The Impact of Wood Dust Particles on the Pulmonary Function of Sawmill Workers

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ABSTRACT

Introduction: Wood dust is one of the most common sources of occupational exposures in the world and cause several respiratory disorders. The main aim of the study is to identify the health issues through the workplace risk assessment among sawmill workers.

Material and methods: A comparative cross-sectional study was conducted among eighteen sawmill workers to evaluate socio-demographic variables through the standardized questionnaire. The spirometry test was conducted as per ATS Spirometry Guidelines 2005 to predict the pulmonary function test parameters such as Forced Expiratory Volume in one second (FEV1) and Forced Vital Capacity (FVC).

Results: The occurrence of respiratory symptoms and abnormal pulmonary function among workers exposed to different levels of saw dust and the factors which may be associated with the respiratory effects were also investigated in this study. A significant difference was also observed between the ideal and actual pulmonary function test parameters among the workers which was resulted in decreased work output and increased respiratory morbidity such as asthma, allergic rhinitis, chronic bronchitis, and impairment of lung function.

Conclusions: The study concluded that efforts must be employed to mitigate the untoward effect of wood dust, the preventive measures and awareness creation about wood dust-related respiratory problems should also be provided in all sawmills.

Keywords: Occupational Hazard; Pulmonary Function Tests; Sawmill Worker; Spirometry Test; Wood Dust.

INTRODUCTION

Wood is harvested almost in all the countries for its traditional use like fuel and as a construction material[6]. Sawmills are mechanical wood industries which produce sawn wood through cutting or shaping of wood materials. The enormous amount of dust was emitted during this process, and this enters into the body through the respiratory system resulting in the risk of occupational hazards such as respiratory disorders, allergy, asthma and cancer etc.,[2,5,13,14] The influence of this occupational hazards mainly depends upon the type of dust, the period of exposure, the concentration and size of dust in the breathing zone[4,6,13]. Apart from these respiratory diseases, the workers are also affected by excess noise and stress at workplace[20]. To avoid these harmful health issues due to excessive exposure of dust, which is developed in workplace, the European Union (EU) have decided the permissible limit for the exposure of inhalable wood dust to be 5 mg m^{-3}, based on 8 hours working day[8,12].

On the other side, many authors have been reported that the occupational hazards and their health issues can be prevented and encountered using Personal Productive Equipment's (PPE) at the workplace [9,10,18,19]. But the provision of PPE such as masks, goggles etc., to the workers at the place of work is very limited in middle income country like India [20]. Despite this provision of PPE to the workers by the employers, the response of the workers in the use of these safety wears is also questionable. Hence these workers are at a high risk of occupational health hazards due to the exposure of high level of wood level at workplace [10,20,15]. Many countries have legislation to ensure health & safety of workers, provision of PPE to the workers and the use of PPE by the workers [15]. To the best of my knowledge, so far, there is no significant study conducted to assess the level of occupational dust exposure among wood workers in sawmill industries and its impact on health in the State of Kerala. Since there are no psychosocial instruments to evaluate the worker knowledge, attitudes, and perceptions with respect to occupational hazards and their safety measures [11]. For this reason, the detailed cross-sectional survey and field study has been conducted among the sawmill workers in the exposure of inhalable wood dust. This study also aimed at determining the impact of wood dust on the pulmonary function of the sawmill workers.

MATERIALS AND METHODS

Selection of Subjects

Eighteen male sawmill workers were selected for this study from a sawmill factory in Kochuveli (Coastal Zone) and Kilippalam (Urban Zone) in Trivandrum, Kerala, India. The sawmill workers were apparently physically fit. The average age of the workers was 33 (age range: 24-59).

Work Schedule

The workers in the sawmill worked 8 hours daily from 9 a.m. to 6 p.m. with one-hour interim break (2 p.m. - 3 p.m.). They had a day off per week in a cyclic manner [3]. The survey was

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S.No	Age (Years)	Work Experience (Years)	Height (cm)	Weight (Kgs)	BMI Status	Lung Function Test Parameters							
						FEV1(Litres)			FVC(Litres)			FEV1 /FVC (%)	
						Ideal (A)	Actual (B)	(A-B)	Ideal (A)	Actual (B)	(A-B)	Ideal %	Actual %
1.	26	6	169	71.60	Normal	4L	1.75L	2.25L	5L	2.21L	2.79L	80	79.19
2.	50	30	165	90.60	Obese	4L	1.98L	2.02L	5L	2.99L	2.01L	80	66.22
3.	24	8	170	73.00	Normal	4L	2.87L	1.13L	5L	2.93L	2.07L	80	97.95
4.	34	10	172	75.00	Over Weight	4L	2.81L	1.19L	5L	2.93L	2.07L	80	95.90
5.	35	20	169	78.50	Over Weight	4L	1.27L	2.73L	5L	1.44L	3.56L	80	88.19
6.	42	10	166	83.40	Obese	4L	2.65L	1.35L	5L	2.93L	2.07L	80	90.44
7.	38	12	168	74.00	Over Weight	4L	2.84L	1.16L	5L	3.06L	1.94L	80	92.81
8.	43	15	173	85.00	Over Weight	4L	3.11L	1.38L	5L	2.69L	2.31L	80	97.40
9.	39	17	175	89.00	Over Weight	4L	2.62L	1.47L	5L	2.69L	2.31L	80	94.05

Table-1: Spiro Metric Lung Function Test of Wood Workers at Kochuveli Coastal Zone Sawmill

S.No	Age (Years)	Work Experience (Years)	Height (cm)	Weight (Kgs)	BMI Status	Lung Function Test Parameters							
						FEV1(Litres)			FVC(Litres)			FEV! /FVC (%)	
						Ideal (A)	Actual (B)	(A-B)	Ideal (A)	Actual (B)	(A-B)	Ideal (%)	Actual (%)
1.	46	25	164	96.50	Obese	4L	1.15L	2.85 L	5L	1.67L	3.33 L	80	69.00
2.	24	7	158	62.00	Over Weight	4L	3.07L	0.93 L	5L	3.21L	1.79 L	80	95.64
3.	42	13	168	74.00	Normal	4L	2.66L	1.34 L	5L	2.99L	2.01 L	80	89.00
4.	59	39	174	95.00	Obese	4L	1.98L	2.02 L	5L	2.99L	2.01 L	80	66.00
5.	30	15	169	76.00	Normal	4L	1.75L	2.25 L	5L	2.21L	2.79 L	80	79.00
6.	31	13	170	79.00	Over Weight	4L	1.27L	2.73 L	5L	1.44L	3.56 L	80	88.00
7.	34	14	173	82.00	Over Weight	4L	2.84L	1.16 L	5L	3.06L	1.94 L	80	93.00
8.	27	7	167	65.00	Normal	4L	3.11L	0.89 L	5L	3.21L	1.79 L	80	96.88
9.	35	12	176	74.00	Normal	4L	2.62L	1.38 L	5L	2.69L	2.31 L	80	97.00

Table-2: Spiro Metric Lung Function Test of Wood Workers at Kilippalam Urban Zone Sawmill

conducted in between March 2021 to June 2022.

Prediction of Physical Parameters

The heights and weights of the sawmill workers were measured by an anthropometer and a weighing machine respectively. The body mass index (BMI) was calculated by the following formulae: Body Mass Index (BMI) = Body Weight (in kg)/ Body Height (in m^2) [3]. The age and working experience of the sawmills were also presented (Table 1).

Method of Study

A cross-sectional descriptive study was incorporated among sawmill workers [2,5,6,15,16,17,19]. The questionnaire consists of a series of objective-type questions with multiple choice responses. The questions were grouped in the context of overall information about the sawmill workers, information about the organization, nature of work and kind of discomfort felt in the body [2,18]. The face-to-face interview was conducted to obtain more reliable and accurate information from the sawmill workers because as they were from a wide range of backgrounds with different educational levels [2].

Spirometry Test

As per ATS Spirometry Guidelines 2005, the spirometry test (Fig. 1) was conducted by using digital spirometer with a different mouthpiece for each subject [7]. A minimum of 3 acceptable and repeatable forced expiratory readings were taken by using spirometer at sitting and upright position. The pulmonary function test parameters such as Forced Expiratory Volume in one second (FEV1) and Forced Vital Capacity (FVC) were successfully predicted [5,6,14].

RESULTS AND DISCUSSION

The predicted pulmonary function test parameters such as Forced Expiratory Volume in one second (FEV1 in litres), Forced Vital Capacity (FVC in litres) and FEV1 /FVC (%) are presented in Table 1 and 2. The statistical analysis was also conducted on basic parameters of this study such as age, work experience, height and weight and the predicted results are also reported (Table 3).

A mean pulmonary function test parameters predicted was FVC (2.63 ± 0.56) L, FEV1 (2.35±0.67) L and FEV1 / FVC 87.54 ± 10.94 %. It was showed that sawmill workers experienced a significant reduction in the mean value of FVC, FEV1 and FEV1 /FVC. This is clearly demonstrated that statistically significant association existed between exposure to wood dust and respiratory symptoms (Fig. 2 and 3) [7]. This results also ascertained that the concentration of wood dust inhaled by the sawmill workers are high resulting in respiratory symptoms such as chronic cough, corrhiza, breathlessness and wheezing [6].

As seen in Table-1 & Table-2, the actual values of FEV1 & FVC represent obstructive or restrictive lung impairment for almost every individual who are exposed to wood dust. This is mainly seen in the reduced values of FEV1 and the reduced values of FVC in comparison to the ideal FEV1 and ideal FVC values of normal pulmonary function.

With reference to Table -1 & Table 2 , the spirometry test values of individuals working in the coastal as well as in the urban zone saw mill unit displays reduced values of FEV1 and reduced values of FVC making index lower than 80% depicting a chronic Obstructive Pulmonary Disorder (COPD) and those individuals with a slight increase of FEV1 and with an index much greater than 80 % and reaching in the order closer to 90-95% is a clear case of Chronic Restrictive Lung Disorder. In table-2, In fact majority of the individuals 6 out of 9 individuals are medically unfit as their spirometry test values show signs of Chronic Restrictive Pulmonary Disorder and the remaining 3 individual's spirometry test values show signs of Chronic Obstructive Pulmonary Disorder whereas in Table -1, 7 individuals out of 9 have their spirometry test values of Tiffeneau - Pinelli Index much greater than 80% displaying tendency for restrictive lung diseases.

The values show very dangerous health conditions leading to increased occupational illness and in grave situation may lead to premature death and attracts the attention of regulatory bodies to take stringent measures in curtailing down the dust pollution levels by bring into place all the necessary pollution control measures at source, path and receiver ends.

The work experience of the sawmill workers plays a vital role in the pulmonary function test parameters. It means that sawmill workers having less experience (less exposure to wood dust) have lower rates of pulmonary disorders than the sawmill workers having more experience (more exposure to wood dust) [2].

Pulmonary function test parameters were negatively correlated with body mass index and duration of wood dust exposure whereas height and weight were positively correlated with these parameters [6]. These results obviously demonstrated that the employer must assure the health condition of the workers periodically.

The periodical medical check-up is essential for all the sawmill workers, and this must be compulsorily provided by the employer. Also, the sawmill workers those who had respiratory disorders such as asthma, allergic rhinitis, chronic bronchitis, and impairment of lung function are advised to take the appropriate treatment [20].

Prevention is better than cure. The dust and other hazardous exposure among sawmill workers should be minimized at the workplace through proper remedial measures. The study recommended that use of PPE is the best way to reduce this hazardous exposure [8,10]. The employers should guarantee a safe working environment to the workers by the provision of PPE, proper ventilation system etc. The employers must also ascertain the use of PPE by the workers.

It was also recommended that there is a need to improve the knowledge of sawmill workers in relation to occupational hazards and safety practices to mitigate its negative consequences [1]. The awareness regarding benefits of wearing proper PPEs should be created through comprehensive training program [9,17,19].

CONCLUSIONS

The occurrence of respiratory symptoms such as asthma, allergic rhinitis, chronic bronchitis and abnormal pulmonary

function was observed among sawmill workers exposed to different levels of saw dust. The efforts must be employed to mitigate the untoward effect of wood dust, the preventive measures and awareness creation about wood dust-related respiratory problems should also be incorporated in all sawmills. The study also recommended that the use of PPE be the best way to minimize these occupational hazards. Also, the knowledge and attitude of sawmill workers towards occupational hazards and use of PPE is still to be improved.

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