



Research Article

Prevalence of Respiratory Disorders among Woodworkers in Jimma Town, Southwest Ethiopia

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Abstract

Background: Wood dust is one of the most common sources of occupational exposures in the world. Occupational exposure to wood dust inhalation results in respiratory disorders. Jimma was the endemic and pioneer of different wood and wood products that creates work opportunity for many individuals but, simultaneous exposure to different respiratory impairments was inevitable.

Objective: The aim of the present study was to assess the prevalence of respiratory disorders among woodworkers in Jimma town, Ethiopia, 2018 G.C.

Method: A community based comparative cross-sectional study was conducted among woodworkers and non-woodworkers in Jimma town, 2018 G.C. Multistage random sampling technique was used to select the exposed study group and convenience sampling technique was used to select the non-exposed group. Spirometer and clinical presentation was used to identify respiratory disorders. A total of 140 study participants were enrolled in the study. Data were checked for completeness, entered into Epi data version 1.7 and exported to SPSS version 20 for further analysis. Descriptive statistics were computed and results were presented with narratives, tables or figures.

Results: The magnitudes of ventilatory impairments were higher among exposed group (44.2%) than non-exposed group (14.3%) specifically identified as restrictive disease (20% and 6.8%), obstructive disease (17.1% and 5.7%) and mixed pattern (7.1% and 0%) among woodworkers and control group respectively.

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Conclusion: In general the prevalence of respiratory disorders/ventilatory impairments was diagnosed among 41 respondents (29.3%) while the left 99 (70.7%) considered as having normal pulmonary function. The burdens of respiratory disorders were higher (44.2%) among woodworkers when compared with control group (14.3%).

Keywords: Respiratory disorders, Woodworkers, Jimma town, Comparative cross-sectional

Introduction

WHO estimated 2.78 million deaths annually being attributed to work related factors globally. Among these, respiratory diseases accounted for 17% with the inclusion of COPD and Asthma next to circulatory diseases (31%) and malignant neoplasms (26%). Together, they contributed more than three-quarter of the total work-related mortality, followed by occupational injuries at 14% and communicable diseases (9%) [1].

Among the identified occupational hazards, exposure to wood dust is responsible for development of various respiratory disease [2]. Two million workers worldwide are regularly exposed to wood dust in the work place and claims for respiratory disorders [3-6].

Dusts from the wood and its components (cellulose, hemicellulose, lignin, organic and inorganic compounds like terpenes and its derivatives such as abietic acid, phenolic compounds, tannins, stilbenes and glycosides) are known for their sensitizing and irritating properties of the mucous membrane and evokes asthma [7,8]. Inhalation of dust via respiratory system accessed to the airways, airways epithelial cells, activate macrophages, dendritic cells and innate immune cells; then initiate responses in various populations of specific immune cells such as T helper cells, T cytotoxic cells and B cells; initiation of inflammatory immune responses, activation of immune cells and releases of many cytokines, chemokines and other inflammatory molecules with variable pathologic effects on lung to cause different respiratory diseases [8-11].

COPD is one of the chronic non communicable disease occurred associated with work related condition including exposure to wood dust [12-14].

There was also evidence of increased risk of lung cancer among workers with substantial cumulative exposure to wood dust [15,16].

Though limited, there are studies conducted in Jimma town to assess the magnitude of work related respiratory disorders and the complex of diseases with comorbidities [17-20]. But, there is no any study conducted among woodworkers in Jimma town and Ethiopia further to assess respiratory disorders to our knowledge yet. Thus, the present study was aimed to assess the magnitude of respiratory disorders among woodworkers by taking the reference group from shop workers.

Methods and Materials

Study area and period

The study was conducted in Jimma town, located in the Oromia region, about 354 km distance to southwest direction from the capital city of the country, Addis Ababa. The town has 17 sub-divisions of town (kebeles) with a total population of 159,009 of whom 80,897 were males. The town has an altitude of 1750-2000 m above sea level with a temperature range of 20-30°C and average annual rainfall of 800-2500mm³.

According to Jimma town entrepreneur and food security agency in 2017/2018 report, there are 300 small-scale wood processing industries in the town involving 1012 male and 548 female woodworkers. The data was collected from April 5 to May 3, 2018 G.C among sampled woodworkers and non-exposed group (shopkeepers) for comparison by employing comparative cross-sectional study design.

Selection criteria

The woodworkers as exposed group with one year and above experience who have no history of smoking and non-exposed group (shopkeepers) who had never worked in woodwork or other wood related industry were recruited in matching with year of service, age, sex and BMI.

All individuals of both groups (exposed and non-exposed) with history of pulmonary tuberculosis, heart failure, common cold, history of smoking, any acute illness were excluded from the study as it affects the results of dynamic pulmonary function tests measured by spirometer.

Sample size determination

The sample size was determined by using analytical study sample size calculation formula by taking two-sided confidence level of 95%, a power of 80% with a double proportion formula. Finally the total sample of 140 (70 exposed group and 70 unexposed group) was endorsed after considering design effect and 5% non-response rate.

Sampling technique

Multistage sampling technique was used to select the exposed study participants. First, five clusters/sub-divisions of town/kebeles were selected by simple random sampling from the total 17 kebeles of the town. Then, by considering equal weight allocation of the sample to each selected clusters/kebeles; 14 small-scale wood work enterprises were selected by simple random sampling from the total 300 small-scale wood processing industries distributed in kebeles of the town. From each enterprise, one eligible respondent was selected by simple random sampling method. The comparison group of shopkeepers was selected by convenience sampling technique matching with age, sex, duration of service and body mass index to sampled woodworkers.

Data collection tools and procedures

Respiratory disorders are diagnosed and categorized based upon clinical manifestation and dynamic pulmonary function results measured by digital spirometer (Contec™ SP10 Spirometer, China) at the ambient room temperature of 20-30°C. A minimum of 3 and a maximum of 8 acceptable and repeatable forced expiratory maneuvers were

done by using spirometer at sitting and upright position according to ATS/ERS 2005 criteria [21]. The following terms are discriminated based on PFTs spirometer criteria.

Airflow obstruction: was defined as FEV1 /FVC <70% and FVC (predicted) >80% [22,23].

COPD: is considered in any patient with dyspnea, chronic cough or sputum production, and/or a history of exposure to risk factors and diagnosed by spirometer result of post-bronchodilator FEV1/FVC < 0.70 [22,23]. It is characterized as onset in midlife, symptoms slowly progressive, long history of tobacco smoking, dyspnea during exercise largely irreversible airflow limitation [24].

Asthma: refers to a generalized obstruction of airways that caused by inhalation of substances at work place which usually reversible. Its onset is early in life (often childhood) with symptoms vary from day to day (at night/early morning), allergy, rhinitis, and/or eczema, family history of asthma [25,26].

Airflow restriction: was defined as FVC <80% predicted value and FEV1/FVC >70% [23,27].

Mixed pattern: refers to both obstructed and restricted ventilatory defect [22,23].

Data analysis

Data was checked for completeness, entered into Epi-data version 1.7 and finally exported to SPSS version 20 for further analysis. Descriptive statistics were used to summarize the finding. Statistical analysis of the difference between the groups was done by chi-square test and independent t-test by considering p value less than 0.05 as statistically significant.

Ethical consideration

Ethical clearance was obtained from the Institutional Review Board (IRB) of Jimma University, Institute of Health with specific number of 260/2018. Letter of cooperation was obtained from Jimma University postgraduate school to facilitate study. Oral and Written consent was obtained from participants before data collection. The objectives of the study were explained to each respondent. The information obtained from the study participants was handled confidentially and not disclose to third party.

Result

Socio- demographic characteristics

A total of 140 (70 woodworkers and 70 shopkeepers) were recruited in the study. The mean age of woodworkers and non-woodworkers were 27.86 (SD±7.88) years and 26.49 years (SD±5.378) respectively. But, there were no significant differences between the two groups (p = 0.209). The mean height of woodworkers and non-woodworkers were 169.90 cm (SD± 6.084) and 170.66 cm (SD± 5.941) respectively. The mean weight of woodworkers were 59.89 Kg (SD ± 5.77) and non-woodworkers 59.99 Kg (SD ± 5.59); no statically significant weigh difference (p>0.05) between the two groups. The mean service year duration of woodworkers was 7.20 ± 5.45 ranges from 1 to 22 years (Table 1).

Parameter	Woodworkers (n=70)	Non-woodworkers (n=70)	P-value
Age, mean ± SD in years	27.86±7.886	26.49 ±5.378	0.209
Height, mean ± SD in cm	169.74± 5.93	170.80±5.958	0.95
Weight, mean ± SD in kg	59.89±5.77	59.99±5.599	0.917
BMI, mean ± SD	20.7871±1.70	20.548±1.22	0.344
Duration of service, mean ± SD in years	7.20 ± 5.45	7.45± 4.40	0.04 *
*- Significant p-value.			

Table 1: Socio-demographic characteristics of woodworkers and reference population in Jimma town, South West Ethiopia, 2018 G.C.

Prevalence of respiratory disorders/ventilatory impairments

Pulmonary functional impairments among woodworkers and non-woodworkers were discriminated based on clinical judgment and dynamic PFT results of spirometer as airflow obstruction, restriction and mixed patterns. The proportion of subjects with respiratory disorders accounted for 29.3% (about 41 respondents totally) which was higher [31 (44.2%)] among woodworkers than the non-exposed group [10 (14.3%)] as seen in Figure 1 and Table 2 in detail.

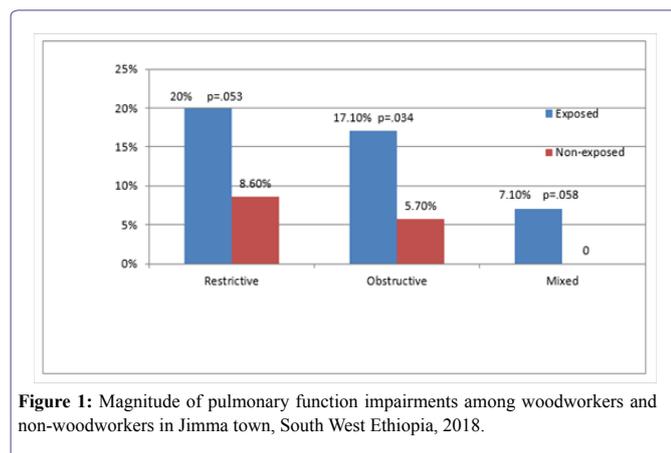


Figure 1: Magnitude of pulmonary function impairments among woodworkers and non-woodworkers in Jimma town, South West Ethiopia, 2018.

The type of respiratory disorders were identified as restrictive type among total 20 respondents (14.3%) and maximum among 14 (20%) of woodworkers and 6 (8.6%) of non-exposed group; obstructive type (11.4%) that diagnosed among 12 (17.1%) of woodworkers and 4 (5.7%) of non-exposed group and mixed pattern (3.6%) that seen only among 5 woodworkers (7.1%) but null among control group.

Among total 16 respondents (11.4%) diagnosed by spirometer for airway obstruction, 11 (7.9%) were diagnosed clinically as asthma while the left 5 (3.6%) were determined as COPD. The burdens of asthma and COPD among woodworkers were higher (11.4% and 5.7%) than the control group (4.3% and 1.4 %) respectively as stated in Table 2.

Discussion

All the sampled woodworkers were males which was in line with different studies [4,28,29] that involve only male woodworkers as study population but the present finding was against other studies that reported also the involvement females [30-32] probably due to the gender

difference towards wood work among countries or different population. The mean age of woodworkers and non-woodworkers were 27.86 (SD±7.88) years and 26.49 years (SD ±5.378) respectively.

Obstructive type of ventilatory impairment was diagnosed by spirometer among 16 respondents (11.4%) where higher prevalence was observed among woodworkers (17.1%) and 5.7% among non-woodworkers which was also in line with the study conducted in Ghana by Ennin IE et al who reported the highest magnitude of obstructive defects (37%) among woodworkers and 22% among non-woodworkers [29] and the study conducted in Cameroon by Francis NDE et al who reported relatively lower burden of obstructive syndrome (6.2%) among woodworkers and 4.9% among non-woodworkers [28]. But, the finding of the present study was against the study conducted by Baran et al who reported that none of the subjects were diagnosed with obstructive pattern among woodworkers [4]. This difference might be due to the difference in the exposed dust concentration, particle size, exposure time and also due to a variety of background and individual factors (e.g., specific sort of wood, wood dust related biohazards or disease history or use of personnel protective equipment).

The present study tried to diagnose and discriminate the two types obstructive diseases (asthma and COPD) clinically as spirometer definition (Post-bronchodilator spirometer result) is not applicable because the respondents didn't start medication; but spirometer result without post-bronchodilator was used as limitation. Accordingly, asthma and COPD were diagnosed among 8 (11.4%) and 4 (5.7%) of woodworkers respectively. The discriminated magnitude of asthma (11.4%) among woodworkers was also supported with the global and African estimated prevalence of asthma among woodworkers (5.6%-18%) and (3%-7%) respectively [7]. The finding of present study was also supported by the study conducted in south-eastern Nigeria that reported about 6.5% prevalence of occupational asthma among woodworkers [30]. But, in contrast to the present finding in regarding to the magnitude of asthma (11.4%) diagnosed among woodworkers, Ameille et al reported lower magnitude of occupational asthma (3.7%) among woodworkers in France [31] probably due to socio-demographic difference in screening, safety and awareness about disease. The prevalence of COPD among woodworkers was 5.7% which is also in agreement with the study of Matheson MC et al who reported 3.4% prevalence of COPD among workers exposed to dust [32].

About 20 (14.3%) of the respondents were diagnosed with restrictive type respiratory disorders and higher magnitude (20%) was identified among woodworkers when compared to the control group (8.6%).

Type of respiratory disorder	Woodworkers (n=70) Number (%)	Non-woodworkers (n=70) Number (%)	Total Number (%)	P-value
Restrictive	14 (20.0)	6 (8.6)	20 (14.3)	0.053
Obstructive	12 (17.1)	4 (5.7)	16 (11.4)	0.034*
Asthma	8 (11.4)	3 (4.3)	11 (7.9)	0.021*
COPD	4 (5.7)	1 (1.4)	5 (3.6)	0.024*
Mixed	5 (7.1)	0 (0.0)	5 (3.6)	0.058
Total	31 (44.2)	10 (14.3)	41 (29.3)	0.023*

*- Significant p-value.

Table 2: The magnitude of respiratory disorders among woodworkers and reference population in Jimma town, South West Ethiopia, 2018 G.C.

The observed restrictive ventilatory defect difference between woodworkers and non-woodworkers may be attributed to inflammatory changes in lung parenchyma caused by the presence of wood dust, a condition that could cause pulmonary edema and fibrosis of lung tissue leading to a reduced FVC values. This finding was also consistent with study conducted in Ghana by Ennin IE et al who reported the magnitude of restrictive defect (32%) among woodworkers and 15% among non-woodworkers [29] and study of Francis NDE et al conducted in Cameroon who revealed that the burden of restrictive syndrome of 17% and 11.5% among woodworkers and non-woodworkers [28]. However, our study was in contrast to the study conducted in Poland by Baran S et al who reported that none of the woodworkers developed a restrictive ventilatory defect on spirometer tests [4]. This could be due to difference in occupational health awareness for preventive measures such as utilization of protective devices, health seeking behavior and duration of wood dust exposure between the study areas.

In the present study, the prevalence of respiratory disorders/ventilatory impairments was 44.2% and 14.3% among woodworkers and control group respectively. Among woodworkers the burden of restrictive, obstructive and mixed pattern was 20%, 17.1% and 7.1% respectively. In harmony with our study, the prevalence of respiratory impairment among exposed group (29.4%) as compared to 2.2% among unexposed controls was reported by Rastogi SK et al with pattern of restrictive type dominance (28.4%) observed among woodworkers [33].

Conclusion

In general the prevalence of respiratory disorders/ventilatory impairments was 29.3% that diagnosed among 41 respondents while 70.7% of respondents considered as having normal lung function. Majority of ventilatory impairment was diagnosed among exposed group (account 44.2%) while it accounts 14.3% among non-woodworkers. Restrictive type of ventilatory impairment was the commonest among respondents 20 (14.3%) followed by obstructive type seen among 16 respondents (11.4%) and mixed type observed among 5 respondents (3.6%). The burden of restrictive, obstructive and mixed pattern was 20%, 17.1% and 7.1% respectively among woodworkers while the burden of restrictive and obstructive pattern of ventilatory impairments among control group was minimal (8.6% and 5.7%) respectively. But, there is no mixed type of respiratory disorders that detected by spirometer among control group. Since the study population didn't screened for respiratory disorders so far and

claim as normal, they didn't initiate treatment. Thus, the reversibly of the air flow obstruction was not determined as post-bronchodilator result of spirometer is not applicable to discriminate the specific types of obstructive disorders. Thus, clinical judgment was used to differentiate COPD and asthma in addition with spirometer result without post-bronchodilator effect. All respondents who diagnosed with any respiratory disorder were informed about their health status and consulted to seek health institution for further screening and management.

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Conflict of Interest

The authors declare that there is no conflict of interest associated with this study.

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