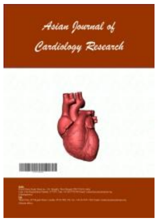

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Occupational Exposure to Saw Dust and Blood Pressure Status of Timber Workers in South East Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. Author EGU designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author UOG managed the analyses of the study, supervision and funding. Author IEE managed the literature searches, administrative report and funding. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: The link between cardiovascular diseases and rise in occupational dust have been known for more than a decade. Occupational dusts are small dry, solid particles generated and projected into the air by mechanical or man-made processes such as crushing, grinding, milling, drilling, shoveling, and sweeping. These dusts when inhaled in high concentration could have some adverse effects on the cardiovascular system. Therefore, this study examined the effects of saw dust on the blood pressure parameters of wood workers in Abakaliki metropolis.

Methods: This was a cross sectional study. The study was conducted on the wood workers and non-wood workers. Wood workers with minimum of three years wood work experience and are not involved in other jobs that generate air pollution participated in this study. Participants with any

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underlying pathology especially cardiovascular diseases, pregnant ones and smokers were excluded from the study. Research area was timber industry, located more than 15 miles away from traffic. 500 subjects participated in this study. 250 wood workers (test group) and 250 non-wood workers (control group). Medical and workplace information was obtained using questionnaire. Systolic, diastolic and pulse rate (PR) were measured using digital sphygmomanometer. The measurement was done early in the morning before the start of wood work. The formula: diastolic pressure + 1/3 (pulse pressure) was used to calculate the mean arterial pressure (MAP). The sizes of particulate matters present in the research area were measured using air sampler PCE-PCO 1. Data was analyzed statistically using graph pad prism 7 software. Level of significance set at 95%.

Results: Participant's age ranged between 20 to 50 years. Wood workers were left unprotected from ultrafine and coarse particulate matters (PM0.5-2.5). The result revealed 20mmHg increase in the diastolic blood pressure (DBP) of timber sawyers, 15mmHg increase in DBP of timber loaders and 17mmHg increase in DBP of timber sellers when compared with the control. Also, 19mmHg rise in systolic blood pressure (SBP) of timber sawyers, 16mmHg increase in SBP of timber loaders and 15mmHg rise in SBP of timber sellers were recorded when compared with the control. In addition, 18mmHg increase in the mean arterial pressure (MAP) of timber sawyers, 11mmHg rise in MAP of timber loaders and 15mmHg increase in MAP of timber sellers were observed when compared with the control. Furthermore, 20 beats per minute (bpm) increase in the pulse rate of timber sawyers, 17bpm rise in pulse rate of timber loaders and 16bpm increase in pulse rate of timber sellers were detected when compared with the control. Among the different groups of timber workers, timber sawyers recorded significant increase in diastolic, systolic and mean arterial pressure when compared with other different groups of timber workers.

Conclusion: The increase in blood pressure parameters of wood workers than non-wood workers may be as a result of the adverse effects of saw-dust inhalation on the cardiovascular system of the wood workers. Also, the recorded increase in systolic, diastolic and MAP of timber sawyers when compared with other groups of wood workers indicate that more exposure to saw dust may cause more harm to the cardiovascular system. Wood workers need to learn cardiovascular health safety procedures and also, be educated on saw dusts risks.

Keywords: Systolic; diastolic; mean arterial pressure; pulse rate; saw-dust.

1. INTRODUCTION

The link between cardiovascular diseases and increase in occupational dust have been known for more than a decade Ezeja and Umahi-Ottah. [1]. Dusts are small dry, solid particles projected into the air by natural forces such as wind, volcanic eruption and by mechanical or man-made processes such as crushing, grinding, milling, drilling, shoveling, conveying, bagging and sweeping IUPAC [2]. Dusts, when inhaled in high concentration could harm animals, humans and vegetation Ottah-umahi et al. [3]. Mineral dust, organic and vegetable dust, metallic dust, and chemical dust are the four major types of dusts that can be found in work environment. Flour, cotton, pollens and wood dusts are examples of organic and vegetable dust. Timber dust produced by the processing of wood, is made up of cellulose, polyoses and lignin compounds (Pedro et al.) [4]. Diverse biologically active low molecular weight compounds may also be present depending on the species of the tree. These compounds include; alcohols, glycerol, sterols, tannins, flavonoids, quinines, alkaloids (Pedro et al.) [4]. Dust particles are usually in the size range from about 1 to 100µm in diameter, and they settle gradually under the control of gravity. They are commonly called particulate matters. Particulate matters are classified by size of the particles into ultrafine PM< (0.1µm), coarse (Pm 1.0-2.5 µm), fine (PM > 2.5µm) and PM ≤10µm Brook et al. [5]. These particles when lodged in the alveoli, goes into the pulmonary circulation and finally, into the systemic circulation Peters et al. [6]. Health risks caused by particulate matters are determined by the particle size, surface area and chemical composition. Change in autonomic function, increase repolarization abnormalities, local and systemic inflammation, increase reactive oxygen species, coagulation and myocardial ischemia are the potential mechanisms through which particulate matters may cause cardiovascular diseases Ottah-umahi et al. [3]. Cardiac arrhythmias, myocardial ischemia, myocardial infarction, atherosclerosis and high blood pressure are the cardiovascular diseases that may be cause by air pollution. The pressure that is exerted on the walls of blood vessels by the circulating blood is called blood pressure. A lot of these pressures are due to work done by the heart as it pumps blood through the circulatory system. It's usually refers to the pressure in the large arteries of the systemic circulation. Blood pressure is generally shown as systolic pressure over diastolic pressure, and it's measured in millimeters of mercury (mmHg) Ezeja and Umahi-Ottah [1]. Approximately 120mmHg systolic and 80 mmHg diastolic (120/80 mmHg) is the normal resting blood pressure of an adult Guyton and Hall [7]. Non-invasively, blood pressure is measured using stethoscope and a mercury tube sphygmomanometer. Generally, auscultation is still considered to be the gold standard of accuracy for non-invasive blood pressure readings in clinics. However, digital methods of blood pressure reading have become popular, majorly because of concerns about potential toxicity that is associated with mercury, although, cost, ease of use even at home have also impacted on this trend. Cardiac output, systemic vascular resistance and arterial stiffness influences blood pressure. Variations seen in blood pressure can be attributed to certain situations such as emotional state, physical activity, and relative health/disease states. Baroreceptors control blood pressure by acting on the cardiovascular center to control the nervous and the endocrine systems. Very low blood pressure (80/50 mmHg) is called hypotension, while very high pressure (140/100 mmHg) is called hypertension. Hypertension and hypotension both have many causes and may be of sudden onset or of prolonged duration. According to Alpert et al. [8], long-term hypertension is a risk factor for many diseases, such as heart diseases, stroke and kidney failure. The average pressure of blood circulating through the arteries, during cardiac cycle is called Mean Arterial Pressure (MAP). The value of MAP is normally derived from the systolic and diastolic blood pressure. It is commonly used to determine blood flow to the internal organs. MAP is considered a more accurate measurement than the systolic blood pressure. The normal value of MAP is between 70 and 110 mmHg. It can be measured through an invasive method, but can also be calculated using the following formulas:

MAP = diastolic pressure + 1/3 (systolic – diastolic pressure), MAP = 2/3 (diastolic pressure) + 1/3 (systolic pressure), MAP = diastolic pressure + 1/3 (pulse pressure) Ezeja and Umahi-Ottah[1]. The medical relevance of MAP is that it shows the perfusion pressure of the different internal organs. Stroke, cardiomegaly and heart attack can occur as a result of MAP greater than 110mmHg while shock, cell death and organ damage can occur as a result of MAP less than 60mmHg. Any change in cardiac output or systemic vascular resistance can negatively influence MAP Zheng et al. [9]. The number of times the heart beats per minute is called pulse rate. Normal pulse rate varies from individual to individual, but a normal range for adults is 60 to 100 beats per minute. Furthermore, age, body size, heart conditions, physical activity, emotions etc, can influence pulse rate Ezeja and Umahi-Ottah [1]. For instance, excitement or fear can increase the pulse rate. The commonest places to check pulse rate are wrists, elbow, and side of the neck. To get the correct reading, place two fingers over one of these areas and count the number of beats in 60 seconds. Pulse rate can also be counted for 20 seconds and multiply by three. Pulse rate is best measured in the morning before activity. Lower than 60 beats per minute pulse rate doesn't necessarily mean a medical condition. Individuals that exercise regularly, always have lower heart rates because their heart muscles don't need to do a strenuous work to maintain a constantly lower pulse rate. For example, an athlete with a resting pulse rate of 40 bpm can be seen to be normal. Hundred beats per minute pulse rate could be seen as tachycardia while a pulse rate of lower than sixty beats per minute could also be seen as bradycardia Guyton and Hall [7]. A large number of researches have looked into the link between particulate matter and blood pressure; Ezeja and Umahi-Ottah[1] looked into the relationship between quarry dust and blood pressures among quarry workers and discovered that quarry workers had elevated systole, diastole, mean arterial pressure and pulse rate than non-quarry workers. Delfino, Sioutas and Malik [10] carried out a study to determine the connection between particulate matter (PM2.5) and blood pressure in Boston residents and revealed that an increase from 10 to 90 μg/m^3 of particulate matters (PM2.5) showed an increase in resting systolic (2.8mmHg) and resting diastolic (2.7mmHg) of the participants. Also, Pope et al. [11] revealed a significant rise in the diastolic blood pressure (6mmHg) among the participants after two hours exposure to particulate matter 2.5. In addition, Pope and Dockery [12] observed a significant rise in the heart rate of the participants by 5 to 10 beat per minute when they were exposed to PM10 (10 μg/m^3). Having reviewed all these studies, none have particularly examined the effects of saw dust on the blood pressure parameters of wood workers in Ebonyi State where large number of people are employed in dust emitting industries, hence the need for this study to bridge the gap in knowledge about the impact of saw dust on the blood pressure parameters of wood workers in Abakaliki metropolis.

2. METHODS

This was a cross sectional study. The study was conducted on the wood workers and non-wood workers. Three different groups of wood workers exist in Abakaliki metropolis namely; timber sawyers, timber loaders, and timber sellers. The blood pressure parameters were also compared among the different groups of wood workers.

Purposively, two hundred and fifty wood workers (test group) and two hundred and fifty non-wood workers (control group) were sampled. Wood workers within the age of 20 to 50 years, with minimum of three years wood work experience and are not involved in other jobs that causes air pollution participated in this study. Participants with any underlying pathology especially cardiovascular diseases, pregnant ones and smokers were excluded from the study.

Sample size was estimated using Cohen [13] formula.

Timber industry, been the study area is located more than 15 miles away from traffic.

The quantity, quality and sizes of particulate matters present in the research area were analyzed using air sampler PCE-PCO 1.

Diastolic, systolic and pulse rate were measured using digital sphygmomanometer (model: ZK–B872YA). The measurement was done early in the morning before the start of wood work. Mean arterial pressure was calculated (1/3 of pulse pressure + diastolic pressure).

Participants were reassured, objectives of the procedure explained, signed consent obtained and a questionnaire to determine participants age, sex, years in the job, exclusion and inclusion criteria obtained. Questionnaire was developed by the authors and it was interviewers – administered.

Blood pressure measurement procedure was done according to the American heart association guidelines. At the completion of measurement, readings of systolic, diastolic and pulse rate were displayed on the digital panel of the sphygmomanometer and the values were recorded appropriately.

The objective of the study was to examine the effect of saw dust on the blood pressure parameters of wood workers in Abakaliki metropolis.

2.1 Data Analysis

Data were presented as Mean ±SEM, analyzed using a 2-way ANOVA, and a multiple comparison test using Tukey's Post Hoc Test. Level of significance was set at 95%. All statistical analyses were carried out using Graph Pad prism 7software.

3. RESULTS

Table 1 shows the total number of participants (500), gender, ethnicity, age groups, marital status and education of participants. It also shows the population of the participants (wood workers and non-wood workers). Participants with any underlying pathology, pregnant ones and smokers were excluded from the study. Furthermore, Table 1 shows job experience in years, systolic, diastolic, mean arterial pressure and pulse rate of the wood worker.

Fig. 1. Shows significant increase in the diastolic blood pressure of timber sawyers (P=0.042), timber loaders (P=0.022) and timber sellers (P=0.034) when compared with the control.

A significant increase in the systolic blood pressure of timber sawyers (P=0.034), timber loaders (P=0.024) and timber sellers (P=0.044) were observed when compared with the control.

A significant increase in the mean arterial pressure of timber sawyers (P=0.023), timber loaders (P=0.043) and timber sellers (P=0.021) were recorded when compared with the control.

Fig. 2. Shows significant increase in the pulse rate of timber sawyers (P= 0.031), timber loaders (P=0.043) and timber sellers (P=0.024) when compared with the control.

Table 2 shows the Mean±SEM for wood workers. The result showed a significant increase in the diastolic, systolic and mean arterial pressure of timber sawyers when compared with other different groups of wood workers.

Table 1. Demographic characteristics of study participants

Variables	Number	% Distribution
Gender		
Male	420	84
Female	80	16
Ethnicity		
Igbo	500	100
Age group (Years)		
20–30	302	60.4
31–40	156	31.2
41– 50	42	8.4
Marital status		
Married	232	46.4
Single	268	53.6
Population		
Wood workers (WW)	250	50
Non-wood workers (Non-WW)	250	50
Education		
Primary	193	38.6
Secondary	228	45.6
Tertiary	79	15.8
Job experience (Years)		
3–13	249	49.8
14– 24	154	30.8
25– 35	97	19.4
Systolic (WW)		
130 – 135	166	33.2
136 – 140	334	66.8
Diastolic (WW)		
90– 95	187	37.4
96– 100	313	62.6
Mean arterial pressure (WW)		
100 – 106	194	38.8
107 – 113	306	61.2
Pulse rate (WW)		
86– 91	190	38
92– 100	310	62
Total number of participants	500	100

4. DISCUSSION

A significant increase in the diastolic, systolic, mean arterial pressure and pulse rate of wood workers was observed when compared with the control, an indication that wood workers may be prone to hypertension, cardiomegaly, stroke, heart attack and tachycardia. The result agrees with the findings of Ezeja and Umahi-Ottah [1] who looked into the relationship between quarry dust and blood pressures among quarry workers and discovered that quarry workers had elevated systolic, diastolic, mean arterial pressure and pulse rate than non-quarry workers. The finding also agrees with the study done by Delfino, Sioutas and Malik [10] who investigated the relationship between particulate matter (PM) and blood pressure in Boston residents and revealed that an increase from 10 to 90 μg/m^3 of particulate matters (PM2.5) showed an increase

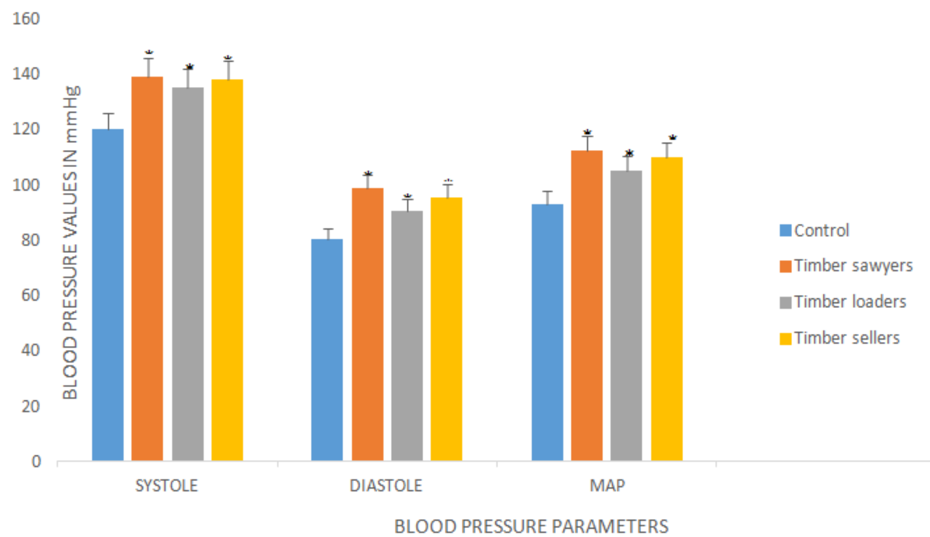

Fig. 1. Comparison of blood pressure status between wood workers and control [1]
** = Level of significance*

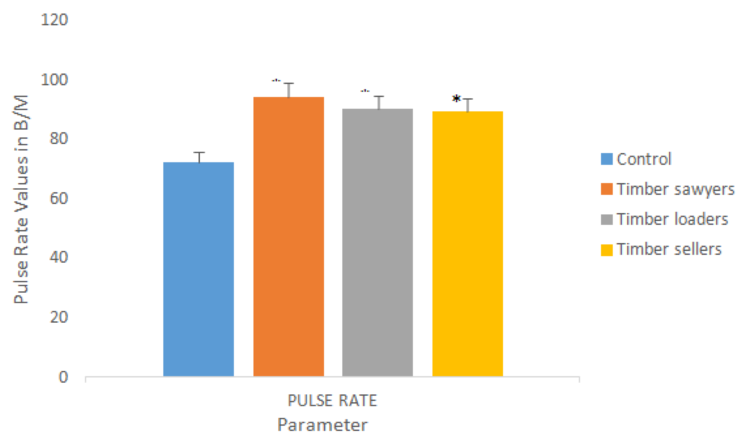

Fig. 2. Comparison of pulse rate between wood workers and control [1]
** = Level of significance*

in resting systolic (2.8mmHg) and resting diastolic (2.7mmHg) of the participants. Furthermore, the result agrees with the study done by Pope et al. [11] who reported a significant rise in the diastolic blood pressure (6mmHg) among the participants after two hours of exposure to particulate matter 2.5. Again, the result is in line with the findings of Na Li et al. [14] who recorded a rise in the mean arterial blood pressure of rural Chinese adults following long-term exposure to PM_1. More so, the result agrees with the study done by Pope and Dockery [12] who revealed a significant rise in the heart rate of the participants by 5 to 10 beat per minute when they were exposed to PM_{10} (10 $\mu g/m^3$).

Comparing the blood pressure parameters among the different groups of wood workers, the finding showed a significant rise in the diastolic, systolic and mean arterial pressure of timber sawyers when compared with other groups of wood workers. This shows that timber sawyers may be more predisposed to hypertension than other wood workers because of their greater exposure to saw dust.

Table 2. Comparison of blood pressure parameters among groups of wood workers

	Systolic	Diastolic	Pulse rate	MAP
Wood workers	**Mean±SEM**	**Mean±SEM**	**Mean±SEM**	**Mean±SEM**
Timber sawyers	138±3.21	97.8±1.92	93±1.33	111.2±2.1
Timber loaders	136±6.6	92.3±1.8	91±2.6	104.2±2.32
P-value	0.044*	0.033*	0.087	0.031*
Timber sawyers	138±3.31	97.8±1.93	93±1.33	112.2±2.1
Timber sellers	135±3.34	94.4±2.8	88±1.7	110.6±1.4
P-value	0.023*	0.021*	0.6409	0.042*
Timber loaders	136±6.8	91.3±1.8	92±2.6	106.2±2.32
Timber sellers	139±3.34	96.4±2.8	91±1.7	108.6±1.4
P-value	0.8600	0.7421	0.7640	0.7121

5. CONCLUSION

Wood workers have increased systolic, diastolic, mean arterial pressure and pulse rate than non-wood workers, an indication that they may have compromised cardiovascular functions. Furthermore, the rise in systolic, diastolic and MAP seen among timber sawyers when compared with other different groups of wood workers shows that greater exposure to saw dust may cause more damage to the cardiovascular system. Wood workers need to be encouraged to accept cardiovascular health safety procedures and also, be educated on the risks associated with saw dusts inhalation.

6. RECOMMENDATIONS

Eight hours of exposure to saw dust per day must not be exceeded.

Every working wood machines must have dust extraction to capture and remove dust before it spreads.

Every timber industry must have dampers fitted in to prevent spread of dusts.

Public health workers must educate wood workers on the risks of exposure to saw dusts through health out reach.

Every wood worker must wear a suitable face mask while on duty to prevent saw dust inhalation and subsequent absorption into the circulation.

7. LIMITATION

Limited sample size because of lack of willingness by the wood workers to participate in the study.

CONSENT

Consents forms were signed by all the participants willingly.

ETHICAL APPROVAL

Ethical approval was obtained from the Ebonyi State University Ethical Committee and the Ministry of Health Ethical Committee with reference number: EBSU/TETfund/IBR/2015/26.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Ezeja GU, Umahi-Ottah G. Occupational exposure to quarry dust and blood pressure status of quarry workers in Nigeria population. AJRCD. 2020;2(2):1-8.
2. International union of pure and applied chemistry.www.iupac.org.vol. 1990;62(11):2167-2219.
3. Ottah-umahi G, Ezeja GU, Okorocha AE, Anwara C, Agwu UM, Onwudiwe CU, Nwodo DO, Ugwu O, Okike PO. Effects of quarry dust on the electrocardiogram of quarry workers in Abakaliki metropolis. J Cardiovasc Dis Diagn. 2020;(8):390.
4. Pedro A, Sanhueza, Monica A, Torreblanca, Luis A, Diaz-Robles L, Peretz

A, Kaufman JD, Trenga CA, Chan CC, Su TC. Effects diesel exhaust inhalation on heart rates variability in human volunteers. J Environ Res 2008;107:178-84.

5. Brook RD, Franklin B, Luis A, James S, Lucky G, Cascio W. Cardiovascular effects of air pollution. Clini Scien. 2008;115(175):187.
6. Peters A, Liu E, Verrier RL, Decramer F, Rabe B, Timbrell F. Air pollution and incidence of cardiac arrhythmia. J Epidemiol. 2000;11(11):7.
7. Guyton AC, Hall, John E. Text book of medical physiology (11th ed.) philadephia: W.B. Saunders. 2005;116-22.
8. Alpert BS, Quinn D, Gallick D. Oscillometric blood pressure: a review for clinicians. J. Am. Soc. Hypertens. 2014; 8(12):930-8.
9. Zheng L, Sun Z, Li J. Pulse pressure and mean arterial pressure in relation to ischemic stroke among patients with uncontrolled hypertension in rural areas of China. Stroke. 2008:39(7):1932-7.
10. Delfino RJ, Sioutas C, Malik S. Potential Role of Ultrafine Particles in Associations between Airborne Particle Mass and Cardiovascular Health. Environ. Health Perspect. 2005;113(934):946.
11. Pope CA, Burnett RT, Thurston GD, Thun MJ, Calle EE, Krewski D, Godleski JJ. Cardiovascular Mortality and Long-Term Exposure to Particulate Air Pollution. Epidemiological Evidence of General Pathophysiological Pathways of Disease. Circulation 2004;(109):71-77.
12. Pope CA, Dockery DW. Health effects of fine particulate air pollution: lines that connect. J Air Waste Manage. 2006;(56): 709-42.
13. Cohen J. Statistical power analysis for the behavioral sciences. New Jersey, Lawrence Erlbaum Associates. Second Edition. 1998;60-102.
14. Na L, Gongbo C, Feifei L, Shuyuan M, Yisi L, Yitan H, Yuanan L, Suyang L, Chongjian W, Hao X, Yuming G, Shanshan L. Association of long-term exposure to ambient PM1 with hypertension and blood pressure in rural Chinese population: The Henan rural cohort study. Environ. Int. 2006;128:95–102.

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