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Research Article

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Effects of wood dust exposure on liver enzymes of carpenters in relation to their lifestyle and job duration

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Keywords

Hepatotoxicity,
lifestyle,
carpenters,
wood dust,
exposure.

Abstract

The effects of occupational exposure to wood dust on plasma levels of AST, ALT, ALP of some carpenters in Port-Harcourt, Nigeria, were investigated. A total of 180 subjects were involved in this study, of which 90 were carpenters (Test) and another 90 were non-carpenters or non-wood worker (Control). The carpenters were gathered at a place , the purposed of the study was made known to them, and consent sort for. Those who gave their consent were included in the study. A control group of healthy male subjects (between the ages of 18 and 60 years) working or residing within the study area (Marine Base), but not exposed to wood dusts, were also used for this study. Structured questionnaire on demographic and lifestyle was administered to both the carpenters and control group and Blood samples were collected for liver enzyme activity estimation. The results showed a significant increase ($p<0.05$) in the plasma levels of AST, ALT, ALP of Carpenters who were regular alcohol drinkers had a significantly higher ($p<0.05$) mean plasma levels of AST, ALT and ALP when compared with that of occasional drinkers and non-drinkers. Carpenters who were smokers had significantly higher ($p<0.05$) mean plasma levels of AST, ALT and ALP when compared with that of ex-smokers and non-smokers. These findings are suggestive that occupational exposure to wood dust and unfavourable lifestyle changes may predispose carpenters and other wood workers to hepatotoxicity. Therefore proper awareness about the health hazard due to wood dust exposure, and lifestyle modification is emphasized.

1.0 Introduction

For many years, wood dust has been considered harmful by inducing irritation to the eyes, nose or throat and one of the oldest and most common occupational exposures in the world [1]. Other studies have shown that wood dust causes more health problems [2]. Wood dusts refer to wood particles formed as a result of processing or handling of woods; it is therefore a by-product of wood processing.

Besides certain chemicals naturally present in woods, several other chemicals are added to woods as preservatives, binders or glues. These chemicals include arsenic, chromium, copper, creosote, pentachlorophenol, urea - formaldehyde resins and phenol-formaldehyde and certain microbes such as fungi and moulds. When the wood is processed, these chemicals and microbes are released into the air, and inhaled, cause health [3,4].

Wood dusts are said to be minute particles resulting from activities such as milling, drilling, and crushing of woods. The sizes of wood dust particles vary depending on the activity from which they are generated [5]. During the healing process of this inflammation, fibrosis ensues, leading to impaired oxygen supply and lung functions [6].

Dust particles when deposited on the skin or in the lungs, have the ability to cause harm locally or elsewhere in the body (Sarah *et al.*, 2016).

According to [7], exposure to wood dust extract resulted in reduction of kidney function, impairment of the biliary system, reduced blood supply to the tissues. [8], stated that occupational exposure of carpenters to wood dust resulted in an increase in the concentrations of serum ALP and total protein, and a decrease in serum albumin concentration.

Increased plasma concentration of these heavy metals (present in wood dust) resulting from inhalation or ingestion, may lead to toxicity and as such affect the kidney, liver and other organs of the body [9].

Life style is an important factor in determining the severity of exposures to xenobiotics and there exits paucity of data on the effect of wood dust on liver enzymes in relation to their life style and occupational duration. And were studies existed there are conflicting reports. This study aims at determining the effects exposure of wood dust on the liver enzymes of carpenters in Port Harcourt city, with objectives of accessing the: plasma levels of the liver enzymes (AST, ALT and ALP) of carpenters and non-carpenters, if duration of occupation and life style has impact on the liver parameters of carpenters.

2.0 Materials and Methods

2.1 Subject characteristics and Design

A carpenter is someone who works with wood on daily basis, and may also be referred to as a wood worker. A smoker is someone who has smoked more than one hundred cigarettes in his/her lifetime and currently smokes. An ex-smoker is someone who has smoked at least one hundred cigarettes in his/her lifetime and has stopped smoking for over six months. A non-smoker is someone who has never smoked cigarettes in his/her lifetime, and does not currently smoke or who has never smoked. A regular alcohol drinker is someone who consumes alcoholic drinks at least 3 to 4 days weekly. An occasional alcohol drinker is someone who consumes alcoholic drinks once in a long while. A non-alcohol drinker is someone who abstains from consuming alcoholic drinks in their lifetime (CDC, 2017). The subjects were males between 18 and 60 years of age who work or leave within the Marine based carpentry workshop.
A total of 180 male subjects (aged between 18 and 60 years) participated in the study, out of which 90 subjects (test subjects) were carpenters at the Marine Base Carpentry Workshop, while 90 subjects (control subjects) were non-carpenters (or non-wood workers). All the carpenters in the workshop gathered at a place through the influence of the Chairman of the Carpenters' Association, where they were spoken to, and blood samples collected from those who gave their consent. A well-structured questionnaire was used to gather information on duration of work, the use or non-use of Personal Protective Equipment (PPE), and lifestyles. It was however, discovered that none of the carpenters made use of PPE.

A control group of healthy male subjects (between the ages of 18 and 60 years) working or residing within the study area (Marine Base), but not exposed to wood dusts, were used for this study. These subjects do not smoke or drink alcohol. They were also addressed, and samples collected from those who gave their consent.

2.2 Inclusion Criteria

All test subjects were confirmed carpenters with at least 4 years of occupational exposure to wood dust. Also, both test and control subjects are confirmed healthy.

2.3 Exclusion Criteria

Subjects who are exposed to burning woods daily in their surroundings, or who use firewood as a source of heat energy for cooking, were excluded from both the control and test group. Subjects with history of diabetes mellitus, kidney disease, hypertension, heart disease, or any other disorder, were excluded from both groups. Finally, subjects who smoke or drink alcohol are also excluded from the control group.

2.4 Blood Sample Collection and analysis

Four millilitre venous blood samples was collected from each subject using sterile hypodermic syringes and needles, into lithium heparin bottles, mixed and spun using a centrifuge; the plasma was then obtained

and transferred into plain bottles. Liver enzyme AST, ALT and ALP activity levels were determined using standard laboratory assay methods.

2.5 Statistical Analysis

The generated data were expressed as Mean ± Standard deviation, and analysed using Graph Prism Pad version 6.2. Comparisons of mean and standard deviation values were made for the various parameters for test and control subjects using the student's t-test and the analysis of variance (ANOVA). Schematic presentations of the data were expressed as aligned dot plots. Results were considered statistically significant at 95% confidence interval ($p<0.05$).

3.0 Results

3.1 Comparison of the AST, ALT and ALP levels of carpenters and control subjects

Details of the comparison of the AST, ALT and ALP levels of carpenters and control subjects are shown in Table1 below. It shows that the mean AST, ALT and ALP of the carpenters was significantly higher ($p<0.05$) than that of the controls.

Table 1 Results of AST, ALT, and ALP of carpenters and control subjects compared

	AST (U/L)	ALT (U/L)	ALP (U/L)
CARPENTERS(N=90)	18.54 ± 7.27	9.7 ± 4.19	34.41 ± 11.13
CONTROLS(N=90)	9.03 ± 2.10	4.91 ± 1.33	18.97 ± 5.04
p-value	<0.001	<0.001	< 0.001
Remark	SS	SS	SS

3.2 Effect Of Alcohol Status On The Liver Enzymes Of Carpenters Exposed To Wood Dust

The AST, ALT and ALP levels of different alcohol status: None, occasional and regular are shown in detail in Figure1-3 below using aligned dot plot. The figure revealed there were significant differences ($p<0.05$) in the mean values of the AST, ALT and ALP levels amongst non-alcohol drinkers, occasional alcohol drinkers and regular alcohol drinkers. The regular alcohol drinkers having significantly higher level than the non-alcohol drinkers and occasional alcohol drinkers.

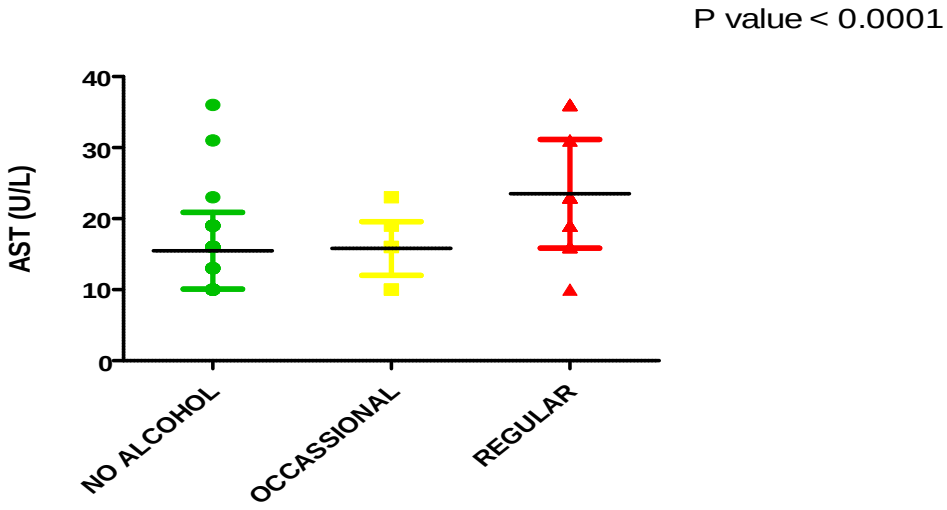

Fig 1 Plasma AST levels in Non-, Occasional and Regular Alcohol drinkers

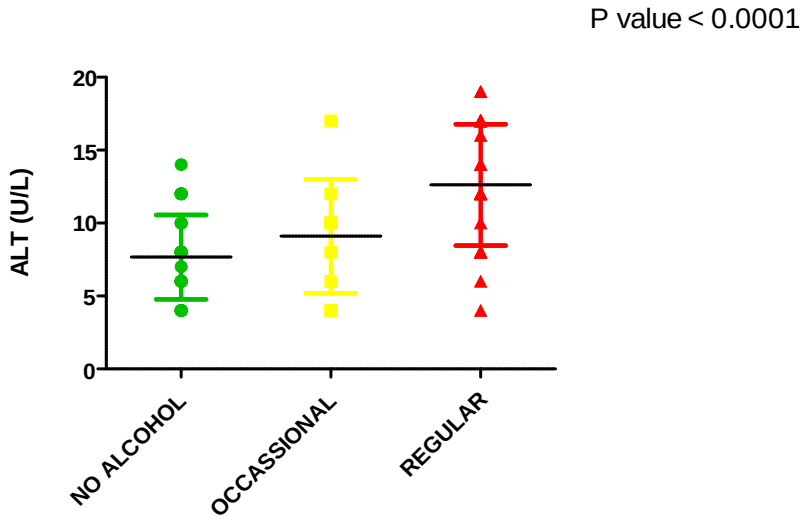

Figure 2 Plasma ALT levels in Non-, Occasional and Regular Alcohol drinkers

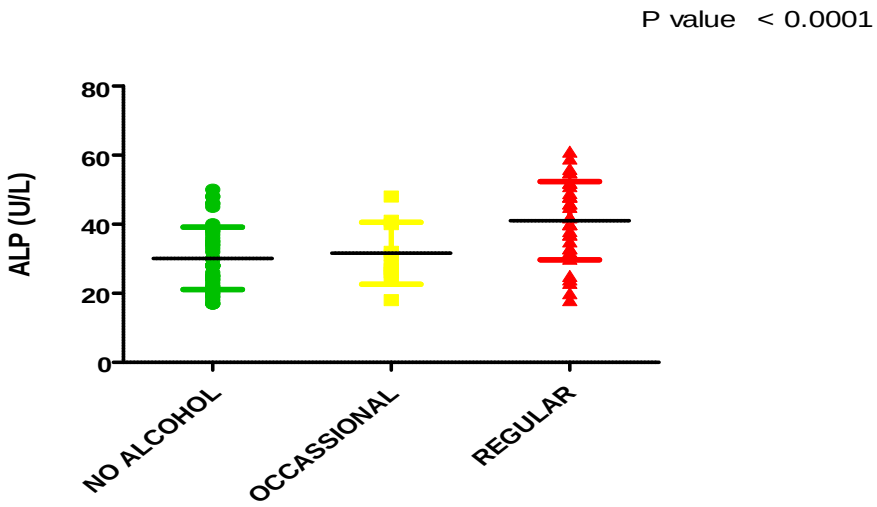

Figure 3 Plasma ALP levels in Non-, Occasional and Regular Alcohol drinkers

3.3 Effect Of Smoking Status On The Liver Enzymes Of Carpenters Exposed To Wood Dust

The AST, ALT and ALP levels of different smoking status: ex-smokers, non-smokers and smokers are shown in detail in Figure 1-6 below using aligned dot plot. The figures depicted that there were significant differences ($p<0.05$) in the mean values of the AST levels between ex-smokers, non-smokers and smokers. The smokers have the highest amongst the categories.

P value 0.0001

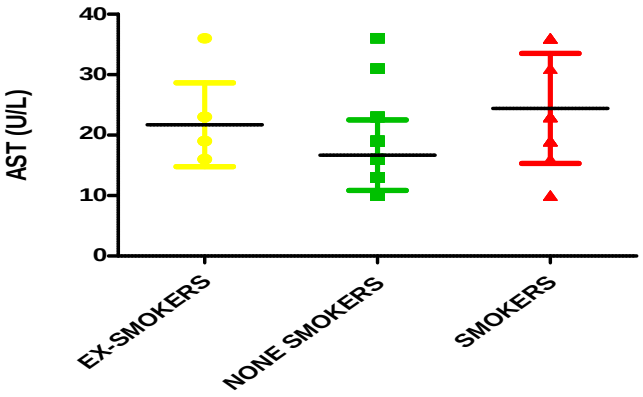

Figure 4 AST levels in Ex-smokers, Non-smokers and Smokers

P value 0.0055

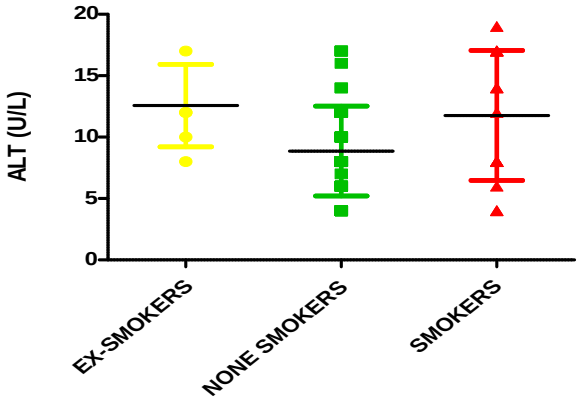

Figure 5 ALT levels in Ex-smokers, Non-smokers and Smokers

P value < 0.0001

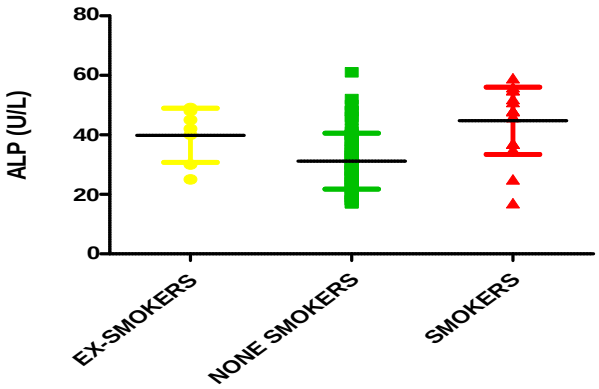

Figure 6 ALP levels in Ex-smokers, Non-smokers and Smokers

3.4 Effect Of Occupational Duration On The Liver Enzymes Of Carpenters Exposed To Wood Dust

The AST, ALT and ALP levels of different durations of occupational exposure: 0-10, 11-20, 21-30 years are shown in detail in Figure 7-9 below using aligned dot plot. The figures also revealed there were no significant differences ($p>0.05$) in the mean values of the AST, AST and ALP levels between those exposed between 0-10, 11-20 and 21-30 years.

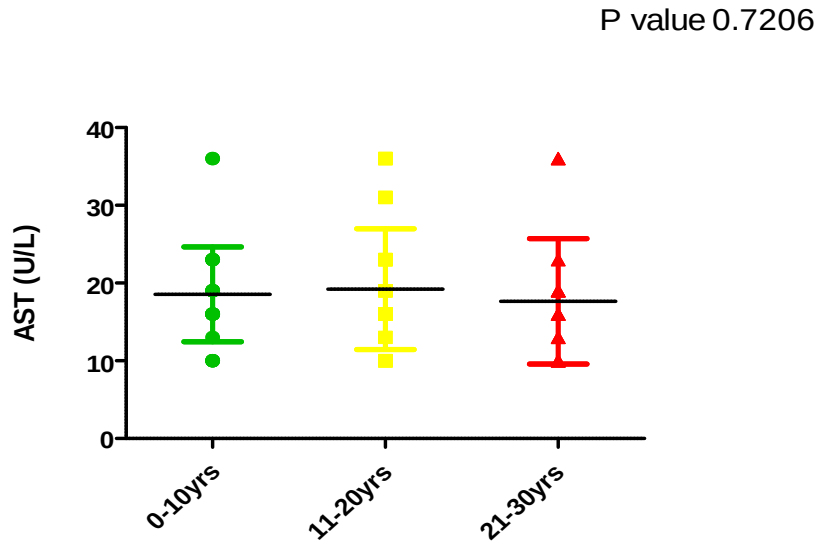

Figure 7 AST levels in subjects between 0-10, 11-20 and 21-30 years of occupational exposure

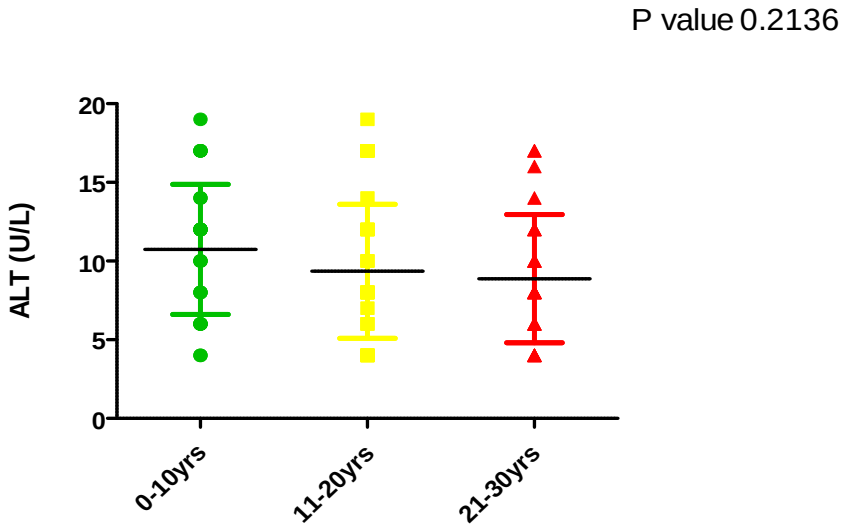

Figure 8 ALT levels in subjects between 0-10, 11-20 and 21-30 years of occupational exposure

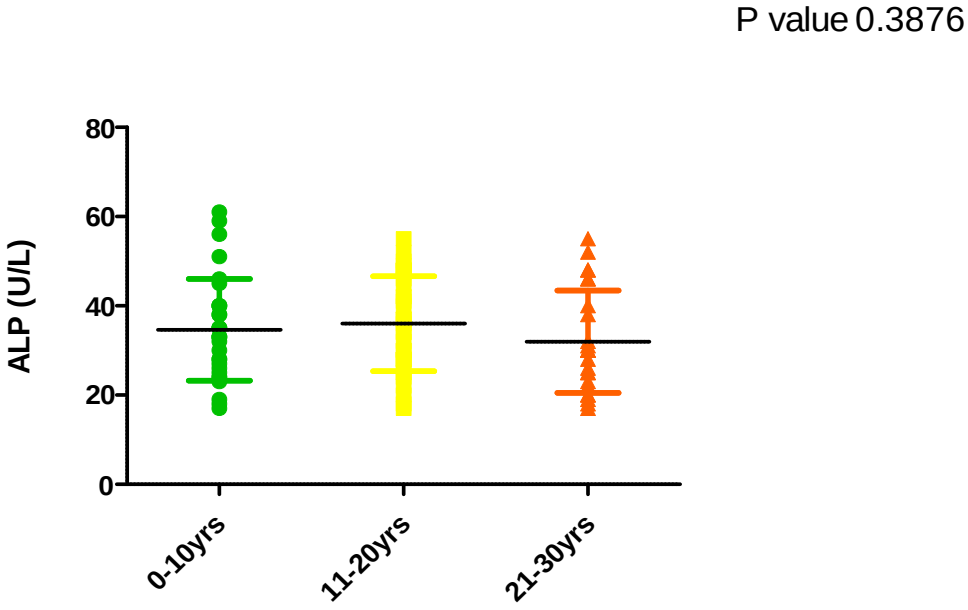

Figure 9 ALP levels in subjects between 0-10, 11-20 and 21-30 years of occupational exposure

4.0 Discussion

The mean plasma AST, ALT and ALP levels for regular alcohol drinkers that were exposed to wood dust over a period has been brought to focus. There was significantly higher AST, ALT and ALP levels amongst the regular alcohol drinkers when compared with that of non-drinkers and occasional drinkers. Although it has been reported in previous studies by [10.11], that alcohol consumption induced elevation of AST, but the degree of elevation may have been influenced by the exposure to the chemical agents used in wood preservation and finishing. About ninety percent of the absorbed alcohol gets transported to the liver to be metabolized while the chemicals absorbed through the skin or inhaled are detoxified. There could be interaction between the alcohol and chemicals that may induce alcoholic hepatitis, alcoholic fatty liver, and alcoholic cirrhosis, causing AST to be released into the blood stream [12].

The mean plasma AST, ALT and ALP levels for regular smokers was significantly higher when compared with that of non-smokers and ex-smokers. This report is in consonance with earlier position of [13,14,14], stated that smokers had slightly higher AST, ALT and ALP levels than non-smokers. However, the exposure to wood dust and chemicals used for preservation and finishing may have enhanced the elevation of these liver enzymes. On the contrary, [15,16] reported that smoking has no effect on AST because it does not damage hepatocytes.

There was no significant difference in the mean plasma AST, ALT and ALP levels among Carpenters with 0-10, 11-20, and 21-30 years of occupational exposure. The reason for this could be adduced from the fact that the age bracket was too large such that effect of duration would have been masked.

5.0 Conclusion

Occupational exposure of the carpenters to wood dusts may induce hepatotoxicity, as shown by an increase in plasma AST and ALT and ALP levels. Carpenters who were smokers and takes alcohol regularly had increased AST, ALT and ALP levels. Therefore, smoking and drinking lifestyles may further predispose these carpenters to liver damage. It is therefore imperative that lifestyle modification and regular use of personal protective equipments be encouraged amongst carpenters.

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