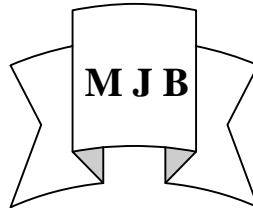


## Spirometric Measurements in Al-Diwaniya Brick Factory Employees

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### Abstract

Spirometric measurements including forced vital capacity (FVC), forced expiratory volume in first second (FEV<sub>1</sub>), forced expiratory volume ratio (FEV%) and peak expiratory flow rate (PEFR) were done for 83 males. Their ages ranged from 20 to 47 years (mean 36.06 ± 9.2 years). Their average height was 171.91 ± 5.47 cm. Some of them were employees in an old brick factory in Al-Diwaniya Governorate (n = 53) who were classified into three groups according to severity of exposure to occupational dusts and fumes which were: first group or 1st (n = 26) including workers with severe exposure, second group or 2nd (n = 15) including employees with moderate exposure and third group or 3rd (n = 12) including employees with mild exposure. The others were healthy subjects randomly selected from the general population of Al-Diwaniya City to be regarded as control group (n = 30). There were no significant differences in age and height among the four study groups. FVC, FEV<sub>1</sub> and PEFR were significantly lower in 1st group than in the other three study groups (p< 0.001) while FEV% was significantly higher in the first group than in the other three groups (p<0.001). FEV% was also significantly higher in the second group than in control group (p<0.001). No other significant differences were observed. It is concluded that workers in continuous close contact with the occupational dusts and fumes of an old brick factory were having mixed restrictive and obstructive patterns of abnormal spirometric measurements.

### Introduction

The impact of engagement in dusty occupations on lung function was thoroughly documented all over the world [1-5] and in Iraq [7-13]. They were shown to result in restrictive and/or obstructive patterns of decline in lung function [12-17]. The restrictive pattern is characterized by severe decline in FVC with normal or slightly declined FEV<sub>1</sub> and PEFR resulting in increased FEV% [18]. The obstructive pattern is characterized by severe decline in FEV<sub>1</sub> and PEFR with normal or slightly declined FVC resulting in decreased FEV% (18). Mixed pattern of restrictive and obstructive patterns is characterized by severe decline in FVC, FEV<sub>1</sub>, PEFR and FEV% [18].

### Subjects and Methods

The majority of employees in the old brick factory under experiment were males with

The type, severity and period of exposure to occupational dusts and fumes vary from one worker to another according to the work they perform [19]. Hence; the effects on lung function may not be the same for all workers.

Modern brick factories are scientifically constructed to reduce their ecologic hazards [20 ,21] in comparison with old brick factories which continuously throw their heavy dusts and fumes to the already polluted environment [22]. Yet, old cheap brick factories are dominated in Iraq merely for pure economic reasons.

The aim of present research is to study the effects of three levels of exposure to the dusts and fumes of an old brick factory on FVC, FEV<sub>1</sub>, FEV% and PEFR.

only very few females. So, females were excluded from present research because of their statistically inconclusive number. A total number of 68 male employees were

working in the factory. Six of them were excluded due to their very short period of employment and the only 9 non-cigarettes smokers were also excluded due to their small number. The other 53 participants were cigarettes smokers working in the factory for duration of six months to five years. They were classified into three study groups according to the severity of exposure to dusts and fumes depending on their place of work in the factory:

**First group (1st):** includes workers in continuous, direct and close contact with dusts and fumes like those who burn the fuel around the batches of clay (n = 26).

**Second group (2nd):** includes workers moderately exposed to dust and fumes like those who transport the produced batches to the store or to the vehicles (n = 15).

**Third group (3rd):** includes employees mildly exposed to dusts and fumes like those who perform administrative tasks (n = 12).

**A fourth group is control group** which includes randomly selected healthy subjects from the general population of Al-Diwaniya City (n=30). They were selected to be cigarettes smokers as the factory workers.

Spirometric measurements including FVC, FEV<sub>1</sub> and FEV% were done with the use of a standardized spirometer produced by Vitalograph Medical Instrumentation Co. Ltd, Buckingham, England.

Measurements of PEFR were done with the use of a standardized Wright peak flow meter while measurements of height were done with a well calibrated scale.

Spirometric measurements were done in sitting position after a period of resting time to achieve the steady state which means that the heart rate in consecutive minutes is changing by less than 3 beats per minute [23]. With a clipped nose, the subject is instructed to inspire forcefully as much as possible and then to blow out through the fully and tightly encircled mouthpiece of spirometer as forceful and as quick as possible until no more air can be blown from the lungs. This is the right

forceful expiratory maneuver [24- 26] which is allowed to be done in three trials with the best result to be recorded [27].

The same forceful expiratory maneuver is done with the use of Wright peak flow meter after a period of rest [28].

Means and standard deviations were calculated for all parameters in the whole study population and in the four study groups separately. Student's t-test was employed to compare the means of various groups and statistical decisions were regarded significant when p values were < 0.05. Graphs were drawn to clarify the results [29].

## Results

The age range of the total population was 20 – 47 years (mean 36.06 ± 9.2 years). Their average height was 171.91 ± 5.47 cm. Spirometric measurements were as follows:

Average FVC = 4.28 ± 0.57 L, FEV<sub>1</sub> = 3.6 ± 0.33 L, FEV% = 84.52 ± 4.64 and PEFR = 464.71 ± 57.43 L/min. Table 1 summarizes the means and standard deviations of ages, heights and spirometric measurements in the four study groups.

There were no significant differences in age and height among the four study groups.

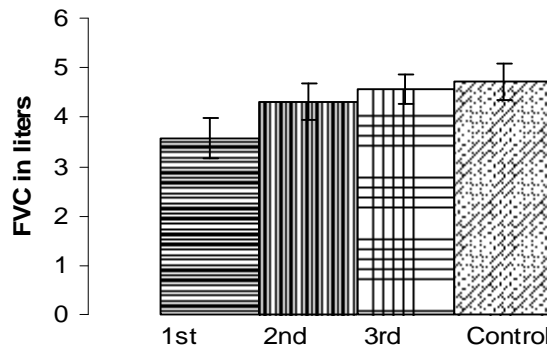
FVC was significantly lower in first group than in the other three groups (p<0.001) while no significant differences in FVC were observed among the other groups (figure 1).

The same results were observed in regard of FEV<sub>1</sub> (figure 2) and PEFR (figure 4).

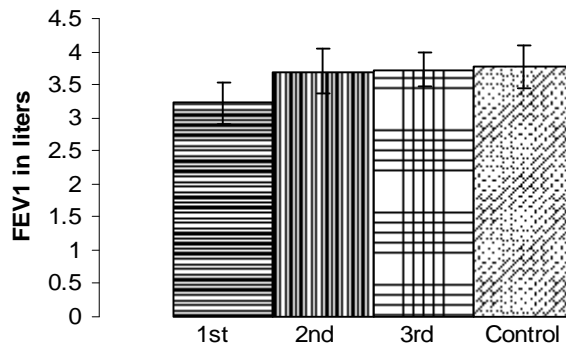
FEV% was significantly higher in the first group than in the other three groups (p<0.001). It was also significantly higher in the second group than in control group (p<0.001) while no other significant differences were observed (figure 3).

**Table 1** Means and standard deviations of ages, heights and spirometric measurements in the four study groups.

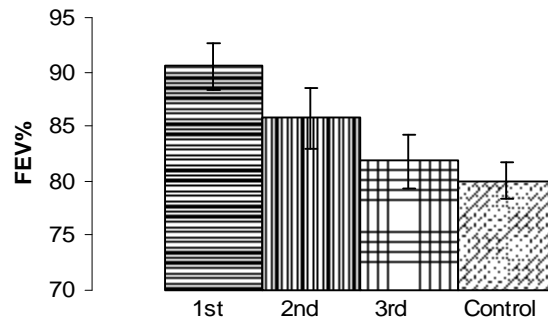
Study groups		1st (n=26)	2nd (n=15)	3rd (n=12)	Control (n=30)
Age (in years)	Mean	31.83	37.75	36.92	37.73
	SD	9.42	9.01	9.2	9
Height (in cm)	Mean	171.92	170.81	171.67	170.33
	SD	5.81	5.38	5.19	5.81
FVC (in liters)	Mean	3.58	4.31	4.56	4.72
	SD	0.42	0.37	0.3	0.38
FEV1 (in liters)	Mean	3.22	3.69	3.73	3.77
	SD	0.31	0.33	0.26	0.32
FEV%	Mean	90.5	85.75	81.83	80
	SD	2.06	2.83	2.48	1.65
PEFR (in L/min.)	Mean	400.83	471.25	497.5	501.25
	SD	47.28	38.85	39.69	41.02



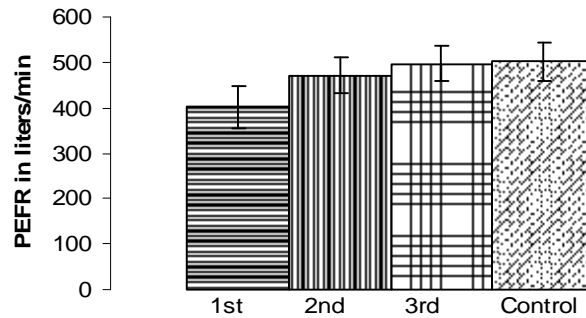
**Figure 1: FVC in the four study groups**



**Figure 2: FEV1 in the four study groups**



**Figure 3: FEV% in the four study groups**



**Figure 4: PEFR in the four study groups**

### Discussion

We were obliged to exclude non-smoker workers due to their very small number that can not be subdivided into three groups. Furthermore, lung function in non-smokers was shown to be less affected than smokers in cement factory [2] Accordingly, control subjects were also selected to be smokers because it is not logical to compare the results of smoker workers with non-smoker controls due to that the differences may be related to smoking effects rather than to the occupational dusts and fumes. Recall that there were no significant differences in age and height among the four study groups (table 1); so, there is a considerable reason to attribute the results to the occupational dusts and fumes.

Despite the fact that FEV% was significantly higher in the first group than in control group which impose a restrictive pattern of spirometric measurements in

that group [12] but the concomitant significantly lower PEFR indicates that there were mixed restrictive and obstructive patterns of spirometric outcomes in the first group.

Cigarettes smoking may worsen the condition by aggravating the tendency for obstructive pattern in brick factory workers. In other words, smoker controls were not found to have obstructive pattern of spirometric measurements but with continuous exposure to occupational dusts and fumes; smoker workers were shown to additively develop obstructive pattern in addition to restrictive pattern [3]

In the second and third groups, moderate to mild exposure (respectively) may not have the same effects on lung function as that found in the first group. Continuous close contact with dusts and fumes may be the most important factors leading to development of abnormal lung

function [22]. The relatively small sample size may be another explanation [14].

Since there are no precautions can be done to protect those poor workers from fatal pulmonary diseases, it is recommended to substitute the hazardous old brick factories with less harmful modern factories in which many protective measures are carried out like using filters and special chemical substances which react with the harmful products in order to minimize the effects of dusts and fumes [20]. Moreover, workers must be instructed to use masks over their noses and mouths to avoid inhalation of many harmful products [30].

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