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ORIGINAL ARTICLE

# Lung Function Comparison by the Technique of Spirometry Between Different Working Groups of Pakistan: A Cross-Sectional Survey Based Study

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***Authors' Contributions***
*1 Conception & Study Design, Data Collection, Data Analysis, Drafting, Critical Review.*
*2 Data Collection, Drafting.*
*3 Data Analysis, Critical Review.*
*4 Conception & Study Design, Data Collection, Drafting.*

***Article info.***
*Received: January 17, 2019*
*Accepted: July 24, 2019*

***Funding Source:*** *Nil*
***Conflict of Interest:*** *Nil*

***Cite this article:*** *Ahmed T, Waqas M, Zuberi SA, Iqbal Q. Lung Function Comparison by the Technique of Spirometry Between Different Working Groups of Pakistan: A Cross-Sectional Survey Based Study. RADS J. Pharm. Pharm. Sci. 2019; 7(2): 97-106.*

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## ABSTRACT

**Objective:** To evaluate the comparison of lung function among carpenters, stone quarry workers, and coal miners.

**Methods:** This was a cross-sectional survey-based study. The study was conducted in two cities, Quetta and Mach, Balochistan province, Pakistan. The validated survey form and spirometer were utilized. A total number of 300 men workers; carpenters, stone quarry workers and coal miners, 15 years and above were considered. The parameters of spirometer; Forced Vital Capacity (FVC), Forced Expiratory Volume in the first second (FEV1), Peak Expiratory Flow Rate (PEFR) and Forced Vital Capacity ratio (FEV1/FVC) were evaluated. The information was exactly evaluated by utilizing Microsoft Excel-2013 and SPSS-22.

**Results:** The FVC mean value± in carpenters were 80.73±16.26, followed by FEV1 (61.74±12.43), PEFR (75.23±19.10), and FEV1/FVC mean value± (77.90±15.77). The FVC mean value± in stone quarry workers were (84.58±12.37), FEV1 (62.46±11.76), PEFR (70.02±17.12), and FEV1/FVC (73.90±10.45). The FVC mean value± in coal miners were (84.36±08.35), followed by FEV1 (60.79±08.77), PEFR (74.44±13.01), and FEV1/FVC 72.13±08.14.

**Conclusions:** The findings indicate that the lung function of all working groups was adversely affected and disclosed restrictive lung disease. The lung function of coal miners was more affected than the carpenters and stone quarry workers.

**Keywords:** Lung function, spirometry, cross-sectional, Quetta, Mach, Balochistan, Pakistan.

## INTRODUCTION

Occupational disorders are the chief source of debility in employees. When timber, silica and coalmines dust passes in the respirational system, the human body deliberates it to be the external material which should be protected against. Contact to atmosphere air pollution is related to the rise in mortality and morbidity from cardiovascular and respiratory diseases [1]. Persons at work in a dusty atmosphere face the danger of inhaling constituents that may lead to adversely affect the respirational system [2]. All working places produce the high level of dust typically from, asbestos, cement, wood, stone, coal mine dust,

concrete, silica, sand, and the labors are unprotected to this flying dust [3, 4]. Persons working in dusty condition task the threat of breathing in particulate materials that may rapid undesirable breathing effects [2, 5]. Wood dust, coal mine dust and cement particles which are inhaled are stuck in the lung and causes lung irritation, mucus hypersecretion primarily, followed by lung function injury, lung swelling, chronic obstructive lung disease, restrictive lung disease, and pneumoconiosis [2, 6-9]. Road sweeping is related with contact to dust, throughout sweeping the roads with brushes, and by the vehicular drive as well as additional human activities raised up several quanta of dust which are inhaled by the labors caused in breathing problems [10] and lung cancer as well as other kinds of cancer [11]. A high frequency of a cough, sneezing and eye irritation, chronic bronchitis coupled by infection of the throat has also been described [12]. The gathering of household excess is a hard job, it also needs recurrent hefty physical activity such as the physical lifting and management of heavy weight bins [13, 14], contact is also related with health belongings such as respirational symptoms, influenza's like symptoms and enlarged risk of chronic obstructive pulmonary disease [7]. Community-based studies have verified, increased comparative risks for respiratory indications consistent by chronic obstructive pulmonary disease as well as for extra annual failures in Forced Expiratory Volume in one second (FEV1) related by work-related contact to gases or dust [15]. In work-related respirational illnesses, spirometry is one of the greatest significant investigative tools which plays an important role in the diagnosis and prognosis of these illnesses and defines the effect of restrictive or obstructive lung disease [16]. It is also used for screening workforces by contacts to agents related by pulmonic diseases. Lung function is inclined by features such as height, weight, environment, sex, age, and ethnicity [17].

Lung function test offers an indistinct understanding of pulmonary function in subjects of different races, age, sex, occupation, and profession. This study was intended in such a way to examine the effect of dust contact and lung function of the carpenters, stone quarry workers and coal miners using the spirometry technique.

## MATERIALS AND METHODS

### Study Design

It's a non-interventional, observational and analytical cross-sectional study design.

### Study Setting

The present study was conducted, on carpenters and stone query workers in Quetta while, on coal miners, the data was collected from the Mach, district of Bolan, Balochistan, Pakistan because there is no coalmine present at Quetta, Pakistan.

### Duration of Study

The duration of the study was from January-2018 to June-2018.

### Sample Size and Selection Criteria

A total number of 300 study respondents, age group 15 years and above were included using a convenience sampling technique method. The ratio was kept as 1:1:1, for each category *i.e*. carpenters, stone query workers, and coal miners, respectively.

### Study Tools

The survey form and the spirometer were utilized. The questionnaire was validated with the help of two assistant professors working at different universities. Questions related to personal and work characteristics including; age group, height, weight, BMI, smoking history, blood pressure, pulse rate, education, and disease status were collected. The several complaints observed and collected from the workers were confirmed by the assistance of a Pulmonologist. Spirometry was performed on a portable Contac (SP10) Digital Electronic Spirometer. This software allows the calculation of the predicted mean values for age, weight, and height and it also gives the recorded values of all the parameters adjusted for the study population.

### Study Method

Pre-consent was debated and fully signed from all the study respondents they wish to participate. All working groups were talked about utilizing an existing respirational safekeeping survey. The study was conducted on carpenters, stone query workers from Quetta and coalminers of Mach districts of Baluchistan, Pakistan and documented the data in the survey and spirometry was done unconnectedly, the

investigation was done by a qualified Pharmacist by 10 AM – 03 PM from Saturday to Thursday a desk site for all the study respondents. The device was standardized every day with one-liter calibration syringe and worked inside a temperature range of (20-25°C). The operation was clarified to the subjects and 3 exercises were performed after a suitable break. Exercises were done in an upright position without a nose clip and disposable mouthpieces used for everybody. Tests were directed according to American Thoracic Society (ATS) references. The FVC, FEV1, PEF, and FEV1/FVC were documented and evaluated.

### Statistical Investigation

The frequency, percent, mean value and standard deviation were calculated. The information was exactly assessed by using Microsoft Excel 2013, SPSS-22 and related sample Friedman's two-way analysis was performed for the statistical significance level ($P<0.05$).

### Consent to Participate

Pre-consents were taken from all the study population who were agreed to participate.

## RESULT

Carpenters; one hundred carpenters were nominated out of which age group of 15-30 years was 59 (59.0%), followed by 30-45 years 23 (23.0%), 46 years and > 18 (18.0%). Most of the carpenters were uneducated 32 (32.0%). The total 8 (8.0%) of carpenters were anemic and most of them were smokers 62 (62.0%). Stone query workers; one hundred stone query labors were chosen, out of which age group of 15-30 years was 92 (92.0%), 30-45 years 7 (7.0%), and 46 years and > above 1 (1.0%). Most of the stone query workers having metric degree 36 (36.0%). The total 4 (4.0%) of stone query workers having cardiac disease and most of them were non-smokers 63 (63.0%). Coal miners; one hundred coal miners were chosen, out of which age group of 15-30 years was 40 (40.0%), 30-45 years 39 (39.0%), and 46 years and above were 21 (21.0%). Most of the coal miners having primary education 55 (55.0%). The total 24 (24.0%) of coal miners were anemic and most of them were non-smokers 53 (53.0%) as shown in Table **1**.

**Table 1. Demographics characteristics.**

| Description (N=300) | Carpenters N (%) | Stone Quarry Workers N (%) | Coal Miners N (%) |
|---|---|---|---|
| **Age Group** | | | |
| 15-30 years | 59 (59.0%) | 92 (92.0%) | 40 (40.0%) |
| 31-45 years | 23 (23.0%) | 07 (7.0%) | 39 (39.0%) |
| 46 years and > | 18 (18.0%) | 01 (1.0%) | 21 (21.0%) |
| **Education** | | | |
| Twelfth Standard | 04 (4.0%) | 09 (9.0%) | 01 (1.0%) |
| Metric | 12 (12.0%) | 36 (36.0% | 10 (10.0%) |
| Middle | 22 (22.0%) | 18 (18.0%) | 06 (6.0%) |
| Primary | 25 (25.0%) | 26 (26.0%) | 55 (55.0%) |
| Islamic Education | 05 (5.0%) | 02 (2.0%) | 26 (26.0%) |
| Uneducated | 32 (32.0%) | 9 (9.0%) | 03 (3.0%) |
| **Diseases Status** | | | |
| Anemia | 08 (8.0%) | 03 (3.0%) | 24 (24.0%) |
| Respiratory system | 03 (3.0%) | 01 (1.0%) | 02 (2.0%) |
| Cardiovascular system | 03 (3.0%) | 04 (4.0%) | 05 (5.0%) |
| Urinary system | 02 (2.0%) | 01 (1.0%) | 04 (4.0%) |
| Nervous system | 01 (1.0%) | 02 (2.0%) | 01 (4.0%) |
| **Smoking History** | | | |
| Smokers | 62 (62.0%) | 37 (37.0%) | 47 (47.0%) |
| Non-Smokers | 38 (38.0%) | 63 (63.0%) | 53 (53.0%) |

**Table 2. Mean value and standard deviation evaluation.**

| Description (N=300) | | Age | Weight (Kg) | Height (m) | BMI | Pulse (R/min) | Systolic B.P (mmHg) | Diastolic B.P (mmHg) |
|---|---|---|---|---|---|---|---|---|
| **Carpenters** | **M** | 29.73 | 70.87 | 1.69 | 24.77 | 84.79 | 130.83 | 82.12 |
| | **SD** | 12.725 | 18.096 | 0.10 | 5.430 | 13.775 | 12.070 | 11.704 |
| **Stone Quarry Workers** | **M** | 24.24 | 74.70 | 1.70 | 25.98 | 84.23 | 134.24 | 83.10 |
| | **SD** | 5.001 | 16.419 | 0.09 | 5.168 | 13.816 | 14.414 | 13.113 |
| **Coal Miners** | **M** | 33.87 | 78.97 | 1.66 | 28.44 | 48.53 | 113.53 | 104.60 |
| | **SD** | 11.453 | 12.120 | 0.05 | 4.266 | 30.882 | 29.021 | 30.987 |

M = mean value, SD = standard deviation

**Table 3. Spirometry comparison of different working groups.**

| Group | | FVC% | FEV1% | PEF% | FEV1/FVC% |
|---|---|---|---|---|---|
| **Carpenters** | **M** | 80.73 | 61.74 | 75.23 | 77.90 |
| | **SD** | 16.265 | 12.434 | 19.104 | 15.779 |
| **Stone Quarry Workers** | **M** | 84.58 | 62.46 | 70.02 | 73.90 |
| | **SD** | 12.378 | 11.760 | 17.129 | 10.457 |
| **Coal Miners** | **M** | 84.36 | 60.79 | 74.44 | 72.13 |
| | **SD** | 8.358 | 8.776 | 13.018 | 8.142 |

M = mean value, SD = standard deviation

Carpenters; The mean value± of age (years) were 29.73±12.75, height (m) (1.69±0.10), weight in kg (70.87±18.09), pulse rate (84.79±13.77), mean value± of systolic B.P (130.83±12.07), diastolic B.P (82.12±11.70) and BMI was (24.77±5.43). Stone query workers; The mean value± of age (years) were (24.24±5.00), height (m) 1.70±0.09, weight in kg (74.70±16.41), pulse rate (84.23±16.81), systolic B.P (134.24 ±14.41), diastolic B.P (83.10 ±13.11) and BMI was (25.98±5.16). Coal miners; The mean value± of age (years) were 33.87±11.45, height (m) (1.66±0.05), weight in kg (78.97±12.12), pulse rate (48.53±30.88), systolic B.P (113.53 ±29.02), diastolic B.P (104.60 ±30.98) and BMI was (28.44±4.26), as exposed in Table **2**.

The FVC mean value± in carpenters were 80.73±16.26, followed by FEV1 (61.74±12.43), PEF (75.23±19.10), and FEV1/FVC (77.90±15.77). The FVC mean value± in stone query workers were (84.58±12.37), followed by FEV1 (62.46±11.76), PEF (70.02±17.12), and FEV1/FVC (73.90±10.45). The FVC mean value± in coalminers were (84.36±08.35), FEV1 (60.79±08.77), PEF (74.44±13.01), and FEV1/FVC (72.13±08.14) as shown in Table **3** and Figure **1**.

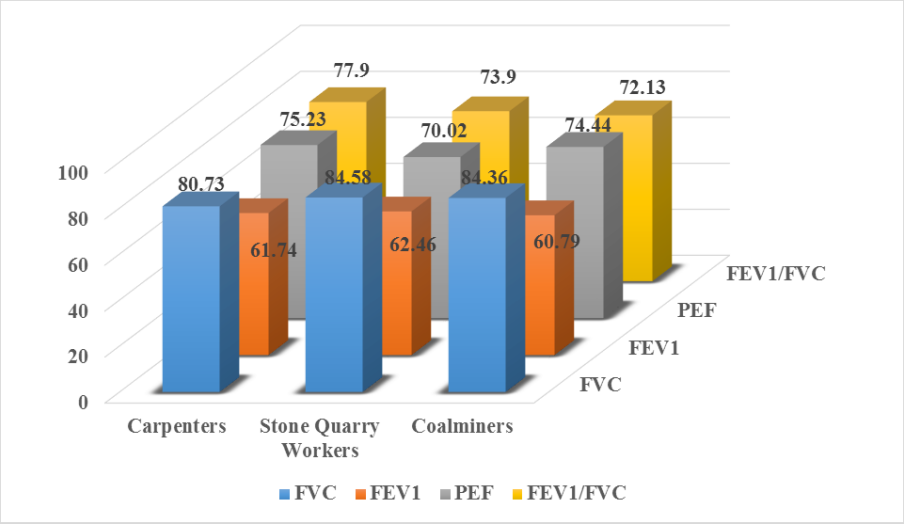


**Figure 1.** Mean value comparison among different working groups.

The FVC mean value of working group <5 years of carpenters were (78.21), followed by FEV1 (59.92), PEF (71.54) and FEV1/FVC (78.58). In the working group, 6-10 years the FVC mean value was (76.39), the FEV1 (62.50), PEF (76.00) and FEV1/FVC (85.53). In the working group, 10 years > the FVC mean value was (84.84), FEV1 (63.07), PEF (78.26) and FEV1/FVC (74.09). The FVC mean value in the working group <5 years of stone query workers was (85.38), FEV1 (61.40), PEF (68.03) and FEV1/FVC (71.48). In the working group, 6-10 years the FVC mean value was (82.15), FEV1 (65.11), PEF (76.11), and FEV1/FVC (80.14). In the working group, 10 years > the FVC mean value was (79.00), followed by FEV1 (70.25), PEF (79.50) and FEV1/FVC (90.85). The FVC mean value in the working group <5 years of coal miners (83.78), FEV1 (60.12), PEF (75.08) and FEV1/FVC (71.75). In the working group 6-10 years, the mean value of FVC was 85.35, FEV1 (61.19), PEF (73.04) and FEV1/FVC (71.99). In the working group, 10 years > the mean value for FVC was (84.50), followed by FEV1 (61.75), PEF (74.62) and FEV1/FVC (73.06) as shown in Table **4**. Graphically spirometry comparison made between different working groups against the work exposure for FVC in the Figure **2**, FEV1 in the Figure **3**, PEF in Figure **4** and FEV1/FVC in the Figure **5**.

**Table 4. Spirometry comparison with work exposure.**

| Work Exposure | FVC% P Value (0.001) | | | FEV1% P Value (0.001) | | | PEF% P Value (0.001) | | | FEV1/FVC% P Value (0.001) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | M | SD | N | M | SD | N | M | SD | N | M | SD |
| **Carpenters** | | | | | | | | | | | | |
| < 5 years | 39 | 78.21 | 16.64 | 39 | 59.92 | 12.37 | 39 | 71.54 | 18.27 | 39 | 78.58 | 17.69 |
| 6-10 years | 18 | 76.39 | 17.59 | 18 | 62.50 | 10.84 | 18 | 76.00 | 13.29 | 18 | 85.53 | 23.42 |
| >10 years | 43 | 84.84 | 14.53 | 43 | 63.07 | 13.16 | 43 | 78.26 | 21.54 | 43 | 74.09 | 6.42 |
| **Stone Quarry Workers** | | | | | | | | | | | | |
| < 5 years | 77 | 85.38 | 11.97 | 77 | 61.40 | 12.17 | 77 | 68.03 | 17.76 | 77 | 71.48 | 6.51 |
| 6-10 years | 19 | 82.15 | 14.25 | 19 | 65.11 | 10.19 | 19 | 76.11 | 12.85 | 19 | 80.14 | 15.06 |
| >10 years | 4 | 79.00 | 10.89 | 4 | 70.25 | 11.76 | 4 | 79.50 | 15.61 | 4 | 90.85 | 19.82 |
| **Coal Miners** | | | | | | | | | | | | |
| < 5 years | 50 | 83.78 | 9.12 | 50 | 60.12 | 9.35 | 50 | 75.08 | 10.27 | 50 | 71.75 | 7.75 |
| 6-10 years | 26 | 85.35 | 8.80 | 26 | 61.19 | 8.35 | 26 | 73.04 | 15.14 | 26 | 71.99 | 9.12 |
| >10 years | 24 | 84.50 | 6.10 | 24 | 61.75 | 8.19 | 24 | 74.62 | 15.88 | 24 | 73.06 | 8.09 |

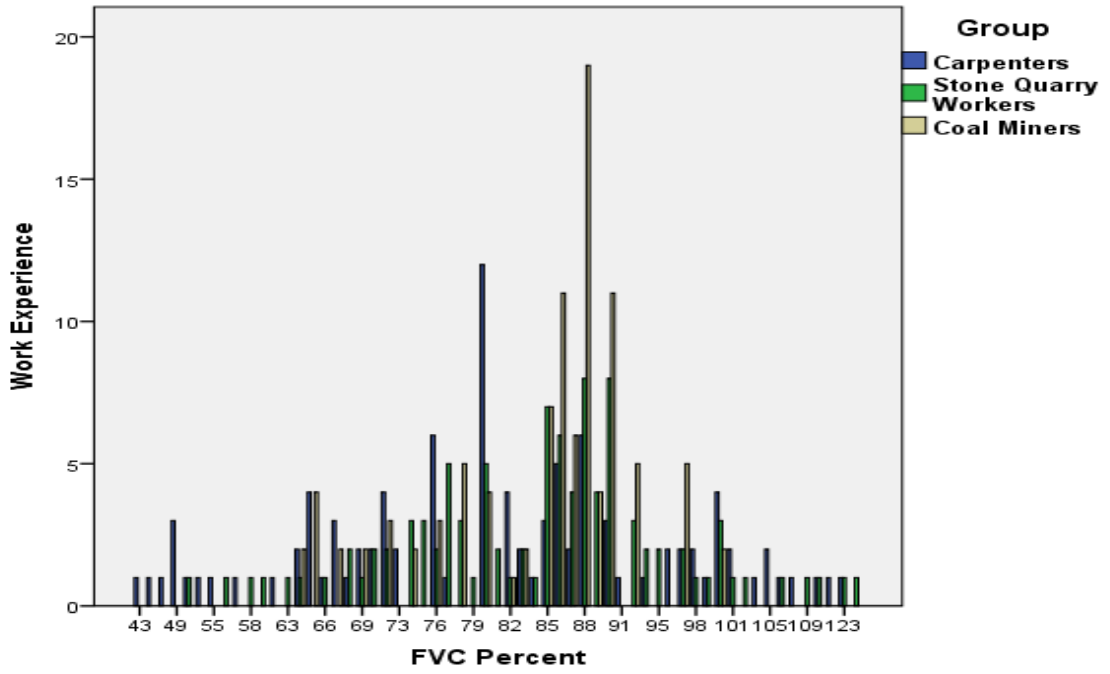


**Figure 2.** FVC mean value percent.

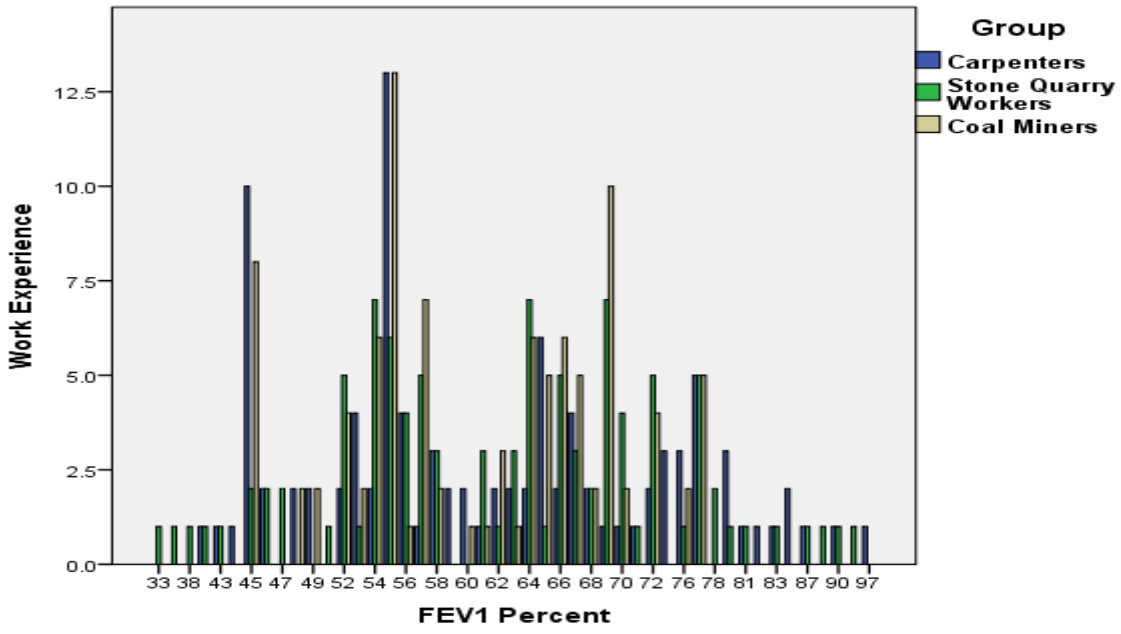


**Figure 3.** FEV1 mean value percent.

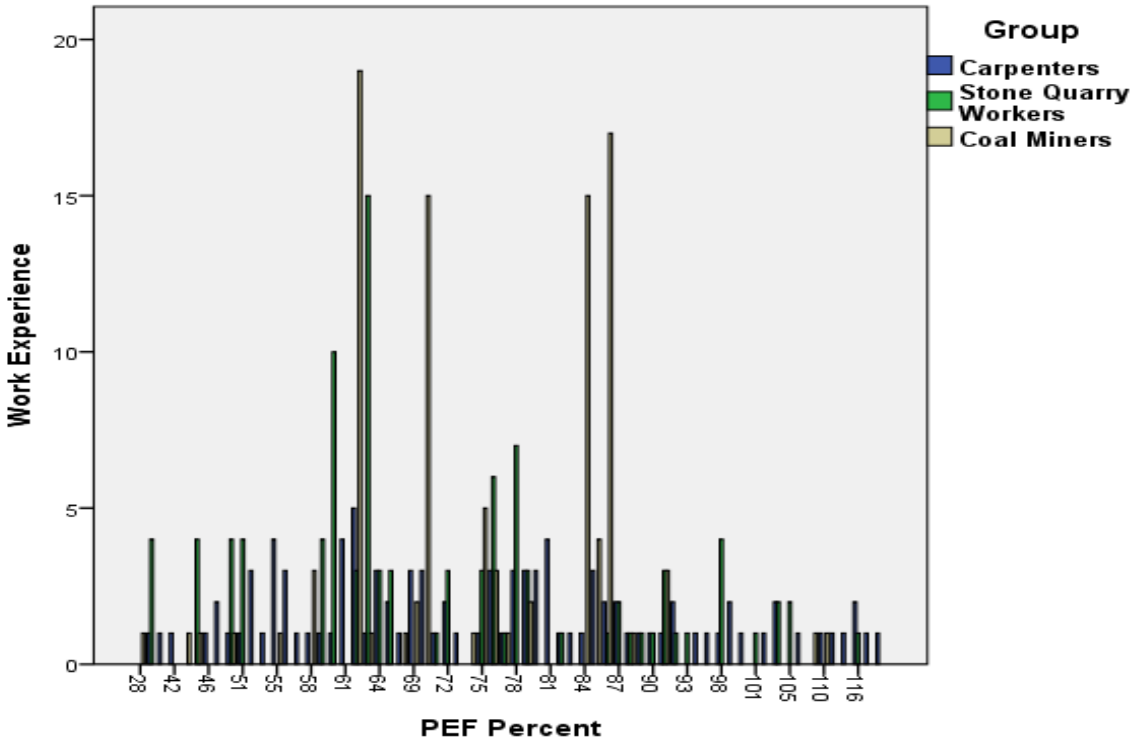


**Figure 4.** PEF mean value percent.

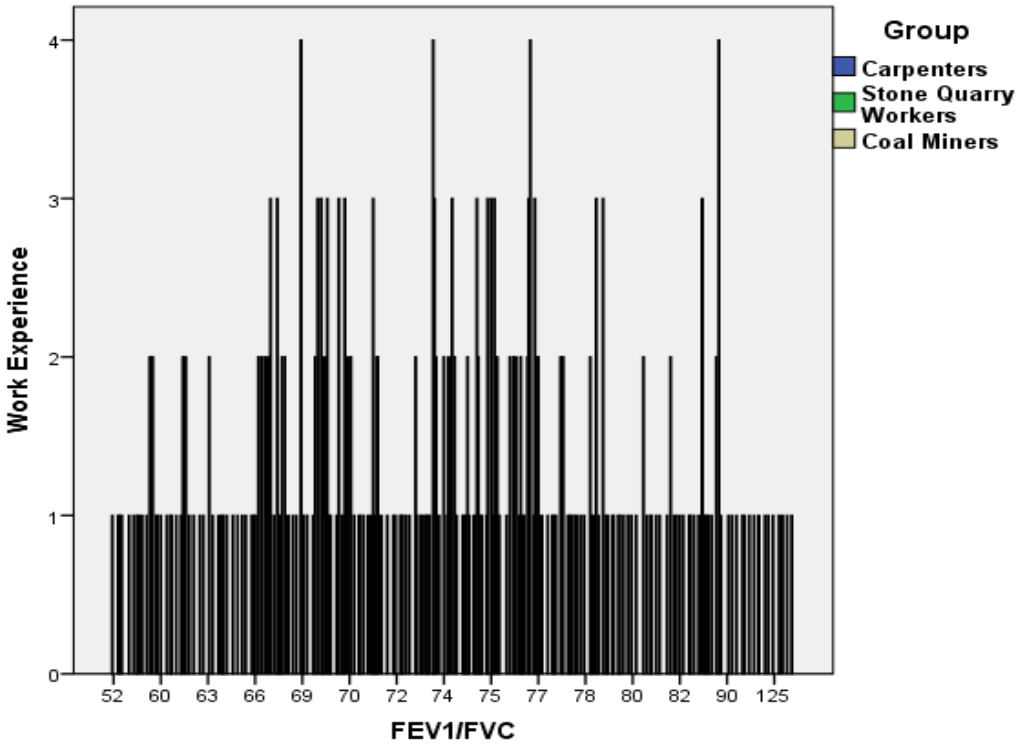


**Figure 5.** FEV1/FVC mean value percent.

## DISCUSSION

In the present study, it was undoubtedly detected that about (77.90%) of carpenters had the restrictive type of pulmonary disorder, (73.90%) of the stone quarry and (72.13%) of coal miners had an obstructive type of bronchial obstruction. As the year of experience increased the pulmonary dysfunction percentage was also significantly increased among the workers [2, 18, 19]. But in the present study, many variations observed in the spirometry values. The carpenter's spirometry values less decreased in less work experience, normal in 6-10 years, but more decreased in the >10 years group. The spirometry mean value percentage of stone quarry workers was decreased in less working experience group and normal in more work experience groups. The mean value percentage of coal miners were decreased in all work exposure groups.

For carpenters; the spirometer mean values of woodworkers decreased in the increase work experience [20, 21], the parallel result observed in the existing study. Considerable decrease in spirometer parameters was recognized between the contact group to timber dust < 5 years and contact group to timber dust for >15 years [22]. But in the existing study carpenter's spirometry values less decreased in less work experience, normal in 6-10 years but more decreased in >10 years group. Bosan and Okpapi, the study proved a significant obstructive pattern of damage in FEV1 and FVC between woodworkers in the Savannah belt of Northern Nigeria. A study also verified the reduction of FEV1 and FVC, in their percentage, projected values [20, 23]. But in the present study, the mean value of FEV1 was significantly decreased but FVC mean value was normal.

For stone quarry workers; a meaningfully decreased in the PEFR value in all workers when coordinated by mean values of the control group [24-30]. The present study supported the results of Ghotkar V, *et al*., 1995, Smilee JS, *et al*., 2011, Rao NM, *et al*., 2006, Singh SK, *et al*., 2006, Ahmed T, *et al*., 2017, Sivacoumar R, *et al*., 2006, Tiwari RR, *et al*., 2004; [24-30]. Detected no significant change in the PEFR value [31]. But a different result was found in the present study. The projected mean value of FVC and FEV1/FVC ratio in the interaction group were greater than the non-interaction group [19], mean value of FVC and FVE1 were greater reduced in exposed group than the controls, but the predicted mean value for FVC and FEV1/FVC ratio in mutually group were in normal range but in exposed group was bit better than non-exposed group [5]. But in the existing study, the FVC mean value percentage was normal, but FEV1 and FEV1/FVC ratio were decreased.

For coal miners; the projected mean value of the FEV1/FVC ratio was normal [32-34] but the FVC, FEV1, and PEFR were decreased in the contact group [34]. The study was conducted by Xiaorong Wang in Japan, 1997, directed that the mean value of FVC and FEV1 between smokers and non-smokers groups w normal, but the FEV1/FVC ratio decreased [4]. But in the existing study, the FEV1/FVC ratio was significantly decreased, but the value of FVC was normal. The mean values between FEV1 and PEFR both were decreased. FEV1 variation over time in novel miners is indirect. New miner's skill early quick FEV1 degenerations, primarily through the first year of mining, slight variation throughout the second year, and limited retrieval throughout the third year. Both direct and quadratic time tendencies in FEV1 variation are extremely important. Smoking miners lost more FEV1 than non-smokers. Referents, all age less than 20 years, showed continued lung growth, whereas the miners who were under age 20 exhibited a decline in FEV1 [33]. But in the present study, no significant difference was found in FEV1 mean value, affected the lung function of all age groups.

### Recommendations

Work-related safety and professional health among carpenters, stone quarry workers, and coal mining should be the responsibilities of the state, employers, managers, supervisors, and surveyors; covers notification and reporting system for work-related accidents and working diseases, first aid, rescue, protective equipment, fires and dust, use of explosives, electricity, equipment and machinery, ventilation, precautions to take against explosions, training needs, *etc*.

## CONCLUSIONS

This study highlights the problem of respiration diseases and indicators. The lung function of all working groups was affected and showed restrictive lung disease. The lung function of coal miners was more affected than the carpenters and stone quarry workers.

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