (2) Results Case and parameters with groups of exposures.

Spirometry		Years of exposure (Mean±SD)				P-Value
State	Parameters	0—5 Group 1 (n=72)	6---10 Group 2 (n=90)	11---15 Group3 (n=51)	15-Over Group 4 (n=143)	
Normal	FVC	4.4±0.40	5±0.5	4.8±0.4	4.44±0.3	0.390
	FEV1	4.5±0.56	5±0.6	4.8±0.4	4.4±0.4	0.295
	PEF	9.44±1.6	9.1±1.9	9.24±1.84	9.2±1.54	0.506
	FEV1/FVC	101.3±6.7	100±5.5	99.1±6.2	99±6.6	0.201
Mild	FVC	4±0.42	3.6±0.8	3.1±0.6	2.6±0.42	0.001
	FEV1	3.9±0.69	3.4±0.5	3±0.6	2.58±0.69	0.001
	PEF	7.6±1.6	6.64±1.8	6.34±1.7	6.14±1.1	0.001
	FEV1/FVC	96.87±8.1	95.6±11.6	95±12	94.57±8.1	0.537
Moderate	FVC	3.33±0.4	3.2±0.8	3 ±0.8	2.8±0.52	0.001
	FEV1	3.15±0.7	2.9±0.6	2.8±0.7	2.4±0.49	0.001
	PEF	6.9±1.8	6.4±1.8	6 ±1.7	5.5±1.4	0.001
	FEV1/FVC	94.57±8.1	91.6±11.6	90±12	94.57±8.1	0.705
Severe	FVC	2.6±0.4	2.29±0.6	2±0.4	1.7±0.5	0.001
	FEV1	2.3±0.9	2.04±0.7	1.8±0.6	1.5±0.8	0.001
	PEF	6.78±1.6	6.2±1.8	5.5±1.3	5.2±1.1	0.001
	FEV1/FVC	89.1±18.3	88.6±16.6	90±12	88.5±20	0.933
Variable	Age (years)	41.7 ± 10.8	41.5 ± 9.4	40.3 ± 10	43 ± 11	0.414
	Height (cm)	172.14± 4.25	170.7 ± 3.3	171 ± 3.6	172.3 ± 7	0.531
	Weight (kg)	77.53 ±4.15	77.9 ± 7.2	76 ± 8.19	76.5± 12.4	0.358
	BMI (kg/m2)	26.6 ± 2.19	26.9± 2.5	26 ± 2.18	26.5 ± 2.5	0.189

While the variable factors of age, height, weight and BMI show no statistically significant difference (P-value of 0.414, 0.531, 0.358 and 0.189) respectively, between exposure groups as shown in table (2). There is increasing percentage of smokers progressively among workers according to the severity of affection; normal 21.7%, mild 22.3%, **Moderate** 24% and sever 32% (Figure 2).

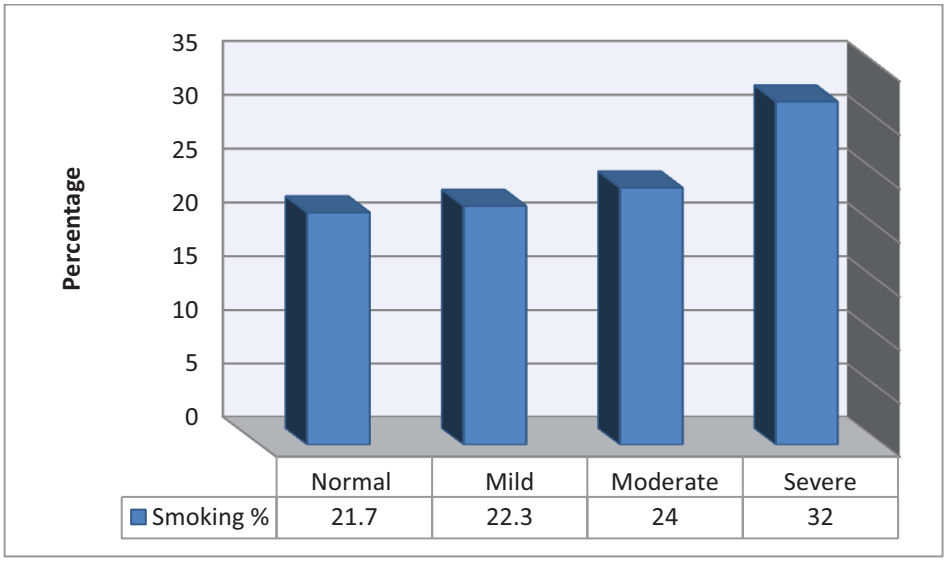

Fig. (2) Percentage smoker's workers results were Depending Spirometric tests.

Discussion

Petroleum means all hydrocarbons, including liquid and gaseous hydrocarbons produced and saved from the contract area [20]. Occupational safety which includes units for safety inspection and accident investigations beside consultative activities regarding safety management in the work place and personal protective equipment specifications and maintenance. Based on these facts, the results of the present study throws brighter light on the adverse effects of occupational exposure on workers of old process plant unit's employees in the lung functional status and the positive relationship between the duration of exposure and the lung volumes. FVC, FEV1, and PEF showed steady decline from 0 to 5 years of exposure till over 15 years' exposure making it clear that the adverse effect is less in short term-exposure and more in long-term exposure. Respiratory conditions are due to inhalation of chemicals, gases, fumes, and vapors; Inhalation of petrol fumes is associated with risk of cancer, respiratory and cardiovascular diseases [21]. The increase in the number of petrol outlets has provided work opportunities to many. However it has simultaneously exposed the people to hazardous chemicals present in petrol and diesel fumes resulting in adverse health effects [22]. On the other hand, in restrictive diseases,

like fibrosis, pneumonia, pulmonary edema, neuromuscular disorders affecting the respiratory muscles etc, the stiffness of the lung tissues increases and the expansibility (compliance) of the lungs is reduced resulting in more decrease in FVC, FEV1 and PEF. Also FEV1/FVC ratio decrease or within normal range. So it may be reduced in both obstructive and restrictive conditions. However, the reduction is more in restrictive diseases than in obstructive diseases [16, 23, 24]. To report spirometric values among petrol company workers in Iraq, showing lung function test which classify the subjects into four states depending spirometery tool, the states were; normal , mild, moderate and severe (15.3%, 56.1%, 17.3% and 11.3%), respectively. In our study there was an increased number of mild cases among the abnormal groups (inspite of increased years of exposure) which mean little affection, this could be due to genetic cause, and /or environmental cause like Exercise and regular physical activity which could increase the strength of the skeletal muscles including respiratory muscles [22]. It is very difficult to diagnose the causes of impaired ventilator capacity, which can be attributed to interrelated genetic and environmental factors [3]. Parameters show reduction in all abnormal states (mild, moderate and severe) when compared with normal state, statistically significant ($P = <0.001$) decrease in FVC and FEV1 was observed in abnormal state when compared with normal state, but their FEV1/FVC ratio did not differ between the two states, this finding indicates the restrictive pattern of pulmonary involvement in the study group [10]. The present study had few limitations; Air analysis was not done, hence the quantification of the amount of fuel vapor inhaled by the subjects could not be commented on, it was also not possible to carry out urine analysis for the metabolites of benzene and toluene to indicate the magnitude of fuel vapor inhalation in the subjects studied [24].

The average exposure was 8h/day; the workers did not wear protective tools like facemask. Pulmonary function abnormality may be because of pulmonary inflammatory response as a result of diluted diesel exhaust over the long duration. These diluted exhausts may contain toxic compound like hydrocarbons and metal like lead, these particles may be responsible for structural damage and impaired lung function [24]. Parameters used were; FEV1, FVC and the parameters FEV1/FVC ratio were within normal limits in 51 of

workers, while the parameters of the remainder 305 workers were abnormal, in whom FEV1, FVC and PEF were decreased progressively according to years of exposure, being lowest in the group of over 15 years of exposure, while the FEV1/FVC ratio was within the normal limit which indicate restrictive type of pulmonary abnormality [15, 24]. Decline in observed values of FVC, FEV1 among abnormal state indicating restrictive type of lung disease was also observed [23]. The prevalence of respiratory functional abnormalities were found to be significantly higher ($p<0.01$) in the smoking workers as compared to nonsmokers [22]. Smoking as an independent variable was found to affect FEV1 significantly and smoking has shown to accelerate the decline in lung function in a time dependent manner [22, 23].

Conclusions

To the best of our knowledge, this is the first study in our country (Iraq) which evaluates pulmonary function tests of workers working in old process plant units of north oil company. Our study suggests that petrol vapors might cause some respiratory impairment in exposed workers, mainly on lower airways with restrictive pattern of disease. It seems clear that exposure to petrol vapors should be considered a potential health hazard. It is recommended to do periodic examination of lung function test for the workers with adherence to safety guidelines like using facemask.

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