



Contents lists available at BioMedSciDirect Publications

International Journal of Biological & Medical Research

Journal homepage: www.biomedscidirect.com

Original article

Effects Of Long Term Exposure To Sawdust In Workers Working In Saw Mills.

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ARTICLE INFO

Keywords:

Forced vital capacity (FVC)
Forced expiratory volume in 1st second (FEV1)
the ratio of FEV1/FVC, Pulmonary function test (PFT), sawmill workers, wood dust.

ABSTRACT

Aim: The lung function impairment is the most common respiratory problem in Saw mill industrial plants and their vicinity. So present study was conducted to investigate the effects of wood dust and its duration of exposure on lung function in Saw mill workers.

Material & Methods: The lung function tests were recorded using PC based Spiroexcel spirometer that is manufactured by medicaid systems Company of Chandigarh, India. A total of 87 sawmill workers were tested and their PFT values were compared with average normal predicted values for same age, sex, height & weight. Parameters such as forced vital capacity (FVC), forced expiratory volume in 1st second (FEV1), the ratio of FEV1/FVC, were assessed. The results were analyzed by using the ANOVA test. Result & conclusion: Saw mill workers showed greater decline in FVC, FEV1 values & this decline increased with increasing duration of exposure to wood dust. FEV1/FVC ratio in saw mill workers was not significantly reduced ($P > 0.05$) as compared to average normal predicted value for same age, sex, height and weight, suggesting restrictive pulmonary disorder.

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Introduction

Occupational diseases are a major concern, and many studies have been done to identify occupations at high risk of inducing disease.[1] Exposure to various chemicals or toxins which are manufactured or processed in industries are lethal for the workers in industries. Although these chemicals at workplace are known to invariably affect all body systems, lungs are most vulnerable to airborne hazards which are caused due to exposure to wood dust in welding, cement and wood industrial sectors.[2] Wood contains microorganisms (including fungi), toxins and chemical substances and they may significantly affect human health. It is recognized that those agents may cause irritation of oral cavity and throat, tightness of the chest, irritant dermatitis, urticaria, alveolitis, deterioration of pulmonary functions and a reduction of FEV1.[1]

Occupational exposure to wood dust has long been associated with respiratory symptoms, including asthma, chronic bronchitis, bronchial hyper-reactivity.[3] Chronic exposure to wood dust is common with carpenters; sawmill workers and furniture making industry.[2] Spirometry is one of the most important diagnostic tools. It is the most widely used, most basic effort dependent pulmonary function test and can measure the effects of restriction or obstruction on lung function.[4] So we used spirometry to assess the pulmonary function tests in sawmill workers. The present study was designed to study effects of saw-dust on the lung functions of saw mill workers in central India.

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Material and Methods

The present study was undertaken in saw mill workers in Nanded region of Maharashtra. A total of 87 saw mill workers in the age group of 20 to 45 years were included in the study. All workers were male. Smokers and tobacco chewers were excluded from the study. Healthy workers with no previous history of respiratory or other significant illness were selected.

History of exposure to wooden dust was noted. Age of the subjects and anthropometric measurement, height (cm) and weight (kg) were recorded. They are matched in terms of height and weight. Procedures were done in accordance with standards of ethical committee of Govt. Medical College, Nanded, Maharashtra on human experimentation. The lung function tests were recorded using PC based Spiroexcel spirometer that is manufactured by medicaid systems Company of Chandigarh, India. Informed consent was obtained from all subject. The pulmonary function indices studied were forced vital capacity (FVC), forced expiratory volume in one second (FEV1), & FEV1/FVC%. Before each test the testing procedure was explained to subjects.

All the procedures were carried during morning hours in sitting position of subjects. During the test, the subjects were adequately encouraged to perform at their optimum level and also a nose clip was applied during vital capacity manoeuvre. Test was repeated 3 times and the highest value was considered as a final reading for each subject and mean of highest values of each group was calculated which are presented in Table I.

All readings were recorded at BTPS. Subjects were divided into four groups depending upon the duration of exposure to wood/saw dust as follows

Group I- Subjects working in saw mill having less than 2 yrs exposure to wood/saw dust.

Group II- Subjects working in saw mill having 2-4 yrs exposure to wood/saw dust.

Group III- Subjects working in saw mill having 4-6 yrs exposure to wood/sawdust.

Group IV- Subjects working in saw mill having more than 6 yrs exposure to wood/ saw dust.

Results And Discussion

Table I : Pulmonary function indices in four groups.

| Parameter | Group I n=18x | | | Group II n=32 | | | Group III n=27 | | | Group IV n=10 | | |
|--------------|------------------|------|----------------|------------------|------|-----------------|-------------------|------|-----------------|------------------|------|--------------|
| | %P | P | O | %P | P | O | %P | P | O | %P | P | O |
| FVC (L) | 76% | 4.17 | 3.15± 0.41 | 63% | 4.32 | 2.74 ± 0.29 | 53% | 4.28 | 2.25 ± 0.30 | 35% | 3.82 | 1.34 ± 0.27 |
| FEV1 (L) | 67% | 3.54 | 2.35 ± 0.61 | 58% | 3.67 | 2.11 ± 0.54 | 49% | 3.61 | 1.77 ± 0.43 | 33% | 3.22 | 1.08 ± 0.29 |
| FEV1/FVC (L) | 93% | 81 | 75.64± 4.57 | 95% | 81 | 77.07 ± 3.22 | 97% | 81 | 79.16 ± 3.29 | 99% | 80 | 79.68± 3.044 |

P = Predicted Value.
 O = Observed Value.
 %P = Percent Predicted Value.

The statistical analysis was done by using “SPSS” software. By applying ANOVA test to the observed values of group I, II,III,IV it was observed that FVC , FEV1 were significantly decreased(TABLE II).However, FEV1/FVC was not altered significantly while FVC was significantly reduced, which is indicative of restrictive pulmonary disease.

3 FEV1/FVC (L) 0.246 Not Significant(0.864)
 Decrease in FVC, is Highly Significant (F calculated Value = 221.402)
 (Highly Significant-0.0001) .while decrease in FEV1/FVC is not significant (F calculated Value = 0.246)(Not Significant.-0.864). This shows that exposure to saw dust causes restrictive pulmonary impairment.

TABLE II : Showing F-Values for four groups according to different parameters:

| Sr. No. | Parameter | Fcal. Value | Result |
|---------|--------------|-------------|-----------------------------|
| 1 | FVC (L) | 221.402 | Highly Significant.(0.0001) |
| 2 | FEV1 (L) | 16.299 | Highly Significant.(0.0001) |
| 3 | FEV1/FVC (L) | 0.246 | Not Significant(0.864) |

Decrease in FVC, is Highly Significant (F calculated Value = 221.402)
 (Highly Significant-0.0001) .while decrease in FEV1/FVC is not significant (F calculated Value = 0.246)(Not Significant.-0.864). This shows that exposure to saw dust causes restrictive pulmonary impairment.

As early as the 18th century, Ramazzini described irritation of mucous membranes after exposure to air contaminants in connection with wood processing.[5] Wood dust is a variety of organic dust, exposure to which is known to cause substantial health impacts.[6]

Decline in FVC, FEV1, among the sawmill workers could be due to the accumulation of dust particles in the air passages.[7]Chronic dust exposure impairs the phagocytic activity of alveolar macrophages and also affects the mucociliary performance. When the dust particles are inhaled, scavenger cells like macrophages dissolve the dust by surrounding it, but if there is dust overload, the macrophages fail to completely clear the dust; consequently the dust particles lodge in and irritate the lungs setting up an inflammation in the small airways of the lung. The healing of the inflammation by fibrosis leads to thickening of lining of airways leading to obstruction.[8]

Sakariya et al in their study they took 25 workers and 25 healthy non workers as control groups. It was observed in the study that the mean values of FVC (2.4±0.55), FEV1 (2.29±0.47) were significantly low as compared to control group (p<0.05) and mean value of FEV1/FVC (87.97±18.3) was significantly higher in workers as compared to control group (p<0.05). High values of FEV1/FVC ratio in workers indicates the restrictive lung disease among the workers. They also explained wood dust particles and lack of proper ventilation and lack of environmental factors were risk factors at workplace of sawmill workers for decreased lung functions. Their study pointed out towards restrictive lung disease among the sawmill workers exposed to wood dust.[9,10]

EA Tobin et al in their study they found that the mean values of all FEV1, FVC, FEV1 /FVC and PEFr pulmonary parameters were significantly higher in the comparison than among the study group. They found that wood dust, made up of cellulose and other soluble chemicals including acetic acid and resins, is largely of large diameter fibres that irritate the cough receptors in the trachea and cause mucostasis in the upper respiratory tract, leading to cough and phlegm production. Because of the irritant and allergic properties of wood dust, this small proportion of wood dust with lack of proper ventilation was responsible for the higher prevalence to provoke pathological changes & subsequent de-arranged respiratory parameters in their subjects.[11]

Dudhmal V.B et al studied pulmonary function tests in 30 saw mill workers grouped into 3 groups depending upon duration of exposure i.e. (a) < 2 years (b) 2-4 years and (c) 4-6 years. These readings were compared with controls of same age & socio-economic status. FVC, FEV1, FEV3, PEFr parameters were tested. They observed that decrease in values of FVC, FEV1, FEV3 and PEFr were in proportion to the duration of exposure. They also showed that the pulmonary functions go on deteriorating as the duration of exposure goes on increasing. They found that wooden dust had an effect on pulmonary parameter. This is probably due to hypertrophy of mucosal cells due to irritation by wood/saw dust, resulting in increased secretions of mucus and formation of mucosal plugs & de-arranged pulmonary parameter.[12]

Conclusion: this study demonstrates that the sawmill workers are more vulnerable to respiratory impairment due to wood dust (saw dust) exposure in the workplace environment. The impairment of pulmonary function parameter is associated with dose-effect response of years of exposure to wood dust, where the subject with longer duration of exposure is worst affected. Efforts are recommended to control the levels of dust to within safe occupational limits with a well designed, efficient and properly used exhaust ventilation system, usage of personal protective equipment, good housekeeping and other measures to similar effect. Periodic medical examination of the workers is also strongly recommended.

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