

Research Article

Assessment of Respiratory Symptoms among Woodworkers in Jimma Town, Southwest Ethiopia, a Comparative Cross Sectional Study

Fentie D¹, Mariam TG², Mulat E² and Demissie WR^{2*}

¹Department of Biomedical Sciences, Dire Dewa University, Ethiopia

²Department of Biomedical Sciences, Jimma University, Ethiopia

*Corresponding author: Wondu Reta Demissie, Department of Biomedical Sciences, Jimma University, School of Medicine, Institute of Health, Jimma, Ethiopia

Received: May 02, 2019; Accepted: June 19, 2019;

Published: June 26, 2019

Abstract

Background: Wood dust is one of the most common sources of occupational exposures in the world.

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

Materials and Methods: 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. A standardized structured questionnaire was used to evaluate the respiratory symptoms. 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: Higher prevalence of respiratory symptoms in woodworkers than non-wood workers was observed. The prevalence of respiratory symptoms like cough (41.4% vs. 10%), phlegm (34.3% vs. 14.3%) and chest pain (32.9 vs. 17.1) shows statistically significance differences among exposed to non-exposed groups were respectively.

Conclusion and Recommendation: The higher prevalence of respiratory symptoms among woodworkers needs due emphasis on preventive measures and awareness creation about wood dust-related respiratory symptoms.

Keywords: Respiratory symptoms; Woodworkers; Jimma town; Comparative cross-sectional

Introduction

Jimma is one of the oldest city of Ethiopia, known as the ever green, forest, 13 month of raining, coffee land and endemic with wood and wood products [1]. Many scholars also argue that Jimma was claimed as the home of respiratory disorders especially asthma [2]. The present study hypothesis that the unique and endemic of the town with wood and wood products exposes woodworkers to different respiratory disorders which manifested with respiratory sign and symptoms as occupational hazard.

Exposure to wood dust is responsible for development of varies respiratory diseases as occupation hazard and affecting about two million workers worldwide [3-6].

Dusts from the wood and its different components enters into respiratory systems *via* inhalation to cause respiratory disorders by sensitizing and irritating mucous membrane of airways which are manifested by different sign and symptoms among exposed wood workers [7-14].

A meta- analysis study conducted in Great Britain has shown

exposure to woodwork was associated with significantly increased risk of respiratory symptoms and asthma among furniture and wood processing [15].

The other study conducted in Asian countries revealed that wood dust is more prone to cause irritant respiratory symptoms and a potent cause of chronic respiratory diseases among wood workers [9].

Despite there is no study conducted on the interested area in the setting and as well as in the country, there are different studies conducted among wood workers to evaluate the magnitude of respiratory symptoms globally [3,5,8,11-14,16-36]. Previous study conducted in the setting among woodworkers reported higher magnitude of respiratory disorders than the control group [37] and also study done among cobblestone road paving workers revealed the significant higher odds of respiratory symptoms, dry cough ($p < 0.05$), cough ($p < 0.01$) and sore throat ($p < 0.001$) compared to the reference group [38]. Study conducted among street sweepers in Addis Ababa showed the high prevalence respiratory symptoms [39]. Thus, the present study was aimed to assess respiratory symptoms among wood workers in Jimma town by taking reference group.

Materials and Methods

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 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 of 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 wood workers 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 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.

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 [40].

$$n = [r+1/r] p \times q (Z_p + Z_a)^2 / d^2$$

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 [16].

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.

Sampling technique

Multistage sampling technique was used to select the exposed study participants. Jimma town has 17 kebeles (clusters) among these clusters: five clusters were 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 work enterprises 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.

Data analysis

Data was checked for completeness, entered in to 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 proportions was done by the use of the chi-square test.

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 study participant's. The information obtained in 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-wood workers were 27.86 (SD±7.88) years and 26.49 years (SD±5.378) respectively. The mean height and weight of woodworkers and non-woodworkers were 169.90cm (SD±6.084) vs 170.66 cm (SD±5.941) and 59.89Kg (SD±5.77) vs 59.99Kg (SD±5.59) respectively. The mean service year duration of woodworkers and non-wood workers was 7.20±5.45 and 7.45±4.40 respectively with range between 1 to 22 years in both groups.

Prevalence of respiratory symptoms

The prevalence of the respiratory symptoms in the last 12 months in woodworkers compared to non-wood workers was higher. The prevalence's of dry cough, cough with phlegm expectoration, chest pain, breathlessness, and wheeze with 95% confidence interval were 41.4% CI (31.4, 51.7), 34.3% CI (25.5, 48.6), 32.9% CI (22.6, 47.1), 21.4% CI (9.7, 29.1) and 12.9% 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,

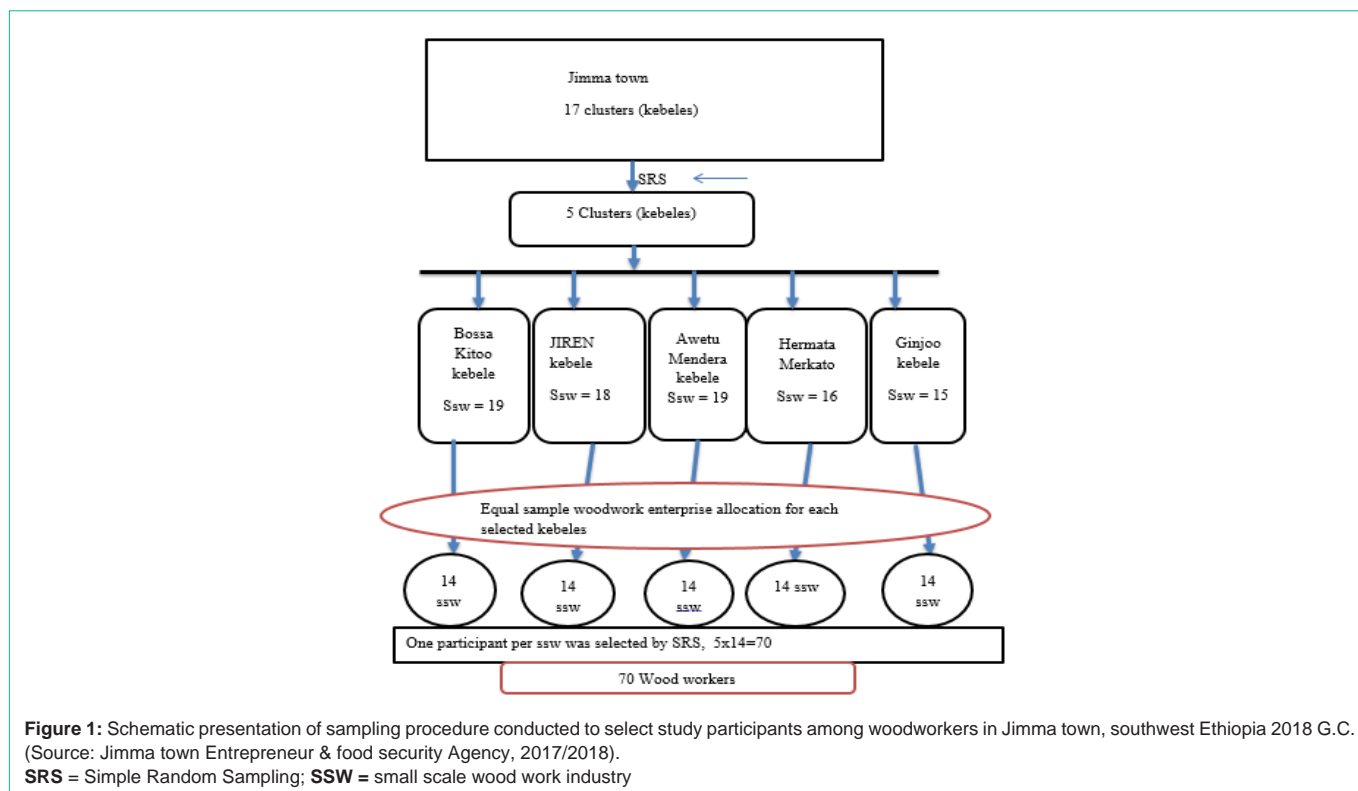


Figure 1: Schematic presentation of sampling procedure conducted to select study participants among woodworkers in Jimma town, southwest Ethiopia 2018 G.C. (Source: Jimma town Entrepreneur & food security Agency, 2017/2018). **SRS** = Simple Random Sampling; **SSW** = small scale wood work industry

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

Parameter	Wood workers (n=70)	Non-woodworkers (n=70)	P-value
Age, mean ± SD	27.86 ± 7.886	26.49 ± 5.378	0.209
Height, mean ± SD	169.74 ± 5.93	170.80 ± 5.958	0.95
Weight, mean ± SD	59.89 ± 5.77	59.99 ± 5.599	0.917
BMI, mean ± SD	20.7871 ± 1.70	20.548 ± 1.22	0.344
Level of education: Primary, number (%)	24 (34.3%)	20 (28.6%)	0.453
Secondary, number (%)	30 (42.9%)	30 (42.9%)	0.568
Higher, number (%)	10 (14.3%)	18 (25.7%)	0.465
Others, number (%)	6 (7.21%)	2 (2.9 %)	
Duration of service, mean ± SD	7.20 ± 5.45	7.45 ± 4.40	0.04*

P < .05 significant; BMI: Body Mass Index; SD: Standard Deviation
 *- Significant p-value.

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.

The prevalence of respiratory symptoms among wood workers was higher than non-wood workers. Moreover, all respiratory symptoms except breathlessness and wheezing showed statistically significant differences between wood workers and non-wood workers. Wood workers were 6.36 times more likely to develop dry cough, 2.94 times more likely to acquire phlegm production, 2.36 times more likely to have chest pain, and 1.64, 1.57 times more likely to develop breathlessness and wheezing than non-woodworkers respectively.

Discussion

The finding of the present study revealed that exposure of wood dust among the wood workers resulted in higher prevalence

of respiratory symptoms compared to non-wood workers. There is statistical significant difference discriminated among the groups in cough (41.4% vs. 10%), phlegm expectoration (34.3% vs. 14.3%), chest pain (32.9% vs. 17.1%). Bu the prevalence of breathlessness and wheeze among wood workers were higher than non-woodworkers but didn't reach statically significant difference between groups.

The higher prevalence of respiratory symptoms among wood workers 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 system and allergic sensitization that could facilitate the development of allergic alveolitis, hyper-responsiveness of the air ways, irritation of cough receptors, hypertrophy of smooth muscle cells due to recurrent hyper-

Table 2: 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 in the last 12 months	Woodworkers	95% CI		Non-wood workers n=70	95% CI		P-value
	n=70	Lower	Upper		Lower	Upper	
Cough	29 (41.4%)	31.4	51.7	7 (10%)	2.6	17.4	0.000**
Phlegm Expectoration	24 (34.3%)	25.5	48.6	10 (14.3%)	5.7	23.1	0.010*
Breathlessness	15 (21.5%)	9.7	29.1	10 (14.3%)	5.7	23.7	0.412*
Wheezing	9 (12.4%)	5.2	22.9	6 (8.6%)	3.5	17.1	0.270*
Chest pain	23 (32.9%)	22.6	47.1	12 (17.1%)	10	28.2	0.032*

Statically significant ($p < .05$), ** $p < .0001$

*Tested by chi-square test.

responsive bronchial constriction and hyperplasia of goblet cells that leads to development different respiratory symptoms [41-43].

This finding was comparable to study done by Francis NDE et al, in 2015 who revealed higher prevalence of respiratory symptom among woodworkers than non-woodworkers with magnitude of dry cough 34.5% vs. 6.6% which was statistically significant difference between groups and phlegm expectoration 3.1% vs. 0.8% in non-woodworkers [16]. Another Similar study was conducted in Republic of Macedonia by Dragana Bislimovska et al, in 2015 also reported higher prevalence of respiratory symptoms in woodworkers than non-woodworkers with magnitude of 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%) among woodworkers and non-woodworkers respectively [26]. The present study was also in harmony with studies of Tobin EA et al who reported the prevalence of respiratory symptoms in the study group as: cough 46.7%, phlegm expectoration 50.2%, wheeze 5.3%, chest tightness 10.1%, chest pain 5.7% and breathlessness 7.5% which were significantly higher among the study than the comparison group [24]. This finding is also in agreement with results of other studies [25,36,44,45].

Study Limitation

The respiratory symptoms were assessed based on study participant health history; so it might be prone to recall bias. This study didn't measure concentration of dust between woodwork and shopkeepers working environment. The present study didn't include both sexes because of unavailability of female woodworkers.

Conclusion

The prevalence of respiratory symptoms among wood workers was higher than non-wood workers. Moreover, all respiratory symptoms except breathlessness and wheezing showed statistically significant differences between wood workers and non-wood workers.

Acknowledgement

We would like to thank Jimma University for financial support and participants of the study.

References

1. Jimma. In: Wikipedia.
2. Tefereedgn EY, Ayana AM, Tefereedgn EY, Ayana AM. Prevalence of Asthma and Its Association with Daily Habits in Jimma Town, Ethiopia. *Open J Asthma*. 2018; 2: 11-7.
3. Schlünssen V, Schaumburg I. Asthma, bronchitis and chronic obstructive pulmonary disease in occupational exposure to wood. *Ugeskr Laeger*. 1998; 160: 609-615.
4. Baran S, Swietlik K, Teul I. Lung function: occupational exposure to wood dust. *Eur J Med Res*. 2009; 14: 14.
5. Jacobsen G, Schaumburg I, Sigsgaard T, Schlunssen V. Non-malignant respiratory diseases and occupational exposure to wood dust. Part II. Dry wood industry. *Ann Agric Environ Med*. 2010; 17: 29-44.
6. Carton M, Goldberg M, Luce D. Occupational exposure to wood dust. Health effects and exposure limit values. *Rev Epidemiol Sante Publique*. 2002; 50: 159-178.
7. Esmaeil N, Gharagozloo M, Rezaei A, Grunig G. Dust events, pulmonary diseases and immune system. *Am J Clin Exp Immunol*. 2014; 3: 20.
8. Shamssain MH. Pulmonary function and symptoms in workers exposed to wood dust. *Thorax*. 1992; 47: 84-87.
9. Ratnasingam J, Ioras F, Tadin I, Wai LT, Ramasamy G. Respiratory Effects in Woodworkers Exposed to Wood and Wood Coatings Dust: A Regional Evaluation of South East Asian Countries. *J Appl Sci*. 2014; 14: 1763-1768.
10. Holmström M, Wilhelmsson BO. Respiratory symptoms and pathophysiological effects of occupational exposure to formaldehyde and wood dust. *Scand J Work Environ Health*. 1988; 306-311.
11. Lion SH, Yang JL, Cheng SY, Lai FM. Respiratory symptoms and pulmonary function among wood dust-exposed joss stick workers. *Int Arch Occup Environ Health*. 1996; 68: 154-160.
12. Goldsmith DF, Shy CM. Respiratory health effects from occupational exposure to wood dusts. *Scand J Work Environ Health*. 1988; 1-15.
13. Schlünssen V, Schaumburg I, Taudorf E, Mikkelsen AB, Sigsgaard T. Respiratory symptoms and lung function among Danish woodworkers. *J Occup Environ Med*. 2002; 44: 82-98.
14. Rastogi SK, Gupta BN, Husain T, Mathur N. Respiratory Health Effect from Occupational Exposure to Wood Dust in Sawmills. *Am Ind Hyg Assoc J*. 1989; 50: 574-578.
15. Wiggans RE, Evans G, Fishwick D, Barber CM. Asthma in furniture and wood processing workers: a systematic review. *Occup Med*. 2015; 66: 193-201.
16. Nde Djiele J, Mbatchou H, Nebo J, Djomo A, Tsafack P, De Brouwer C. Respiratory symptoms and pulmonary function tests among informal sectors workers exposed to wood dust in Douala, Cameroon. *J Allergy Ther*. 2015; 6.
17. Kayhan S, Tutar U, Cinarka H, Gumus A, Koksall N. Prevalence of occupational asthma and respiratory symptoms in foundry workers. *Pulm Med*. 2013; 2013.
18. Löfstedt H, Akan, Hagström K, Bryngelsson IL, Holmström M, Rask-Andersen A. Respiratory symptoms and lung function in relation to wood dust and monoterpene exposure in the wood pellet industry. *Ups J Med Sci*. 2017; 122: 78-84.
19. Bohadana AB, Massin N, Wild P, Toamain JP, Engel S, Goutet P. Symptoms, airway responsiveness, and exposure to dust in beech and oak wood workers. *Occup Environ Med*. 2000; 57: 268-273.
20. Campo P, Aranda A, Rondon C, Doña I, Díaz-Perales A, Canto G, et al. Work-related sensitization and respiratory symptoms in carpentry apprentices

- exposed to wood dust and diisocyanates. *Ann Allergy Asthma Immunol*. 2010; 105: 24-30.
21. Mandryk J, Alwis KU, Hocking AD. Work-related symptoms and dose-response relationships for personal exposures and pulmonary function among woodworkers. *Am J Ind Med*. 1999; 35: 481-490.
22. Milanowski J, Krysińska-Traczyk E, Skorska G, Cholewa G, Sitkowska J, Dutkiewicz J. The effect of wood dust on the respiratory system. Medical examination of furniture factory workers. *Pneumonol Alergol Pol*. 1996; 64: 32-37.
23. Mahmood NMA, Karadaky K, Hussain SA, Ali AK, Mohammad GM, Mahmood OM. Respiratory function among sawmill workers in different areas of Sulaimani city. *Int J*. 2016; 5: 351.
24. Tobin EA, Ediagbonya TF, Okojie OH, Asogun DA. Occupational Exposure to Wood Dust and Respiratory Health Status of Sawmill Workers in South-south Nigeria. *J Pollut Eff Control*. 2016; 1-6.
25. Boskabady MH, Rezaian MK, Navabi I, Shafiei S, Arab SS. Work-related respiratory symptoms and pulmonary function tests in northeast iranian (the city of Mashhad) carpenters. *Clinics*. 2010; 65: 1003-1007.
26. Bislimovska D, Petrovska S, Minov J. Respiratory symptoms and lung function in never-smoking male workers exposed to hardwood dust. *Open Access Maced J Med Sci*. 2015; 3: 500.
27. Asia AA, Atram GG. Respiratory symptoms and ventilatory functions among saw mill workers. *Cough*. 2017; 6: 336-340.
28. Borm PJA, Jetten M, Hidayat S, Van de Burgh N, Leunissen P, Kant I, et al. Respiratory symptoms, lung function, and nasal cellularity in Indonesian wood workers: a dose-response analysis. *Occup Environ Med*. 2002; 59: 338-344.
29. Jacobsen G, Schlünssen V, Schaumburg I, Sigsgaard T. Increased incidence of respiratory symptoms among female woodworkers exposed to dry wood. *Eur Respir J*. 2009; 33: 1268-1276.
30. Liou SH, Cheng SY, Lai FM, Yang JL. Respiratory symptoms and pulmonary function in mill workers exposed to wood dust. *Am J Ind Med*. 1996; 30: 293-299.
31. Wilhelmsson B, Drettner B. Nasal problems in wood furniture workers: A study of symptoms and physiological variables. *Acta Otolaryngol (Stockh)*. 1984; 98: 548-555.
32. Mandryk J, Alwis KU, Hocking AD. Effects of personal exposures on pulmonary function and work-related symptoms among sawmill workers. *Ann Occup Hyg*. 2000; 44: 281-289.
33. Osman E, Pala K. Occupational exposure to wood dust and health effects on the respiratory system in a minor industrial estate in Bursa/Turkey. *Int J Occup Med Environ Health*. 2009; 22: 43-50.
34. Pisaniello DL, Connell KE, Muriale L. Wood dust exposure during furniture manufacture-results from an Australian survey and considerations for threshold limit value development. *Am Ind Hyg Assoc J*. 1991; 52: 485-492.
35. Pisaniello DL, Tkaczuk MN, Owen N. Occupational wood dust exposures, lifestyle variables, and respiratory symptoms. *J Occup Med Off Publ Ind Med Assoc*. 1992; 34: 788-792.
36. Sripaiboonkij P, Phanprasit W, Jaakkola MS. Respiratory and skin effects of exposure to wood dust from the rubber tree *Hevea brasiliensis*. *Occup Environ Med*. 2009; 66: 442-447.
37. Dilnessa Fentie, Tewodros G Mariam, Elias Mulat, Wondu Reta Demissie. Prevalence of Respiratory Disorders among Woodworkers in Jimma Town, Southwest Ethiopia. *J Pulm Med Respir Res*. 2019; 5: 1-6.
38. Hassen KA, Ibrahim MS. Exposure to occupational dust and changes in pulmonary function among cobblestone paving workers of Jimma, Ethiopia. *Rev Ambiente Água*. 2014; 9: 19-26.
39. Abraha MT. Occupational Respiratory Health Symptoms and Associated Factors among Street Sweepers in Addis Ababa, Ethiopia. 2016.
40. Jain S, Gupta A, Jain D. Estimation of sample size in dental research. *Int Dent Med J Adv Res*. 2015; 1: 1-6.
41. Robalo-Cordeiro C, Cemlyn-Jones J, Alfaro TM, Ferreira AJ. Bronchoalveolar lavage in occupational lung diseases. 2007; 28: 504-513.
42. Määttä J. Cytokine, Chemokine, and Chemokine Receptor Expression in RAW 264.7 Mouse Macrophages and in the Lungs of Mice after Exposure to Wood Dust. University of Kuopio. 2008.
43. Pykkänen L, Stockmann-Juvala H, Alenius H, Husgafvel-Pursiainen K, Savolainen K. Wood dusts induce the production of reactive oxygen species and caspase-3 activity in human bronchial epithelial cells. *Toxicology*. 2009; 262: 265-270.
44. Oppliger A, Rusca S, Charriere N, Vu Duc T, Droz PO. Assessment of bioaerosols and inhalable dust exposure in Swiss sawmills. *Ann Occup Hyg*. 2005; 49: 385-391.
45. Hailu S, Tessema T, Silverman M. Prevalence of symptoms of asthma and allergies in schoolchildren in Gondar town and its vicinity, northwest Ethiopia. *Pediatr Pulmonol*. 2003; 35: 427-432.