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Original Research Article

Pulmonary Function Analysis in Carpenter Workers Exposed to Wood Dust: A Study from Maharashtra

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Abstract

Background: There has been an increase in proportion of workers suffering from occupational diseases compared to past. Only limited studies have been conducted to evaluate the pulmonary functions of carpenters, exposed to wood dust. Hence the present study was undertaken to find out any functional impairment in carpenters due to their occupational environment.

Methods: Study was done in 200 subjects who were divided into two groups of 100 each. One group comprised carpenters with minimum 5 years exposure to wood dust. Other group comprised matching healthy subjects who served as controls. Pulmonary function parameters were recorded from all subjects. Parameters recorded were Forced Vital Capacity (FVC), Forced Expiratory Volume in 1 second (FEV1), Forced expiratory flow (FEF25-75%) and Peak Expiratory flow Rate (PEFR). Statistical analysis of the data of study subjects and the controls were done by using unpaired 't' test. The level of significance was fixed as 5%.

Results: A statistically significant reduction in FVC, FEV1, FEF25-75% and PEFR was seen in the study group compared to control group. FEV1/FVC was not reduced.

Conclusions: Lung functions of carpenters show statistically significant reduction compared to normal healthy adults. This could be due to their exposure to wood dust.

Keywords: Carpenters, PFT, Wood dust

Introduction

Occupational diseases have become one of the major economic burdens of every country. According to International Labor Organization report 2013, more than 2.3 million people die of occupational diseases. Impairment of health due to exposure to wood dust is an important occupational hazard. It is estimated that at least 2 million people are exposed to wood dust every day around the world.[1]

Wood dust exposure deteriorates pulmonary function, increases the prevalence of respiratory diseases, increases cancer incidence and death.[2] Wood dust also causes allergic dermatitis and decreased mucociliary clearance leading to mucostasis. Out of these, effects on respiratory system are more common.[3] Wood contains microorganisms like fungi, toxins and chemical

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substances which may significantly affect human health.[4]
The Observatoire National des Asthmes Professionnels (ONAP) employed a network of occupational and chest physicians to report the incidence of occupational asthma in France. ONAP reported the highest risk of occupational asthma in bakers and pastry makers (683/million).[5]

Several studies have shown respiratory disorders in carpenters, including the reduction of pulmonary function tests in these workers[6] and the existence of specific IgE in some of the carpenters.[7] There is a relationship between maximal mid-expiratory flow and duration of working as a carpenter.[8] Carpenters have been shown to be susceptible to developing asthma related to their work.[9] Pulmonary function is also decreased in people exposed to wood dust and tea.[10]

Carpentry is one important occupation in which there is considerable exposure to wood dust. Spirometry is one of the basic tools in evaluating the respiratory function.[11] Studies conducted worldwide have proven the impairment of pulmonary functions in wood workers.[12,13]

Even though several studies have been conducted in wood workers worldwide, not much have been published from India. One study from Nagpur, reported significant decrease in PEFR in wood workers.[12] Therefore, the aims of this study were to assess the pulmonary function tests in carpenter's compared to unexposed controls.

MATERIALS AND METHODS-
This study was conducted under the auspices of the Department of physiology, Ashwini Rural Medical College, Kumbhari, Solapur.
Study design- cross-sectional study.

Inclusion criteria for study group-
a) Male subject
b) Age 20-50 years
c) More than 5 years of exposure to wood dust

Inclusion criteria for control group-
a) Male subject
b) Age 20-50 years
c) Normal healthy volunteers

Exclusion criteria for study group-
a) Respiratory complaints before joining for work
b) Subjects with cardiac diseases
c) Taking any medications

One hundred carpenters were taken as subjects of the present study. Data were collected from 100 carpenters with a minimum period of 5 years exposure to wood dust and 100 healthy volunteers were included as controls for the study. Basic demographic data, history of exposure to wood dust, history of respiratory symptoms present and history of any other illnesses were collected using the help of proforma from all subjects. Proforma was prepared based on standard questionnaire published by British Medical Research Council.[14] Vital parameters were recorded. Blood pressure was recorded using manual sphygmomanometer. The

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anthropometric measurements including height and weight were recorded. Height recorded using stadiometer and weight using a floor weighing balance. Physical examination was done by an experienced pulmonologist. Guidelines were strictly followed in taking clinical data.[15] Pulmonary function tests were done using Spiro excel machine.

Spirometry performance and validation were done according to the guidelines published by American Thoracic Society[16]. The various indices of spirometry that were recorded and used for analysis were Forced vital capital (FVC), Forced Expiratory volume in 1second (FEV1), FEV1/FVC Ratio, Peak Expiratory Flow Rate (PEFR) and Forced Expiratory Flow (FEF 25-75%).

Procedure

All the subjects were given clear instructions prior to each test. Spirometry was done in the morning, in sitting position with neck slightly extended. A disposable mouth piece was used for each subject. After the insertion of mouth piece it was made sure that there were no air leaks around the mouthpiece. All maneuvers were performed in sitting position and at rest with the nose clip in place. The subjects were asked to loosen tight clothing, if any. Each worker was taught about the various maneuvers to be performed for about 5minutes. Demonstration was also given. Every subject was given ample time to understand carefully and then was allowed to do some practice blows. Sufficient rest was provided between the procedures.

Statistical analysis

Analysis of the data obtained from the study subjects and the controls was done by using unpaired- t test. The level of significance is fixed at 5%. Analysis done using SPSS software.

RESULTS-

Table1- Mean and SD of age

	Study group	Control group	P-value	Statistical significance
Mean age ± SD	40.741±4.84	40.6±6.80	0.8970	NS

Table 2- Pulmonary Function parameters in study and control group

Parameter	Study group Mean ± SD	Control group Mean ± SD	P- value	Statistical significance
FEV1	2.30 ± 0.07	2.5 ± 0.57	0.03*	S
FVC	2.70±0.62	3.0±0.78	0.03*	S
FEV1/FVC	85.23±11.99	85.1±10.26	0.96	NS
PEFR	5.80±1.25	6.3±1.58	0.01*	S
FEF25-75%	2.58±0.45	2.9±0.73	0.01*	S

*P – value < 0.05 is statistically significant.

Table 1 shows that there is no significant difference between age distribution of study and

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control groups.
Table 2 shows that FEV1 of the study group was significantly reduced when compared to that of control group.
FVC was also reduced significantly.
But FEV1/FVC was not reduced.
PEFR and FEF25-75 was also reduced significantly.

DISCUSSION

This study was done to observe the effects of wood dust on the pulmonary function of carpenters. Total number of study population were 100 and equal no of controls were added. All members in the study and control group were males.

The lung parameters showed that there was statistically significant reduction in FVC and FEV1. This shows impairment of lung function due to exposure to wood dust. This is in agreement with previous studies like Boskabady M, Pramanik P.[17,18]

FEV1/FVC was not impaired significantly. This points to a restrictive type of abnormality as supported by the previous studies like Mahamood NM, Noertjojo HK and Schlunssen.[19-21] Significant reduction in PEFR in study group compared to the control group shows that there is an element of obstruction along with restrictive abnormality. FEF 25-75% shows small airway disease. In our study there was significant reduction FEF 25-75%. This shows small airways were affected in wood dust exposure.

The mean FEV1 and FVC values of woodworkers were significantly low, although the FEV1/FVC value was normal. The results of this study indicated that exposure to wood dust adversely influenced the workers' respiratory func-tions, which supports the results of our study.[22] Another recent study among 685 carpenters in Thailand showed significant negative correlations between mean dust expo- sure levels and FVC and FEV1/FVC%, but not FEV1, which suggests that wood dust exposure negatively affects normal lung function.[23]

In fact, the results of the present study showed that there was a significant decrease in FVC among carpenters, while the FEV1/FVC ratio was normal. These results may indicate the presence of restrictive lung disease among carpenters. These findings are supported by previous studies con- ducted by Rastogi et al.,12 indicating lower levels of forced vital capacity (FVC), and Robinson et al.,[24] demonstrating emphysema among carpenters. The significant reduction in FEV1 and PEFR could be secondary to restrictive lung disease, or carpentry work may result in a combination of restrictive and obstructive lung diseases, which should be clarified in further studies.

This study indicated that the main reason for the reduction in pulmonary function is air pollution in the workplace of carpenters and the main irritant in the workplaces of these workers is wood dust. However, other substances that carpenters were exposed to, such as cotton fibers and glue contents or solvents, may also contribute to increased respiratory and allergic symptoms and decreased PFT values. In addition, wood contains many microorganisms (including fungi) and toxins that may affect respiratory status. In fact, agents such as terpenes, abietic acid, and plicatic acid contained in different types of wood are, potentially, implicated in the occurrence of asthma by inducing increased bronchial responsiveness or by dama- ging

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the bronchial epithelial cells.[25-27] Therefore, serious effort should be undertaken to reduce air pollution in the workplaces of carpenters. The study of Laraqui Hossini et al.,[28] as well as some other studies, also have recommended implementation of an occupational health service and development of a means for collective and individual prevention to reduce the risk maximally.

CONCLUSION

A statistically significant reduction was seen in FVC, FEV1, PEF and FEF 25-75% compared to normal healthy adults. No significant reduction was seen in FEV1 /FVC, pointing to the restrictive nature of dysfunction. Millions of people are involved in the wood industry and millions depend on them. Governments have to make and implement strict rules and regulations for the betterment of workers in this field to prevent excess exposure and pulmonary dysfunction.

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