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ASSESSMENT OF PULMONARY FUNCTIONS AMONG SAWMILL WORKERS – A PRELIMINARY STUDY

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Abstract

In occupational exposure, respiratory absorption is usually greater than any other routes of absorption. Occupational respiratory illnesses are more extensive and more hindering than any other group of occupational ailment. Exposure to dust in the workplace environment is linked with a variety of systemic and lung infirmity.

Human lungs are large, spongy organ with thin alveolar epithelium and high blood flow that is an imperative site for interact with substance in environment. Workers in this industry, inhale large amounts of dusts over periods of time lead to proliferation and fibrotic changes in lungs. The workers in these units suffer from different kinds of air way diseases include chronic bronchitis, asthma and pulmonary fibrosis. So a preliminary study was carried out to assess the effects of wood dust on pulmonary functions of exposed workers.

Pulmonary function tests were carried out in 75 saw mill workers (Exposed) and 66 unexposed (Control) participants. Correlation between year of exposure and lung function parameters was assessed. Results of computerized spirometric parameters of saw mill workers were expressed as percentages of predicted values.

Inhalation of saw dust is associated with decrease in respiratory function. Year of exposure to saw dust was negatively correlated with percentage predicted FEV1/FVC indicating greater reduction in pulmonary function. However, additional objective measures (inflammatory/Bio markers) are warranted in order to reach to a more reliable conclusion.

Key words: *Occupational exposure, Pulmonary functions, Spirometry, Saw dust.*

Introduction

In general, approximately 10% of humans are affected by wood dusts around the world[1,2,3]. Furniture manufacturing sectors, dimension mills and sawmills workers are under high risk of wood/saw dusts exposure. Acute and chronic health effects have been encountered in personnel's who are working in these industries. Chronic exposure to saw dust leads to various respiratory ailments. Exposure to wood/saw dust may cause external, internal and adverse health effects which include allergic, mucosal and non respiratory effects, dermatitis and cancer[4, 5].

International Agency for Research on Cancer (IARC) states that wood dust causes cancer and considered as a Group 1 carcinogen[6]. Moreover, wood consists of many germs, chemical substances and toxins and they are potentially harmful to human health[7,8]. Several researchers report that these agents cause decline of respiratory functions, a reduction of forced expiratory volume in 1 second, tightness of the chest and irritation of throat[9, 10, 11]. Pulmonary function tests are basic tools for assessing the consequence of exposure on respiratory system[12].

The pulmonary function test is a significant measure to evaluate effectiveness of respiratory function. These tests are imperative for clinical diagnostic, prognostic value and research purpose too. It is clearly known that pulmonary function test has been useful tool for early detection of pulmonary ailments in patients considering to being normal in accordance with radiological and clinical examination. Spirometry is a readily available tool to detect lung function abnormalities at an early stage. It plays a significant role in an industrial respiratory health observation program. It helps health professionals to determine a specific pattern of pulmonary ailments and assists to evaluate the efficiency of measures employed to protect the individual worker. Spirometric (Vitalograph) results of exposed group workers can be assessed in order to know potential occupational hazards[13].

A large number of workers are engaged in saw mills in Coimbatore, Tamilnadu. Hence, it is essential to evaluate health hazards of this workers group. So the present study is executed to evaluate the consequence of wood dust on respiratory function of exposed workers of our locality.

Material and Methods

Subject Area and Population

A preliminary study is performed among workers employed in saw mills in Coimbatore (Vadavalli and Saibaba Colony) Tamilnadu. Seventy five (n = 75) male saw mill workers aged 18-50 years were selected for the study and they were

designated as "exposed groups". Sixty six participants (n = 66) of the same age with no relation to saw dusts exposure were served as "control group." After taking prior permission of institutional review board and ethical committee an informed written consent was obtained from each participants of control and exposed groups. The study consisted of selected inclusion and exclusion criteria for the selection of the participants. Workers with minimum one year of exposure were included and those with known history of diabetes mellitus, hyper tension and any other pathological conditions were excluded from the study. Each participant of the study received a questionnaire and orally was explained in local language for illiterates, to get their personal details.

Pulmonary Function Test

Assessment of pulmonary function by spirometry is a routine practice in epidemiological surveys in participants exposed to toxic dust and air pollution. Pulmonary function was assessed by using Vitalograph Alpha 6000, UK. Spirometry was performed according to the American Thoracic Society (ATS)/European Respiratory Society (ERS) guidelines. Reversibility testing was not considered feasible and hence was not performed. The lung function values assessed were: Vital Capacity (VC), Forced Vital Capacity (FVC), Forced Expiratory Volume in 1 Second (FEV_1), FEV1/FVC (FEV1 Ratio), Forced Expiratory Flow in the middle half of FVC (FEF25-75%) and Peak Expiratory Flow Rate (PEFR). Results were expressed as percentages of predicted values, using equations published in 1993 by the European Respiratory Society.

Statistical Analysis

SPSS package version 16.0 was used for the statistical analysis of data. Statistical significant level was set at $p<0.05$. Shapiro-Wilk test was done to identify the normal distribution of the data ($p>0.05$). Mann-Whitney test was performed to compare the lung function parameters between control and exposed participants. Spearman's correlation was carried out to know association between year of exposure and selected pulmonary function parameters.

Results and Discussion

Work place related lung diseases are occurred due to the long time exposure to dust and toxic substances that are responsible for acute and chronic respiratory ailments[14]. Most of the respiratory diseases occurred through occupational settings[15]. Reduction in VC, FVC, FEV1/FVC and FEF25% - 75% among the sawmill workers might be due to the accumulation of dust particles in airway of the lungs[16].

Demographic profile and anthropometric measurements of exposed and control group are listed in Table 1. There were no significant difference in age distribution, alcoholic and smoking habits, height, weight, BMI, systolic pressure and diastolic pressure between the sawmill workers and control. Smoking habit of the selected participants was expressed in pack years which is calculated in terms of number of pack years = (number of cigarettes smoked per day × number of years smoked)/20; 20= number of cigarette in a pack. Alcohol consumption of selected participants was stated in units/week (1 unit = 10 ml).

Table: 1 Demographic Profile and Anthropometric Measurements of Selected Sawmill Workers

General profile	Control (n = 66)	Exposed (n = 75)	p Value
Age in years	33 (25-38)	34 (27 - 39)	0.221*
Frequency of alcohol consumption	4.0 (0.00-18)	6.0 (0.00 - 23)	0.306*
Pack years	0.85 (0.1-3.5)	0.81(0.23 -3.1)	0.511*
Height	162 (159-168)	165 (162-170)	0.146*
Weight	66 (61-72)	69 (65- 74)	0.192*
BMI	27(26-34)	25 (22-29)	0.09*
Systolic pressure	120(115-125)	123 (118-130)	0.178*
Diastolic pressure	74 (70 -80)	80 (76-84)	0.215*

***= median value (inter quartile range); Mann Whitney test computed for groups with unequal sized samples.**

Pulmonary Function and Exposure

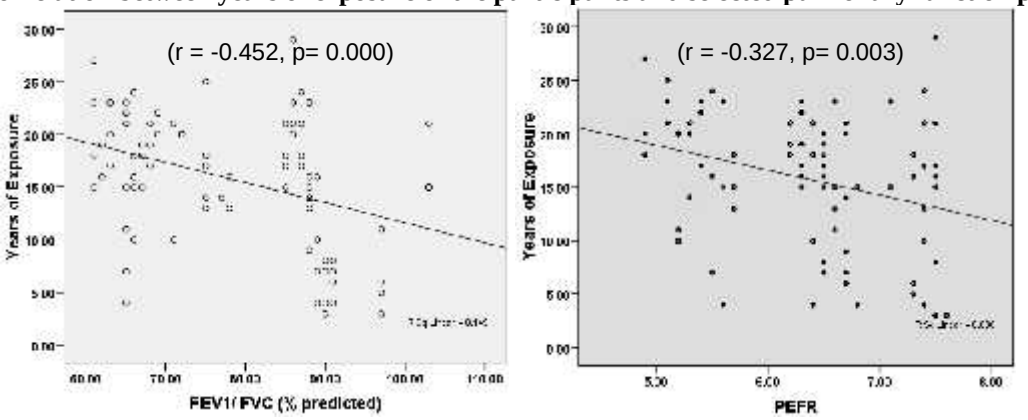
Lung function parameters of the subjects studied are presented in Table 2. Correlation between years of exposure and selected pulmonary function parameters of the participants are shown in Figure 1.

Table: 2 Pulmonary Function Parameters among Workers Employed in Saw Mills

Lung function Parameters*	Control (n = 66)	Exposed (n = 75)	p Value (>0.05)
VC (% Predicted)	79 (73-85)	62 (60-65)	0.012
FVC (% Predicted)	83 (80-92)	58(53-61)	0.015
FEV (% Predicted)	86 (79-90)	57 (52- 60)	0.014
FEV1(% Predicted)	104 (96-108)	53(50-65)	<0.01
FEV1/FVC(% Predicted)	99 (85-103)	70 (61-75)	<0.01
PEFR	7.3 (6.5-7.6)	5.6(4.9-6.3)	0.01
FEF 25%-75%	4.5 (4.0-5.2)	3.8 (3.2-4.1)	<0.01

*** Values are expressed as median (inter quartile range), Mann Whitney test computed for groups with unequal sized samples.**

Figure 1: Correlation between years of exposure of the participants and selected pulmonary function parameters



Acute and chronic exposure to saw dust influences mucociliary performance and may weaken the phagocytic activity of alveolar macrophages. In general, these dusts are scavenged and destroyed by macrophages, but overloaded dusts are accumulated and cause lungs irritation which may lead to thickening of lining of airways leading to obstruction[17,18]. This study was carried out to assess the influences of increased duration of exposure to saw dust on respiratory functions among exposed male workers. This study indicated that significant decline (p> 0.05) of all pulmonary function parameters of saw mill workers were observed than control. The decrease in PEFR in the studied population might indicate inflammatory changes in the respiratory tract which leads to increased airway resistance as a result of the saw dust exposure thereby bringing about the remodeling of the airway and consequently lung dysfunction[19,22]. The reports of Jacobsen *et al*. (2008) and Douwes *et al*. (2001) revealed that exposure to saw/wood dusts increase the risk of restriction and obstruction respiratory effects. A similar result was noticed in the present study that was proved through correlation analysis (Figure:1). Years of exposure to saw dust was inversely correlated with % predicted FEV1/FVC (r = -0.452, p= 0.000) and PEFR (r = -0.327, p= 0.003).

Conclusion

Chronic exposure of Wood dust causes bronchial irritation that is responsible for obstructive and restrictive type of pulmonary impairment. Chronic and acute inhalation of wood/saw dusts are related with a decline in lung function and greater decline in pulmonary function with greater extent of exposure. Moreover further measures are necessary in order to come to a more reliable conclusion.

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