Assessment Of Lung Function in Goldsmiths an Observational Study

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Abstract :
Background - Goldsmiths are commonly renowned for possessing the intricate art, skills and capability to mould the precious metal into an aesthetic masterpiece. However these Goldsmiths are exposed to various occupational health hazards in respiratory. Commonly used chemicals during jewellery making are cyanide, lead, zinc, cadmium, Palladium, Iridium, sulphuric acid, nitric acid, chalk moulds Containing high percentage of silica, etc. due to lack of proper monitoring of the workplace environment, workers get very much affected by the occupational exposure to those irritants. Their bodies react to metals, dust, salts and oxides during manufacturing ornaments by touching, breathing and ingesting that can irritate and permanently damage lungs. The route from exposure to metal fumes, steam and dust is mostly through inhalation. The present study was conducted to find prevalence of respiratory health problem in goldsmith workers of India by pulmonary function testing.
The aim of this study is to assess the lung function.
Methodology - Ethical approval had been obtained. An observational study was conducted on 74 workers with age in between 20-60 years in both genders. Pulmonary function testing was performed by using the PFT software (parameters : FVC, FEV_1, $FEV_1/FVC\%$, PEFR, PIFR).
Result - In this present study, the result shows that out of 74 subjects 57% of subjects had reduced their lung function significantly due to their workplace environment, fumes, chemicals or acids, metallic particles and exposure work time. In this present study compare to the smokers, non smokers have shown greater affection in lung function of goldsmiths.
Conclusion - This study concludes that goldsmiths have higher prevalence of respiratory disturbances and deterioration of the lung function.

Keywords: Goldsmiths, Pulmonary function test (PFT), Respiratory disturbances and deterioration.

INTRODUCTION

Goldsmiths are commonly renowned for possessing the intricate art, skills and capability to mould the precious metal into an aesthetic masterpiece.[1] Indian people especially women are very much crazy about Golden ornament, which is highlighted by the fact that India contributes significantly to the total gold sold worldwide. However, most of the people are blissfully unaware that the Goldsmith workers who are manufacturing the jewellery maybe doing so at the cost of their health.[2] However these Goldsmiths are exposed to various occupational health hazards in respiratory.[1]

Commonly used chemicals during jewellery making are cyanide, lead, zinc, cadmium, Palladium, Iridium, sulphuric acid, nitric acid, chalk moulds Containing high percentage of silica, etc. [2] due to lack of proper monitoring of the workplace environment, workers get very much affected by the occupational exposure to those irritants.[3] Their bodies react to metals, dust, salts and oxides during manufacturing ornaments by touching, breathing and ingesting that can irritate and permanently damage lungs.[6] Inhaling such chemicals and fine dust is associated with metal fume fever, redness of the throat, coughing, sneezing, shortness of breath and nausea.

The route from exposure to metal fumes, steam and dust is mostly through inhalation.[4] Exposure tends to accumulate chronically from a Goldsmiths exposed every day at work. There is lack of literature regarding the Goldsmith workers with this perspective, the present study was undertaken to assess the pulmonary functions in Goldsmith workers of India.[2]
The most important function of the lungs is gas exchange.[7] Pulmonary function tests or Lung function tests are useful in assessing the functional status of the respiratory system both in physiological and pathological conditions. Lung function tests are based on the measurement of **volume of air breathed in and out** in quite breathing and forced breathing. These tests are carried out mostly by using **spirometry.**[5] The primary purpose of pulmonary function testing is to identify pulmonary impairment and quantify the severity of pulmonary impairments if present.[7]

The main uses of lung function testing are:
- To help define more clearly the type of functional disorder.
- To measure serially natural progression (or regression with therapy) of the disorder.
- To assess the degree of respiratory failure.[8]
  - **Indications for Pulmonary function test :**
  A. Diagnose the presence or absence of lung disease :-
    - History of pulmonary symptoms a. Dyspnea, wheezing b. Cough, phlegm production c. Chest discomfort, orthopnea
    - Physical indicators a. Decreased breath sounds 42 b. Chest wall abnormalities

> ➤ Abnormal laboratory findings a. Chest x-ray or CT studies b. Blood gases or pulse oximetry
> ➤ Before beginning strenuous physical activities

B. Quantify the extent of known disease on lung function.

- Pulmonary disease a. Chronic obstructive pulmonary disease b. Asthma c. Cystic fibrosis d. Interstitial diseases
- Cardiac disease (congestive heart failure)
- Neuromuscular disease (Guillain-Barré syndrome)
- Measure effects of occupational or environmental exposure : 1. Smoking 2. Working in hazardous or dusty environments
- Determine beneficial or negative effects of therapy:
    1. Bronchodilators or steroids
    2. Cardiac drugs (antiarrhythmics, diuretics)
    3. Lung resection, reduction, or transplant
    4. Pulmonary rehabilitation.
- Assess risk for surgical procedures :
    1. Lung resection (lobectomy, pneumonectomy)
    2. Thoracic procedures (sternotomy)
    3. Upper abdominal procedures
- Evaluate disability or impairment :
    1. Social security or other compensation programs
    2. Legal or insurance evaluations
    3. Cardiopulmonary rehabilitation assessment
- Epidemiologic or clinical research involving lung health or disease .[15]
- **Patterns of impaired pulmonary function :**
    Sometimes, patients display patterns during testing that are consistent with a specific diagnosis. This section presents an overview of some commonly encountered forms of impaired pulmonary function. [15]

> ➤ **Obstructive Airway Diseases :**

An obstructive airway disease is one in which airflow into or out of the lungs is reduced. This simple definition includes a variety of pathologic conditions.

Chronic Obstructive Pulmonary Disease :

The term COPD is often used to describe long-standing airway obstruction caused by emphysema, chronic bronchitis, or asthma .[15]

> ➤ **Restrictive Lung Diseases :**

Restrictive lung disease is characterized by the reduction of lung volumes. The VC and TLC are both reduced below the lower limit of normal (LLN).

Any process that interferes with the bellows action of the lungs or chest wall can cause restriction.

Restriction is often associated with:
- interstitial lung diseases, including idiopathic fibrosis, pneumoconioses, and sarcoidosis
- disease of the chest wall and pleura
- neuromuscular disorders
- congestive heart failure (CHF)
- obesity
- lung resection
- scarring (fibrosis) caused by radiation or chemotherapy
- transient problems such as pleural effusions, abdominal ascites, or pregnancy[15]

Basically, the pulmonary function tests or lung function tests are categorized as a volume, flow, or diffusion studies. Diagnosis of pulmonary/lung diseases or dysfunction and impairment with treatment will be evaluated as a result of interpreting a patients pulmonary Function test.[9]

AIM –

To assess the lung function of goldsmiths.

OBJEECTIVES –

1. To find prevalence of respiratory health problems in Goldsmiths by pulmonary function testing.
2. To compare lung function between smokers and non smokers in goldsmiths.

METHODOLOGY AND MATERIALS –

Study Design - Observational Study

Study setup- Gold jewellery industry (Mumbai)

Sampling Technique- convenient Sampling

Sample Size- 74

Study Duration - 6 months

INCLUSION AND EXLUCION CRITERIA

Inclusion Criteria	Exclusion criteria
Workers with age of 20-60 years	Those who have undergone any recent surgery
Both genders	Who are having history of cancer /undergoing in radiation therapy or chemotherapy
Workers who are willing to participate	Patients who have recovered from Covid-19

Workers who are having more than 2 years of experience	-

OUTCOME MEASURE
- Pulmonary Function Testing (PFT machine) .
- Parameters: (FVC, FEV_1, $FEV_1/FVC\%$, PEFR, PIFR).

PROCEDURE -

The ethical committee provided its approval. Permission was taken from management department of gold jewellery industry and from the manager of jewellery industry. Consent from workers or smiths was taken. Patient was selected as per our inclusion criteria. Pulmonary Function test was performed by using the PFT software (turbine based software)Data analysis was done which is based on the result of the PFT.

STATISTICAL ANALYSIS
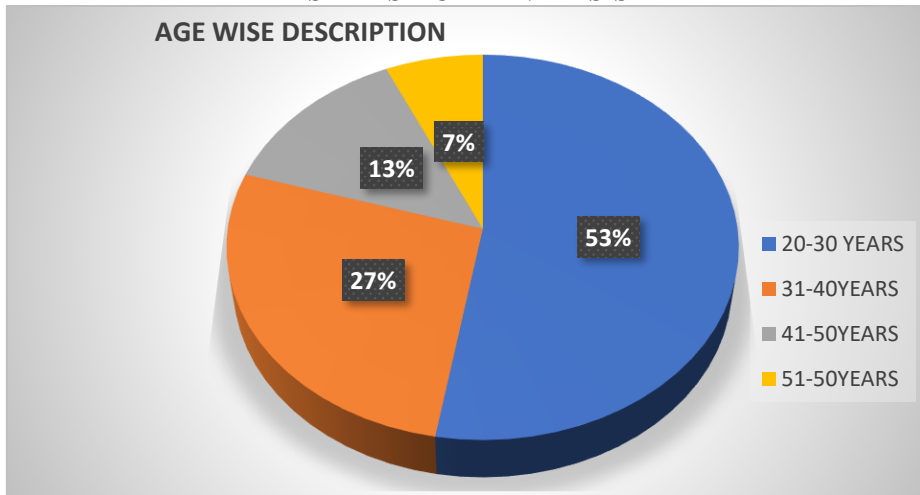
FIGURE 1

- Figure 1 shows that out of 74 subjects ,
  59% subjects are between age 20 to 30 years , 27% subjects are between 31 to 40 years , 13% subjects are between 41 to 50 years , and 7% subjects are between 51 to 60 years.

AGE GROUP	NO. OF SUBJECT
20 – 30 YEARS	39
31 – 40 YEARS	20
41 – 50 YEARS	10
51 – 60 YEARS	05

TABLE : 1

In table 1 , out of 74 subjects , 39 subjects are included in age between 20 to 30 years , 20 are included in age between 31 to 40 years , 10 are included in age between 41 to 50 years and 5 are included in age between 51 to 60 years.
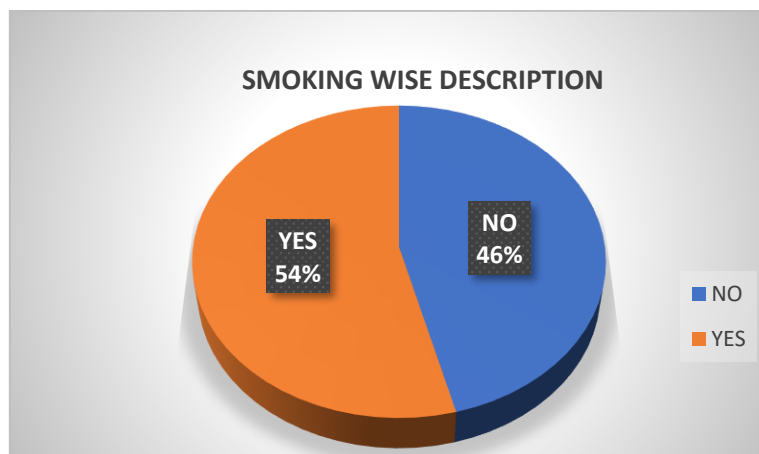

FIGURE : 2

- Figure 2 shows that out of 74 subjects ,
  54% subjects are smoking cigarettes and 46% subjects are non smoking .

SMOKING OR NON SMOKING	NO OF SUBJECTS
Smoking	40
Non smoking	34

TABLE : 2

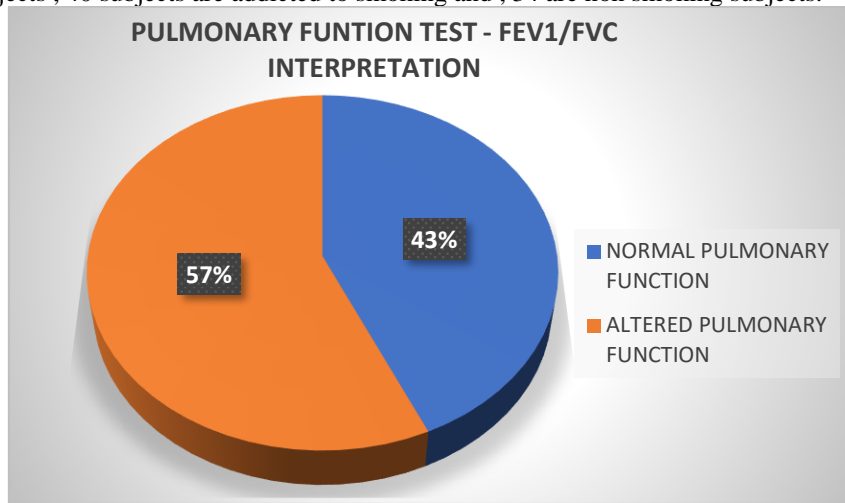In table 2 , out of 74 subjects , 40 subjects are addicted to smoking and , 34 are non smoking subjects.

FIGURE : 3

- Figure 3 shows that out of 74 subjects ,
  43% subjects are having normal pulmonary function , and 57% subjects are having altered or abnormal pulmonary function

PULMONARY FUNCTION IN FEV1/FVC%	NO OF SUBJECTS
NORMAL PULMONARY FUNCTION	32
ALTERED PULMONARY FUNCTION	42

TABLE : 3

Table 3 shows that , out of 74 subjects , 32 subjects are having normal pulmonary function and 42 subjects are having altered or abnormal pulmonary function.
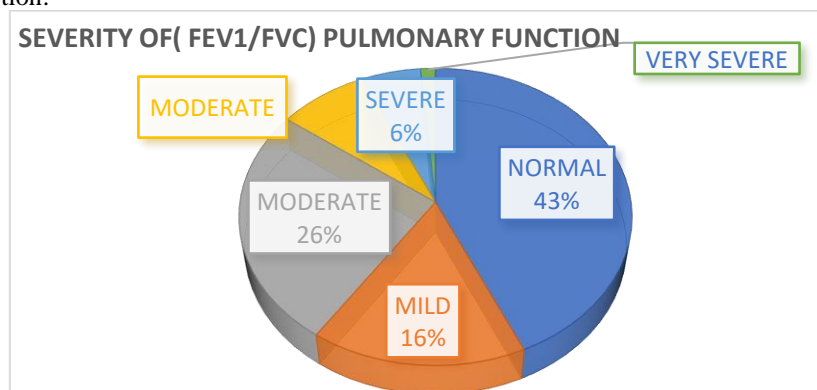

FIGURE : 4

In figure 4 , out of 74 subjects , 43% sujects are normal , 16% subjects having mild severity , 26% subjects are having moderate severity , 8% subjects are having moderately severe type of severity , 6% subjects are having severe type of severity and , 1% subject having a very severe type of severity .

SEVERITY	NO. OF SUBJECT
NORMAL	32
MILD	12
MODERATE	19
MODERATELY SEVERE	6
SEVERE	4
VERY SEVERE	1

TABLE : 4

In table 4, out of 74 subjects, 32 are normal, 12 are having mild severity, 19 are having   moderate type of severity, 6 are having moderately severe type of severity, 4 are having severe type of severity and 1 is having very severe type of severity.
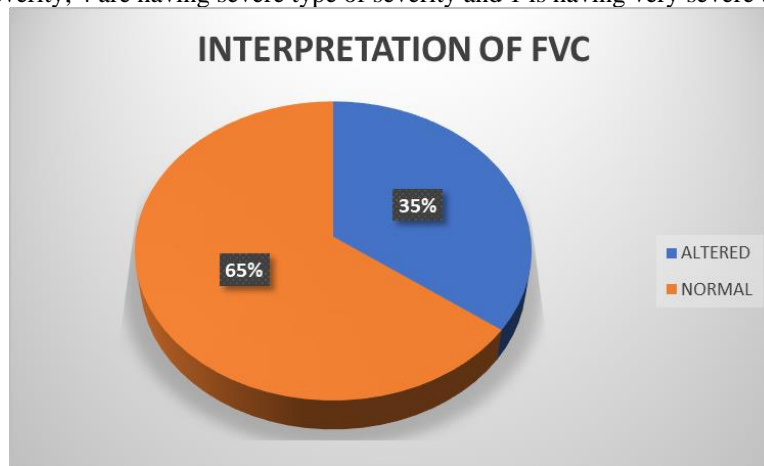

FIGURE : 5

Figure 5 showing , out of 74 subjects , 35% are normal and 65% are having altered FVC function.

FVC FUNCTION	NO OF SUBJECTS
NORMAL	48
ALTERED	26

TABLE : 5

In table 5 , out of 74 subjects , 48 are normal and 26 are having altered function of FVC.
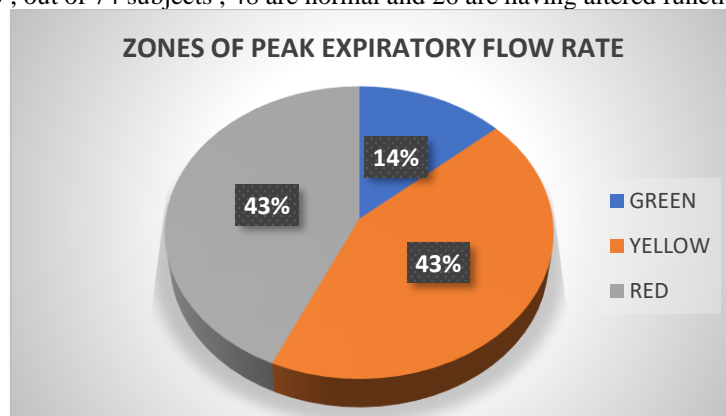

FIGURE : 6

Figure 6 shows that , out of 74 subjects , 14% are comes in green zone which is normal , 43% are comes in yellow zone which is mild to moderate , and 43% are comes in red zone moderate severe of peak expiratory flow.

ZONES	NO OF SUBJECTS
GREEN	10
YELLOW	32
RED	32

TABLE : 6

Table 6 shows that , out of 74 subjects , 10 subjects are comes in green zones , 32 subjects comes in yellow zone and 32 comes in red zone .
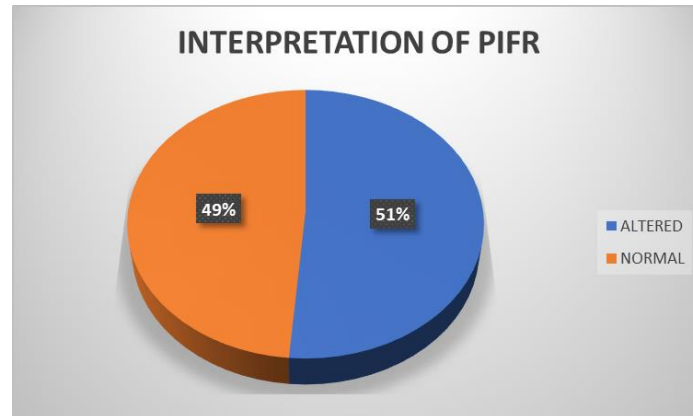

FIGURE : 7

In figure 7 out of 74 , 49% are normal and 51% are having altered peak inspiratory flow rate in goldsmiths.

INTERPRETATION OF PEAK INSPIRATORY FLOW RATE	NO OF SUBJECTS
NORMAL	36
ALTERED	38

TABLE : 7 In table 7 out of 74 subjects , 36 are normal and 38 are having altered or reduced peak inspiratory flow rate.

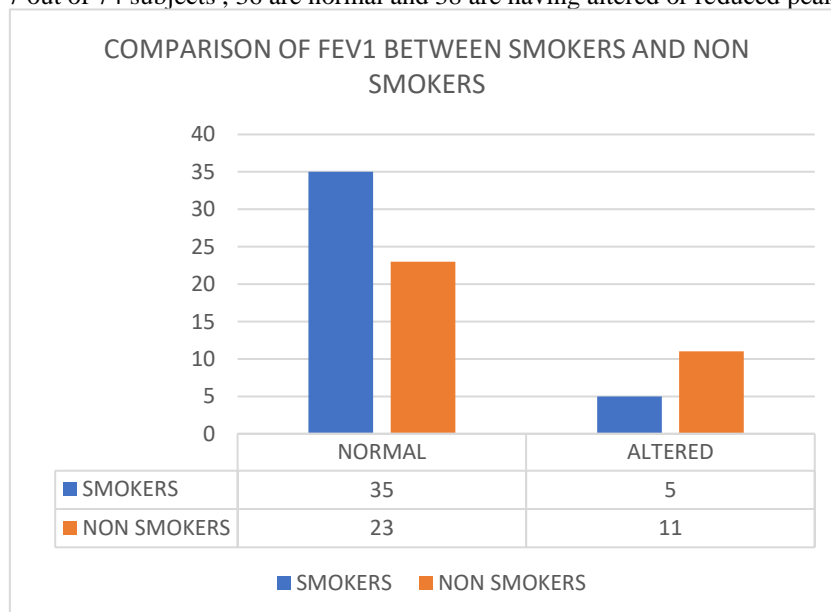| COMPARISON OF FEV1 BETWEEN SMOKERS AND NON SMOKERS	NORMAL	ALTERED
SMOKERS	35	5
NON SMOKERS	23	11

FIGURE : 8

In figure 8 , out of 74 subjects , in smokers 35 are normal and 5 are having altered FEV1 function and, in non smokers 23 are normal and 11 having reduced or altered FEV1 function.
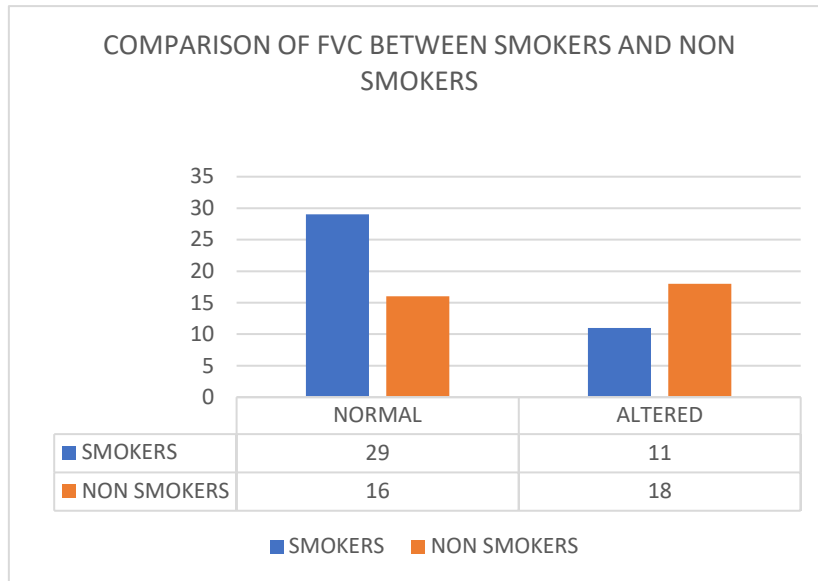

FIGURE : 9

In figure 9 out of 74 subjects , in smokers 29 are normal and 11 are having reduced FVC function and in non smokers , 16 are normal and 18 are having reduced FVC function .
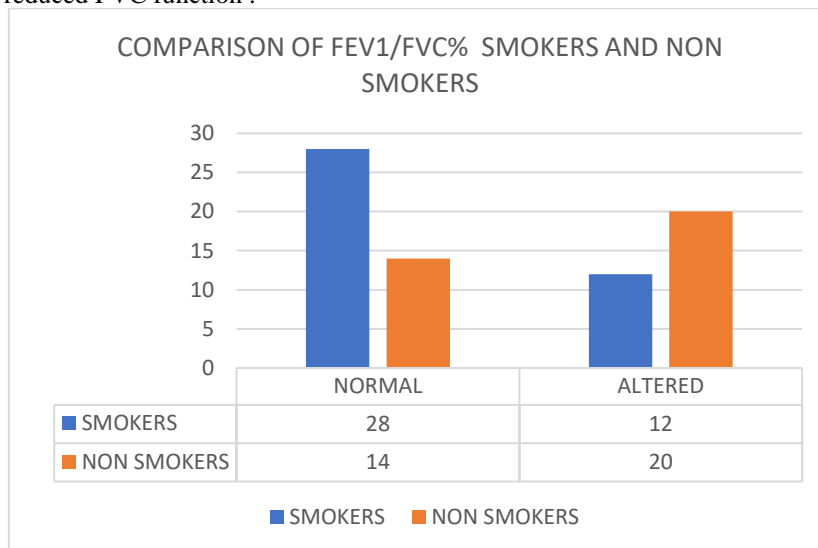

FIGURE : 10

In figure 10 out of 74 subjects , in smokers 28 are normal and 12 are having reduced or altered FEV1/FVC% and in non smokers 14 are normal and 20 are having reduced or altered FEV1/FVC%.
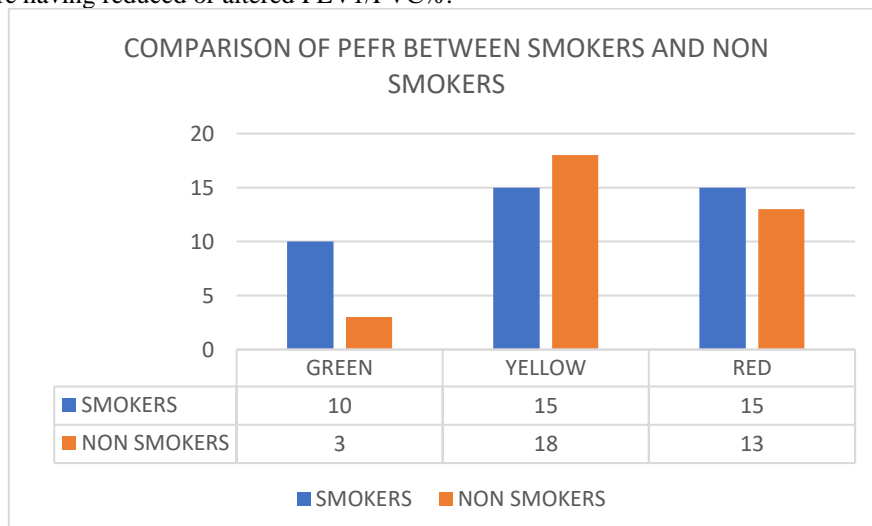
<div align="center">**FIGURE : 11**</div>

In figure 11 out of 74 subjects , in smokers 10 are comes in green zone 15 comes in yellow and 15 comes in red zone and in non smokers 3 comes in green zone 18 comes in yellow zones and 13 comes in red zone.
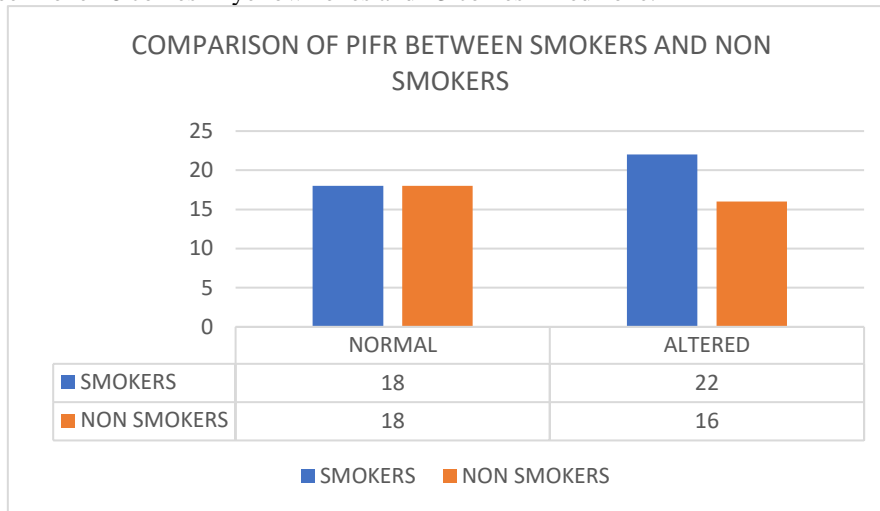

<div align="center">**FIGURE : 12**</div>

In figure 12 out of 74 subjects , in smokers 18 are normal 22 are having reduced peak inspiratory flow rate and in non smokers , 18 are normal and 16 are having altered or reduced peak inspiratory flow rate.

<div align="center">**FIGURE : 13**</div>

Figure 13 shows that , out of 74 subjects , 43% of subjects are normal , 24% are having obstructive diseases and 33% are having restrictive diseases.

INTERPRETATION	NO OF SUBJECTS
NORMAL	32
OBSTRUCTIVE DISEASES	18
RESTRICTIVE DISEASES	24

<div align="center">**TABLE : 8**</div>

Table 8 showing that , out of 74 subjects , 32 subjects are normal , 18 having obstructive conditions , and 24 are having restrictive conditions.

RESULT –
- Figure 1 shows that out of 74 subjects,

59% subjects are between age 20 to 30 years, 27% subjects are between 31 to 40 years, 13% subjects are between 41 to 50 years, and 7% subjects are between 51 to 60 years.

In table 1, out of 74 subjects, 39 subjects are included in age between 20 to 30 years, 20 are included in age between 31 to 40 years, 10 are included in age between 41 to 50 years and 5 are included in age between 51 to 60 years.

- Figure 2 shows that out of 74 subjects,
54% subjects are smoking cigarettes and 46% subjects are non smoking.
In table 2, out of 74 subjects, 40 subjects are addicted to smoking and, 34 are non smoking subjects.

- Figure 3 shows that out of 74 subjects,
43% subjects are having normal pulmonary function, and 57% subjects are having altered or abnormal pulmonary function.
Table 3 shows that , out of 74 subjects , 32 subjects are having normal pulmonary function and 42 subjects are having altered or abnormal pulmonary function .

- In figure 4 , out of 74 subjects , 43% sujects are normal , 16% subjects having mild severity , 26% subjects are having moderate severity , 8% subjects are having moderately severe type of severity , 6% subjects are having severe type of severity and , 1% subject having a very severe type of severity .
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- Figure 5 showing , out of 74 subjects , 35% are normal and 65% are having altered FVC function.
In table 5 , out of 74 subjects, 48 are normal and 26 are having altered function of FVC.

- Figure 6 shows that, out of 74 subjects , 14% are comes in green zone which is normal , 43% are comes in yellow zone which is mild to moderate , and 43% are comes in red zone moderate severe of peak expiratory flow.
Table 6 shows that , out of 74 subjects , 10 subjects are comes in green zones , 32 subjects comes in yellow zone and 32 comes in red zone .

- In figure 7 out of 74 , 49% are normal and 51% are having altered peak inspiratory flow rate in goldsmiths.
In table 7 out of 74 subjects , 36 are normal and 38 are having altered or reduced peak inspiratory flow rate.

- In figure 8 , out of 74 subjects , in smokers 35 are normal and 5 are having altered FEV1 function and, in non smokers 23 are normal and 11 having reduced or altered FEV1 function.

- In figure 9 out of 74 subjects , in smokers 29 are normal and 11 are having reduced FVC function and in non smokers , 16 are normal and 18 are having reduced FVC function .

- In figure 10 out of 74 subjects , in smokers 28 are normal and 12 are having reduced or altered FEV1/FVC% and in non smokers 14 are normal and 20 are having reduced or altered FEV1/FVC%.

- In figure 11 out of 74 subjects , in smokers 10 are comes in green zone 15 comes in yellow and 15 comes in red zone and in non smokers 3 comes in green zone 18 comes in yellow zones and 13 comes in red zone.

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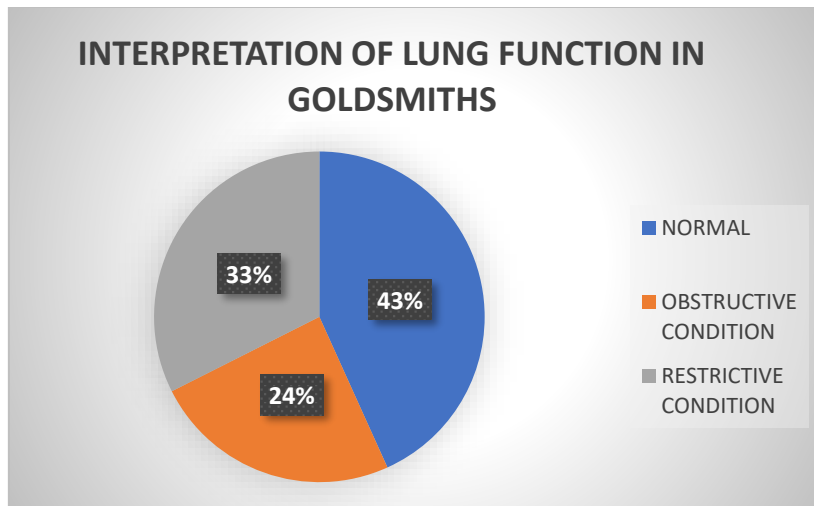
- Figure 13 shows that , out of 74 subjects , 43% of subjects are normal , 24% are having obstructive diseases and 33% are having restrictive diseases.
Table 8 showing that , out of 74 subjects , 32 subjects are normal , 18 having obstructive conditions , and 24 are having restrictive conditions.

DISCUSSION-

Gold ornament / jewellery making industries are one of the widespread small–scale industries of india .[11]

The goldsmiths are exposed to various acidic and metallic fumes at work, but no study has been reported on goldsmiths neither on the Indian jwellery industries evaluating the relationship between on occupational exposure and respiratory health.[12]

Pulmonary function tests are an important tool in the investigation and monitoring of patients with respiratory pathology. They provide important information relating to the large and small airways, the pulmonary parenchyma and the size and integrity of the pulmonary capillary bed.[13]

In the study done by **Subhabrata moitra, Subhashis sahu** , European Respiratory Journal 2012 40:P1027:DOI shows that, The goldsmiths had significantly higher prevalence of chronic cough, nasal allergy, production of phlegm and tightness in chest wall. Results of spirometry showed significantly lower percent predicted values of FVC, FEV1, FEVI/FVC and FEF25-75.[13]

Due to exposure to various sensitizers and irritants (metallic and acidic fumes) in the workplace the goldsmiths had higher prevalence of respiratory disturbances and reduced lung function.[13]

Pulmonary function test measure lung volume, capacity rates of flow and gas exchange. Obstructive and Restrictive these are two types of disorders that cause problems with air moving in and out of lungs.

Restrictive lung dysfunction is an abnormal reduction in pulmonary ventilation due to restriction of expansion by the chest wall or the lungs. Lung expansion is restricted, and therefore the volume of air moving in and out of the lungs is decreased.[17]

Three major aspects of pulmonary ventilation must be considered to understand the pathophysiology of respiratory lung dysfunction. They are -

　　　(1) compliance of both the lungs and chest wall;
　　　(2) lung volumes and capacities; and
　　　(3) the work of breathing.[17]

All obstructive conditions have the potential to decrease the size of the bronchial lumen and/or increase the size of alveolar sac and increase the resistance to expiratory airflow.[17]

The purpose of my study was to find prevalence of respiratory health problems in goldsmiths by using pulmonary function test.

In this present study, 74 goldsmiths were taken as subjects, lung function test was done by using PFT software. The result shows that out of 74 subjects 57% of subjects had reduced their lung function significantly due to their workplace environment, fumes, chemicals or acids, metallic particles and exposure work time.

In this present study compare to the smokers, non smokers have shown greater affection in lung function in goldsmiths.

Present study also shows the interpretation of respiratory diseases as **Obstructive** and **Restrictive** conditions, out of 74 subjects 43% are normal, 24% are having obstructive conditions and 33% having restrictive conditions.

Alteration of FEV1, FVC, FEV1/FVC%, PEFR(peak expiratory flow rates), and PIFR(peak inspiratory flow rate) showed significant changes in goldsmiths which could lead to the development of different types of pulmonary diseases.

CONCLUSION

This study concludes that goldsmiths have higher prevalence of respiratory disturbances and deterioration of the lung function.

CLINICAL IMPLICATION

- Out of 74 subjects, 43% are normal and other 57% are having altered pulmonary function which includes respiratory conditions like obstructive (24%) and restrictive (33%). Which shows higher prevalence of reduced lung function in goldsmiths.
- To reduce this prevalence and to prevent goldsmiths from any respiratory disorders we can suggest or educate them with proper ergonomics (all soldering or work should be done with local exhaust ventilation e.g. window exhaust fan, suitable masks should be used to minimise exposure to fumes, recommendation to have periodic health check up including PFT of goldsmiths once or twice in year . For those who have suffering from the respiratory conditions suggest them treatment (incentive spirometry, breathing exercises) as per their conditions.

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