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ASSESSMENT OF KIDNEY FUNCTION IN CARPENTERS EXPOSED TO WOOD DUST IN PORT-HARCOURT

Ibama Onengiyeofori[1]*, Brown Holy[2] and Briggs Ojoye Ngoye[3]

[1,2,3]Department of Medical Laboratory Science, Rivers State University, Nkpolu-Oroworukwo Port Harcourt, Nigeria.

***Corresponding Author: Ibama Onengiyeofori**

Department of Medical Laboratory Science, Rivers State University, Nkpolu-Oroworukwo Port Harcourt, Nigeria.

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ABSTRACT

Wood dust exposure is the oldest and commonest occupational exposures, which is considered harmful by inducing several health challenges such as irritation to the skin, eyes, nose or throat, respiratory defects and others. This study examined the kidney function in carpenters exposed to wood dust in Port-Harcourt. A total of 180 apparently healthy male subjects were used for the study, out of which 90 subjects were carpenters (tests), while the other 90 subjects were non-carpenters (controls). Relevant information was collected using a structured questionnaire, and blood samples collected and analysed for creatinine and urea, and the eGFR calculated. Creatinine was analysed using Jaffe`s Method, while the Urea was analysed using Diacetyl-Monoxime Method (DAM). The eGFR was calculated using the Cockcroft-Gault equation. The results showed significantly higher ($p<0.05$) serum levels of creatinine and urea in the test as compared to controls, and a significantly lower ($p<0.05$) eGFR in the test compared to the control subjects. These results suggest that occupational exposure to wood dust may predispose carpenters and other wood workers to nephrotoxicity, and thus the health hazards induced by wood dust exposure, as well as the safety measures should be made known through proper awareness.

KEYWORDS: Estimated glomerular filtration rate (eGFR), Wood dust, Kidney function, Carpenters, Nigeria.

1.0 INTRODUCTION

Wood dust exposure happens to be one of the world`s most-aged and commonest occupational exposures, causing several health challenges such as conjunctivitis, rhinitis, dermatitis, respiratory defects, and cancer of nasal and paranasal sinuses (Vallieres*et al.*, 2015).

Wood dust is produced when wood is being handled or processed, and chronic exposure to wood dust is common with carpenters, sawmill workers and workers in the furniture making industry (Deshpande & Afshan, 2014). Wood processing activities produce different sizes of wood dust particles; these activities include crushing, milling and drilling processes. Chemicals such as arsenic, creosote, pentachlorophenol, copper and chromium are added to wood as preservatives, while urea-formaldehyde and phenol-formaldehyde resins are added to wood as binders or glues. During wood processing, these chemicals together with the wood dust are released into the work environment and inhaled, and may induce several health challenges (North Carolina Department of Labor, 2012).

Wood dust extracts exposed to albino rats induced an increase in haemoglobin and haematocrit levels, as well as serum creatinine, urea, total cholesterol and low density lipoprotein levels. There were reductions in levels of the liver enzymes, aspartate aminotransferase (AST), alanine aminotransferase (ALT), and alkaline phosphatise (ALP). Albumin and triglyceride levels were lowered, and there was also a decrease in platelet number in the rats (Ashade & Igbokwe, 2014). Exposure of carpenters to wood dust is associated with increased plasma ALP and total protein levels (Sarah *et al.* 2016).

Some of the chemicals added to wood as preservative are heavy metals, these heavy metals together with the wood dust after being inhaled or ingested, are usually eliminated via the kidneys, and may exert deleterious effects on the kidneys. This study is aimed at determining the effects of exposure to wood dust on the kidney function of carpenters in Port-Harcourt, Nigeria, by assessing the plasma levels of creatinine and urea in carpenters, and also calculating their estimated glomerular filtration rate (eGFR).

2.0 MATERIALS AND METHODS

A total of One hundred and eighty (180) apparently healthy male subjects within the ages of 18 to 60 were used for the study. 90 subjects were carpenters (Tests) with a minimum of 4 years occupational exposure, who worked at different locations in Port Harcourt (Marine Base, Mile 3 and Iloabuchi Carpentry Workshops). The other 90 subjects (Controls) were non-carpenters (or non-wood workers) working or residing within the study areas but not exposed to wood dusts. Ethical approval for

the study was gotten from local authorities and informed consent obtained from the subjects. Smokers, alcoholics, persons exposed to burning wood or who use firewood as a source of heat energy for cooking were excluded from the study.

Proper venepuncture technique was employed in the sample collection of 5ml whole blood. Serum obtained was used in the analysis of the various parameters. Creatinine was analysed using Jaffe`s Method, as modified by Randox laboratories (United Kingdom) while Urea was analysed using Diacetyl-Monoxime Method (DAM). The eGFR was calculated using the Cockcroft-Gault equation.

Data generated were analysed using SPSS version 22. Comparisons of mean and standard deviation values for the parameters for test and control subjects were made using the independent student`s t-test. Results were considered statistically significant at 95% confidence interval ($p<0.05$).

3.0 RESULTS

Table 1: Mean Age and Weight of Carpenters and Controls compared.

	Mean Age	Mean Weight
CARPENTERS (N=90)	37.80 ± 9.71	71.80 ± 13.9
CONTROLS (N=90)	25.97 ± 4.79	66.4 ± 14.6

Table 2 Results of eGFR, Creatinine and Urea of carpenters and control subjects.

	eGFR(ml/min)	CREATININE (µmol/l)	UREA (mmol/l)
CARPENTERS (N=90)	79.65 ± 19.75	103.6 ± 22.46	3.85 ± 0.59
CONTROLS (N=90)	95.22 ± 10.99	95.2 ± 12.65	3.13± 0.55
P-VALUE	<0.001	0.0023	<0.001
REMARK	S	S	S

S - Significant

Details of the comparison of the eGFR, creatinine and urea levels of carpenters and control subjects are shown in Table 2 above. It shows that the mean eGFR of the carpenters was significantly lower ($p<0.05$) than that of the controls, while the mean serum creatinine and urea levels of the carpenters were significantly higher ($p<0.05$) than that of the controls.

4.0 DISCUSSION

The results from this study show that the mean eGFR of carpenters was significantly lower than that of the control subjects. This suggests that wood dust exposure may have induced a decrease in the eGFR, probably by inducing an inflammation at the glomerulus, which may have resulted in a diminished capillary lumen. It may also suggest renovascular resistance. The decrease in eGFR may be due to the action of heavy metals (mixed with the wood dust) on the kidney, which is the primary target organ of heavy metal toxicity (Barbier *et al.*, 2005). Heavy metals are filtered by the glomerulus into the proximal tubule (as part of the ultrafiltrate), where they are primarily reabsorbed. They may also be reabsorbed in the loop of Henle, distal tubules and collecting ducts (Barbier *et al.,* 2005). In cases of increased intoxication, most heavy metals may depress the glomerular filtration rate (Diamond & Zalups, 1998). Therefore, these effects may be due to a combined effect of the wood dust and heavy metals contained in it.

The mean serum creatinine level for carpenters, were significantly higher than that of the control subjects. The mean serum urea level for carpenters was also found to be significantly higher than that of the control subjects. Similar report of elevated plasma creatinine and urea levels was made by Ashade & Igbokwe (2014), by exposing albino rats to composite wood-shavings. This elevated serum levels of creatinine and urea may be attributed to the decreased eGFR. A decreased rate of blood filtration (reduced eGFR), leads to a decreased excretion of creatinine and urea in urine, and thus their elevated plasma levels (Bishop *et al.*,2010).

5.0 CONCLUSION

Occupational exposure of carpenters to wood dusts may induce nephrotoxicity, specifically at the glomeruli, as shown by the elevated levels of serum creatinine and urea, and a decrease in the eGFR. These effects may partially be attributed to the non-use of personal protective equipment (PPE) by the carpenters. Therefore, use of appropriate PPE such as dust masks, hand gloves, and regular renal health checks in these artisans are highly recommended.

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