

Assessment of Alterations of Serum Heavy Metals Levels and Some Hepatic and Renal Markers in Automobile Artisans in Port Harcourt

Tamuno-Opubo, A.^{1*}, Ibiyengibo¹, Amah-Tariah F.S.¹¹Department of Human Physiology, Faculty of Basic Medical Sciences, College of Medicine, Rivers State University, PMB 5080, Port Harcourt. Rivers State, Nigeria

*Corresponding author: Tamuno-Opubo, A.

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Abstract: The prevalence rates of hepatic and renal conditions have become global burden as they are significantly influenced by changing lifestyles/occupational engagements, etc. Thus, the present study investigated the alterations of some hepatic/renal markers and serum heavy metals levels in automobile artisans in Port Harcourt. The study adopted the purposive/snowball sample size selection methods in recruiting participants. A total of 100 volunteers were surveyed for the study, comprising 60 automobile repair artisans and 40 non-automobile artisans. Data from the study were subjected to statistical analyses using the appropriate tools of the IBM Statistical Product and Service Solutions (SPSS) version 25.0. The auto spray painters, blacksmiths and electricians had significantly ($p < 0.05$) raised levels of chromium level when compared to those of the controls (non-auto artisans), auto mechanics, welders and panel beaters. The levels of lead (Pb) in all other sub-groups of the auto-artisans, aside from the auto-mechanics, were significantly raised ($p < 0.05$) when compared to the mean value of the control subjects. The Cd level in the blacksmith were significantly higher when compared to all other groups including that of the control group. For the creatinine levels, all the sub-groups of the auto-artisans had significant ($p < 0.05$) increases in their levels when compared to that of the non-automobile artisans (control) and the inverse of the foregoing occurred in the eGFR, only that that of the mechanics were excluded. The present study found a significantly raised alkaline phosphatase (ALP) level in the blacksmiths when compared to that of all other groups. The aspartate transaminase (AST) and alanine transaminase (ALT) levels in all artisans had significantly raised levels when compared to the respective mean values of the control group. In conclusion, the tendency for the development of CKD and liver-conditions amongst the auto-artisans may be sufficiently connected with occupational/environmental factors.

Keywords: lifestyles/occupational health impacts; hepatic/renal markers; serum heavy metals levels; automobile artisans in Port Harcourt.

INTRODUCTION

Over 800 million people worldwide suffer from chronic kidney disease (CKD), which has an age-standardized prevalence of about 10% (Jager *et al.*, 2019; Kovesdy, 2022). The burden of chronic kidney disease (CKD) is disproportionately high in low- and middle-income nations, especially in sub-Saharan Africa and Asia, where rates can exceed 13% (Jager *et al.*, 2019; Kovesdy, 2022). In Nigeria, a report has it that, CKD and its risk factors are prevalent among middle-aged urban populations (Olanrewaju *et al.*, 2020).

In the same vein, considering liver conditions, it has become a major and rising cause of death (Younossi *et al.*, 2023). Liver conditions caused by cirrhosis, liver cancer, alcohol-associated liver disease

(ALD), and non-alcoholic fatty liver disease (NAFLD) are on the increase as well; while 1.26 million people died from chronic liver disorders (Sepanlou *et al.*, 2020; Gan *et al.*, 2025).

Although the prevalence of hepatic and renal conditions vary by region, factors such as changing lifestyles, middle-aged/aging populations, and rising alcohol consumption are contributing to an increasing global burden (Olanrewaju *et al.*, 2020; Sepanlou *et al.*, 2020; Gan *et al.*, 2025).

Further, jobs that expose workers to heat, chemicals, physical strain, and long or irregular hours have been related to raise the risk of kidney problems (Afolabi *et al.*, 2021; Adei *et al.*, 2022; Saldaña *et al.*, 2023; Tamuno-Opubo *et al.*, 2024). Succinctly,

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excessive physical activity, dehydration, exposure to industrial pollutants, improper toilet access that results in infrequent voiding and long work hours are known risk factors for renal and hepatic conditions associated with these occupations (Nerbass *et al.*, 2017; Ho *et al.*, 2022). Automobile repair artisans, by the nature of their jobs and workplace, fall into the aforementioned categories (Adu-Gyamfi, 2025).

Thus, considering the foregoing, the current study investigated the alterations of some hepatic/renal markers and serum heavy metals levels in automobile artisans in Port Harcourt.

MATERIALS AND METHODS

Study Design

To assess the association between occupational exposure and renal / liver functional efficacy of auto-artisans in Port-Harcourt Metropolis, the study adopted a cross-sectional approach. This approach was necessary for the proper evaluation of the nature and extent of workplace risks faced by automobile workers; as it specifically improved the simultaneous collation of data on different renal/hepatic health indicators and occupational exposures.

Study Area

Port-Harcourt Metropolis and Port Harcourt is the capital of Rivers State, Southern Nigeria was the focus of the study. The study area is a major commercial hub of Nigeria. It is as well home to wide collections of multinationals who engage in several industrial explorations. Having a comparatively huge population, the city is known for the presence of vast automobile use. This, of course, is capable of seriously affecting both residents and other categories of workers (Tamuno-Opubo *et al.*, 2024). Also, the study area is characterized with heavy vehicular traffic presence with its resultant air pollution (Nkwocha *et al.*, 2017; Ucheje *et al.*, 2022). It, thus, justifies the perspective of the present study, probing the health impact of occupational exposure in automobile repair workers.

Study Population

Automobile repair workers who are self-employed or employees in various workshops spread across Port-Harcourt Metropolis were recruited for the study. The study population was chosen following its great exposure to hazardous substances from vehicular emissions, solvents, amongst others, used by the artisans.

SAMPLE SIZE CALCULATION

Sample Size and Power Calculation

The required sample size was estimated to detect a statistically significant correlation between pulmonary function indices and cardiovascular risk markers among automobile repair workers.

Based on findings from a previous study, which reported correlation coefficients ranging from $r = 0.30$ to

$r = 0.77$ between key variables such as Atherogenic Index of Plasma (AIP), triglycerides, LDL, VLDL, and pulmonary function markers like peak expiratory flow rate (PEFR) (e.g., $r = -0.322$ between PEFR and 1-HOP; $r = 0.774$ between AIP and triglycerides) (Olujim *et al.*, 2020), an effect size of $r = 0.30$ was considered to detect the minimum meaningful correlation.

Using a two-tailed test with $\alpha = 0.05$ and 80% power ($1 - \beta = 0.80$), the required sample size was calculated using the correlation coefficient (r) as the effect size. The formula is based on the Fisher Z-transformation.

$$\text{The standard formula is; } n = \left(\frac{Z_{\alpha/2} + Z_{\beta}}{0.5 \times \ln \frac{1+r}{1-r}} \right)^2 + 3$$

Where:

n = required sample size

- r is the expected correlation coefficient (effect size = 0.3) • α is significance level (commonly 0.05)
- β is type II error rate (commonly 0.20, i.e., power = 0.80)
- $Z_{\alpha/2}$ is the Z-score for 2-tailed test (1.96 for $\alpha = 0.05$)
- Z_{β} is the Z-score for desired power (0.84 for 80% power)
- $\ln$ = natural logarithm
- Therefore, the Fisher's Z transformation of the correlation coefficient:
- $Z_r = 0.5 \times \ln \left(\frac{1 + 0.30}{1 - 0.30} \right) = 0.5 \times \ln \left(\frac{1.30}{0.70} \right) = 0.5 \times \ln (1.857) = 0.5 \times 0.619 = 0.3095$

This gives:

$$n = [21.96 + 0.84 / 0.3095]^2 + 3 = (9.05)^2 + 3 = 81.91 + 3 = 85$$

- To account for a potential 10% dropout or incomplete data rate, the sample size was adjusted using this formula:
- $n_{adjusted} = n / (1 - \text{attrition rate}) = 85 / (1 - 0.10) = 85 / 0.90 = 95$
- Therefore, the minimum sample size was estimated as 95 participants to detect a correlation of $r = 0.30$ with 80% power, 5% significance level, and a 10% dropout rate.

REFERENCE

Olujimi, O. O., Akinbami, F. O., Olavemi, E. T., Omidiji, O., & Olayiwola, A. O. (2020). Lung function and cardiovascular risk among automobile repair workers in Lagos Metropolis, Nigeria. *Toxicology Reports*, 7, 1160–1166. <https://doi.org/10.1016/j.toxrep.2020.09.009>

Eligibility Criteria

The study eligibility includes apparently healthy male and female workers within 18 to ≤ 50 years; who have been actively engaged in the industry for at least two years. The non-autoartisan subjects were

recruited using convenience sampling from non-exposed population in same study location with similar demographic characteristics in order to reduce confounding factors.

Methods of Data Collection

Standardized measurement instruments and a structured questionnaire were used to gather data. The survey evaluated health status, exposure to hazardous substances, work history, and demographic data. Data was gathered through the survey administration method and trained research assistants were recruited to personally deliver well designed questionnaires to participants in order to guarantee accurate completion and address any questions from the participants. Upon approvals and consent issuance by the study participants, blood samples were obtained from the antecubital vessel by phlebotomists, using standard procedures.

Methods of Data Analysis

The data obtained from the study were subjected to statistical analysis using version 25.0 of the IBM Statistical Product and Service Solutions (SPSS) programme. Statistical significance was done using one-way analysis of variance (ANOVA) followed by post-Hoc LSD multiple comparison test. And P-value less than 0.05 were considered statistically significant. All data were presented as mean $\pm$ standard deviation (SD).

Ethical Consideration/Informed Consent

Ethical approval was obtained from the Ethics Committee of the Department of Human Physiology, Faculty of Basic Medical Sciences, Rivers State University, Nigeria and from other relevant agencies. Signed consent was equally obtained from the study each participant prior to enrolment into the study.

RESULTS

Table 1: Age Range Variations between auto-artisans and non-auto artisans in Port Harcourt

Age Range (Yrs.)	Non- Auto- Artisans	Auto- Artisans
18-27	15(30%)	7(14%)
30-40	20(40%)	35(70%)
41-52	8(16%)	5(10%)
>53	7(14%)	3(6%)
Total	50(100%)	50(100%)

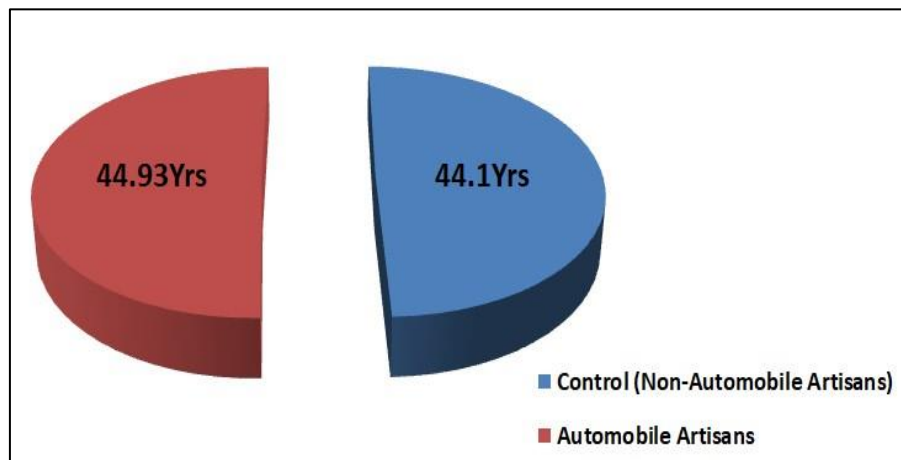


Figure 1: Mean Age Distribution of Study Participants (Yrs)

Note: Values are expressed as Mean $\pm$ Standard Deviation (SD); n =40(Non-Automobile Artisans) & 60 (Automobile Artisans).

The data on Figure 1 shows the mean age distribution of the study participants.

The mean age of non-automobile artisans is 44.1yrs whereas that of the automobile artisans was 44.93yrs. The latter is marginally ($P>0.05$) higher than that of the former.

In Table 1, the frequency of age range distribution was presented and that of 30 to 40yrs followed by that of 18 to 27yrs made most of the participants [20(40%) and 35(70%) and then 15(30%) and 7 (14%)].

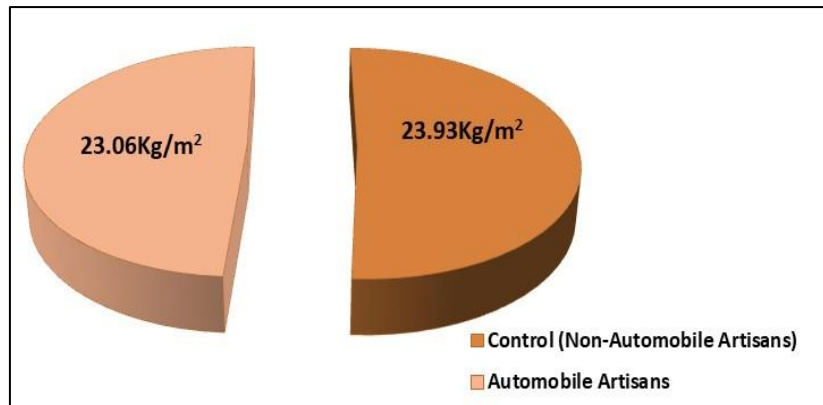


Figure 2: Mean Body Mass Index (BMI) of Study participants

Note: Values are expressed as Mean $\pm$ Standard Deviation (SD); n =40(Non-Automobile Artisans) & 60 (Automobile Artisans).

Figure 2 shows mean body mass index (BMI) of study participants. There was a non-significant ($p>0.05$) increase in the BMI of the non-automobile

artisans (23.93kg/m²) when compared to that of the automobile artisans (23.06kg/m²).

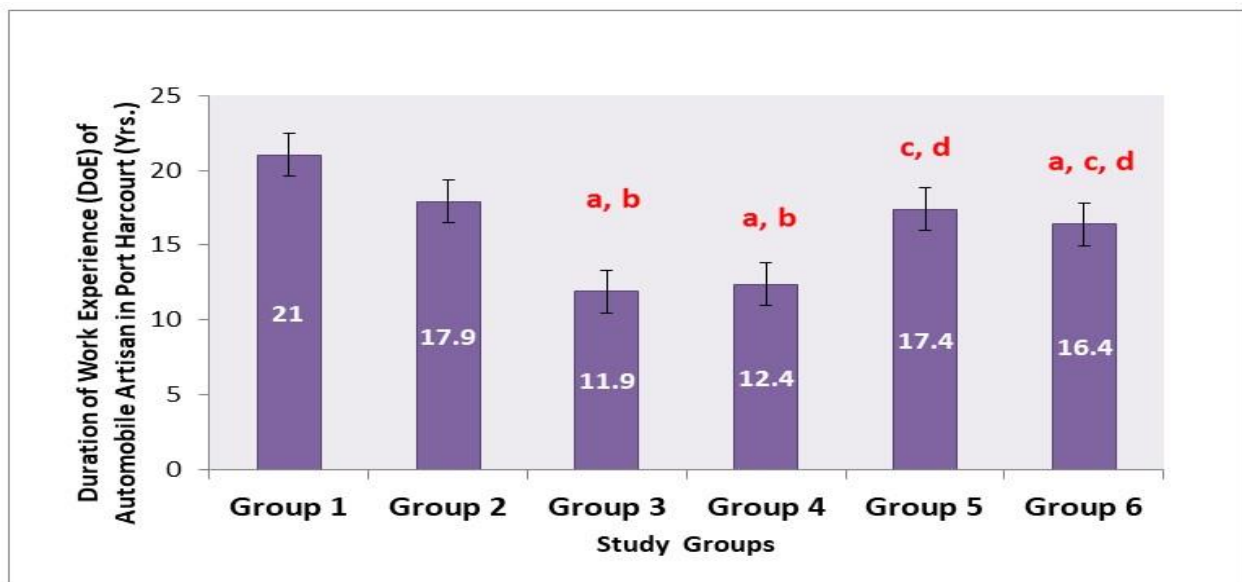


Figure 3: Distribution of Duration of Work Experience (DoE) of Automobile Artisan in Port Harcourt.

Note: Values are expressed as Mean $\pm$ Standard Deviation (SD); ^a Significant at $p<0.05$ when compared to the mean value of Automobile Mechanics; ^b Significant at $p<0.05$ when compared to the mean value of automobile welders; ^c Significant at $p<0.05$ when compared to the mean value of Automobile Panel Beaters; ^d Significant at $p<0.05$ when compared to the mean value of Automobile spray painters; ^e Significant at $p<0.05$ when compared to the mean value of automobile

Key:

Group 1:	Automobile Mechanics
Group 2:	Automobile Welders
Group 3:	Automobile Panel Beaters
Group 4:	Automobile Spray Painters
Group 5:	Automobile Blacksmiths
Group 6:	Automobile Electricians

The data on Figure 3 shows the distribution of the duration of work experience (DoE) of Automobile Artisans in Port Harcourt.

The panel beaters and spray painters followed by the electricians had the least duration of work experience when compared to those of others.

Table 2: Changes in Serum Heavy Metals Levels amongst different categories of Automobile Artisans in Port Harcourt

Study Groups	Chromium (Cr) (mg/L)	Lead (Pb) (mg/L)	Cadmium (Cad) (mg/L)
Non-Automobile Artisans (Control)	0.07 ± 0.01	0.07 ± 0.02	0.01 ± 0.00
Automobile Mechanics	-2.43 ± 3.54	0.87 ± 6.52	0.49 ± 0.71
Automobile Welders	-1.73 ± 5.45	5.57 ± 1.75 ^a	0.41 ± 0.38
Automobile Panel Beaters	-2.11 ± 2.91	6.33 ± 1.10 ^a	2.51 ± 1.16 ^a , a, b
Automobile Spray Painters	4.76 ± 2.51 ^a , a, b, c	3.88 ± 1.63 ^a	0.62 ± 0.29 ^c
Automobile Blacksmiths	4.79 ± 2.31 ^a , a, b, c	15.39 ± 2.08 ^a , a, b, c, d	0.10 ± 0.29 ^{c, d}
Automobile Electricians	3.16 ± 4.95 ^a , a, b, c	4.62 ± 2.27 ^a , a, e	0.42 ± 0.33 ^c

Values are expressed as Mean ± Standard Deviation (SD); Significant at $p < 0.05$ when compared to the mean ^a Significant at $p < 0.05$ when compared to the mean value of Automobile Mechanics; ^b Significant value of control ; at $p < 0.05$ when compared to the mean value of automobile welders; ^c Significant at $p < 0.05$ when compared to the mean value of Automobile Panel Beaters; ^d Significant at $p < 0.05$ when compared to the mean value of Automobile spray painters; ^e Significant at $p < 0.05$ when compared to the mean value of automobile

The data on Table 2 shows the changes in serum heavy metals levels amongst different categories of Automobile Artisans in Port Harcourt.

Considering the changes in serum chromium (Cr) level, the auto spray painters, blacksmiths and electricians had significantly ($p < 0.05$) raised levels of the heavy metal when compared to those of the controls (non-auto artisans), auto mechanics, welders and panel beaters. In fact the Cr levels in the mechanics, welders and panel beaters were less than zero limits and below that of the control even though, the difference was not significant ($P > 0.05$). And notably, the blacksmiths had the highest level of this metal.

The level of lead (Pb) was found to be lowest in the control group which was followed by that of the auto-mechanics. Notably, in all other sub-groups of the auto-artisans, Pb levels were observed to be significantly ($p < 0.05$) raised (far above the zero limits) when compared to those of control and the auto-mechanics. Notably, the Pb level in the blacksmith was seen to be profoundly and significantly ($p < 0.05$) elevated when compared to all other of their contemporaries.

Concerning the variations in serum cadmium (Cd) levels, the auto-panel beaters had the most elevated level of the metal and the mean value was significant ($p < 0.05$) when compared to those of control and all other sub-groups of the auto-artisans.

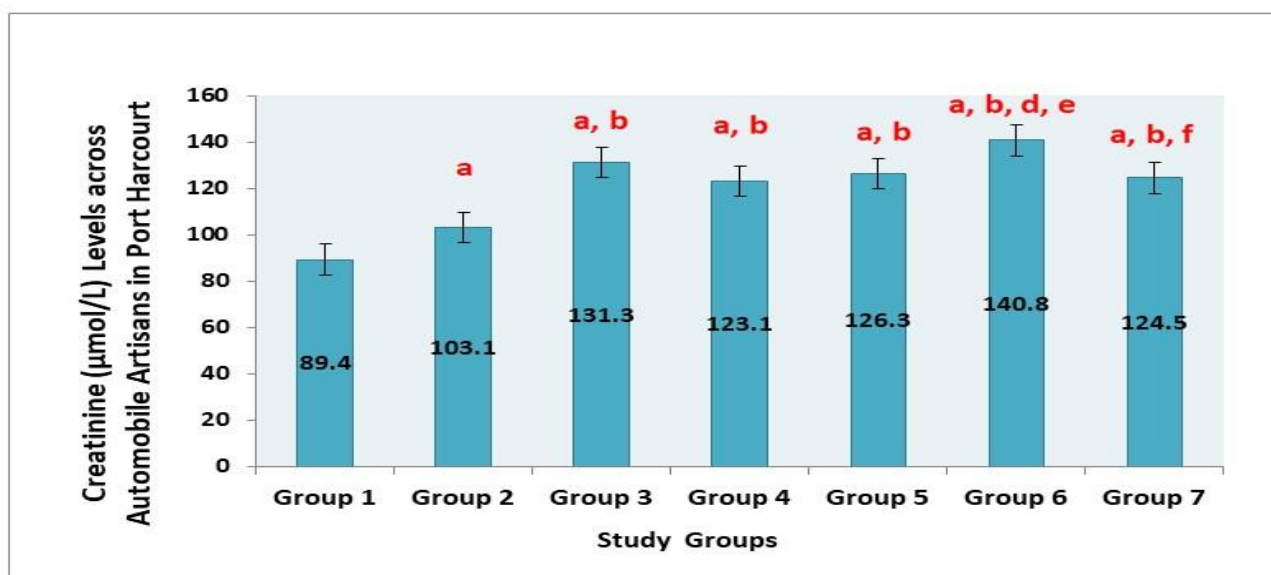


Figure 4: Changes in Creatinine (µmol/L) Levels across Automobile Artisans in Port Harcourt

Note: Values are expressed as Mean ± Standard Deviation (SD); ^a Significant at $p < 0.05$ when compared to the mean value of control group; ^b Significant at $p < 0.05$ when compared to the mean value of Automobile Mechanics; ^c Significant at $p < 0.05$ when compared to the mean value of automobile welders; ^d Significant at $p < 0.05$ when compared to the mean value of Automobile Panel Beaters; ^e Significant at $p < 0.05$ when compared to the mean value of Automobile spray painters; ^f Significant at $p < 0.05$ when compared to the mean value of automobile Electricians.

Key:

Group 1:	Control (Non-Automobile Artisans)
Group 2:	Automobile Mechanics
Group 3:	Automobile Welders
Group 4:	Automobile Panel Beaters
Group 5:	Automobile Spray Painters
Group 6:	Automobile Blacksmiths
Group 7:	Automobile Electricians

Figure 4 shows the changes in creatinine (Cr) levels across Automobile Artisans in Port Harcourt. The mean creatinine level of all the sub-groups of the auto-artisans were found to be significantly ($p < 0.05$) elevated when compared to that of the control group (i.e. non-automobile artisans). Similarly, the level of Cr in the

mechanics was significantly ($p < 0.05$) low when compared to all other auto—artisans' sub-groups. The Cr concentration in the auto-blacksmiths was observed to be significantly ($p < 0.05$) higher than those of all other auto-artisans' groups.

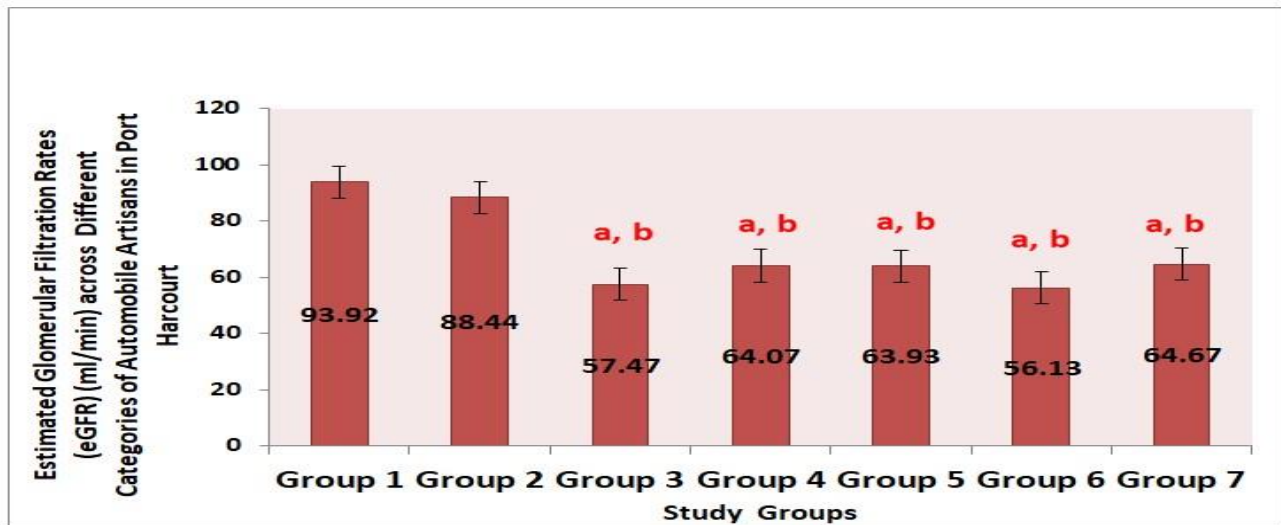


Figure 5: Changes in Estimated Glomerular Filtration Rates (eGFR) (ml/min) across Different Categories of Automobile Artisans in Port Harcourt

Note: Values are expressed as Mean $\pm$ Standard Deviation (SD). ^a Significant at $p < 0.05$ when compared to the mean value of control group; ^b Significant at $p < 0.05$ when compared to the mean value of Automobile Mechanics; ^c Significant at $p < 0.05$ when compared to the mean value of automobile welders; ^d Significant at $p < 0.05$ when compared to the mean value of Automobile Panel Beaters; ^e Significant at $p < 0.05$ when compared to the mean value of Automobile spray painters; ^f Significant at $p < 0.05$ when compared to the mean value of automobile Electricians.

Key:

Group 1:	Control (Non-Automobile Artisans)
Group 2:	Automobile Mechanics
Group 3:	Automobile Welders
Group 4:	Automobile Panel Beaters
Group 5:	Automobile Spray Painters
Group 6:	Automobile Blacksmiths
Group 7:	Automobile Electricians

Note that the Cockcroft and Gault formula was used to calculate the eGFR of the subjects using their creatinine levels (Cockcroft & Gault, 1976).

$$\text{eGFR (mL/min)} = [(140 - \text{age}) \times \text{Wt} / (0.814 \times \text{S.Cr in } \mu\text{mol/L})] \times (0.85 \text{ if female})$$

Where Wt= weight, S.Cr= serum creatinine;

The data on Figure 5 displays the changes in the Estimated Glomerular Filtration Rates (eGFR) (ml/min) across the different categories of Automobile Artisans in Port Harcourt.

The eGFR levels in the automobile welders, panel beaters, spray painters, blacksmiths and

electricians were all found to be significantly ($p < 0.05$) reduced when compared to those of the control group and the mechanics. Expectedly, with reference to the corresponding Cr level, the eGFR level of the blacksmiths was the least amongst the rest of the auto-artisans.

Table 3: Changes in Serum Hepatic Enzymes Levels amongst different Categories of Automobile Artisans in Port Harcourt

Study Groups	Alkaline Phosphatase (ALP) (U/L)	Aspartate Transaminase (AST) (U/L)	Alanine Transaminase (ALT) (U/L)
Non-Automobile Artisans (Control)	75.33 $\pm$ 11.15	23.57 $\pm$ 2.42	24.13 $\pm$ 3.86
Automobile Mechanics	59.80 $\pm$ 18.43	48.50 $\pm$ 16.47*	65.50 $\pm$ 30.26*
Automobile Welders	83.50 $\pm$ 8.88 ^a	41.90 $\pm$ 11.44*	48.50 $\pm$ 19.84*, ^a
Automobile Panel Beaters	59.80 $\pm$ 22.16 ^b	43.50 $\pm$ 13.74*	49.60 $\pm$ 12.48*, ^a
Automobile Spray Painters	108.70 $\pm$ 43.30 ^{a, b, c}	42.80 $\pm$ 10.14*	41.80 $\pm$ 9.86*, ^a
Automobile Blacksmiths	128.30 $\pm$ 7.01*, ^{a, b, c, d}	57.70 $\pm$ 28.94*, ^{b, c, d}	56.60 $\pm$ 8.34*, ^d
Automobile Electricians	112.5 $\pm$ 12.71 ^{a, c}	41.40 $\pm$ 7.01*, ^e	46.50 $\pm$ 6.80*, ^a

Values are expressed as Mean $\pm$ Standard Deviation (SD). Significant at $p < 0.05$ when compared to the mean value ^{a, b} of control; Significant at $p < 0.05$ when compared to the mean value of Automobile Mechanics; Significant at $p < 0.05$ when compared to the mean value of automobile welders; ^c Significant at $p < 0.05$ when compared to the mean value of Automobile Panel Beaters; ^d Significant at $p < 0.05$ when compared to the mean value of Automobile spray painters; ^e Significant at $p < 0.05$ when compared to the mean value of automobile.

Table 3 displays the changes in serum hepatic enzymes levels amongst different categories of automobile artisans in Port Harcourt.

From the changes in Alkaline Phosphatase (ALP) levels, the mechanics and panel beaters had marginally ($P > 0.05$) lower mean values when compared to that of the control group. Only the ALP level in the blacksmith were found to be significantly ($P < 0.05$) higher when compared to that of the control group. Again, considering the ALP level in the mechanics and panel beaters, it indicated significantly ($p < 0.05$) reduced levels when compared to those of all other counterparts. The raised levels of the enzymes followed this order: Blacksmiths>Electricians>Spray Painters>Welders>Non-Automobile Artisans (Control) >Mechanics and panel beaters. Regarding the levels of Aspartate Transaminase (AST), the control group had the lowest level; meanwhile, the blacksmiths had significantly ($p < 0.05$) elevated mean values when compared to those of control and all other sub-groups of the auto-artisan except that of the mechanics.

In view of the changes in Alanine Transaminase (ALT) levels, the control group had significantly ($P > 0.05$) reduced level when compared to those of all sub-groups of auto-artisans Across the different categories of the artisans, the mechanics had significantly ($p < 0.05$) elevated mean value of ALT when compared to those of all other groups except that of the blacksmiths.

DISCUSSIONS

Regular exposure to hazardous or toxic substances may result in a variety of effects on the body (Bhat *et al.*, 2019). In general, when chemicals and other dangerous compounds are absorbed, they travel through different parts of the body and arrive at specific visceral organs and exert on them as their targets (WHPP, 2013). Although the body has reliable preventive mechanisms against various environment insults (primarily in the liver and kidneys that breakdown and eliminates many of these substances). This ability to eliminate such toxic substances may reduce their impact on the target organ(s). However, on continuous exposure and intensity of such substance on these organs may lead to overwhelming impacts on them (WHPP, 2013). Thus, timely screening of possible hepatic and renal dysfunctions may be helpful in quick treatment and prevention of their progressions (Moitra *et al.*, 2006). Consequently, the present study evaluated the level of blood heavy metals and the changes in renal and hepatic parameters of automobile repairs artisans in Port Harcourt Metropolis. The main findings are discussed in the following paragraphs.

The mean age of non-automobile artisans is 44.1yrs whereas that of the automobile artisans was 44.93yrs. The latter is marginally ($P > 0.05$) higher than that of the former.

Physical demand refers to the amount or length of physical effort required to complete jobrelated tasks (such as extended periods of sitting, standing, lifting, carrying, reaching, pushing, and pulling, as well as exposure to harsh materials or environments) (Hodder &

Kretsos, 2015; Boström *et al.*, 2016). Thus, the natural demand of the automobile artisans' job type may have influenced the age bracket of the study subjects such that they are neither very young nor middleaged. An earlier report emphasized that workplace safety is considerably impacted by age (Sámano-Ríos *et al.*, 2019). Therefore, it may be stated here that, the demands of automobile artisans' job nature may have directly and indirectly the above age bracket of the study subjects.

The auto-mechanics, welders, followed by the blacksmiths had the longest serving /period of exposures. On the other hand, panel beaters and spray painters followed by the electricians had the least duration of work experience when compared to those of others.

Working for extended periods in physically demanding jobs can have severe adverse health effects, including a greater likelihood of musculoskeletal disorders, cardiovascular disease, and mental health problems. These effects can result from factors such as repetitive strain, long periods of standing or lifting, and the stress associated with high-intensity work, which can lead to injuries, chronic illnesses, and even early death (Karlqvist *et al.*, 2003; Johnson and Lipscomb, 2006). Thus, with the understanding of the possible health impact of the long duration of doing high risk jobs, regular checks on the individuals' health status may be very helpful in preventing the earlier manifestation and severity of different chronic health conditions.

Considering the changes in serum chromium (Cr) level, the auto spray painters, blacksmiths and electricians had significantly ($p < 0.05$) raised levels of the heavy metal when compared to those of the controls (non-auto artisans), auto mechanics, welders and panel beaters. The study as well recorded that the Cr levels in the mechanics, welders and panel beaters were less than zero limits. And remarkably, the blacksmiths had the highest level of this metal. Elevated concentrations of blood chromium levels, especially hexavalent chromium (Cr(VI)), can be harmful, causing a variety of health challenges. These include blood cell damage, carcinogenesis, and damage to the respiratory, cardiovascular, gastrointestinal, hepatic, and renal systems. Chronic inhalation at high levels, which is common in occupational settings, can result in nasal septum perforation, respiratory irritation, lung cancer, and potentially kidney problems (Alvarez *et al.*, 2021). Thus, considering the outcome of this finding, the auto spray painters, blacksmiths and electricians may be said to be at a high risk of multiple health conditions. It is also important for them to identify their sources of chromium contaminations.

The present study found that the levels of lead (Pb) in all other sub-groups of the auto-artisans, aside from the auto-mechanics, had significantly rose (far above the zero limits) when compared to the mean value of the control subjects. Similarly, it has been previously

stated that mechanics and other personnel engaged in vehicle maintenance and repair are the principal victims of lead toxicity, a serious occupational hazard in the automotive sector (Saliu *et al.*, 2015). This is because lead is present in many automobile components and because workers may swallow, breathe, or absorb lead particles, lead exposure can result in both immediate and long-term health issues (Prabhakar *et al.*, 2019).

de Souza *et al.*, (2018) stated that, the main cause of lead poisoning is its capacity to interfere with vital divalent cations such as calcium and zinc, mimic them, and bind to protein sulfhydryl groups, which results in oxidative stress and decreased enzyme performance. Reactive oxygen species (ROS) can be produced as a result of lead exposure, which exacerbates cellular damage (de Souza *et al.*, (2018). Of course, chronic lead (Pb) exposure is known to destroys the central nervous system and encephalon, acute Pb toxicity causes problems with the kidney, reproductive system, and brain. Lead also prevents hemoglobin from being synthesized. Lead accumulation is more likely to affect pregnant women who have low levels of calcium, iron, or zinc amongst other adverse effects (Kwong *et al.*, 2004; Collin *et al.*, 2022). To add to this, the WHO, (2023) stated that, extremely high lead exposure may seriously harm the brain and central nervous system, resulting in coma, seizures, and even death and those children who overcome severe lead poisoning may develop behavioral issues and lasting intellectual limitations. Considering the foregoing outcome of the present study it is important state that, virtually all categories of the auto-artisans recruited in the study are exposed to remarkable lead toxicity but is worse in the blacksmiths. The implication is that they may definitely, with time, present with varying degrees of health complications. However, a good and early health-seeking attitude can help prevent the weight of the risks they are exposed to.

In another finding of the present study, the serum cadmium (Cd) levels were found to be raised in all artisans when compared to the mean level of the control subjects. The Cd level in the blacksmith were significantly higher when compared to all other groups including that of the control group and interestingly, unlike in other heavy metals, the blacksmiths had the lowest of Cd serum level.

According to Rahimzadeh *et al.*, (2017), cancer and toxicity to organ systems, including the skeletal, urinary, reproductive, cardiovascular, central and peripheral nervous, and respiratory systems, are caused by prolonged exposure to cadmium through various sources including the air, water, soil, and food. This finding on exposure level and the possible Cd toxicity corroborates with the earlier report of Rahimzadeh *et al.*, (2017), which stated that among other things, breathing in vaporized cadmium when under oxidative stress and without antioxidants can cause inflammation in the

lungs. It is thus not surprising that the panel beaters who probably are consistently exposed metallic rust dust from their activities are having the highest serum level of the heavy metal. Again, it can be said that exposure to significant levels of Cd and its possible toxicity constitutes one of the major occupational dangers of the automobile artisans in our locale, especially with the panel beaters.

In view of the renal function investigation of the present study, it was observed that, the mean creatinine level of all the sub-groups of the auto-artisans significantly increased when compared to that of the non-automobile artisans (control) and the inverse of the foregoing occurred in the eGFR, only that that of the mechanics were excluded.

This finding of the present study is in line with notion on the two parameters. Of course, it has been stated that there is an inverse association between creatinine and glomerular filtration rate (GFR). Serum creatinine levels, a waste product, tend to rise as GFR, a gauge of renal function, falls. This happens because creatinine is effectively filtered from the blood by healthy kidneys; when kidney function deteriorates, creatinine clearance decreases, raising blood concentrations (Rule & Lieske, 2011; Riyani *et al.*, 2024). Reports have it that a decrease in kidney function is typically indicated by a lower glomerular filtration rate (GFR), and this may have a number of important ramifications. It is linked to higher chances for cardiovascular disease, renal failure, and death and is frequently a sign of chronic kidney disease (CKD). In order to reduce these risks and maybe slow down progression, early detection and management are essential (Bos *et al.*, 2007; Ford *et al.*, 2009). There is thus, the need for health sensitization amongst this subpopulation of auto-artisan, to present themselves regularly for renal health screening and possible follow up.

The present study found a significantly raised alkaline phosphatase (ALP) level in the blacksmiths when compared to that of all other groups. Again, an order of elevation in the ALP level amongst the artisans followed thus: Blacksmiths>Electricians>Spray Painters>Welders> Mechanics and panel beaters.

Concerning the levels of aspartate transaminase (AST) and alanine transaminase (ALT), all artisans had significantly raised levels when compared to the respective mean values of the control group. The blacksmiths had significantly elevated mean values when compared to those of their counterparts except that of the mechanics.

And in view of the changes in ALT levels across the different categories of the artisans, the mechanics had remarkably raised value when compared to those of all other groups except that of the blacksmiths.

A variety of hepatic disorders can result from occupational exposures that have a substantial impact on liver health (Yurt, 2023). Workplace exposure to specific chemicals, medications, and other substances can harm the liver in a variety of ways, from minor inflammation to serious diseases like cirrhosis and even liver cancer. Because of its detoxifying function, the liver is susceptible to exposures at work. Numerous types of hepatic diseases can result from exposure to specific toxicants, which can have a substantial impact on liver health. Inflammation, liver cell damage, and even permanent diseases like cirrhosis and liver failure can result from toxicants (Al-Eryani *et al.*, 2015). The most raised ALP and AST level in the blacksmith and the highest level of the ALT (liver specific enzyme) in the mechanics put these two sub-groups at higher risks for hepatic disorders. It can thus be said that the job nature of the automobile artisans, particularly the mechanics and the blacksmiths, is such that could predispose them to hepatic dysfunctions.

CONCLUSION

In conclusion, aside from the mechanics, welders and panel beaters with negative values of Chromium levels, all other sub-auto artisan groups had mostly remarkably raised chromium, Pb and Cd levels when compared to that of their non-auto artisan counterparts. From the renal function investigation of the present study, it was observed that, the mean creatinine level of all the sub-groups of the auto-artisans significantly increased when compared to that of the nonautomobile artisans and the inverse of the foregoing occurred in the eGFR values. Thus, the tendency for the development of CKD amongst the auto-artisans may be sufficiently connected with occupational and environmental factors. Virtually all sub-groups of the auto-artisans had comparatively significantly raised liver enzymes levels. Notably, the Blacksmiths had the most raised levels of these enzymes

REFERENCES

- Adei, D., Agyemang-Duah, W., & Mensah, A. A. (2022). Demographic and socio-economic factors associated with exposure to occupational injuries and diseases among informal sector workers in Kumasi metropolis, Ghana. *Journal of Public Health*, 30(9), 2191-2199.
- Adu-Gyamfi, A. B. (2025). Occupational Risk Perception and Utilization of Personal Protective Equipment Among Informal Auto-Artisans in Ghana: A Cross-Sectional Study. *Health Science Reports*, 8(7), e71080.
- Afolabi, F. J., de Beer, P., & Haafkens, J. A. (2021). Can occupational safety and health problems be prevented or not? Exploring the perception of informal automobile artisans in Nigeria. *Safety Science*, 135, 105097.
- Al-Eryani, L., Wahlang, B., Falkner, K. C., Guardiola, J. J., Clair, H. B., Prough, R. A., & Cave, M. (2015). Identification of environmental

chemicals associated with the development of toxicant-associated fatty liver disease in rodents. *Toxicologic pathology*, 43(4), 482-497.

- Alvarez, C. C., Gómez, M. E. B., & Zavala, A. H. (2021). Hexavalent chromium: Regulation and health effects. *Journal of trace elements in medicine and biology*, 65, 126729.
- Bhat, S. A., Hassan, T., & Majid, S. (2019). Heavy metal toxicity and their harmful effects on living organisms—a review. *International Journal of Medical Science and Diagnosis Research*, 3(1), 106-122.
- Bos, M. J., Koudstaal, P. J., Hofman, A., & Breteler, M. M. (2007). Decreased glomerular filtration rate is a risk factor for hemorrhagic but not for ischemic stroke: the Rotterdam Study. *Stroke*, 38(12), 3127-3132.
- Boström, M., Holmgren, K., Sluiter, J. K., Hagberg, M., & Grimby-Ekman, A. (2016).
- Experiences of work ability in young workers: an exploratory interview study. *International Archives of Occupational and Environmental Health*, 89, 629-640.
- Cockcroft, D. W., & Gault, H. (1976). Prediction of creatinine clearance from serum creatinine. *Nephron*, 16(1), 31-41.
- Collin, M. S., Venkatraman, S. K., Vijayakumar, N., Kanimozhi, V., Arbaaz, S. M., Stacey, R. S., ... & Swamiappan, S. (2022). Bioaccumulation of lead (Pb) and its effects on human: A review. *Journal of Hazardous Materials Advances*, 7, 100094.
- de Souza, I. D., de Andrade, A. S., & Dalmolin, R. J. S. (2018). Lead-interacting proteins and their implication in lead poisoning. *Critical reviews in toxicology*, 48(5), 375-386.
- Dreyer, G., Hull, S., Aitken, Z., Chessier, A., & Yaqoob, M. M. (2009). The effect of ethnicity on the prevalence of diabetes and associated chronic kidney disease. *QJM: An International Journal of Medicine*, 102(4), 261-269.
- Ford, I., Bezlyak, V., Stott, D. J., Sattar, N., Packard, C. J., Perry, I., ... & Shepherd, J. (2009). Reduced glomerular filtration rate and its association with clinical outcome in older patients at risk of vascular events: secondary analysis. *PLoS medicine*, 6(1), e1000016.
- Gan, C., Yuan, Y., Shen, H., Gao, J., Kong, X., Che, Z., ... & Xiao, J. (2025). Liver diseases: epidemiology, causes, trends and predictions. *Signal Transduction and Targeted Therapy*, 10(1), 33.
- Guidotti, T. L., & Ivanov, I. D. (2021). Global Occupational Health: Burden, Strategies, and Challenges. In *Handbook of Global Health* (pp. 2257-2291). Cham: Springer International Publishing.
- Ho, F. K., Celis-Morales, C., Gray, S. R., Demou, E., Mackay, D., Welsh, P., ... & Pell, J. P. (2022). Association and pathways between shift work and cardiovascular disease: a prospective cohort study of 238 661 participants from UK Biobank. *International journal of epidemiology*, 51(2), 579-590.
- Hodder, A., & Kretsos, L. (2015). Young workers and unions: Context and overview. In *Young Workers and Trade Unions: A Global View* (pp. 1-15). London: Palgrave Macmillan UK.
- Jager, K. J., Kovesdy, C., Langham, R., Rosenberg, M., Jha, V., & Zoccali, C. (2019). A single number for advocacy and communication—worldwide more than 850 million individuals have kidney diseases. *Nephrology Dialysis Transplantation*, 34(11), 1803-1805.
- Johnson, J. V., & Lipscomb, J. (2006). Long working hours, occupational health and the changing nature of work organization. *American journal of industrial medicine*, 49(11), 921-929.
- Karlqvist, L. K., Härenstam, A., Leijon, O., Schéele, P., & MOA Research Group. (2003). Excessive physical demands in modern worklife and characteristics of work and living conditions of persons at risk. *Scandinavian journal of work, environment & health*, 363377.
- Kovesdy, C. P. (2022). Epidemiology of chronic kidney disease: an update 2022. *Kidney international supplements*, 12(1), 7-11.
- Kwong, W. T., Friello, P., & Semba, R. D. (2004). Interactions between iron deficiency and lead poisoning: epidemiology and pathogenesis. *Science of the Total environment*, 330(1-3), 21-37.
- Moitra, V., Diaz, G., & Sladen, R. N. (2006). Monitoring hepatic and renal function. *Anesthesiology Clinics of North America*, 24(4), 857-880.
- Nerbass, F. B., Pecoits-Filho, R., Clark, W. F., Sontrop, J. M., McIntyre, C. W., & Moist, L. (2017). Occupational heat stress and kidney health: from farms to factories. *Kidney international reports*, 2(6), 998-1008.
- Nkwocha, A. C., Ekeke, I. C., Kamalu, C. I. O., Kamen, F. L., Uzundu, F. N., Dadet, W. P., & Olele, P. C. (2017). Environmental assessment of vehicular emission in Port-Harcourt city, Nigeria. *International Journal of Environment, Agriculture and Biotechnology*, 2(2), 238746.
- Olanrewaju, T. O., Aderibigbe, A., Popoola, A. A., Braimoh, K. T., Buhari, M. O., Adedoyin, O. T., ... & Ilorin Renal Study Group. (2020). Prevalence of chronic kidney disease and risk factors in North-Central Nigeria: a population-based survey. *BMC nephrology*, 21(1), 467.
- Prabhakar, A., Mishra, S., & Das, A. P. (2019). Isolation and identification of lead (Pb) solubilizing bacteria from automobile waste and its potential for recovery of lead from end-of-life waste batteries. *Geomicrobiology journal*, 36(10), 894-903.
- Rahimzadeh, M. R., Rahimzadeh, M. R., Kazemi, S., & Moghadamnia, A. A. (2017). Cadmium

toxicity and treatment: An update. *Caspian journal of internal medicine*, 8(3), 135.

- Riyani, A., Nerisandi, R., Wiryanti, W., Rahmah, W., & Kurnaeni, N. (2024). The correlation between creatinine levels and estimated glomerular filtration rate (GFR) with blood glucose levels in diabetes mellitus type 2 patients. *Healthcare in Low-resource Settings*, 12(1).
- Rule, A. D., & Lieske, J. C. (2011). The estimated glomerular filtration rate as a test for chronic kidney disease: problems and solutions. *Cleveland Clinic journal of medicine*, 78(3), 186.
- Saldaña-Villanueva, K., Méndez-Rodríguez, K. B., Zamora-Mendoza, B. N., Gómez-Gómez, A., Díaz-Barriga, F., & Pérez-Vázquez, F. J. (2023). Health effects of informal precarious workers in occupational environments with high exposure to pollutants. *Environmental Science and Pollution Research*, 30(31), 76818-76828.
- Saliu, A., Adebayo, O., Kofoworola, O., Babatunde, O., & Ismail, A. (2015). Comparative assessment of blood lead levels of automobile technicians in organised and roadside garages in Lagos, Nigeria. *Journal of Environmental and Public Health*, 2015(1), 976563.
- Sámano-Ríos, M. L., Ijaz, S., Ruotsalainen, J., Breslin, F. C., Gummeson, K., & Verbeek, J. (2019). Occupational safety and health interventions to protect young workers from hazardous work—A scoping review. *Safety science*, 113, 389-403.
- Sepanlou, S. G., Safiri, S., Bisignano, C., Ikuta, K. S., Merat, S., Saberifirooz, M., ... & Padubidri, J. R. (2020). The global, regional, and national burden of cirrhosis by cause in 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *The Lancet gastroenterology & hepatology*, 5(3), 245-266.
- Tamuno-Opubo, A., Odimabo, M., Stanley, R. O., Wihioke, J. O., Dede, S. B., Dienye, Z. U., ... & Chris-Biriowu, H. (2024). Evaluation of Alterations in Basic Cardiac Functions in Operators of Artisanal Refineries in Rivers State, Nigeria. *Sch J App Med Sci*, 4, 325330.
- The Worker Health Protection Programme [TWHPP], (2013). Screening for Liver and Kidney Disease. (Retrieved online on 1stb July, 2025 from: <https://www.workerhealth.org/liverkidneyscreen.html>)
- Ucheje, O., Ogbuene, E. B., & Ofoezie, I. E. (2022). Trend analysis of vehicular traffic contribution to air pollution in urban cities: a case study of Port Harcourt, Nigeria. *Asian Journal of Environment & Ecology*, 45-62.
- Vart, P., Powe, N. R., McCulloch, C. E., Saran, R., Gillespie, B. W., Saydah, S., & Crews, D. C. (2020). National trends in the prevalence of chronic kidney disease among racial/ethnic and socioeconomic status groups, 1988-2016. *JAMA network open*, 3(7), e207932e207932.
- World Health Organization. (2023). Exposure to lead: a major public health concern. Preventing disease through healthy environments. World Health Organization.
- Younossi, Z. M., Wong, G., Anstee, Q. M., & Henry, L. (2023). The global burden of liver disease. *Clinical Gastroenterology and Hepatology*, 21(8), 1978-1991.
- Yurt, Y. (2023). Work-related and occupational liver diseases. *EJMA*, 3, 51-55.