International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2016): 79.57 | Impact Factor (2017): 7.296

Correlation between Some Heavy Metals and Hepatic Enzymes of Carpenters Residing in Port-Harcourt, Nigeria

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Abstract: ***This study examined the correlation between some heavy metals (chromium, nickel, arsenic) and hepatic Aspartate transaminase, Alanine transaminase and Alkaline phosphatase (AST, ALT, ALP) in carpenters residing in Port-Harcourt. A total of 90 carpenters were used for the study. Blood samples were collected and analysed for chromium, nickel, arsenic, AST, ALT and ALP, using standard laboratory procedures. There were statistically significant positive correlations between chromium and the hepatic enzymes (AST, ALT and ALP). A statistically significant positive correlation also was observed between nickel and ALP. However, non-significant positive correlations were observed between arsenic and the hepatic enzymes (AST, ALT and ALP). There appears to be an association between the chromium, nickel and the hepatic enzyme levels of the carpenters in this study.***

Keywords: Heavy metals, hepatic, enzymes, carpenters

1. Introduction

Carpenters are individuals who work with wood routinely. They are mostly males specialised in making cabinets, building houses or furniture using woods. Carpentry is one of the oldest skilful occupations; the skill can be achieved through apprenticeship. Wood, which is the major material in carpentry, is obtained from trees, and these trees may either produce softwoods or hardwoods [1].

Several chemicals are added to woods as preservatives or binders; some of which are heavy metals such as chromium and arsenic, and other chemicals such as copper, creosote, pentachlorophenol, urea-formaldehyde resins and phenol-formaldehyde. During processing of the woods, these heavy metals together with the wood dusts are released into the air and inhaled, which overtime may accumulate and cause some health challenges [2].

In a study conducted in Sapele, wood dust contained elevated levels of some heavy metals such as lead, cadmium, chromium, barium, arsenic and mercury [3]. Exposure to chromium, arsenic and nickel occur during processing of wood [4], and these heavy metals may accumulate and overtime and damage the liver.

In humans, the liver is the largest internally-placed and most complicated organ which plays vital roles in secretion and excretion of bile, synthesis of biological compounds, metabolism, storage of nutrients, and detoxification and drug metabolism. Two main cell types occur in the liver, which are the hepatocytes and kupffer cells. The hepatocyes contain enzymes which are often used to assess the state of a patient`s liver, and to provide information that determines the primary disorder of a patient; whether it is hepatic or extrahepatic in origin [5]. An increase in the plasma levels of AST and ALT is an indication of hepatocellular necrosis, while that of ALP is suggestive of cholestasis.

In individuals exposed to arsenic, the higher the arsenic concentration, the higher the plasma levels of AST, ALT and ALP [6]. Treatment of male albino rats with potassium dichromate induced an increase in plasma AST and ALT levels [7,8], investigated the effect of nickel-induced toxicity in an experimental fish, and discovered that there was a dose-response relationship between nickel and the hepatic enzymes AST, ALT and ALP.

2. Materials and Methods

2.1 Study Design

Ninety apparently healthy subjects within the ages of 18 to 60 were involved in the study. These subjects were spoken to, and those who gave their consent, partook in the study.

2.2 Inclusion and Exclusion Criteria

All subjects were apparently healthy carpenters with at least four years of occupational exposure, while subjects exposed to burning woods daily were excluded.

2.3 Blood Sample Collection and Analysis

Ten millilitres (10 ml) of venous blood was collected from each subject and was dispensed into lithium heparin bottles, mixed and spun using a centrifuge; the plasma was obtained and transferred into plain bottles. AST, ALT, ALP were analysed using commercial test kit, while the Solar Thermo-Elemental Atomic Absorption Spectrophotometer (AAS) model SE-71906 was used to determine the Aspartate transaminase, Alanine transaminase and Alkaline phosphatase (AST, ALT, ALP) in the plasma.

2.4 Statistical Analysis

The data generated were expressed analysed using correlation tool of Graph Pad Prism version 6.1. Results were considered statistically significant at 95% confidence interval ($p<0.05$).

3. Results

The correlation and regression plots between Chromium and AST, ALT, and ALP are shown in Figures 1-3. The figure revealed there was a significant positive correlation ($p<0.05$) between chromium and AST , ALT and ALP respectively. The figures 4, 5,and 6 revealed there was a non-significant positive correlation ($p>0.05$) between Nickel and AST, ALT respectively. However there was significant positive correlation ($p<0.05$) between Nickel and ALP as depicted in Figure 6. The correlation between Arsenic and AST , ALT and ALP are Figure 7, 8 and 9. The figures revealed that there were no significant positive correlation ($p>0.05$) between Arsenic and AST, ALT and ALP respectively.

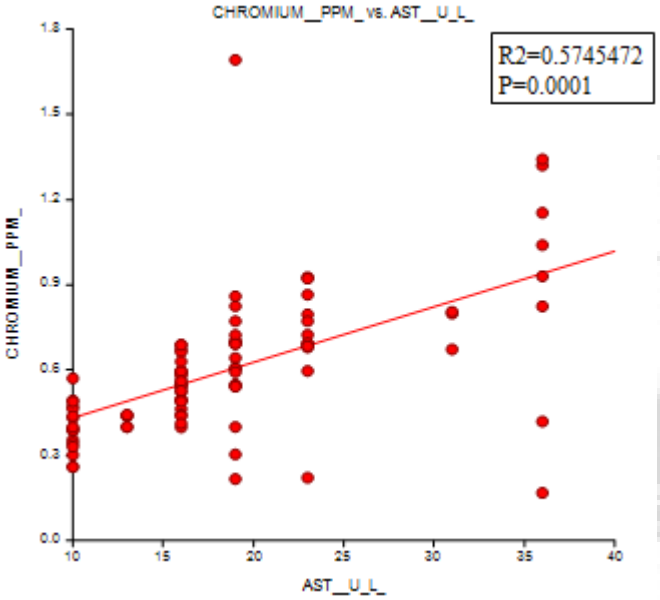

Figure 1: Correlation and regression plots between Chromium and AST

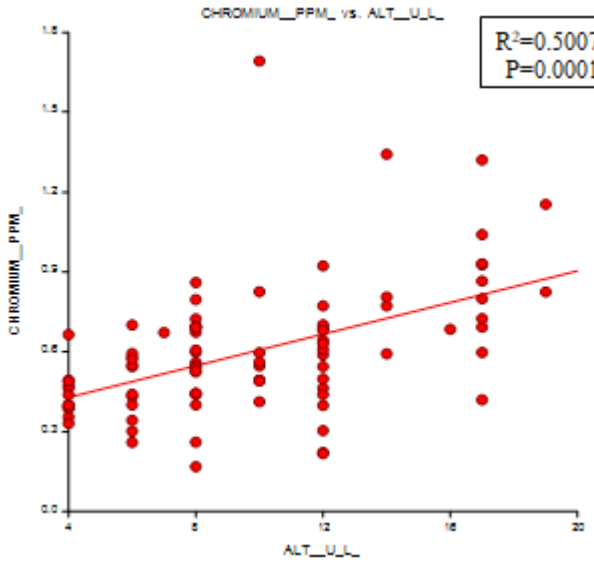

Figure 2: Correlation and regression plots between Chromium and ALT

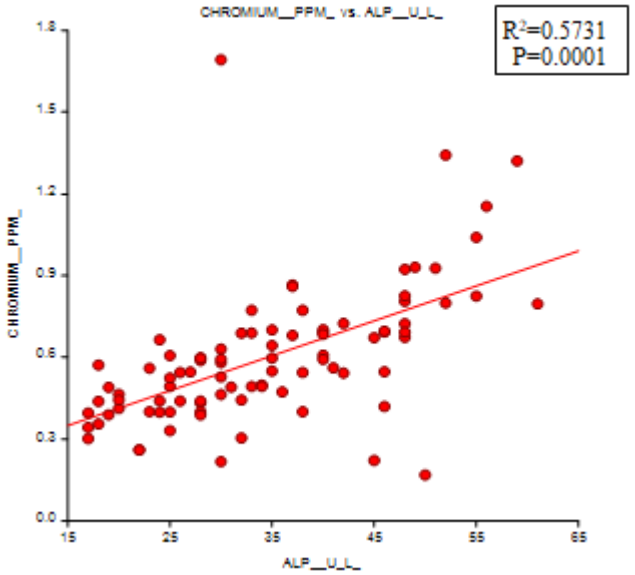

Figure 3: Correlation and regression plots between Chromium and ALP

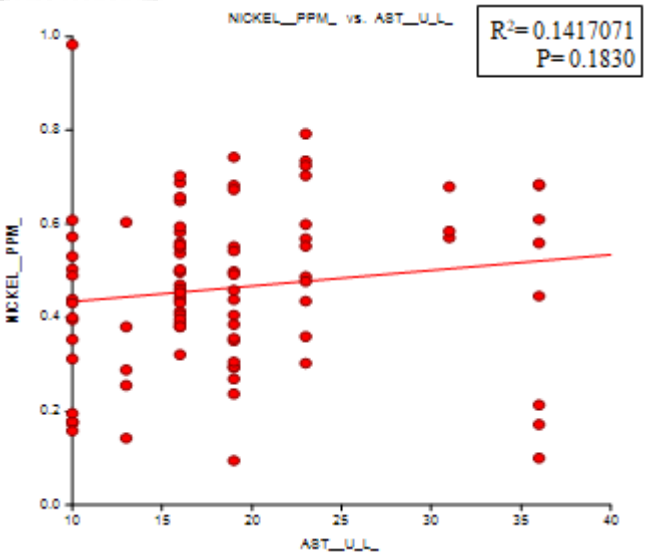

Figure 4: Correlation and regression plots between Nickel and AST

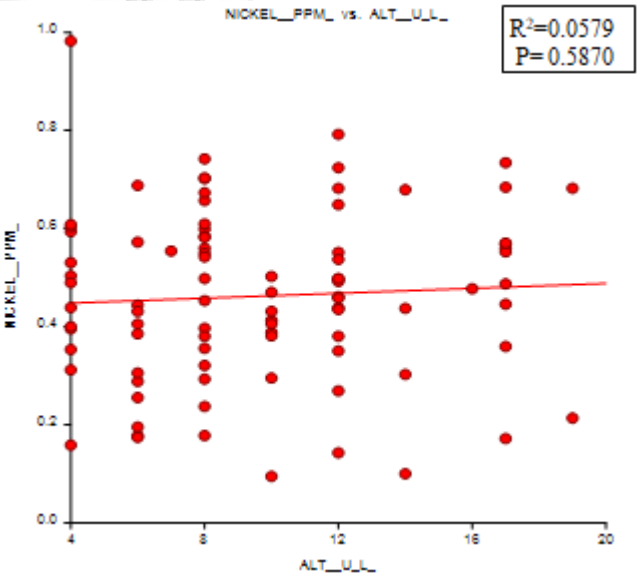

Figure 5: Correlation and regression plots between Nickel and ALT

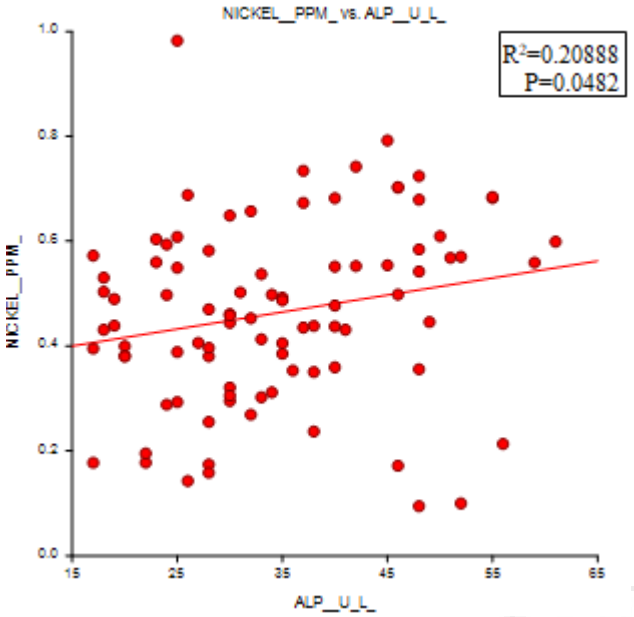

Figure 6: Correlation and regression plots between Nickel and ALP

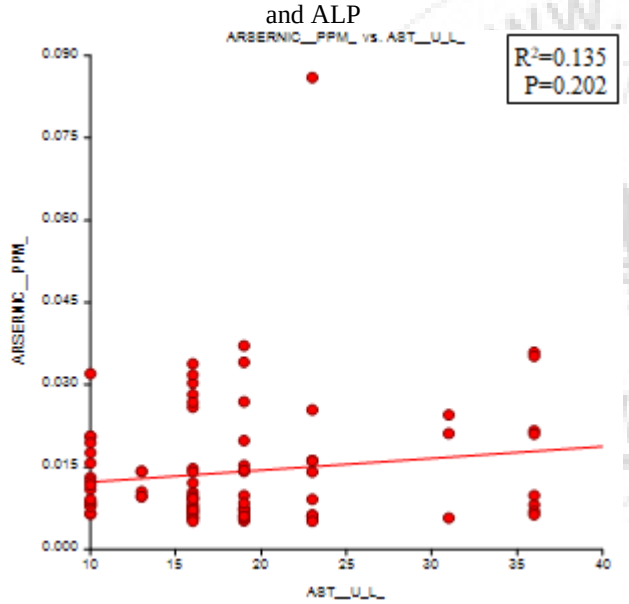

Figure 7: Correlation and regression plots between Arsenic and AST

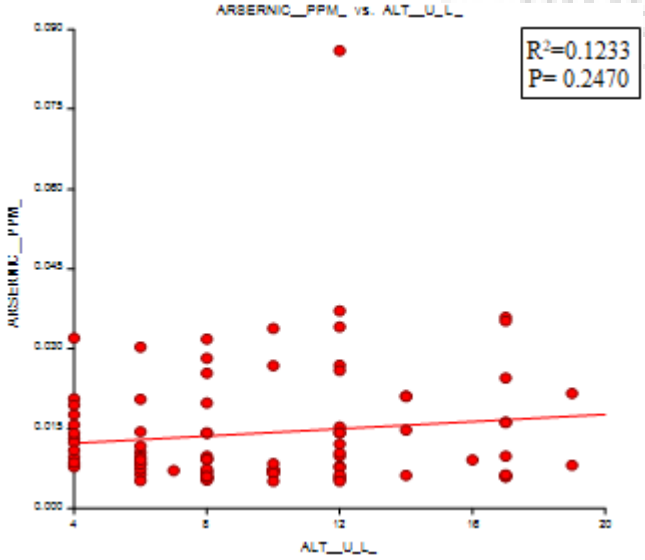

Figure 8: Correlation and regression plots between Arsenic and ALT

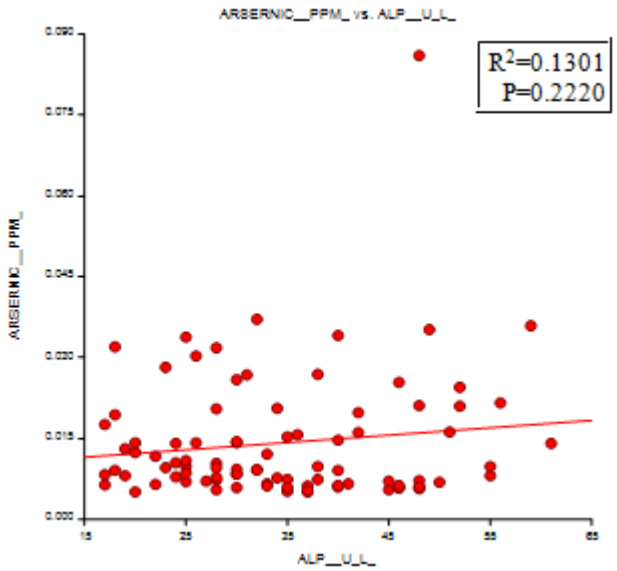

Figure 9: Correlation and regression plots between Arsenic and ALP

4. Discussion

This work studied the correlation between the heavy metals (Chromium, Nickel and Arsenic) and the hepatic enzymes (AST, ALT and ALP) of carpenters residing in Port-Harcourt, Nigeria.

A statistically significant positive correlation was recorded between chromium and each of the hepatic enzymes (AST, ALT and ALP), such that, the higher the chromium levels, the higher the levels of these enzymes in plasma. Thus, the level of these enzymes in the plasma depends on the level of the heavy metals. A similar report was given by [9] in a study that significant positive correlations existed between chromium levels and ALT, and chromium levels and ALP in the plasma of chrome plating workers, but posited that there was no significant correlation between chromium levels and AST. The report from this study also disagrees with that of [10], which stated that there were no significant changes in AST and ALT in an experimental fish exposed to chromium. Furthermore, in agreement is a report from a study by [8], that there was an increase in the plasma levels of AST and ALT in albino rats after treatment with potassium dichromate.

A statistically significant positive correlation also occurred between Nickel and ALP, such that the higher the nickel levels, the higher the ALP levels, but the correlations between Nickel and AST, and nickel and ALT were non-significant. This report disagrees with that of a study by [11] which stated that statistically significant positive correlations occurred between the enzymes (AST and ALT) and urine nickel levels; the level of nickel in urine is a reflection of the nickel level in blood.

There were statistically non-significant positive correlations between Arsenic and AST, arsenic and ALT, and arsenic and ALP. This report disagrees with that of a study by [7] that reported a significant positive correlation between arsenic and the hepatic enzymes (AST, ALT and ALP).

5. Conclusion

A statistically significant positive correlation existed between chromium and the hepatic enzymes (AST, ALT and ALP), as well as between nickel and ALP in the plasma of the carpenters. Therefore, the plasma levels of these enzymes are to a higher extent, dependent on the plasma levels of chromium and nickel in the carpenters. On this note, higher plasma levels of chromium may induce hepatocellular necrosis and cholestasis, while higher plasma levels of nickel may induce cholestasis in the carpenters.

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