

## **Pulmonary Function Changes Among Offset Printer Workers Of Sivakasi**

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### **ABSTRACT**

#### **BACKGROUND**

Sivakasi houses the largest number of printing machines in the world next to Guthenberg in Germany. Nearly 60% of India's offset printing solutions are produced in sivakasi. Printer workers are occupationally exposed to a variety of chemicals such as white spirits, methylene chloride ,isopropanol, trichloroethylene and airborne contaminants through inhalation.

#### **AIM**

To assess the pulmonary function changes among Offset Printer workers in Sivakasi population

#### **MATERIALS AND METHOD**

This descriptive study was carried out after obtaining Institutional Ethical Committee clearance. Sample size (n)=200. All the subjects were educated about the manoeuvre of PFT before doing assessment. PFT was done using Portable RMS Helios 701. Paired t test and One way ANOVA were applied for statistical analysis by using SPSS.

#### **RESULTS**

FVC, FEV1/FVC, FEV1, FEF25%, FEF50%, FEF75% values of printer workers were significantly affected .Prevalence of restrictive, obstructive and mixed type of lung disorder were 36% , 29.5% and 17% respectively.

#### **CONCLUSION**

The offset printer workers are a vulnerable group and have more probability of getting lung diseases due to exposure to a variety of chemicals emitted during their working process. Preventive measures like wearing masks and routine medical examination should be carried out among this population to reduce morbidity.

**KEYWORDS - Occupational lung disease, Pulmonary function test, Offset printer workers**

### **1. INTRODUCTION**

Sivakasi is an active town and a municipality in virudhunagar district in the Indian state of Tamilnadu(1). It is well known for its printing industries(2). Nearly 60% of India's offset printing solutions is produced in sivakasi. Sivakasi houses largest number of printing machines in the world next to Guthenberg in Germany.

All kinds of printing jobs are undertaken in sivakasi including security jobs like printing bank cheques books, flight tickets etc. Most of the leading offsets are exporting children book, notebooks, magazines, greeting cards, calendars, trade labels throughout the world. More than 50,000 workers are engaged in printing industries. The town has a school of printing technology. The printing industry in sivakasi is worth about 1000 crores(3).

Besides these, workers in these industries have been exposed to various chemicals , solvent in inks, thinners, clean up materials for years through inhalation(4). Therefore the printing industries has always been known as environmental pollution contributor(5).

Solvent exposure in offset establishments includes white spirits, methylene chloride, isopropanol, trichloroethylene(6), diazoresins, quinone diazides and radical photopolymers(7). A chemical polyurethane lacquers and high speed printing ink misting is used in adhesive lamination which causes irritation of upper respiratory tract and lungs and also acts as a potential for occupational asthma(8). The effects of inhaling such chemicals causes respiratory problems, aggravation of existing respiratory and cardiovascular diseases, damage to the lung tissues , carcinogenesis and premature death(9).

Inhaled particulates can adhere to the lung surface, adsorb and bond their vapours that are inhaled, thereby increasing their toxicities. This leads to various restrictive and obstructive types of diseases such as chronic obstructive pulmonary disease(COPD) , emphysema, bronchial asthma , lung carcinoma that are accompanied by irreversible destruction of alveolar walls(10).

Various types of chemicals have been reported to cause fibrotic changes when inhaled deeply into the lungs. These changes can be detected in chest radiographs as small or irregular opacities in the lung fields. Fibrotic changes in the periphery also results in deterioration of the pulmonary function. This can be detected by conventional spirometric measurements, for which it also provides the predicted values(11).

Due to emission of a huge number of contaminating substances, air media of an workplace is the most vulnerable component of indoor environment(12). Thus the offset workers are exposed to various hazardous chemicals, which may cause variation in the pulmonary function. Investigations were done whether occupational exposure to emissions from printing industries is associated with decline in lung functions.

All these problems are chronic and mostly neglected so it drove our attention to this undeserved community and understanding this critical issue made us put a step forward and make an attempt to spread awareness and prevent the occurrence of such fatal disease conditions. This study would throw a light on the problems of existing printing industry. Further, it may pave the way for the betterment of socioeconomic conditions, health problems, welfare measures, safety problems among the workers in the study area(13) .

## **AIMS AND OBJECTIVES**

- To assess the pulmonary function changes among the printer workers of sivakasi.
- To assess the prevalence of restrictive and obstructive types of respiratory diseases among the printer workers of sivakasi.

## **2. METHODS AND METHODOLOGY**

### **Study Area :**

This study was carried out in the town of sivakasi, Virudhunagar district. It is well known for its printing industries. Sivakasi is India's printing hub. More than 50,000 workers are engaged in printing for 8-9 hours per day in these industries. The workers are all exposed to various chemicals and heavy metals throughout the work period.

### **Study design and study population:**

The study is a descriptive cross sectional study by the department of Physiology among the 200 offset workers of sivakasi. The study was conducted from Feb 2019-Oct 2019 to assess the pulmonary function changes and prevalence of restrictive and obstructive diseases.

### **Inclusion criteria:**

- Age limit : 30-60 years.
- Working more than 5 years.
- Both genders working in offset printers.

### **Exclusion criteria:**

- Post surgery with known respiratory disorders like asthma, tuberculosis.
- Physically or mentally disabled persons unable to follow simple instructions were excluded.
- Smokers

### **Pulmonary function test:**

The primary purpose of pulmonary function testing is to identify the severity of pulmonary impairment. Pulmonary function test will be performed using portable RMS spirometer(HELIOS 701). The best values of forced vital capacity (FVC), forced expiratory volume (FEV1-FEV3), FVC/FEV1, forced expiratory flow at 25-75% (FEF 25-75%), peak expiratory flow rate(PEFR) and lung age was assessed and the results was obtained. Disposable mouth piece and other suitable precautions will be taken as per the equipments specification of the American thoracic society.

### **PROCEDURE:**

The subject was asked to sit in a upright position.

The instructions given to the subjects were

- Take a deep breathe and fill your lungs with air
- Put the mouthpiece into your mouth. Tightly seal your lips around it so that no air goes out
- Blast the air out as hard and fast as you can. Minimum 6 seconds of exhalation is recommended
- Inhale the air with the same force as much as you can.(14)

If it was not done properly, repeated maneuver were done. The best of the three attempts were taken and a complete flow loop is obtained

Ethical consideration:

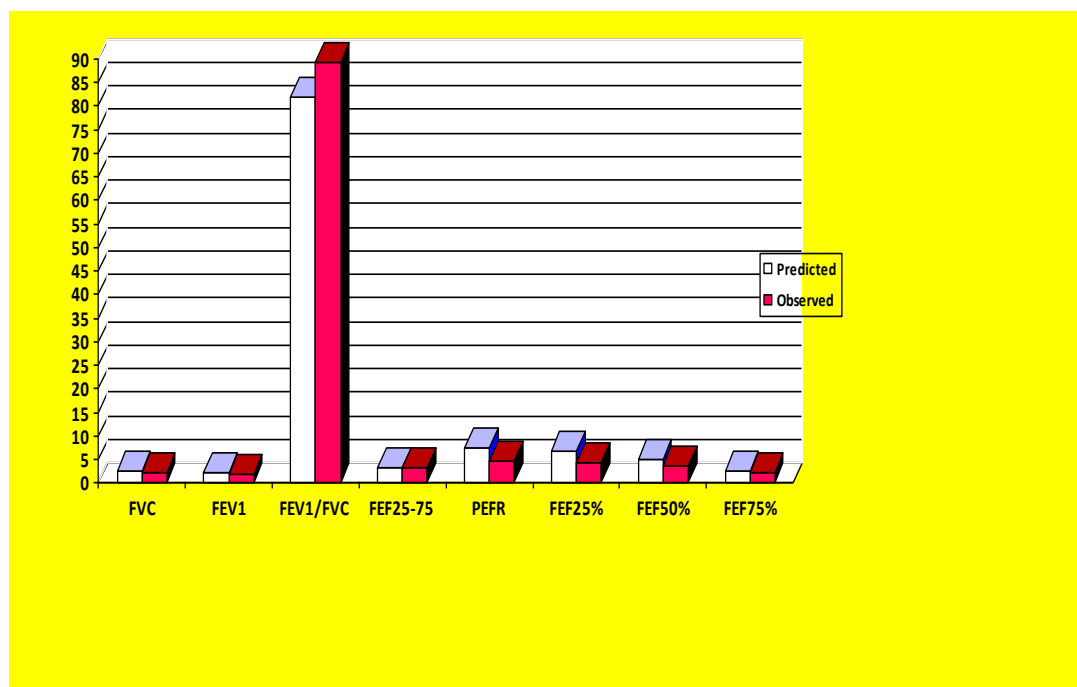
Ethical clearance was obtained from institutional ethical committee MAHER University, Chennai. Permission was also obtained from offset workers association. Written signed consent was obtained in their language from all the subjects after explaining the study procedure to them. All the subjects were trained to do the spirometry procedure.

Statistical analysis: The statistical analysis was done using SPSS version 21.0 .The Paired 't' test for means and One Way Anova test were used for this analysis.

### 3.RESULTS

Table 1: Comparison of observed and predicted values of pulmonary function parameters

PARAMETERS	PREDICTED (N=200)	OBSERVED (N=200)	P-VALUE
FVC	2.7855	2.2125	0.000
FEV1	2.3059	1.9890	0.000
FEV1/FVC	81.8813	89.1003	0.000
FEF25-75%	3.4541	3.2078	0.001
PEFR	7.4755	4.6756	0.000
FEF25%	6.9160	4.3488	0.000
FEF50%	5.0458	3.5495	0.000
FEF75%	2.5556	2.1714	0.000
LUNG AGE	37.29	43.08	0.000

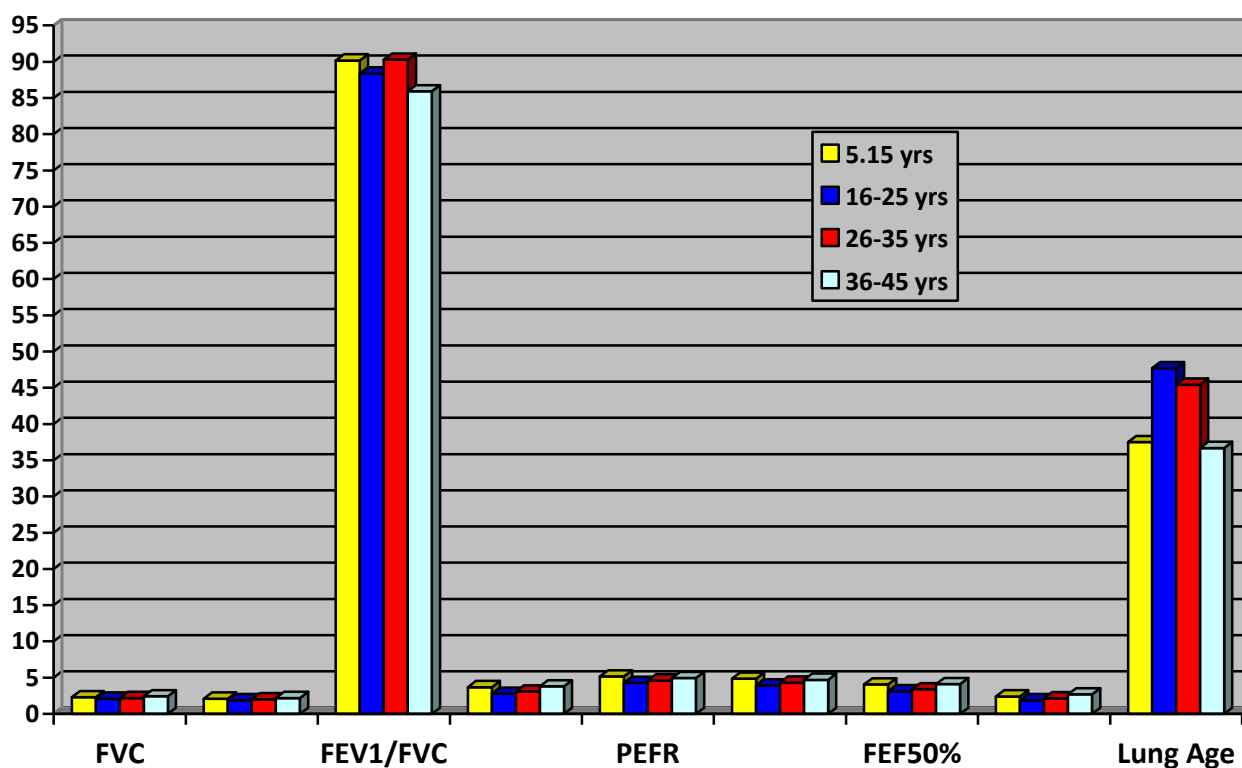


GRAPH 1

The table 1 shows the marked difference in the pulmonary function parameters. There is significant reduction in the mean values of FVC, FEV1, FEV1/FVC, PEFR, FEF25%, FEF50%, FEF75% and lung age between predicted and observed datas.

Table 2: Mean values of PFT parameters with respect to years of exposure

PARAMETERS	5-15YEARS (N=200) MEAN	16-25YEARS (N=200) MEAN	26-35YEARS (N=200) MEAN	36-45YEARS (N=200) MEAN	P-VALUE
FVC	2.3±0.09	2.08±0.08	2.18±0.10	2.42±0.15	0.138
FEV1	2.08±0.11	1.86±0.08	2.00±0.11	2.18±0.23	0.297
FEV1/FVC	90.18±2.80	88.37±2.08	90.29±2.42	85.93±7.02	0.830
FEF25-75%	3.67±0.18	2.77±0.15	3.09±0.23	3.80±0.301	0.001
PEFR	5.16±0.22	4.27±0.20	4.60±0.312	4.94±0.355	0.042
FEF25%	4.85±0.21	3.91±0.19	4.29±0.32	4.70±0.39	0.022
FEF50%	4.04±0.20	3.11±0.155	3.40±0.244	4.10±0.32	0.001
FEF75%	2.40±0.13	1.87±0.11	2.14±0.166	2.69±0.23	0.003
LUNG AGE	37.53±1.85	47.76±2.061	45.43±3.69	35.68±5.94	0.007



GRAPH 2

Table 2 shows the correlation between the pulmonary function parameters and the duration of exposure to the printing industry chemicals in years. It was also observed that the mean value increases as the duration of exposure to chemicals increases and this was found to be statistically

significant. There is significant reduction in the pulmonary function parameters like FEF 25-75%, PEFR, FEF 25%, FEF 50%, FEF 75%, lung age as there is increase in duration of exposure in years. There is decreased mean value of PFT parameters in 26 -35 years and 36-45 years when compared to 16 -25 years.

Table 3: Prevalence of respiratory disorders among 200 subjects

TYPES OF RESPIRATORY DISORDERS	SAMPLE SIZE (N=200)	PERCENTAGE (%)
NORMAL	59	29.5%
RESTRICTIVE	72	36%
OBSTRUCTIVE	35	17.5%
MIXED BLOCKAGE	34	17%

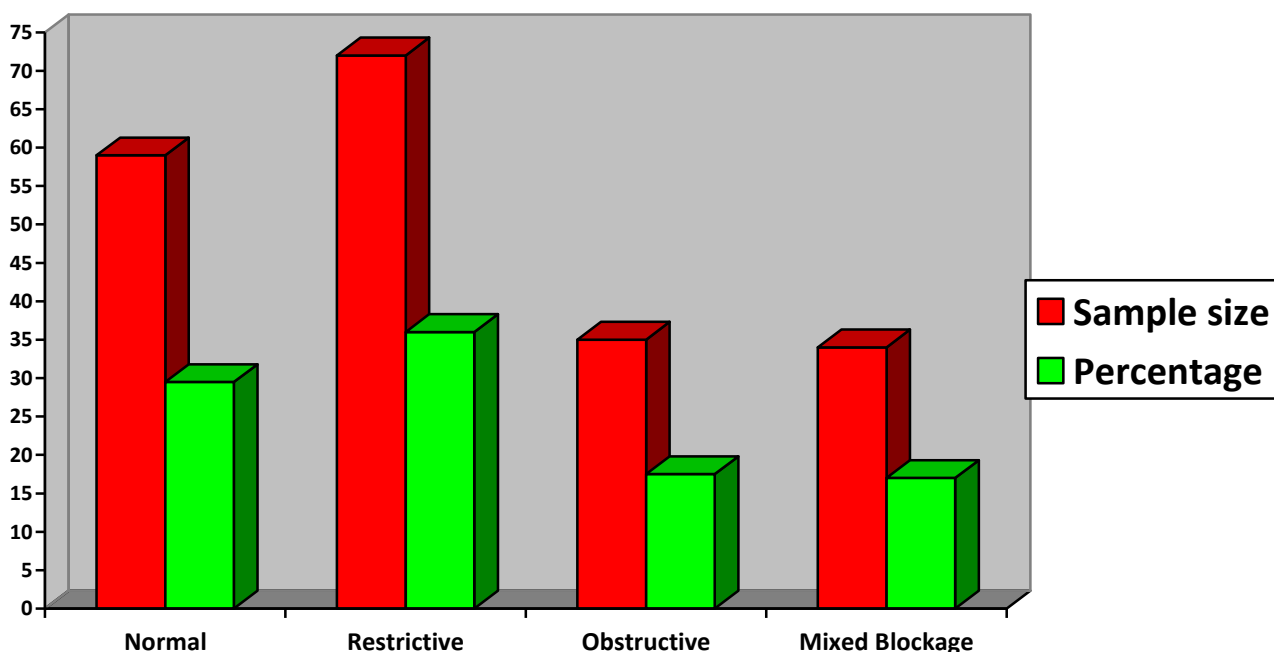


Table 3 show the prevalence of respiratory disorders among 200 subjects. Among 200 subjects, 29.5% people are normal, 36% of the people have restrictive type of diseases, 17.5% of people have obstructive type of people and 17% of the people have mixed blockage. This study showed that people exposed to printing inks and chemicals have prevalence of both restrictive and obstructive types of diseases among which restrictive type is highly significant.

#### 4. DISCUSSION

Sivakasi placed in virudhunagar district has a large scale of printing industries. Residents of this area showed marked occupational health hazards in day to day life. In this study, the PFT values of printer workers were affected severely. Moreover ,the printing press which is the main occupation of the people of sivakasi has the major health hazards when compared to other occupations.

The pulmonary function data for the workers represented in this study showed alteration when compared to the predicted values of the same individuals. This might be due to the presence of heavy metals in the composition of chemicals used in long runs. This may affect the respiratory system.

Offset printing inks contains heavy metals like lead, copper, zinc, selenium, nickel ,barium ,arsenic, cadmium, silver and zinc(14). The nature of these heavy metals is considered to be toxic and its severity depends on the way it has been administered. Among all these,the level of lead may contribute for changes in PFT since its level may elevated during the process of printing according to the findings of Bushra et al(2007) (15).The lethal effect of lead increases due to its poor absorption through intestine and it contributes more adverse respiratory changes since lead excretes mainly through lungs(16).

Similarly, the pulmonary changes were severely observed in the parameters like FEF 25%, FEF50%, FEF 75%, PEFR, FEF25-75% and lung age which could be due to small fine particulates emitted during the process of binding and printing and they settle deeply inside the lungs. The particles may reach the alveoli and the gas exchange region because of their small size leading to more prevalence of restrictive types of diseases(17).

The exposure to bioaerosols such fungi, 1,3 beta glycan, endotoxin which may produce inflammation in the respiratory airways leading to pulmonary function changes and respiratory diseases(18). This also could be the other probable reason for altered PFT values in offset workers of sivakasi. The findings of this study also concurs with the study of Kanyakumari et al(19), emphasized that there is a thickening of alveolar epithelium and pulmonary capillary basal laminar membrane. This leads to reduced pulmonary elastic recoil due to non enzymatic glycosylation of connective tissues affecting FEF 25%, FEF 50%.

The adverse effect of health on printer workers depends on the pollutants inhaled , handling of chemicals from mixing the chemicals till printing on paper. This may lead to high prevalence of respiratory problems like allergies ,difficulty in breathing, nose block, irritation, infection in throat,pain during swallowing,sneezing,coughetc.Rare or no usage of safety measures such as gloves, face mask by these workers is also the major cause of diseases.

## 5. CONCLUSION



The study concludes that the workers of offset printers showed changes in respiratory system with alterations in PFT parameters providing that chemicals, dust and mode of working area influences much on various system especially the respiratory system. The adverse effects can be minimized by following various preventive measures like mask, gloves. Using well aerated rooms while handling chemicals may also decrease the chemical exposure. Awareness programme should be conducted as sivakasi is a industrial area and this may improve the life style of the workers.

## 6. SUMMARY

This study was conducted in sivakasi with 200 subjects. A informed and written consent was obtained from all the 200 subjects. All the subjects were trained to do the spirometry procedure after which the procedure was done. The subjects were asked to repeat the procedure until the complete flow loop is obtained. The best of the maneuvers was used for the analysis.

The datas obtained had predicted and observed values of PFT parameters like FVC, FEV1 , FEV1/FVC, FEF 25%, FEF50%, FEF75%, PEFR for every individuals. The datas were analysed under Paired 't' test and One Way Anova. The results obtained showed significant variation in the pulmonary function parameters and it was observed that duration of exposure in years also influences the PFT parameters. It was also observed that 29.5% of people had normal lung function, 36% of the people had restrictive type of diseases, 17.5% of the people had obstructive type of diseases and 17% had mixed blockage

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