

THE USE OF PULMONARY FUNCTION TEST TO PREDICT OCCUPATIONAL LUNG DISEASE AMONG WORKERS IN BASRAH STEEL INDUSTRY

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ABSTRACT

One hundred and eighty asymptomatic workers in the steel industry of Basrah whose duration of employment ranges from 5-15 year were randomly selected and examined at Al Sader teaching hospital during the period (2000-2002). Workers was assessed clinically and the function of their respiratory system were studied by measuring FEV₁ (Forced Expiratory Volume in the first second) and FVC (Forced Vital Capacity). The results showed that the majority of the examined workers 45.55% had restrictive pulmonary defect, 20% had obstructive pulmonary defect while 7.22% had combined obstructive and restrictive defects.

INTRODUCTION

Repeated and continuous long term exposure to certain irritant particles during the work can lead to respiratory system injuries.^[1] The range of injuries depend on size of the particles, large particles are deposited in the nose and upper air way, while roughly particles between one and seven microns have a good chance of reaching and depositing in the alveoli^[2] causing irritation and reaction of lung tissue to their presence leading to pneumoconiosis.^[3]

The aim of this study is to find out the prevalence of respiratory diseases among steel factory workers resulting from their exposure to steel dust. And to install a protective measures like wearing a mask during the work or changing the job for affected workers to prevent and reduce the incidence of respiratory diseases resulting from inhalations of steel dust.

PATIENTS AND METHODS

One hundred and eighty asymptomatic workers working in steel industry in Basrah city were

randomly selected. Ages ranged from 30-50 years. One hundred and sixty nine were males (93.9%) and 11 were females (6.1%), who were free of recurrent episodes of wheezing, chest tightness and breathlessness. One hundred & thirty seven of the workers were non smokers (76.1%), the rest (43) were smokers (23.9%). All workers had different degree of exposure to substances, gases and dust in the steel factory. Physical examination and respiratory function test (FEV₁ and FVC) by using Spirometer models (Buckingham,UK) were done to all workers in the Physiology Department of Basrah medical college. The highest values of FEV₁ & FVC from technically satisfactory maneuvers differing by less than 5% were recorded, measurements were corrected to BTPS (Body Temperature Pressure Saturated with water vapor). The normal and abnormal Spirometry values as a percentage of Predicted values were followed according Cherniack RM and Raber MB.^[4] as shown in (Table-1).

Table 1. *The pattern of values on spirometry*

	Normal	Obstructive disease	Restrictive disease	Combined disease
FEV ₁	Greater than 80% predicted	Less than 80% predicted	Less than 80% predicted	Less than 75% predicted
FVC	Greater than 80% predicted	Usually Greater than 80% predicted but may be reduced in severe diseases	Always less than 80% predicted	Less than 75% predicted
FEV ₁ / FVC %	Greater than 70% predicted	Less than 70% predicted	Greater than 70% predicted	Less than 75% predicted

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The assessment of severity of airflow obstruction(COPD) according to FEV₁ as a percentage of predicted value was graded as follows.^[5]

Grades of COPD

- Normal:** FEV₁ % ≥ 80% predicted
- Mild:** FEV₁ % = 60-79% predicted
- Moderate:** FEV₁ % = 40-59% predicted
- Severe:** FEV₁ % < 40% predicted

RESULTS

Sixteen (20%) out of 180 workers had pattern of obstructive lung disease (4 workers were smokers and 12 were non smokers), of whom none had severe, 2 had moderate and 14 had mild COPD, Eighty-two (45.55%) out of 180 workers had restrictive pulmonary disease, 23 were smokers and 59 were nonsmokers (Table-2).

Table 2. Types of abnormalities in respiratory function tests among non smoker & smoker workers

No. of workers	↓FEV ₁ % Obstructive	↓FVC% Restrictive	Combined obstructiv/ restrictive	Normal
180	16 (20%)	82 (45.55%)	13 (7.22%)	69 (38.33%)
Smokers	4	23	1	15
Non smokers	12	59	12	54

Thirteen (7.22%) out of 180 workers had combined obstructive/restrictive pulmonary defects (one was smoker and 12 were non smokers) (Table-2). Statistical analysis using the χ^2 test for the obstructive and restrictive defects with normal profile (pattern) in relation to smoking is shown in (Table-3).

Table 3. The relationship between smoking and restrictive & obstructive defects.

Number of workers	↓FVC Restrictive (%)	↓FEV ₁ Obstructive (%)	Normal
Smokers	23 (28%)	4 (25%)	15 (21.7%)
Non smokers	59 (71.9%)	12 (75%)	54 (78.2%)
Total	82	16	69

Restrictive: Chi-square test was applied, P-value= 0.4828 (not significant)
 Obstructive: Chi-square test was applied, P-value= 0.9594 (not significant)

DISCUSSION

According to the results of this study, it was found that 82 out of 180 workers had restrictive pulmonary defect & majority of then (71%) were non-smokers which indicate that inhalation of steel dusts in the lung can result in pulmonary fibrosis and other parenchymal changes irrespective of smoking habit. Occupational pneumoconiosis will not have immediate symptoms, so workers continue being exposed to harmful toxins without realizing its harmful & potentially deadly effects especially on working in an enclosed or poorly ventilated working space.^[6] On the other hand, 23 smoker workers out of 82 had restrictive defect which may indicate that cigarette smoking is an important co-factor in many dust related diseases, because cigarette smoke impairs bronchial clearance by slowing and disorganizing ciliary's action, thus promoting greater dust retention in the lung.^[7] Reduction in the diffusing capacity is generally apparent in more advanced chronic exposure to dust and probably reflects associated emphysema.^[8] Our results are generally consistent with the results of previous studies which demonstrated abnormal pulmonary function tests among miners^[8] especially when exposure period maintained throughout individual's working life. The results in of the present study also indicate that there is no significant association between smoking and obstructive lung diseases, this indicate that occupational exposure is associated with increased risk for accelerated loss of lung function although the effect is usually small compared to the effect of cigarette smoking.^[9] Work in dusty environment increases the risk of developing chronic bronchitis two to three folds and in combination with smoking the risk increases to six folds^[10] and episode of increased pollution may contribute to a cute mortality.^[11] However, a clinician should never reject the diagnosis of a pneumoconiosis solely on the grounds that exposure was too remote, too short. The miner may be unusually susceptible, may have had an unusual exposure profile, or may retain more dust than others similarly exposed.^[12,13] In United States two longitudinal studies were performed which showed that mine dust exposure resulted in an FEV₁ loss during follow-up period that was approximately one third as severe as the effect

of smoking. This effect increased to be comparable to that of smoking with higher dust exposure levels. Pneumoconiosis, should be considered year for year to be equivalent to smoking as a cause of COPD. Over all 7.22% of workers had combined obstructive and restrictive pulmonary defects. A reduced FVC together with a low FEV₁/FVC% ratio is a feature of a mixed ventilatory defect, in which a combination of both obstruction and restriction appear to be present. Several studies had found an association between a mixed ventilatory defect in exposed population, a substantial proportion of patients (up to half in some series)^[14] exhibit a mixed or obstructive function profile in keeping with parallel development of airway and parenchymal effect of working in dusty environment contaminated by mineral dust. On the other hand, 38.33% had normal pulmonary function test this indicates that occupational lung disease may be associated with apparently normal lung function, or with a predominantly obstructive, restrictive, or mixed pattern of dysfunction.

In conclusion, steel industry exposure adversely affects pulmonary function tests through decreasing both FEV₁ and FVC in asymptomatic workers which confirms the suggestion that respiratory function tests abnormality may precede symptoms for many years. Steel industry workers, therefore, should undergo periodic spirometry pulmonary function tests at rest and during exercise where indicated. In addition, there is a need to determine whether there has been environmental or occupational exposure of duration, intensity, and character sufficient to account in full or in part for the miners present condition.

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