

Preliminary study of spirometric evaluation of lung functions in Arc Welding Workers

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Abstract

Introduction: Welding is an important component of industry in India. Welding workers are exposed to inhalation of fumes coming out during welding process and this welding fume inhalation has been associated with many respiratory problems.

Aims and Objective: To Measure the pulmonary function parameters such as forced vital capacity (FVC), forced expiratory volume during the first second (FEV1), FEV1/FVC and maximal voluntary ventilation (MVV) in controls and arc welders, depending upon the period of exposure of arc welders to welding fumes by using Spirometry, To compare FVC, FEV1, FEV1/FVC and MVV between controls and arc Welders and to give information to the welders about the side effects of Welding fumes on their health.

Materials and Method: This study was done on the 50 male welding workers with the age of 25-40 years working at local welding shops for 5-7hours/day, working during the last 5 years. FVC, FEV1, FEV1/FVC and MVV were recorded on a whole body Plethysmograph (Elite Dx model, med graphics, USA). The results obtained were compared with that of the controls.

Results: The exposure of welders to the welding fumes causes the significant decrease in lung function parameters like FVC, FEV1, FEV1/FVC%, MVV as compared to control groups.

Keywords: Spirometry, Plethysmograph, Welding workers.

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Introduction

Welding is an important part of industry in India. In 1988 national institute of occupational safety and health (NIOSH) evaluated that there are about 2 million welders in the world.⁽¹⁾ Welding process is the metal-joining procedure in which metal is produced by heating to a appropriate temperature.⁽²⁾ In the Electric arc welding pieces of metals are joined by a heat produced as a result of passage of electricity from one electrical conductor to another.⁽³⁾

In welding the heat of the arc vaporizes the base metal, which condenses in air and forms the metal fume and this contains various particles that deposit in the bronchioles and alveoli.⁽⁴⁾

The Common chemical hazards of welding is due to the metal particles, and due to the various gases present in the metal fume and the Physical hazards of welding is due to the electrical energy, heat, noise, vibration and radiation.^(5,6)

Welding is associated with the various respiratory problems, such as cough, dyspnea,⁽⁷⁾ chronic bronchitis,⁽⁸⁾ interstitial lung disease,⁽⁹⁾ asthma,⁽¹⁰⁾ pneumoconiosis⁽¹¹⁾ and lung cancer.⁽¹²⁾

Materials and Method

Present study was conducted in Department of Physiology, Aurangabad. Approval was taken from the ethical committee before the start of study and the informed consent was taken from each subject before the study.

Study Design: Crossectional Study

Selection of study groups:

Group: 1- 50 normal healthy male subjects with their age 25-40 years who had not exposed to the arc welding fumes, were composed of local shopkeepers and salesmen.

Group: 2- 50 male arc welding workers with their age 25-40 years working since last 5 years, having exposure for at least 5-7 hours/day to arc welding fumes. They were selected from local welding shops. They did not use self protection measures during welding.

Arc welding workers were matched for the age, height, and weight with that of control groups.

Sample size: 100 subjects with 50 arc welding workers and 50 normal healthy subjects were taken, with precision of 7% and confidence interval of 95%.

Inclusion criteria: Normal healthy male subjects with their age 25-40 years who had not exposed to the arc welding fumes.

Male arc welding workers with their age 25-40 years working since last 5 years, having exposure for at least 5-7 hours/day to arc welding fumes.

Exclusion criteria: Subjects with H/o smoking, various respiratory infections, cardiac, respiratory and neuromuscular disease. Subjects with H/o diabetes mellitus, abdominal or thoracic surgery, abnormalities of the vertebral column.

Materials used for the study: Whole Body Plethysmograph in the Dept. of Physiology, Aurangabad.

Case record form was used to record the finding.

Plastic sputum container for sputum examination.

Procedure: The subjects were asked about the demographic data, work history, smoking habit and questions regarding respiratory symptoms such as h/o cough, sputum, wheeze or dyspnoea. Two consecutive sputum samples were tested before performing pulmonary function tests to rule out tuberculosis.

Pulmonary function test was recorded using "Medgraphics U.S.A. Body Plethysmograph, Elite DX Model No: 830001-005" at the department of physiology, volume calibration was done at three litres and temperature calibration at room temperature, this removes blockage in the wire mesh in based spirometers.

Parameters like age, height, weight were noted while recording the observations. Spirometry is an effort based test in which Subjects were encouraged for maximum efforts. Three readings were recorded and the best acceptable reading have been chosen.

The sitting position was preferred for subject. Pneumotach was fitted tightly in the mouth with teeth & lips to avoid leakage of air. Nose clip was used to prevent leakage of air from nose. The test procedure was explained to the subject nicely.

The procedure was done in the following steps: The Parameters used in these two groups for comparison on PFT were FVC, FEV1, FEV1/FVC, and MVV.

FVC (Forced Vital Capacity) is the amount of the air that can be expired rapidly with a maximal expiratory effort after a maximal inspiration.

Forced vital capacity was checked by asking the subject to take normal inspiration & expiration, for four times. This is followed by a deep inspiration to fill the chest as much as possible, then the subject forcefully blow out as much as possible followed by continuous blow as long as possible.

FEV1 (forced expiratory volume during first) Is the amount of air that can be forcefully expired during the first second of maximal expiration.

FEV1/FVC Is the FEV1 expressed as percentage of FVC.

Maximal Voluntary Ventilation (MVV) Is the amount of air that an individual inspire and expire in one minute with maximum voluntary effort.

Statistical Analysis: All the calculations and statistics were done using Microsoft Excel 2007 and all the statistics were compared by using "graph pad prism 5 software" version 5.01.

P-value less than 0.05 means it is significant and a p-value less than 0.01 means it is highly significant.

For each parameter the mean value and standard deviation were calculated in control and welder groups and they were compared using 'unpaired t test'.

Results

Table 1: The demographic data of the two study groups

Parameter	Control (Mean±SD)	Welders (Mean±SD)
Age (Yrs)	34.2±5.198	32.06±5.512
Weight (Kg)	58.5±10.25	52.43±13.44
Height(m)	1.620 ±0.070	1.605± 0.076
BMI	22.21±4.198	21.004±4.841

Table 2: Mean FVC, FEV1 FEV1/FVC%, MVV in control groups and welder groups

Parameter	Control (Mean±SD)	Welders (Mean±SD)	P value
FVC(L)	2.596±0.888	2.071±1.197	0.0144
FEV1(L)	2.543±0.637	2.297±0.595	0.0490
FEV1/FVC%	90.6±6.131	85.8±7.027	0.000439
MVV(L/min)	116.29 ± 22.96	94.18 ± 33.406	0.000207

Thus it is evident from the observation table that the exposure to welding fumes in welder groups causes the significant decrease in pulmonary function parameters like FVC, FEV1, FEV1/FVC and MVV as compared to the control groups.

Discussion

The present study shows that the welders with exposures during the last 5 years showed a significant reduction in pulmonary function parameters such as FVC, FEV1, FEV1/FVC and MVV, as compared to the controls.

This shows the association between welding years and pulmonary function impairment, this association is not explained by age, height or smoking.

Similar findings as that of our study, Sultan A. Meo. Et al.⁽¹³⁾ studied that the MVV in 50 male control groups and 50 male arc welders and all were non-smokers with the age of 20-60 years showed that MVV in arc welders is significantly decreased as that of control groups.

Erhabor G. E. Et al.⁽¹⁴⁾ studied the 44 arc welders and 50 age and sex matched controls. They showed that the arc welding workers have lower lung function parameters than controls ($p < 0.05$).

Stern et al.⁽¹⁵⁾ reported that FEV1, forced expiratory flow (FEF) 25-75% and PEF sometimes be reduced in welders

Erkinjuntti-pekkänen et al.⁽¹⁶⁾ reported that, welding workers without respiratory protection measures during welding had a greater decline in both FVC and FEV1 than welders with protection.

Several investigators have shown little or no changes in lung function in welders.

Hayden S. P. Et al.⁽¹⁷⁾ studies pulmonary function among 258 welders and equal number of matched control subjects in the engineering factories. In a subset of 186 subjects the maximum expiratory flow rate at low lung volumes was significantly less in welders who smoked than in control subjects who smoked, but there was no difference in non-smokers. Welders working under these conditions in the engineering industry appear to have no increased risk of chronic obstructive lung disease.

McMillan & Pethybridge⁽¹⁸⁾ showed that dockyard welders had no change in lung function, relative to controls, even though employed for an average of 33 years. The authors state that there was a suspicion that the welders might develop mild airways obstruction, without overt symptoms. This, according to the authors, could only be confirmed by increasing the study size.

We showed that FEV1, FEV1/FVC%, and FVC, MVV all have a significant association with duration of exposure, whereby increase in duration of exposure of welders to the welding decreases the lung function parameters. This is in contrast to finding of other⁽¹⁸⁾ where no effect was seen in duration of exposure among welders.

The apparent disparity in studies of lung function in welding workers could be due to differences in the smoking habits, exposure to various welding agents such as asbestos, differences in working place, the welding materials used, the amount of ventilation in the working place, and the kinds of protective measures taken.

Subjects in the present study welded for 5-7 hours a day, with no respiratory protective equipment, in small workshops without exhaust or ventilation systems. Adequate ventilation appears to be an important in the health of welders.

Conclusion

In the present study we found that the mean values

of lung function parameters such as FVC, FEV1, FEV1/FVC and MVV were significantly reduced in arc welding workers with duration of exposure longer than 5 years as compared to that of control groups. This shows that the effects of years of welding on lung function.

It is advisable to the welding workers, their managers and health officers work together to implement the various preventive measures such as ventilated working place, using mask and less harmful welding agent.

Welding workers must undergo periodic medical check-up and in severe cases they could be encouraged to change profession.

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