JIMMA UNIVERSITY INSTITUTE OF HEALTH, FACULTY OF MEDICAL SCIENCE, DEPARTMENT OF BIOMEDICAL SCIENCES

RESPIRATORY SYMPTOMS AND PULMONARY FUNCTION TESTS AMONG WOOD WORKERS IN JIMMA TOWN, SOUTHWEST ETHIOPIA

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JIMMA, ETHIOPIA

RESPIRATORY SYMPTOMS AND PULMONARY FUNCTION TESTS AMONG WOODWORKERS IN JIMMA TOWN SOUTH WEST ETHIOPIA: COMPARATIVE CROSSECTIONAL STUDY

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Abstract

Background*: Globally, 2.9 billion workers are exposed to hazardous risk at their workplaces; from this two million deaths are attributable to occupational diseases and injuries, while 4% of Gross Domestic Product (GDP) is lost due to occupational diseases and injuries. Wood dust is one of the most common sources of occupational exposures in the world. Health problem from wood dust inhalation results in decreased work output and increased respiratory morbidity. Despite the potentially hazardous nature of the woodwork, there is no any documented data collected on the state of respiratory health status and safety of wood workers in Ethiopia.*

Objective*: The aim of the present study was to establish the effect of wood dust on the respiratory health status of woodworkers in Jimma town, Ethiopia, 2018.*

Method:*A community basedcomparativecrossectional study was conducted between woodworkers and non-woodworkers in Jimma townon April 5 to May 3, 2018. Multistage random sampling technique was used to select the exposedstudy groupand convenience sampling technique was used to select the non-exposed group. A standardized structured questionnaire was used to evaluate the respiratory symptoms and pulmonary function test parameters. A total of 140 study participants were enrolled in the study. Data were checked for completeness and entered to SPSS version 20 for analysis. Descriptive statistics were computed and results were presented by numerical summary,tables, and graphs.*

Results*: We found a higher prevalence of respiratory symptoms in woodworkers; with significant differences in cough, phlegm and chest pain compared to non-woodworkers.*The prevalence respiratory symptoms between exposed to non-exposed groups were statistically significance difference *cough (41.4% vs. 10%), phlegm (34.3% vs.14.3%), chest pain (32.9 vs 17.1) respectively. The present study also showed statistically significant reduction of mean pulmonary function tests values in woodworkers compared to their matched non-wood workers; FVC (litters)(3.19±.64 vs. 3.69±.57 p<0.001), FEV1 (litter) (2.70±0.66 vs. 3.23±0.44, p<0.001), PEFR (litter per second) (5.22±.1.63 vs. 6.01±1.59, p=0.005) and FEF25-75% (litter per second) (3.97±1.29 vs. 4.54±.99, p=0.006). The magnitude of ventilatory impairments were higher in exposed than non-exposed group which were restrictive disease (20% vs 6.8%), obstructive disease (17.1%, 5.7%) and mixed pattern of disease(7.1%, 0%) respectively.*

Conclusion and Recommendation*:There was higher prevalence of respiratory symptoms and reduced lung function tests in woodworkers. All restrictive, obstructive and mixed lung disease patterns were highly prevalent among wood workers. More efforts should be exerted on preventive measures and awareness creation about wood dust-related respiratory health impacts.*

Key Words*: Respiratory symptoms, Pulmonary function tests, Woodworkers, Jimma town*

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Abbreviations

ATS	American Thoracic Society
BMI	Body Mass Index
BMRC	British Medical Research Council Questionnaire
CM	Centimeter
COPD	Chronic Obstructive Pulmonary Disease
DM	Diabetes mellitus
FEF25-75 %	Forced Expiratory Flow rate at the middle part of FVC
FEV1	Forced Expiratory Volume in one second
FEV1 %	percentage of the FEV1
FVC	Forced Vital Capacity
GDP	Gross domestic product
HTN	Hypertension
ILO	International labor organization
MOH	Ministry of Health
PFTs	Pulmonary Function Tests
PEFR	Peak Expiratory Flow Rate
PPE	Personal Protective Equipment
PTB	Pulmonary Tuberculosis
SPSS	Statistical Package for Social Science
WHO	world Health Organization

1. Introduction

1.1. Background

Industries have been established since the time of civilization to meet the demand of human being(1). Half of the world's population are economically active and spend at least one third of their time at the workplace; fair employment and decent work are important social determinants of health and a healthy workforce is an essential prerequisite for productivity and economic development; however only a small proportion of the global workforce has access to occupational health services for primary prevention and control of occupational and work-related diseases and injuries(2).

Occupational hazards such as dust, unfavorable microclimatic condition, excessive noise, and insufficient light are the most important health risks for workers (3).Among the various types of organic dust to which humans are exposed; wood dust is one of the world's most important as it is harvested in almost all countries for its traditional use for fuel and construction material and its mean exposure of around 1 mg/m3 wood dust is considered to be a mucous membrane irritant (4).

Wood dust is made as a by-product of wood processing during cutting or shaping of wood materials; the major components (about 95% by weight) of wood is cellulose, hemicellulose, and lignin and the remaining 5% comprises numerous other high and low molecular weight organic and inorganic compounds including proteins, the low molecular compounds like terpenes, terpene derivatives such as abietic acid, phenolic compounds, tannins, stilbenes, and glycosides, many with known sensitizing and irritative properties of the mucous membrane (5).

Most wood dust particle enters the human body through the respiratory system(6). Wood dust consists mainly of sub-5µm particles which mainly become trapped in the upper respiratory system but particles with an aerodynamic diameter of under 5µm are especially hazardous via sedimentation and diffusion;they infiltrate into the lower non-ciliated respiratory system where their half-life exceeds one month, and hence the removal rate is very slow(7).

Animal studies have shown that wood dust components terpenes and abietic acid causes direct toxicity via lytic damage to alveolar, tracheal and bronchial epithelial cells; in addition to this wood-dust extracts from both hard and soft woods are able to induce the release of pro-inflammatory mediators from macrophages to express and induce the release of inflammatory mediators in human epithelial cell line and modulate the expression of cytokines and chemokines(8).The first line of defense against airway exposure to organic dust is mounted primarily by alveolar macrophages in the respiratory system; these phagocytes ingest and destroy intruding pathogens and secrete a variety of cytokines and chemokines that are involved in the development and maintenance of the inflammatory response(9).

The most likely causes of occupation-related lung diseases are due to the deposition of dust in the lungs ;this affected by the types of dust, the period of exposure, the concentration and size of airborne dust in the breathing zone (10).Wood dust exposure has been shown to the proposed causes for several respiratory disorders ;such as allergic rhinitis, chronic bronchitis, occupational asthma, and impairment of pulmonary function parameters(6).

Ethiopia is one of the developing nations that is industrializing rapidly with a focus on construction, manufacturing, mining, and road infrastructure with an estimated workforce of about two million; males constitute the majority of this workforce and most of the workforce has basic primary education and the commonly observed hazards in the workplace in Ethiopia include excess noise (24%), airborne dust (57%), heat stress (14%), electric hazards (57%), and inadequate use of personal protective devices (36%)(11).

1.2. Statement of the Problem

Globally, 2.9 billion workers are exposed to hazardous risk at their work places; from this two million deaths are attributable to occupational diseases and injuries, while 4% of Gross Domestic Product (GDP) is lost due to occupational diseases and injuries, Asia is the highest contributor and constituted about two-thirds of the global work-related mortality followed by Africa at 11.8% and Europe at 11.7% (12).

According to WHO report respiratory diseases and musculoskeletal disorders are considered to be leading cause of occupationally related diseases in most countries, but only one-third of countries have special programs to address these occupationally related diseases(13).

Approximately, 3.6 million workers in European Union member states exposed occupational inhalable wood dust per year(14).Population-based studies done in Europe have shown that workplace-exposure to dust the attributable fraction of COPD morbidity estimated to range from 15–20% (15)(16).

Metanalysis done in Great Britain among furniture and wood processing workers the relative risk for occupational asthma in exposed wood workers was 1.5 times more than non-woodworkers(17).

The study has shown in Asian countries wood dust associated respiratory symptoms such as a chronic cough or phlegm was the predominant complaints of the respondent as high as 32%, dyspnea 11% and wood dust-related respiratory disorders such as chronic bronchitis 5%, acute bronchitis 8%, asthma 9%(18).
Globally the prevalence of occupational asthma in woodworkers is between 5.6% and 18% and in Africa, it is between 3% and 7% (19).

Wood dust is one of the most common occupational exposures, with millions of workers exposed worldwide; this found to contribute respiratory health impacts as per literature reviewed. Despite the potentially hazardous nature of the work, there is no any publication in wood dust-related respiratory health status in Ethiopia including the study area. Therefore this study sought to investigate the respiratory symptoms and lung function abnormalities from occupational exposure to wood dust among woodworkers.

1.3. Significance of the study

In Ethiopia, there is no documented data regarding burden of wood dust related respiratory disorders.So that, this study will be the pioneer community based study in assessing respiratory health status of wood workers.

The findings from this study will be used as an input for policy makers and for regional, zonal and district health planners and decision makers to make decision about occupation health hazards especially dust-related works to introduce laws which promote the health of workers.

In addition to this, the finding of this study will helpfor regional labor and social affairs to encouragecommunicationbetween various concerned groups and organizations and to foster an improved understanding of the potential problems of wood dust in the country. The study may also add some variables to district health information system as there are no possible causes of diagnosis based on occupational history of the patient.

It will add additional knowledge to the existing literature so as to trigger different researchers to conduct further study on the impacts of wood dust on the health of woodworker at large.

2. Literature Review

2.1.Occupational Health and Safety

According to the International Labor Organization (ILO) occupational health and safety awareness is regarded as being aware of safety issues and the potential hazards to oneself and others in the workplace (20).Occupationally related health problems are the fourth main cause of fatalities after work-related cancers, circulatory diseases and communicable diseases (21).

2.1.1. Personal Protective Equipment (PPE)

The application of preventive strategies offers significant human and economic benefits; workers in the informal economy are much more likely than formal workers to be exposed to poor working environments; low safety and health standards, environmental hazards, and to suffer poor health or injury as a result(21).Operators working with wood are always exposed to flying particles that can strike the eyes, face and they are exposed to pathogenic wood dust (22) . The exposures can be minimized by using proper types of personal protective equipment such as masks, Safety glasses, Goggles snugly on the face or Face shields (23).

2.2.Wood Dust Related Respiratory System Disorders

A cross-sectional study conducted in Turkey among wood workersthey found that 20.46% of wood workers develop phlegm, 14.98% develop cough,8.06%breathlessness, 4.03% develop chest tightness and 2.01%wheezing(24).

A study done in Sweden in 2017 wood pellet workers reported a higher frequency of dry cough and utilizationof asthma medication compared to controls from the general population and lower lung function than expected and no correlation between lung function tests and years of working in pellet wood production(25).A study done by Mamta Mohan et al on 2013 reported that mean PEFR in study subjects decreased with an increase in age and increased in duration of exposure to wood dust.There was a positive correlation between PEFR and weight (r=+0.224) and height in the study subjects (r=+0.269)(26).

A study conducted in Poland by Baran S, Swietlik K, Teul in 2009 durationof wood dust exposure would not relate to pulmonary function impairmentsand none of the subjects was found to have ventilatory defects of restrictiveand obstructive pattern of spirometry. They had an average work experience of 8.5 years and negative significant ($p<0.05$) correlation was found

between the following variables: age and FEV1(r = -0.54), age and FVC (r = -0.79), age and FVC (r =-0.57)(27).

A study conducted in India in 2017 the prevalence of respiratory symptoms were cough (72 % vs 7%),shortness of breath (59% vs10%), chest pain(3% vs 2%) between woodworkers and controls respectively and pulmonary function tests were significantly reduced in woodworkers than non-wood workersFVC (3.57± 0.11 vs 3.04 ± 0.20) , (FEV1/FVC % (86.3 ±5.96 vs 67.4 ± 10.8), PEFR(L/SEC) (6.36 ± 0.172 vs 5.71 ± 0.15). The mean age of the woodworkers were 38.6±10.3(23).

A study done in northeast Iranian by Mohammad Hossain Boskabady et al,53% of carpenters reported work-relatedrespiratory symptoms such as cough (34.4%),wheezing (15.15%)and sputum (33.3%)(28).A similar study was done by Phateme Badirdast in 2017, A statistically significant correlation was observed between the lung parameters and a dose of wood dust exposure that is, single linear regression slope was negative for FVC, FEV1, FEV1/FVC% and FEF25-75% against years of exposure to wood dust(29).

A study conducted in the Republic of Macedonia by Dragana Bislimovska et althe prevalence of respiratory symptoms among parquet manufacturers were higher than office workers cough (29.7% vs 13.5%),phlegm (15.2% vs 5.4%),shortness of breath (10.8% vs 8.1%) , chest pain (13.5% vs 10.8%) respectively. The mean values of all spirometric parameters with exception of forced ventilatory capacity (FVC) were significantly lower in the parquet manufacturers as compared to office workers FVC (92.3 vs. 94.2) , FEV1 (82.6 vs. 86.8) ,FEV1/FVC (0.75 vs. 0.78) , FEF25%-75% (65.9 vs 70.8) respectively(30).

A study done in Cameroon in 2015 by Francis NDE et al, the common respiratory symptomsamong exposed to non -exposed groups cough (34.5% vs 6.6%), phlegm expectoration(3.1 % vs 0.8%) respectively. The prevalence ventilatory impairments among exposed to non-exposed groups were restrictive syndrome (17% vs 11.5%), obstructive syndrome (6.2%,4.9%) respectively(31).

A study reported by Isaac E. Ennin, Festus K et al in 2015 in Ghana lung function indices of woodworkers to non- wood workers were significantly reduced; FEV1 (2.58 ± 0.07 vs 2.90 ± 0.06), FEV1% (73.12 ± 2.03 vs 79.13 ± 1.01and FEF 25-75% (2.52 ± 0.11vs 3.00 ± 0.10)

respectively. The prevalence of obstructive defect between woodworkers to non- wood workers were 37% vs 22% and restrictive defect 32% vs 15% respectively(32).

2.3.Pathophysiological mechanisms of wood dust on respiratory system

wood dust exposure was associated with a variety of adverse health effects like tracheitis, bronchitis, pneumonitis and pulmonary edema(33). The two main respiratory diseases of allergic-type caused by occupational exposure to particles are occupational asthma and extrinsic allergic alveolitis(34).

Occupational exposure to wood dust has been reported to impair ciliary clearance and to contribute to mucostasis resulting in impaired clearance of wood dust particles could lead to prolonged contact with the upper respiratory epithelium and allows particulate antigens to gain entry to nasal-associated lymphoid tissues and enhance allergic sensitization (35).

A study conducted in animal model to elucidate the mechanisms of particle-induced inflammatory responses to wood dust particles show that enhancement of lymphocytes and neutrophils was seen after wood dust exposure. Wood dust appeared to be a more potent inducer of inflammatory mediators that elicit lung inflammation which is accompanied by induction of several proinflammatory cytokines and chemokine's (36).The mechanisms of wood dust causes occupational asthma is not clearly explained but it might be due tospecific immunoglobulin E (IgE) sensitization responsible for asthma in woodworkers (5).

Animal studies have shown that wood dust components such as the major constituent in pine resin abietic acid cause direct toxicity via lytic damage to alveolar, tracheal and bronchial epithelial cells and wood-dust extracts from both hard and soft woods are able to induce the release of pro-in ammatory mediators from macrophagesthat induce the release of in ammatory mediators in human epithelial cell line (36).

The monoterpene component of wood dust can cause respiratory tract inflammation by enhancing the immune reaction of the exposed individual this was supported in an experimental study increased alveolar cell concentration mainly macrophages in Bronchoalveolar lavage after exposure to concentrations of 450 ng/m3.The capacity of wood dust to induce the production of reactive oxygen species (ROS) and caspase3 activity in human bronchial epithelial cells which may lead to shedding of the bronchial mucosaand the exacerbation of asthma (37).

According to the literature reviewed above, a number of authors have written on the respiratory symptoms and pulmonary functional parameter among woodworkers. Most of them showed that the respiratory effects have been associated with dust exposure. In Ethiopia, there is no study to describe the magnitude of wood dust-related respiratory function impairment despite a high number of workforces employed as a major job and conducting their duties without any employment risk screening test. Accordingly, this study attempted to fill the gap to make its own contribution.

2.4.Conceptual Frame Work

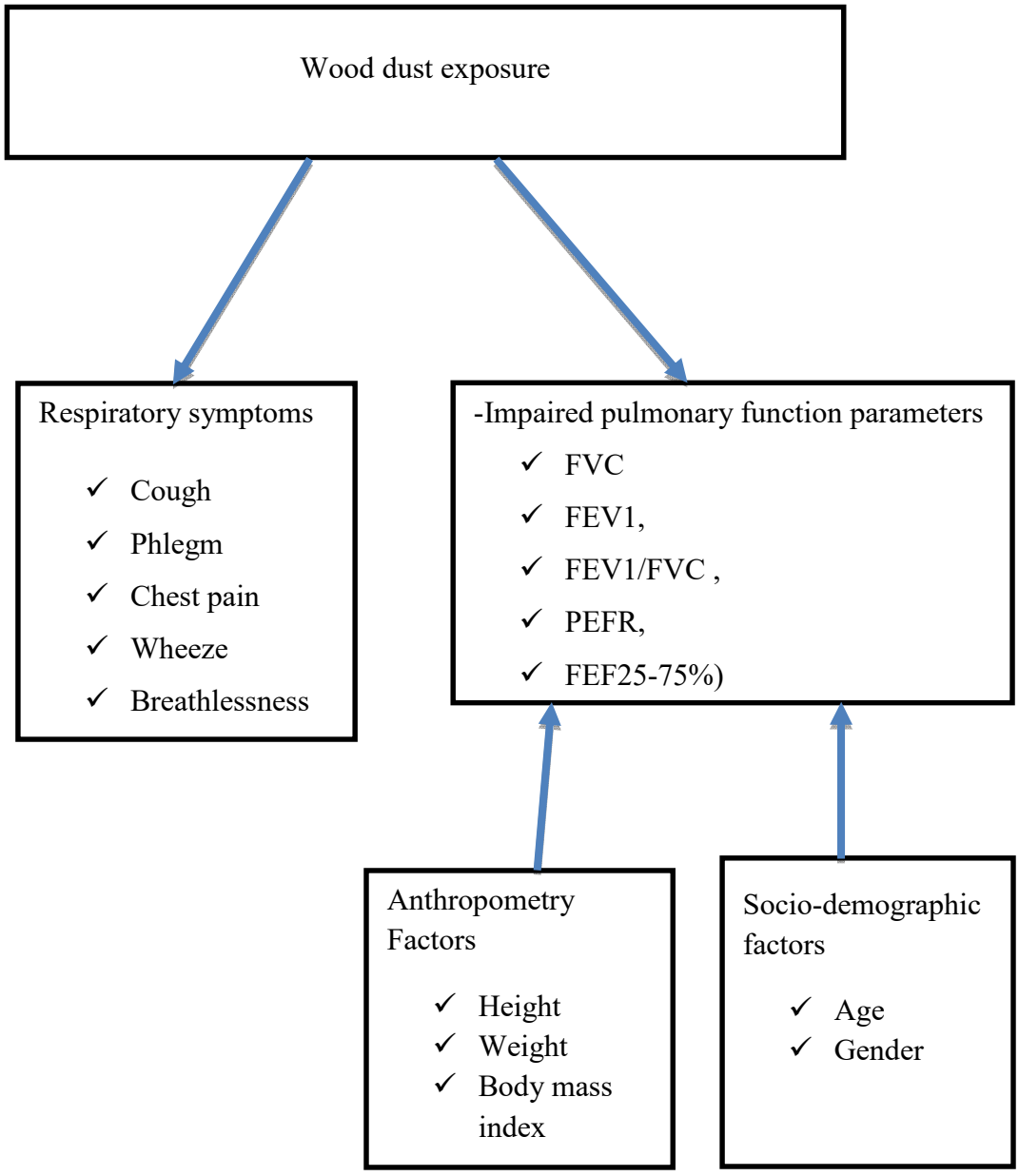

Figure 1 :Conceptual framework developed after revising different kinds of literature on factors that affect respiratory functional status among woodworkers

3. Objectives

3.1. General Objective:

The main aim of the study was to investigate respiratory symptoms and lung function indices among woodworkers in Jimma Town, Ethiopia, 2018

3.2. Specific Objectives

1. To evaluate the effect of wood dust exposure on respiratory symptoms among woodworkers
2. To evaluate the effect of wood dust exposure on pulmonary function tests among woodworkers
3. To assess the magnitude of ventilatory impairmentsamong woodworkers.
4. To evaluate the relationof pulmonary function tests to predictor variables among woodworkers

Research Hypotheses

- The magnitudes of respiratory symptoms among woodworkers are greater than non-woodworkers.
- The woodwork is a risk for pulmonary functional impairment in woodworkers compared to non-wood workers.
- Predictorvariables of wood workers linearly correlated to pulmonary function tests
- The proportions of ventilatory defects are greater among woodworkers than non-wood workers.

4. Methods and Materials

4.1. Study Areaand Period

The study was conducted in Jimma town, located in the Oromia region, 354 km South West of the capital city of the country, Addis Ababa. The town has 17 kebeles. Projecting from 2007 census Jimma town has a total population of 159,009 of whom 80,897 were males. According to Jimma town entrepreneur and food security agency, 2017/2018 report shows that there are 300 small-scale wood processing industries in the town with 1012 male and 548 female woodworkers. The town has an altitude of 1750-2000 m above sea level with a temperature range of 20-30oC and average annual rainfall of 800-2500mm3.The data was collected from April 5 to May 3, 2018.

4.1. Study Design

Comparative cross sectional study design was employed

4.2. Source Population

The source populations were all woodworkers and shopkeepers residing in Jimma town, Ethiopia during the study period.

4.3. StudyPopulation

The study population was both exposed and non-exposed groups working in the selected five clusters during the study period, whichwere fulfilling the study inclusion criteria.

4.4. Selection Criteria

4.4.1. Inclusion Criteria

The woodworkers having one year and above wood workexperience were included in the study.The non-exposed group who had never worked in woodwork or other wood related industrywas included.

4.4.2. Exclusion Criteria

Taking of the short clinical history prior to data collection was takento obtain detailed clinical information and to determine whether they would be included in the study or not.All Wood workers who work from other sections of the factory (spray, and painting sections) did not consider in study. For both exposed and non-exposed groups with history of pulmonary

tuberculosis, heart failure, abdominal tumor, recent surgery of thorax or abdomen, self-reported or known diagnosis of lung or chest wall disease like asthma, pneumothorax, neuromuscular disease, vertebral column deformity, common cold, history of smoking, any acute illness and abdominal pain of any cause, unable to perform spirometry procedures were excluded from the study.

4.5. Sample Size Determination

The sample size was determined by using analytical study sample size calculation formula the two-sided confidence level of 95%, a power of 80% with a double proportion formula was used (38).

$$n=\left[\frac{r+1}{r}\right]\frac{p\times q\,(Z_{\beta}+Z_{\alpha})^{2}}{d^{2}}$$

Where

n = sample size required in each group

Z a/2 = critical value at 95% confidence level of certainty (1.96) (a constant).

Zβ: This depends on power,(the probability that if the two proportions differ the test will produce a significant difference) for 80% this is .84

P1=Prevalence of symptoms among exposed group/cases

P2= Prevalence of symptoms among non -exposed controls

p = average percentage between two groups=(p1+p2)/2

q = 1 p

d = clinically meaningful difference between two groups (p1-p2)

r= ratio of exposed to non-exposed =1 because of equal number of exposed to non-exposed group. Based on the previous study conducted in Cameroon by Francis NDE et

al the magnitude of respiratory symptoms among woodworkers was cough with 34.5% in exposed to 6.6% non- exposed which was the statically significant difference between exposed to non-exposed group(31).

n (each group) $= [(2)x(.21)x(.79)x(1.96+.84)^2]/(.345-.066)^2 = 33.4*2$ (two groups)≈67

Due to multi –stage sampling technique the calculated sample size was multiplied by 2 (design effect) which equals to 134.By adding 5% of the non- response rate the total sample size was 140 for both exposed and non-exposed groups.

4.6. Sampling Technique

Multistage sampling technique was used to select the exposed study participants. Jimma town has 17 kebeles (clusters) among these clusters: five clusterswere selected by simple random sampling. After selection of five clusters by lottery method sampling frame was prepared; all wood work enterprises in the selected five clusters obtained from the existing list of 2017/2018 Jimma town entrepreneurs and food security agency data.By considering equal weight allocation of the sample to each selected clusters; 14 small-scale wood workenterprises were selected by simple random sampling. From each enterprise one eligible respondent was selected by simple random sampling method. The comparison group comprised shopkeepers selected by convenience sampling technique and matched for age, sex, height, weight, and body mass index to sample woodworkers.

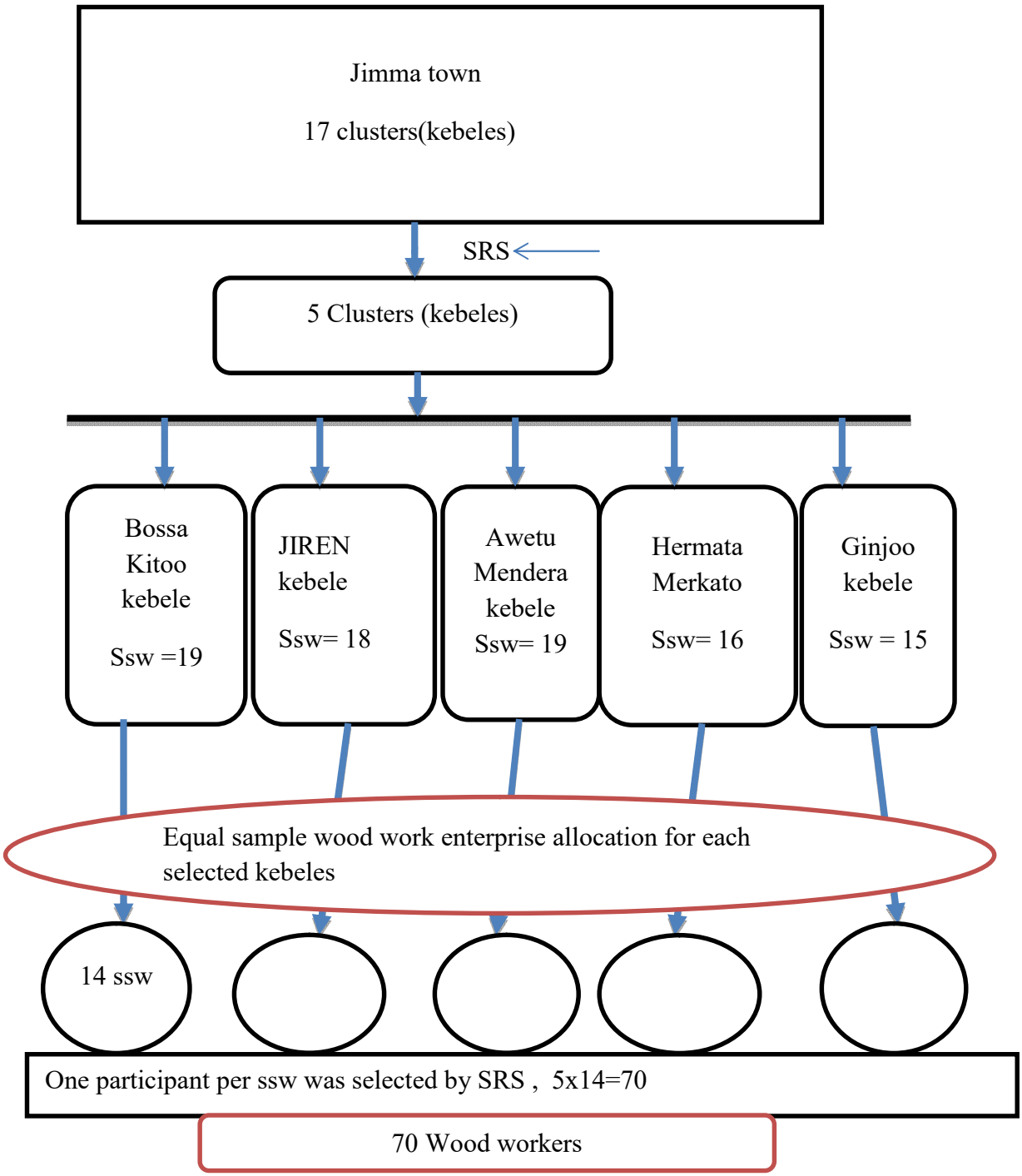

Figure 2: Schematic presentation of sampling procedure conducted to select study participants among woodworkers in Jimma town, Southwest Ethiopia 2018: (source: Jimma town Entrepreneur & food security Agency, 2017/2018). SRS=Simple Random Sampling, **ssw**=small scale wood work industry

4.7. Study Variables

4.8.1 Independent Variables

Our independent Variables were: sex, age, weight, height, body mass index and duration of work experience were included.

4.8.2 Dependent variables

Pulmonary function parameters(FVC, FEV1, FEV1/FVC %, FEF25 - 75%, and PEFR) and respiratory symptoms (cough, wheezing, breathlessness, phlegm and chest pain) were under the outcome variable.

4.8. Operational definitions

Wood dust: refers to the inhalable fraction of dust originating from solid wood processing

Woodworker/Exposed:a person who makes and repairs objects and structures made of wood

Small scale wood work enterprise: is a local wood processing factory with temporarily constructed shelter and most of the tasks done manually..

Respiratory symptoms: the summative complains of studyparticipant during survey classified as cough, chest tightness, Wheeze and shortness of breath.

Dry Cough:is the development of cough as much as 4–6 times each day happening for most days of the week (≥5 days) for at least three months in one year(39)(40)

Phlegm production: is sputum expectoration as much as twice per day for most days of the week (≥5 days) for at least three months in one year(40).

Breathlessness: having to walk slower than persons of the same age on level ground because of shortness of breath or difficulty of up hilling on level ground.

Chest pain /tightness: feeling of pain or discomfort on the chest occurring anytime during the work shift or any workday.

Wheeze:whistling breathing during respiratory cycle perceived by the respondents at least three months in a year(40).

Airflow obstruction was defined as FEV1/FVC %70% and FVC (predicted)>80%(41)(42)

Airflow restriction was defined as FVC<80% predicted value andFEV1/FVC % (41)(42)

Mixed pattern was defined both obstructed and restricted ventilatory defect (36)(42)

4.9. Data Collection tools and Procedures

4.10.1 Questionnaire

The instruments for data collection were a questionnaire and digital Spirometer (Model, Sp10). A standardized structured questionnaire adapted from British Medical Research Council (BMRC) was used to evaluate the respiratory symptoms (43)and American Thoracic Society Respiratory Disease (ATS) Questionnaire was used to assess pulmonary function parameters (44) .Before any procedure, a brief explanation was given to the study subjects about the purpose of the study. The questionnaire contained information on socio-demographic data, detailed medical history about the respiratory system. The data was collected by two trained native Afan Oromo speaker BSC nurses with close supervision of one supervisor and principal investigator.

4.10.2 Anthropometric Measurement

After the interview, anthropometric measurements were performed. Height and weight of each subject were measured by using a scale to the nearest 1 cm and 1 kg respectively. The height of a subject was measured by using an erect height measuring scale. Measurements of height made with the subject's bare feet. The subjects stand straight against the erect measuring scale and their head, shoulder, buttocks, and heels touched the scale. The subject's axis of vision was horizontal. Then, they took a deep breath to relax the shoulders. With a flat object, the upper level of their head marked against the scale was measured to the nearest 1 cm. Weight was measured using a weighing scale with light clothing and without shoes

4.10.3 Pulmonary function test

In preparation for Spirometry, the environment was monitored and operated at an ambient room temperature (20-30^{0}c). Trained persons conduct spirometry tests. In the Spirometry, a minimum of 3 and a maximum of 8 acceptable and repeatable forced expiratory maneuvers was done with the study participant seated and upright according to ATS/ERS 2005 criteria(45).This is the test from an acceptable curve that has the highest sum of forced vital capacity (FVC) and forced expiratory volume in one second (FEV1) into the expiratory maneuver. A practical presentation about the test and the way it is done was performed on the subjects before the test (45).FEV1, FVC, FEV1/FVC, PEFR and FEF25%-75% values were measured three times and

the largest value from at least three acceptable blows was recorded. The person took 10-15 minutes a rest before the test and informed about the procedure before measurement. Before every test, the mouthpiece was disinfected in standard solution and then attached to the spirometer. The study participant was asked to sit in a comfortable way on the chair; then after appropriate placement of mouthpiece, sealed the lips around the mouthpiece of the spirometer. A few breaths normally, followed by deep inhalation and the forceful expiration of the air as fast and forcefully as possible. The test was repeated three times after adequate rest and results were obtained in the spirometer. A satisfactory test required that the FVC and FEV1 of two maneuvers were reproducible within 5%. The best test per individual (highest FVC and FEV1) was recorded as the lung function capacity of the participant (45).Predicted values of FVC, FEV1, PEFR, and FEV1% for age, sex, and body size were provided in the spirometer by the Vitalography manufacturer.

4.10. Data quality control

The same equipment and observer were used in all subjects and the recordings were made between 3.00 and 12:30 am (46).Weight scale was calibrated on each day before data collection and spirometry was calibrated based on manufacturer instruction and operated within the room temperature range. The tool prepared in English was translated to local language Afan Oromo and retranslated back to English, for consistency of the questionnaires. Pretest of the data collection tool was done in Mendera Kochi kebele on seven individuals and necessary correction was done prior to the actual data collection period. In the data collection process, two trained BSC nurses and one BSc nurse who were fluent in the local language participated as a data collector and supervisor respectively. Two days of training were given to the data collectors and supervisor about the purpose of the study, measurement technique and ethical consideration. Mock interviews and practical field exercise was given to data collectors and supervisor to ensure the quality of the field operation. All questionnaires were checked daily for completeness, accuracy, and clarity by the supervisor and the principal investigator. Furthermore, the data was checked during entry and compilation before analysis

4.11. Data Analysis and presentation

Data was checked for completeness and entered to SPSS version 20 for analysis. Data was presented using narrative, figures, and tables from the result of statistical analysis. Descriptive statistics were used to summarize anthropometric measurements of subjects, personal and occupational information of woodworkers and non-wood workers. Statistical analysis of the difference between proportions was done by the use of the chi-square test. Where the expected frequency in more than 20% of cells were less than 5, or any cell had an expected cell count less than 1, Fishers‟ exact test was used to test for difference in proportion between group variables. The mean respiratory test scores of the exposed and non-exposed group were compared using independent sample t-test. Pearson‘s correlation coefficient was used to quantify the degree of linear relationship between pulmonary function tests and some predictor variables.

4.12. Ethical consideration

Ethical clearance was obtained from the Institutional Review Board (IRB) of Jimma University, Institute of Health Sciences (No. 260/2018) before data collection. Letter of cooperation was obtained from Jimma university postgraduate school. Oral and Written consent was obtained from each study participants on the time of the study. The objectives of the study were explained to each study participant's. The information obtained in the study participants was handled with confidentiality, and the studying tools such as interview guide was recognized by code number, and permission was asked for each respondents and none of them was forced to participate in this study.

4.13. Dissemination plan of results

The finding of this study will be submitted to Research and post-graduate study coordinating office of institute of health sciences, Jimma University, department of biomedical sciencesand presented to Jimma University community as a part of master's thesis. The result will be communicated to the stakeholders through presentations on the meeting, scientific panels and workshops after approved by Jimma university postgraduate school. Finally to the ministry of health and moreover the results will be sent for publication in reputable Journals.

5. Result

5.1. Socio- Demographic Characteristics

A total of 140 (70 woodworkers and 70 shopkeepers) study participants were included in the study. Most of the woodworkers attended secondary level of education;30(42.9%) and 14.5% of wood workers attended higher level of education whereas more than one fourth (25.7%) of the non-wood workers attended secondaryschool. The mean service year duration of woodworkers was 7.20 ± 5.45 with range between 1 to 22 years.

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

Parameters		Wood workers N=70	Non-wood workers =70
Level of education	Primary	24 (34.3%)	20 (28.6%)
	Secondary	30 (42.9%)	30(42.9%)
	Higher*	10 (14.3%)	18 (25.7%)
	Others**	6 (7.21%)	2 (2.9 %)
Mean Service year duration	(Mean ± SD)	7.20 ± 5.45	

** Preparatory and above*

***Religious,"Meseret Timihrit"*

5.2. Use of Personal Protective Device

Regarding the use of personal protective devices, only 14.3% of the woodworkers were using always personal protective equipment but the majority of woodworkers didn't use personal protective equipment's every day. The common type of personal protective equipment used by wood workers was masks. The major reason for wood workers didn't use personal protective equipment was lack of supply and awareness about the protective function of the equipment which represent 68% and 32% respectively.

Table 2: Personal protective equipment utilization by woodworkers in Jimma town, South West Ethiopia, 2018

		Frequency	Percent
How often do you use personal protective equipment?	Always	10	14.3
	Sometimes	14	20.0
	Never	46	65.7
	Total	70	100.0
Reasons not used PPE always?	Not available	41	68
	Lack of awareness	19	32
	Total	60	100

PPE *–personal protective equipment*

5.3. Anthropometric parameters

Table -3 demonstrates the comparison of the anthropometric parameters between the wood workers and their matched non-woodworkers. There was no significant difference between the means of anthropometric parameters in terms of age, height, weight and BMI between the study groups. The mean age of woodworkers and non-wood workers were27.86 (SD±7.88) years and 26.49 years (SD ±5.378) old respectively, there were no significant differences between the two groups (p=.209).The mean height of woodworkers and non-woodworkers were 169.90 cm (SD± 6.084) and170.66 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.

Table 3: Comparison of the anthropometric parameters in woodworkers and non-wood workers by independent sample t-test (mean±std.deviations) in Jimma town, South West Ethiopia, 2018

Parameters	**Wood workers Mean±SD**	**Non-wood workers Mean±SD**	**Sig (p-value*)**	**95% Confidence interval of the difference**	
				Lower	Upper
Age	27.86±7.886	26.49 ±5.378	.209	-.684	3.827
Height	169.74± 5.93	170.80±5.958	.95	-3.044	.930
Weight	59.89±5.77	59.99±5.599	.917	-2.001	1.801
BMI	20.7871±1.70	20.548±1.22	.344	-.2579	.73453

- *P<.05 significant , BMI- body mass index,SD-standard deviation*
- **Test statistics by independent sample t-test*

5.4. Prevalence of respiratory Symptoms

The prevalence of the respiratory symptoms in woodworkers compared to non-wood workerswere higher in the current study. The prevalence of dry cough, cough with phlegm expectoration, chest pain, breathlessness, and wheeze with 95% confidence interval (CI)were 41.4%CI (31.4,51.7), 34.3% CI (25.5 ,48.6), 32.9% CI (22.6 ,47.1),21.5% CI (9.7,29.1), and 12.4 %CI (5.2, 22.9) for exposed study participants respectively and the prevalence's of phlegm expectoration, dry cough, chest pain, breathlessness, and wheeze for non- exposed group with 95% confidence interval were 14.3% CI (5.7,23.1), 10%CI(2.6,17.4), 17.1% CI (10,28.2), 14.3% CI(5.7 , 23.7) and 8.6% CI (3.5,17.1), respectively.

Table 4.The prevalence of respiratory symptoms in the last 12 months in wood workers and non-wood workers in Jimma town, South West Ethiopia, 2018

Respiratory symptoms	Woodworkers n=70	95%CI		non-wood workers n=70	95%CI		p-value
		Lower	Upper		Lower	Upper	
Cough	29 (41.4%)	31.4	51.7	7(10%)	2.6	17.4	.000**
Phlegm Expectoration	24 (34.3%)	25.5	48.6	10(14.3%)	5.7	23.1	.010*
Breathlenessness	15(21.5%)	9.7	29.1	10(14.3%)	5.7	23.7	.412*
Wheezing	9(12.4%)	5.2	22.9	6(8.6%)	3.5	17.1	.270*
Chest pain	23(32.9%)	22.6	47.1	12(17.1%)	10	28.2	.032*

- *Statically significant (p<.05),**p<.0001*
- **tested by chi-square test*

5.5. Pulmonary Function Tests

The overall mean values of pulmonary function parameters for exposed and their matched non-exposed group were presented in table 6. The values of FVC, FEV1, PEFR and FEF25%-75% were significantly decreased in woodworkers compared to their matched non –woodworkers except FEV1/FVC%. Mean FVC (L) in the woodworkers were 3.195 and in non –woodworkers were 3.6961. There was significant (P<0.001) decrease in the mean FVC in the woodworkers in comparison with non –woodworkers. Mean FEV1 (L) in the woodworkers was 2.703and in non-wood workers was 3.237 and the difference was highly significant (P<0.001).Mean FEV1/FVC (%) in the wood workers was 85.0813 and in the non-wood workerswas 86.857, the difference was not statically significant (P=0.222). Mean PEFR (L/sec) in wood workers was 5.2283 and in non-wood workers was 6.009 and the difference was significant (P=.005). There was significant decrease in mean FEF25-75% (L/sec) in the woodworkers (3.979) in comparison with non-wood workers (4.5431).

Table 5: Comparison of pulmonary function parameters of wood workers and non-wood workers in Jimma Town, South West Ethiopia, 2018

Parameters	Groups	Mean	Std. Deviation	Std.Error Mean	p-value*	95% CI	
FVC (L)	wood workers	3.1956	.64608	.07722	P<.001	-.9540	-.5328
	Non-wood workers	3.6961	.5773	.06901			
FEV1 (L)	wood workers	2.7030	.66022	.07891	P<.001	-.9448	-.9448
	Non-wood workers	3.2371	.4978	.05950			
FEV1/FVC %	wood workers	85.0813	14.28614	1.70752	.222	-5.954	2.40174
	Non-wood workers	86.8577	10.41434	1.24475			
PEFR(L/S)	wood workers	5.2283	1.63788	.19576	.005	-1.322	-.24049
	Non-wood workers	6.0097	1.59886	.19110			
FEF25-75% (L/S)	Wood workers	3.9791	1.29986	.15536	.006	-.9512	-.1767
	Non-wood workers	4.5431	.99753	.11923			

*Data are expressed as mean value of certain spirometric parameter with standard deviation. *Tested by independent-samples t-test ,P<.05 significant P>.05, Non-significant, CI: Confidence interval,L/S: litter per second, FVC-Forced vital capacity,FEV1-Forced expiratory volume in the first second,FEV1/FVC%-Percentage of FEV1 to FVC,PEFR-Peak expiratory flow rate,FEF25-75%-forced expiratory ow at 25% to 75% of FVC.*

5.6. Prevalence of Ventilatory Impairments

Pulmonary functional impairment of woodworkers and non-woodworkers were categorized on the bases of airflow obstruction, restriction and mixed patterns(42). The proportion of subjects with an FEV1/FVC% below 70% and predicted value for FVC less than 80% was higher (p <0.001) in the exposed workers than in the non-exposed subjects (fig 3). Based on the finding about 14(20%) of wood workers developed restrictive type of lung disease, 12(17.1%) of developed obstructive lung disorder whereas, 5 (7.1%) developed mixed ventilatory defect. The disorder among wood workers were high compared to the non-woodworkers where 6(8.6%) and 4(5.7%) of them developed restrictive and obstructive lung disorders respectively (Figure 3).However, obstructive defects were significantly higher in wood workers compared to non-wood workers.

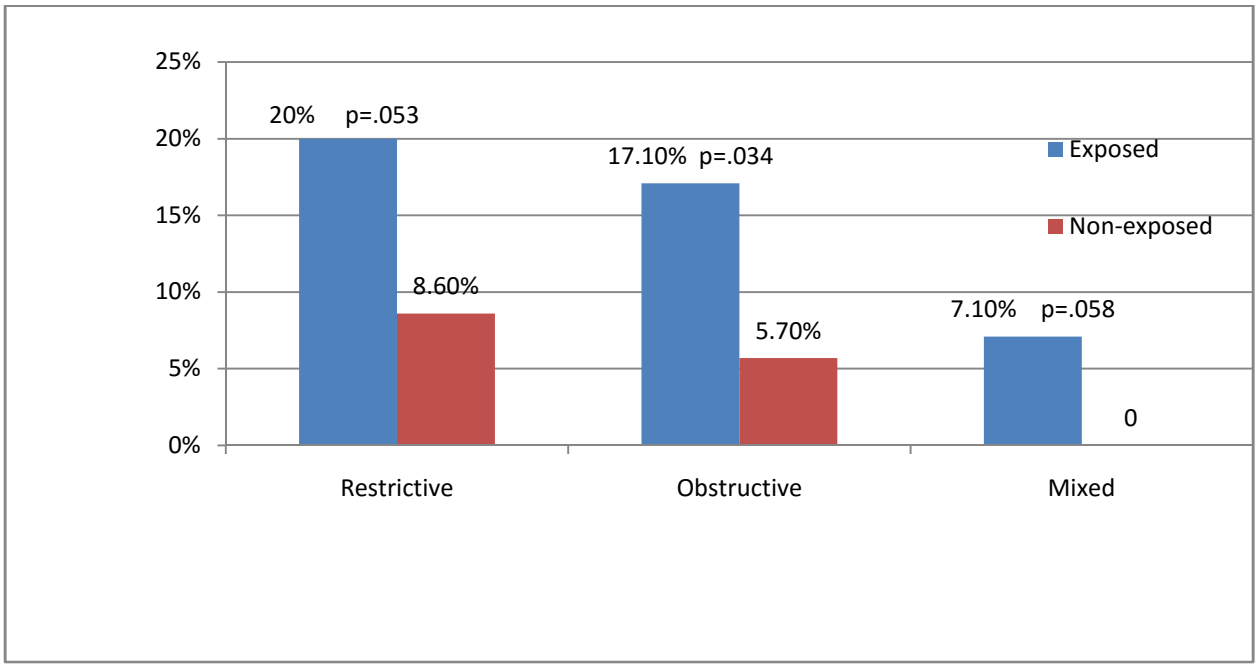

Figure 3: Magnitude of pulmonary function impairments between wood workers and non-wood workers in Jimma town, South West Ethiopia, 2018.

Data are expressed as number and percentage of study subjects with certain variable.

**Tested by Chi-square test (or Fisher's exact test where appropriate)*

5.7. Relation of Pulmonary Function Tests to predictor Variables

The Pearson's correlation was described between pulmonary function tests and predictors variables like age, body mass index, height, and duration of service year in wood work. A statistically significant ($p < 0.05$) negative correlation was found between the following variables: age and FVC (r=-0.36, p=0.02), age and FEV1 (r=-0.35, p=.003), age and PEFR (r=-0.36, p=.002), age and FEF25-75% (r=-.286, p=.016) ,work experience and FVC (r= -0.501 , P<.001) , work experience and FEV1 (r=-0.402, p=.001), work experience and PEFR (r=-0.340, p=.004),work experience and FEF25-75% (r=-.337, p=.004) .A significant positive correlation was found between: weight and FVC (r=.275 ,p=0.021), weight and FEV1 (r=0.236, p=.049). No significant correlation (p>.05) was found between BMI and the values of lung function parameters.

Table 6: Pearson correlation coefficient results between pulmonary function parameters and predictors among wood workers in Jimma town, Southwest, Ethiopia, 2018.

Test parameters	Duration of wood work employment	Age	Height	Weight	BMI
FVC (L)	r= -0.501 P<.001	r= -0.36,p=0.02	r=0.16,p=.17	r=.275 p=0.021	r=-.178 p= 0.141
FEV1(L)	r=-0.402,p=.001	r= -0.35,p=.003	r=0.19 p=.116	r=0.236 p=.049	r=-0.108 p=.372
FEV1/FVC%	r=0.008, p =.949	r=0.10,p=.399	r=.004,p=.97	r=-0.07 p=.540	r=-0.087 p=.472
PEFR (L/S)	r=-0.340 ,p=.004	r= -0.36,p=.002	r=0.091 p=.456	r=-0.09 p=.450	r=-0.038 p=.756
FEF25%-75% (L/S)	r=-.337,p=.004	r= -.286,p=.016	p=.244, p=.042	r=.194,p=.108	r=-.056 p=.643

P<.05 significant, p>.05, non-significant

r =Pearson Correlation coefficient

6. Discussion

6.1. Anthropometry Measurements

Wood workers were matched with the reference non-wood workers by anthropometric factors to increase the efficiency of statistical analysis. Age, weight, height andbody mass index were used for matching, whereas matching for sex was not done because the selected wood workersweremales.

6.2. Prevalence of respiratory symptoms

The finding from the present study showed that exposure of wood dust in wood workers resulted in higher prevalence of respiratory symptomscompared to non-wood workerswhich were statically significant difference; cough(41.4%vs. 10%), phlegmexpectoration (34.3% vs.14.3%),chest pain(32.9 vs 17.1). The prevalence of breathlessness and wheeze among wood workers were higher than non-wood workers but didn't reach statically significant difference between the two groups.

The higher prevalence of respiratory symptoms among woodworkers could be air pollution in the working environment due to wood dust resulting in activation and infiltration of inflammatory cells (T cells, mast cells, basophils, eosinophil's, neutrophils, and/or macrophages) in the respiratory systemand allergic sensitization that couldfacilitate the development ofallergic alveolitis, hyper-responsiveness of the air ways,irritation of cough receptors, hypertrophy of smooth muscle cells due to recurrent hyper-responsive bronchial constriction, and hyperplasia of goblet cells this leads to develop different respiratory symptoms(9,36,37).

This finding was comparable to study done by Francis NDE et al, in 2015they showed that respiratory symptom among woodworkers werehigher than non-woodworkers; dry cough 34.5% vs 6.6%which was statistically significant difference between the two groups and phlegm expectoration was 3.1 % in woodworkers to 0.8% in non-woodworkers(31). Another Similar study was conducted in Republic of Macedonia by Dragana Bislimovska et al , in 2015 they found that a higher prevalence of respiratory symptoms in woodworkers than non-woodworkers; cough (29.7% vs 13.5%),phlegm (15.2% vs 5.4%),shortness of breath (10.8% vs 8.1%) , chest pain (13.5% vs 10.8%) between woodworkers andnon-woodworkers respectively(30).In contrastthe prevalence of respiratory symptoms among wood workers in our study was lower than the study done in India by Anju. A.et al, in 2017 breathlessness and cough were 59% and

72% respectively. This difference could be the mean age difference among woodworkers which was 38.6±10.3 in India vs 27.86 ±7.88 in our study,duration of service year in wood work environment , personal protective device utilizationand awareness difference between the two study groups(23).

6.3. Pulmonary function test

The present study was undertaken to establish the effect of wood dust on the respiratory health status of wood workers by measuring their pulmonary function test values. Also influence of age, height, weight, body mass index and duration of exposure on pulmonary function test of wood workers was studied. Statistically significant reduction was detected for all measured spirometric parameters between the groups with exception the mean values of FEV1/FVC%.

In this study, there was significant decrease in the mean FVC, FEV1, PEFR and FEF25%-75% in the woodworkers in comparison with non-woodworkers; which was 3.19 vs 3.69,2.70 vs 3.23,5.22 vs 6.01 and 3.97 vs 4.54 respectively. The decrease in pulmonary function tests in woodworkers is attributed to the inhaled high wood dust concentration in the air and it reflects the number of woodworkers having lung function impairmentsdue to inflamation of lung parenchyma, mucosal hyperplasia, bronchial smooth muscle cell hypertrophy and decreased lung connective tissue reduces adequate filling of the lungs, increased air way resistance, and decreased air flow rate(6,9).

Additionally, wood dust induced activated inflammatory cells increased release of protease enzyme that digests lung parenchymal tissue like collagen and elastin fibers resulting in decreased lung recoil force and increase air trapping (36).

The result of this study was comparable to the study done in Ghana by Isaac E. Ennin, et al in 2015 reported that pulmonary function tests in woodworkers were significantly reduced compare to non-woodworkers.FVC (3.46 ± 0.08 vs 3.63 ± 0.07), FEV1 (2.58 ± 0.07 vs 2.90 ± 0.06), FEV1% (73.12 ± 2.03 vs 79.13 ± 1.01, and FEF 25-75% (2.52 ± 0.11vs 3.00 ± 0.10) (32).Another similar study done byAtram GG 2017 in India revealed that a significant decline in pulmonary test parameters in woodworkers as compared to non- woodworkers:FVC (3.57± 0.11 vs 3.04 ± 0.20) , (FEV1/FVC % (86.3 ±5.96 vs 67.4 ± 10.8), PEFR(L/SEC) (6.36 ± 0.172 vs 5.71 ± 0.15) (23).

Obstructive ventilatory defects were characterized by reduction in FEV1/FVC% below normal predicted values (70%)(41,42). This definition identified 17.1% of woodworkers and 5.7% of non-woodworkers with an obstructive ventilatory defect in this study.This observation is in line with the previous studies reported in Ghana byEnnin IE et al in 2015 the proportions of obstructive defects were37% in woodworkers vs 22% in non-woodworkers(32) and the study conducted in Cameroon in 2015 by Francis NDE et al obstructive syndrome was 6.2% of woodworkers vs 4.9% non-woodworkers(31).The observed obstructive ventilatory defect difference between exposed to non-exposed group in the present study is attributed to allergic and non-allergic reactions caused by wood dust(5,35). These reactions result in inflammatory changes and over-secretion of mucus in the airways causing reduction in the airway diameter. These further result in a disproportionate reduction of airflow from the lungs in relation to the maximum volume that could be expelled(47).

The percent predicted value of FVC is less than the predicted lower limit of normal (i.e. <80%) and FEV1/FVC% is greater than the lower limit of normal (i.e. >70%),which indicates the presence of restrictive pattern(41).

In all, 20% of wood workers and 8.6% of non-woodworkers showed restrictive ventilatory defects in the current study.The observed restrictive ventilatory defect difference between wood workers and non-wood workers 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(37).This study is consistent with previous study in Ghana by Ennin IE et al 2015the proportions of restrictive defect was 32% in wood workers vs, 15% in non-wood workers (32) and Cameroon on 2015 by Francis NDE et al ,the restrictive syndrome was the most prevalent represented 17% of woodworkers and 11.5% of non-wood workers(31).However, our study was in contrast to the study conducted in Poland by Baran S et al 2009 none of the woodworkers was develop a ventilatory defect of a restrictive and obstructive pattern on spirometry tests(27). This could be due to difference in occupational health awareness for preventive measures such as utilizationof protective devices,health seeking behavior and duration of wood dust exposure between the study areas.

The influence of age, height, weight, body mass index and duration of exposure on pulmonary function test of wood workers was studied. In the present study; pulmonary function tests were

negatively correlated for age, body mass index, duration of wood dust exposure andpositive correlation between height and weight of wood workers to pulmonary function tests which was in agreement with the study done by Mamta Mohan et al which wasmean pulmonary function tests in study subjects decreased with an increase in age and increased wood dust exposure. However, there was a positive correlation between PEFR and weight of wood workers (r=+0.224) and PEFR and height in wood workers (r=+0.269) (26).Similar study was conducted by Baran S, et al age was negatively correlated wih pulmonary function tests: age and FEV1(r = -0.54), age and FVC (r = -0.79), however duration of wood dust exposure would not related to pulmonary functional parameters(27). This could be due to individual immune status, health awareness and enviromental variation between the study groups.

7. Limitation of the study

This study has been interpreted with certain limitations:

The respiratory symptoms were assessed based on study participant health history;so that it might be prone to recall bias. This study didn't measure concentration of dust between woodwork and shopkeepers working environment. In the spirometry exclusion criteria, it was based on study participant'shistory thereforesub-clinical pulmonary and other systemic disease might affect the result of the study. Another limitation of this study, it didn't include both sexes because of the availability of male woodworkers in the time of data collection.

8. Conclusion and Recommendation

8.1. Conclusion

In conclusion, this study found a higher prevalence of respiratory symptoms and reduced mean pulmonary function test values among wood workersthan matched(age,weight, height and BMI)non-woodworkers. The decrease in pulmonary function tests or increased respiratory symptoms in wood workers could be caused by a continuous occupational exposure to wood dust, which had caused an adverse effect on their respiratory functions. There was higher prevalence of cough, phlegm, wheezing, breathlessness and chest pain and significant reduction in FVC, FEV1, PEFR and FEF25-75% in woodworkers as compared to non- woodworkers. All restrictive, obstructive and mixed lung disease patterns were highly prevalent among wood workers compared to non-wood workers.The mean pulmonary function parameters in woodworkers were closely related to age, body mass index,height and weight. The duration of exposure in woodwork was inversely related with FVC, FEV1, PEFR and FEF25-75% ;increased in duration of exposure (in years) to wood dust reduce pulmonary function tests.All those facts allow concluding that the problem of wood dust is importance in that it highlights the need to reduce exposure.

In general, our study showed that adequate evidence of the need for awareness creation by health educationandpromoting personal protective equipment's to reduce respiratory problems in order to enhance workers' health, working ability and productivity.

8.2. Recommendations

Based on the findings of this study it is recommended that:

To occupational Safety and Health within the Ministry of Labor and Social Affairsincluding MOH

- Strengthen advocacy for a strong occupational health policy and health insurance.
- Wood dust exposure permissible limits for nation should be declared and control the level of air pollution based on the permissible limit.

To Regional health office

- To enhance the awareness of wood workers about wood dust induced health problems and providing protective measures by health extension workers with collaboration of owner of the manufacturer.
- Wood workers should be trained on the hazards nature of wood dust on their respiratory health

To Jimma Town wood manufacturer Owners/Managers

- Provision of personal protective equipment's for wood workers
- Medical checkup on pre-employment, on service to reduce wood dust related respiratory complications and work absenteeism. These measures will help to identify high risk wood workers so they can take additional preventive measures as well as medications.
- Employers should be required to verify the implementation of applicable standards on occupational safety and health regularly, for instance by environmental monitoring and to undertake systematic safety audits from time to time.
- To provide adequate supervision for application and use of occupational safety and health measures.

To researchers

- Further studies with large sample size including both sexes should be done on the effects of wood dust on pulmonary functional status among woodworkers in Ethiopia and
- Wood dust concentration in woodwork environment should be studied.

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10. Annex.

Questionnaire

Hello,

My name is _____

I have been attending postgraduate program in the field of medical physiology at Jimma University. I am going to conduct research on **respiratory symptoms and pulmonary functional parameters among wood workers** residing in Jimma town, Ethiopia.

Information sheet

Study Title- Assessment of respiratory symptoms and pulmonary function parameters among wood workers in Jimma town, Ethiopia with principal investigator -Dilnessa Fentie contact phone-0913376812.

Dear respondents: This Participant information Sheet will help you to decide if you'd like to take part. We will go through the necessary information you would like to know about with you and answer any questions you may have, in addition to thiswe take anthropometric and pulmonary function tests. Before you decide to take part in this study, feel free to talk about the study with other people if you want. The participantswillbe asked to fill out a set of questions that will take 12- 15 minutes in maximum. This study will help to determine the magnitude of respiratory symptoms and pulmonary function parameters in wood workers. Whether or not you take part is your choice. If you don't want to take part, you don't have to give a reason, and it won't affect you in any way. If you do want to take part now, but change your mind later, you can pull out of the study at any time. In the event of withdrawal from the study, all associated data collected will be immediately destroyed. Names or identity will be omitted for the privacy and confidentiality. Any questions you may have will be answered.

Are you voluntary? A. yes B. no

CONSENT FORM: I have read / understand the Participant Information Sheet. I have been given sufficient time to consider whether or not to participate in this study. I understand that taking part in this study is voluntary (my choice) and that I may withdraw from the study at any time without this explanation. I know who to contact if I have any questions about the study in general. I understand that my participation in this study is confidential. I have asked some questions and clarification has been given to me. I have given my informed consent freely to participate in the study, and I_____ hereby to approve my agreement with my signature.

Name of the data collector: _____ Signature:___ Date_____

Name of principal investigator: _____signature: _____Date _____

1. Socio demographic Related Questionnaire

S. no	**Questionnaire**	**Response Options**
1	Code	_____
2	Participant serial number	_____
3	Sex	
4	Age in years of the participant	_____
9	For how long you have been doing this work? (years)	____
10	How many hours do you work every day?	_____
Dry Cough Related Questions		

11	Do you have a cough most days of the week?	1. Yes 2. No
12	How many days per week do you cough?	
13	At what time of the day do you cough mostly?	1. In the morning 2. In the day time 3. At night 4. If other specify _____
14	Have you ever coughed for 3 consecutive months or more during the year?	1.Yes 2. No
15	For how many years you have had this Cough?	_____ (year)
Cough with phlegm		
16	Do you bring up sputum on most days of the week during cough?	1. Yes 2. No
17	How many days per week do you bring up sputum?	_____
18	At what time of the day do you bring up sputum?	1. In the morning 2. In the day time 3. At night 4. If other specify _____
19	Do you bring up phlegm on most days	1. Yes

	for 3 consecutive months or more during the year?	2. No
20	For how many years have you had trouble with phlegm?	_____(year)
Wheeze		
21	Does your chest ever sound wheezy or whistling?	1. Yes 2. No
22	If yes to question 21: see the following questions. When the wheezy sounds mostly occur?	1. Day 2. Night
23	Have you ever had an attack of wheezing that has made if you feel short of breath?	1. Yes 2. No
Breathlessness		
24	Are you troubled by shortness of breath when hurrying on the level or walking up a slight hill	1. Yes 2. No

25	If yes to Q128**:** Do you have to walk slower than people of your age on the level because of breathlessness?	1. Yes 2 No
26	Do you ever have to stop for breath when walking at your own pace on the Level?	1.Yes 2 No
27	For how long have you been this short of breath?(in years)	_____
	Chest pain	
28	Do you have chest illness?	1) Yes 2) No
29	If yes to Q29: Did you produce phlegm with any of these chest illnesses?	1) Yes 2) No
30	In the last 3 years, did you have such illnesses, with (increased) phlegm which lasted a week or more?	1) Yes 2) No
	Personal protective Equitment	
31	How often do you wear personal protective equipment before starting	A 1. Always 2. Sometimes 3 never.

	work?	
32	If your answer in no 31 is never, what is the reason	_____
33	If You say always/sometimes to number 2-please mark the type of protective devices you used:	1. Safety goggle 2. Masks 3. Respirators 4. Gloves 5. Cover al 7.Others specify_

Questionnaire for weight, height and Pulmonary Function Tests measurement

34	Height in meter			_____		
35	Weight (kg)			_____		
36	BMI			_____		
	PFTS	1ST trial	2nd trial	3rd trial	Best trial	% pre
37	FVC					
38	FEV1					
39	FEV1/FVC%					
40	PEFR					
41	FEF25-75%					
Patterns of ventilation						
42	Normal					
43	Restrictive					
44	Obstructive					
45	Mixed					

Kutaa 1

Gaaffilee

Heloo,

Maqaan koo _____jedhama.

barataa digrii lammaffaa fiisiloojii jimma yuniversitii yoon tahu,waraqaa eebbaa(qorannoo) hojjechaan jira. Mata dureen qorannoo kootii sirna hargansuu fi usaansaa namoota magaalaa jimmaatti hojii mukaa hojjetan irratti.

Guca odeeffannoo

Mata duree- sirna hargansuu fi usaansa namoota magaala jimmaa keessatti hojii mukaa hojjetan. Qorataan: Dilneessaa Faantee bilbila 091337681.

Kabajamoo hirmaattootaa: Gucni odeeffannoo kun hirmaannaa gochuuf murteessuuf isin gargaara.Adeemsa keenya keessatti odeeffannoo barbaachisoo ta'anii fi isin beektan/deebisuu dandeessan ilaalla. Dabalataan immoo, waa'ee anrtopomeetrii fi qorannoo sirna usaansaa fudhanna. Utuu hin murteessin qorannicha keessatti qooda fudhadhu, barbaannaan bilisaan namoota biroo waliin waa'ee qorannichaa dubbadhu.hirmaataan gaaffilee muraasa kan yoo baay'ate daqiiqaa 12-15 fudhatu gaafatama.hirmaachuu fi dhiisuun filannoo keeti.yoo hin barbaanne sababa dhiyeessuun hin barbaachisu,akkasumas dhiisuun kee haala kamiinuu si hin miidhu. Yoo hirmaachuu barbaaddee fi gidduutti dhiisuu yaannanis yeroo kamittuu dhiistee deemuu dandeessa.akka hirmaannaa xumurteen dataan walitti qabame yeroosuma tajaaila ala ta'a.maqaa ykn eenyummaan isaas/kee sababa icciitii eeguuf ni balleeffama.gaaffiin kamiiyyuu kan akka tasa ati qabdu yoo jiraate ni deebi'a.

Hirmaachuuf fedhii qabdaa? A. eeyyee B. hin qabu

Walii galtee: Guca odeeffannoo hirmaataa dubbisee/hubadheen jira. Qorannicha keessatti hirmaachuu fi dhiisuu murteessuuf yeroo gahaan naaf kennameera.qorannichi keessatti hirmaachuun fedhiin ta'uu isaa hubadhee jira. Kanaaf gidduutti yeroo kamittuu ibsa tokko malee addaan kutuu nan danda'a.gaaffiin yoo jiraate eenyu akkan gaafadhu bareera, akkasumas odeeffannoon ani kennu icciitii/nama kamittuu dabarfamee akka hin kennamne

hubadheera.gaaffiilee muraasa gaafadhee ibsi naaf kennameera. Qorannicha keessatti bilisaan hirmaachuuf murtee/walii galuu koo mallattoo koon nan ibsa._____

1. Odeeffannoo wa'ee bultii jireenyaa nama gaafatamuu ilaalatu

Lakk.	**Gaaffilee**	**Debbii**
1	Koddii hirmatota	_____
2	Toora lakkobsa hirmaatan irratti argamu	_____
3	Saala	_____
4	Umurii hirmatota waggadhaan	_____
5	Sadarkaa barnoota	1. barnoota odeffanoo 2. Barnoota sadarkaa tokkoffaa 3. barnoota sadrkaa lammaffaa 4. Banoota adarkaa olaana 5. kan biraan yoo jiraate (ibsii)_____
6	Kanaan bakka dirree hojiii dhukeeen itti bayaturra hojjee beekta?	1 eeyyee 2 miti
7	Kanaan dura doktooriin fayyya nama yookan ogessi fayya kan biraan dhukuuba kan akka asma, dhukkuba onne, dhukkuba sombaa, dhukuba sukaraa,dhiita garaa keessa, dhiiba dhiiga, rakkoo argansuuu nomoniyaa,dhukubaa narvii, dhukuba	1 eeyyee 2 miti

	lafee dugdaa, naafumma, dhukuba qufaa qabda siin jedhanii beeku?	
8	Tombo ni xuxxa?	1 eeyyee 2 miti
9	Ogumma kanan yeroo meqaaf hojatte?	____
10	Guyya guyyadhan sa'aattii meqaa hojetta?	_____

kutaa 2: **Gaffillee malatto hargensu irratii**

Gaffille quffa goga walqabatan		
11	Turban keessa guyya baayyee Quffasn si qabaa?	1.Eeyyee 2.Miti
12	Torban kessatti guyyaa meqaa si qufasisa?	
13	Guyyaa kesatti yeroo kam bayisse si kufasisa?	1. Ganama 2. Guyyaa 3. Galgala 4. Kan birowwan _____
14	Yeroo baay'ee waliitti fufinsaan wagga keessa ji'a sadii fi isaa ol	1.Eeyyee

	siqufaasisee bekaa?	2.Miti
15	Wagga meqaaf qufaan kun sira turee?	_____ (wagga)
Qufaa hakkitaa qabu?		
16	Torbee keessa yeroo baayyee oggati kufaatu hakkitaan ni ba'aa?	1.Eeyyee 2.Miti
17	Torbeetti qufaa hakkitaa qabu hagam baasta?	_____
18	Guyyaa keessatti yeroo akkamii qufaan hakkitaa qabu baasta?	1. Ganama 2. Guyyaa 3. Halkan 4. Kan biroo _____
19	Yeroo baay'ee waliitti fufinsaan wagga keessa ji'a sadii fi isaa ol qufaa hakkitaa qabu qabdaa?	1.Eeyyee 2.Miti
20	Waggaa meeqaaf quffaa hakkitaa qabu faana dhiphatte?	_____(Waggota)
Xiixuu		
21	Yeroo hargaantuu sagalee xiixuu fakkatu qomakee irraa sitti dhagamee bekaa?	1. Eeyyee 2.Miti

22	Deebiin gaaffii 21 eeyyee yoo ta'e; sagaalee xiixuu qoomakee irrattii yeroo kam dhaga'ama?	1. Guyyaa 2. Halkan
23	Sagaalee xiixuu kanaan wal qabatee haafura kutuun sii mudatee beekaa?	1.Eeyyee 2.Miti
Hafura kutaa		
24	Yeroo daddafte demtuu fi lafa olka'aa demtuu hafura si kutaa?	1.Eeyyee 2.Miti
25	Deebiin gaffii 24 eeyyee yoo ta'e namota ummuri kee wal gittan gad ta'ee deemtaa?	1.Eeyye 2.Miti
26	Yeroo darbii baatu hafuraa si kutaa?	1.Eeyyee 2.Miti
27	Hafura kuuttaan kun hamam sitti turee?	_____
	Dhukuba qoma	
28	Dhukubbii qoma qabdaa?	1.Eeyyee 2.Miti
29	Yoo deebiin kee gaaffii 28"eeyyee" ta'e;dhukubbii qoma kanaan walqabate	1.Eeyyee

	hakkitaa baastu jiraa?	2.Miti
30	Waggota sadan darbanitti dhukuba akkasii kanakkitanitti baay'ate (yoo xiqqaate si,a 5) torbeetti qabdaa?	1.Eyyee 2.Miti
31	Yeroo hammamiif uffata ittisaa qaama uuffata?	1. Yeroo hundaa 2. Si'a tokko tokko 3. gonkumaa hin uuffadhu
32	Yoo deebiin gaaffiin 31 gonkumaa hin uufffadhu ta'ee maalliidha sababnikee?	_____
33	Yoo Deebiin gaaffii 31 yeroo hundaa yokaan si'a tokko tokko ta'e uffata ittisaa qaama fayadamtu isa kami?	1. Fuulle ijaa kan eeggumsaa 2. Haguugi fuula yookaan afaanii 3. Gilaavii harkaa 4. Gawoonii 5. Kan biraa(ibsii)_____

DECLARATION

I, the undersigned, declare that this thesis is my original work, has not been presented for a degree in this or any other university and that all sources of materials used for the thesis have been fully acknowledged.

Name of the student:

Signature: _____

Name of the institution:

Date of submission: _____

This thesis has been submitted for examination with my approval as University advisor

Name and Signature of the first advisor

_____

Name and Signature of the second advisor

_____

Name and Signature of the external examiner

_____

_____

Name and Signature of the internal examiner

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