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PEAK EXPIRATORY FLOW CHANGES AMONG WELDERS

Physiology

Dr. Geetika Gupta Department of Physiology, Associate Professor, ASCOMS, Jammu
Dr. Gurmeet Kaur Department of Physiology, Assistant Professor, Govt. Medical College Jammu,
Dr Veena Gupta Department of Physiology, Demonstrator, Govt. Medical College, Kathua.
Dr Sabita Yograj Department of Physiology, Professor, Govt. Medical College, Kathua.
Dr Mumtaz Goni Retired Principal & Dean, Govt. Medical College Jammu.
Dr Rajneet Kaur* Department of Physiology, Associate Professor & Head, Pt. Jawahar Lal Nehru Govt. Medical College, Chamba.*Corresponding Author

ABSTRACT

Background & Objective: Occupational exposures to dust, fumes and gases are associated with increased prevalence of respiratory symptoms and impairment of lung functions. The decline in pulmonary function on exposure to welding fumes in steel industries has been reported in many studies. The aim of this study was to assess the effect of welding on the respiratory health of workers in steel factory and also to determine the contribution of smoking to welder's lung. **Methods:** The present study was undertaken on 200 workers working in a steel factory engaged in welding . Out of these 200 workers, 100 were welders (workers especially exposed to welding) and the rest of 100 were taken as controls. The controls were selected from office workers, drivers, electricians and maintenance staff. The lung parameter chosen to assess lung function was PEFR (Peak Expiratory Flow Rate). PEFR was carried out using a portable Medspiror. The data was analysed with the help of computer software SPSS 12.0 for Windows and Epi-Info version 6.1. **Results:** PEFR was decreased significantly in welders as compared to controls. Smoking caused a further decline in PEFR values in cases in comparison to non-smoker cases. **Conclusion:** In the present study mean PEFR values showed significant reduction in welders as compared to the control group implying impairment of lung function.

KEYWORDS

Welders, welding-fumes, steel dust, PEFR (Peak Expiratory Flow Rate).

INTRODUCTION

Iron and Steel industry is a major industry in India giving occupation to many people.[1] However, steel workers are continuously exposed to variety of agents and hence at risk of developing Occupational Respiratory Diseases [ORD] – a major health problem in many industries. Melting and casting process in a steel plant produce fumes and pollutant gases. Steel workers are potentially exposed to inorganic metal dusts (from iron ore, coal, silica, cobalt, zinc) and toxic gases that produces adverse effects on lung function.[2] In steel industry, dust is known to be a common hazard since every operation in workplace like handling of material, fabrication, welding releases into the air a certain amount of dust.[3] Even in the 21st century, welding is still an important occupational activity; 0.2% - 2% of the working population in industrialized countries has been reported to be engaged in welding.[4] Welding exposure over prolonged periods of time is cause for concern; several studies have illustrated that the health of workers is impacted by continued exposure to 'welding fumes'.[5] Welding is the process of joining metal components by melting the work piece by means of heat or pressure, or both, and adding filler material to form a strong joint. The majority of welding processes produce toxic fumes which are released by the heating of metals such as nickel, chrome, iron, copper, magnesium, zinc and cadmium.[6] The main components of welding emissions are oxides of metals formed due to contact between the oxygen in the air and the vaporized metal. Welding fumes can cause irritation, inflammation and oxidative damage to the airways and in the longer term can lead to lung diseases like chronic obstructive pulmonary disease COPD (term including chronic bronchitis and emphysema).[4,6]

Smoking per se is considered as an important risk factor in causing lung impairment. Furthermore smoking is a very common habit among welders in our country and hence, a significant confounding factor in much of the existing research and seems to have a synergistic adverse effect on lung functions in welders.[7] Combined occupational exposure to dusts, gases and fumes have been reported to reduce peak expiratory flow rate (PEFR).[8]

PEFR is primarily a measure of large airway caliber, can be used to identify and assess airflow limitation in clinical practice and epidemiological studies.[9]

This cross-sectional study was carried out with the aim to determine the relationship between metal dust exposure and lung functions in steel workers (welders) .

MATERIAL AND METHODS

A Cross sectional study was conducted on steel factory workers . Study population included 200 adult males > 18 years of age, permanent workers. Study subjects were divided into two groups: Welders (n=100) exposed to effect of welding and Controls (non-welders n=100) who were selected from office workers, maintenance department, drivers and electricians. After institutional ethical committee approval and written informed consent from the participants. Eligible subjects were enrolled after taking detailed history and making thorough clinical examination. Factors viz. duration of employment in years, smoking habits (those who currently smoke cigarette / bidis 1-9gm daily are mild smokers and moderate smokers are those with daily intake of 10-19gms/d) were considered. { One cigarette contains one grams of tobacco and an equal amount contained in 4 bidis.}.Standing height was recorded with the help of calibrated measuring scale mounted on a wall, weight was recorded using standardized weighing machine. PEFR was recorded with the help of portable Medspiror. Three reading were taken at the same time in sitting position and best of the three was considered in the study.

Inclusion Criteria:

- Male Subjects > 18 years of age exposed to welding in steel factory.
- Atleast one year of continuous / regular service.

Exclusion Criteria:

- Subjects suffering from any medical ailments or any cardiovascular disorder.
- History of previous occupational respiratory disease like asthma, bronchitis, allergies and abdominal surgeries.
- Excessive smokers (daily intake > 20 gms)

Parameter Studied:

Anthropometry – Age, Height, Weight and Body Surface Area.

Peak Expiratory Flow Rate – maximum expiratory flow rate sustained by a subject for atleast 10 milliseconds and is expressed in

litres/seconds.

STASTISTICALANALYSIS

Data was entered into Microsoft excel sheet and analysis was done with Epi- info version 6.1. Mean and standard deviation were calculated. Categorical variables were analyzed by Chi square test. P-value of < 0.05 was considered to be stastically significant.

RESULTS

Table 1 : Physical parameters among Welders and Controls

Parameters	Welders	Controls	p- value
Age	33.16 ± 11.08	34.41 ± 8.06	0.36
Weight	53.08 ± 9.24	55.73 ± 14.4	0.12
Height	164.05 ± 7.71	164.52 ± 8.34	0.67
Body Surface Area	1.57 ± 0.138	1.60 ± 1.19	0.12

Table 2: Comparison of different parameters among Welders and Control groups.

Parameters	Mean ± SD PEFR		p-value
	Welder	Control	
PEFR (L/sec)	5.70 ± 1.77	7.96 ± 2.13	0.0000**
Smokers	5.50 ± 1.86	7.46 ± 2.32	0.0008**
Non-Smokers	6.28 ± 1.36	8.54 ± 1.73	0.0002**
Frequency of Smoking < 10 gm	5.52 ± 1.64	7.60 ± 2.32	
Frequency of Smoking 10 – 19 gm	5.06 ± 1.94	6.67 ± 2.33	
Duration of Exposure 5 years	5.66 ± 1.73	8.03 ± 2.15	0.0000**
Duration of Exposure ≥ 5 years	5.66 ± 1.83	7.72 ± 2.25	0.0000**

* Significant ** Highly Significant

Table 2 - shows comparison of different parameters studies between welders and control groups. There was significant decrease in Mean PEFR value of welders when compared to that of control groups ($p < 0.0000^{**}$). PEFR showed significant decline in welders who smoked in comparison to smokers in control group ($p < 0.0008^{**}$). PEFR of smokers with frequency of smoking < 10 gm/d was lower than that of controls with same frequency. Same is true for PEFR value with more frequency of smoking (> 10 gm/d). When intragroup comparison was made between the welders and controls regarding the duration of exposure, the PEFR values were found to be significantly lower in welders in both the situations i.e. when duration of exposure was less than five years and more than five years.

DISCUSSION

High prevalence of occupational respiratory problems among metal workers is well documented.[10] The study was carried out in a local steel factory to assess the impact of 'welding fumes' on the respiratory health of the employees. Several studies have demonstrated reduction in lung function due to high exposure to dust and fumes in steel factory workers.[1,2,8,10,11,12,13] Our results were in agreement with these studies. The mean PEFR (the parameter chosen to assess lung function) was found to be significantly lower in welders as compared to controls.

Furthermore the mean PEFR value was found to be significantly less both in welders having exposure to welding for less than five years and welders exposed for more than five years when compared to the controls in their respective groups.

The decrease in PEFR is attributed to the consequences of the significant atmospheric exposure to 'airborne dust' found in large amounts in welding fumes. The potential hazards from exposure to metal fumes during common welding techniques depend on many factors such as metal being welded, composition of the welding electrode, position of the welders and the existing ventilation at the workplace. Pollutants such as toxic gases and fume particles are able to reach the terminal alveolar endings and exert a wide variety of effects.[14] Welders are known to have increased prevalence of bronchitis and respiratory impairment.[4]

In our study, the smoking profile of welders was also considered as most of the welders have the habit of smoking which in turn is one of the most important causes of impaired lung function.

The mean PEFR value in welders who smoked was lower than non-smoker welders and the difference was highly significant, suggesting that smoking in welders further impairs the lung functions. Similar results i.e. relatively more decline in PEFR in welders who smoked than non-smoking welders was reported by Hunnicutt TN et al.[2,15]

Also, smokers both in welder and control groups showed much more decrease in PEFR than the non-smokers in corresponding groups (p-0.0000). Chauhan S et al [16] have also reported decreased PEFR in cigarette smokers as compared to non-smokers. According to these authors, the intensity of cigarette smoking (pack-years) is the main variable to influence airway obstruction in smokers that caused greater reduction in PEFR.

Smoking has been identified as the most important risk factor in chronic obstructive pulmonary disease. It significantly increases progressive deterioration of lung function[17]. Majority of the existing research points towards a synergetic adverse effect on lung function in welders.[18]

CONCLUSION

Occupational exposure continues to be a major problem among steel factory workers, especially in workers engaged in welding sections. Our study showed decline in lung function in welders and this decline was more pronounced in welders who were smokers. Adverse health effects of work-related atmosphere are of great public interest. Inadequate control measures in the workplace and undesirable habits or hygiene practices will affect both workers well being and productivity. To decrease risk of work-associated respiratory morbidity, smoking cessation is highly recommended to personnel engaged in welding. Also all other possible interventions for damage prevention like use of protective personal equipment, monitoring the work environment and periodic and scheduled screening of lung functions of the workers should be carried out in accordance with the existent guidelines.

LIMITATIONS OF THE STUDY:

The limitations of the present study was lack of knowledge about specific dust exposure to which the welders were exposed as that is a strong determinant of the degree and type of lung impairment. Another limitation was relatively small sample size.

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