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Assessment of some toxico-inflammatory, hepato-renal and cardio-oxidative stress biomarkers among waste pickers in Ajegunle Lagos State Nigeria

Emmanuel Tonbra Egoro [1,*], Godwin Ikhide Ilegbedion [1], Emmanuel Sunday Oni [2] and Hope Charlotte [3]

[1] *Department of Medical Laboratory Science, Niger Delta University, P.M.B. 071, Wilberforce Island, Bayelsa State, Nigeria.*
[2] *Department of Medical Laboratory Science, Rivers State University, Port-Harcourt, Rivers State, Nigeria.*
[3] *Department of Pharmacology, Bayelsa Medical University, Imgbi Road, Bayelsa State, Nigeria.*

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Abstract

Individuals who move from one place to another in search of recyclable goods for financial benefits or other purposes are known as wastes pickers. This study aimed on assessment of some toxico-inflammatory, hepato-renal and cardio-oxidative-stress biomarkers among wastes pickers in Ajegunle, Lagos State, Nigeria. Five milliliters of blood specimens were withdrawn from each of the 120 participants into lithium heparin anticoagulated bottles respectively. This was followed by the measurements of some biomarkers with data analyzed using SPSS version 20.0 and ANOVA used for statistical analysis. There were significant elevations (p=0.00) in the mean values for lead, cadmium (toxic heavy metals), C-reactive protein and interleukin-6 (inflammatory biomarkers) in wastes pickers with working experience of < 2 years, 2-5 years and > 5 years as compared with that of the control group . Also, there was significant elevation (p=0.02) in the mean values of alanine aminotransferase, aspartate aminotransferase and alkaline phosphatase (liver enzymes) in wastes pickers with > 5 years working experience whereas wastes pickers with < 2 and 2-5 years working experience did not reveal any significant alterations (p > 0.05) in the mean values of these liver enzymes when compared with the control group. There were significant elevations in the mean values for glutathione peroxidase (p=0.02) and malondialdehyde (p=0.03) (oxidative-stress biomarkers) in wastes pickers with working experience of < 2 years, 2-5 years and > 5 years as compared with the control group. However, no significant alterations (p > 0.05) were seen in the mean values of creatinine and urea (renal biomarkers) and cardiovascular biomarkers (troponin-1 and creatinekinase-MB) among the wastes pickers with various working experiences. It is concluded that chronic roadside wastes pickers may be prone to risk of heavy metals poisoning, inflammatory disorder, hepatotoxicity and oxidative stress. Therefore, it is recommended that roadside wastes pickers should be embraced by the appropriate authorities and enlightened to comply with safety precautions when discharging their duties

Keywords: Assessment; Toxico-inflammatory; Hepato-renal; Cardio-oxidative-stress biomarkers; Waste pickers; Ajegunle; Lagos State, Nigeria

1. Introduction

Disposable waste is something that is no longer needed or helpful [1]. Waste pickers are the people who go about selecting and rescuing recyclable and/or re-usable goods that have been discarded by others for either their own use or for sale [2].

Millions of people engage in waste picking all over the world, especially in developing nations, exposing them to toxic heavy metals like lead, cadmium, mercury, chromium, manganese, etc., which may then have an impact on their health and organs like the kidneys, liver, and lungs. This occupation is viewed in Nigeria with a glaring misunderstanding and

* Corresponding author: Emmanuel Tonbra Egoro

disregard, which leaves room for conflicts, role-duplication, and bureaucratic bottlenecks that could obstruct the efficiency in providing this service to the public [3].

Wastes are divided into five categories, some of which are recyclable while others are not. These categories include hazardous wastes, recyclable wastes, organic wastes, solid wastes, and liquid wastes. The liquid wastes are those that are typically produced in homes and businesses and are further divided into point and nonpoint categories. Point category includes all manufactured liquid wastes such as unclean water, organic liquid, wash water, waste detergents, and rain water [4].

The various objects found in residential, commercial, and industrial areas are included in the solid wastes. They are further divided into trash made of plastic, paper, metals, ceramic, glass etc and are classified based on their environmental risks, sources, utility and physical property. They are classified as municipal, industrial and agricultural based on their origin or source [5]. Common home wastes make up the organic wastes (such as food wastes, garden wastes, manure, rotten meat etc). Microorganisms slowly transform these wastes into manure over time. They should be placed in a garden bag before disposal instead of being rid of with regular waste because they can also produce methane in landfills. Indiscriminate disposal of waste may cause air, soil and water pollutions. Also these solid wastes have the tendency to clog drains, thus leading to formation of stagnant water for breeding insects as well as flood during rainy season [5].

Metals, paper, furniture, and organic wastes are among the recyclable wastes, which encompass all waste materials that can be recycled into usable goods. Local government councils have failed in carrying out their statutory responsibilities of municipal waste management in various towns and cities which in turn violates the edicts and regulations of environmental sanitation which have posed threats to the dwellers' health. [5]. The National Institute for Occupational Safety and Health noted in 2022 that roadside rubbish pickers may be more susceptible to several negative health impacts as a result of their line of work thus offered the following recommendations for waste pickers and employers:

- They should refrain from smoking and chewing gum when handling human excrement [6].
- When in touch with sewage, eyes should be gently rinsed with safe water [6].
- Wounds, cuts, and sores should be covered with bandages that are clean and dry [6].
- Water-proof gloves should be worn often while working to protect against wounds and contact with human waste [6].
- Regular use of glasses is advised to shield the eyes from splashing potentially dangerous waste materials [6].
- Safety boots should be worn frequently in order to prevent and shield the feet from harm, [6].
- The use of protective waste coats is required to protect the body from any dangerous substances, and the usage of protective helmets is required [6].
- Employees should practice good hygiene [6].
- Intermittent training should be required of personnel in this industry, and also obligatory vaccinations for all workers in this industry [6].

There is a dearth of literature regarding the population, demography, and creation of quantitative data for waste pickers worldwide. This may be an indication of anxiety that the government crackdown on waste collection could be influenced by the findings of such study [7]. This study which aimed on assessment of some toxico-inflammatory, hepato-renal and cardio-oxidative-stress biomarkers among wastes pickers in Ajegunle Lagos State Nigeria was embarked on based on the increase rate of youths in this occupation.

2. Material and methods

2.1. Study area

This study was carried out in Ajegunle, Lagos State Nigeria

2.2. Ethical approval

This study was carried out in strict compliance with the principle of Helsinki declaration of 1975 as revised in 2008 after obtaining approval from the University ethical committee as well as getting oral informed consent from the respective participants.

2.3. Scope of experimental design

One hundred and twenty apparently healthy participants who are not addicted to smoking, abuse of drugs, coffee, snuffing and also free from illnesses (such as diabetes mellitus and hypertension) constituted this study. Among these participants, 111 (92.5) % are males while 9 (7.5) % are females

These participants were subsequently grouped as follow after filling questionnaires:

2.4. Control group

Thirty white collar job participants within the age range of 18-25 years constituted this group.

2.5. Experimental group one

Thirty roadside waste pickers within the age range of 18-25 years with < 2 years working experience made up this group

2.6. Experimental group two

Thirty roadside waste pickers within the age range of 18-25 years with 2-5 years working experience were incorporated into this group

2.7. Experimental group three

Thirty roadside waste pickers within the age range of 18-25 years with > 5 years working experience were utilized in this group

2.8. Specimen collection and processing

Five milliliters of blood specimen were withdrawn from each of these participants into lithium heparin anti-coagulated bottles respectively via a venipuncture technique and spun for 10 minutes at 1,500 revolution / minute using a Gulfex medical and scientific macro centrifuge model 800 D England. The obtained plasma was subsequently used for the quantitative measurement of lead, cadmium, C-reactive protein, interleukin - 6, alanine aminotransferase, aspartate aminotransferase, alkaline phosphatase, creatinine, urea, troponin-1, creatine-kinase-MB, glutathione peroxidase and malondialdehyde,

2.9. Measurement of lead

Atomic absorption spectroscopy (AAS) method using Solar thermo-elemental model SE-71906 as described by [8] was adopted.

2.10. Measurement of cadmium

Atomic absorption spectroscopy (AAS) method using Solar thermo-elemental model SE-71906 as described by [9] was adopted.

2.11. Measurement of C-reactive protein

Latex turbidimetry method of Spinreact Diagnostic manual, Spain as described by [10] was adopted

2.12. Measurement of interleukin-6

Elabscience method with catalogue number E-EL-H0102 as described by [11] was adopted

2.13. Measurement of alanine aminotransferase

Colorimetric method of Randox Laboratories Limited, 55, Diamond Road, Crumlin, County, Antrim, BT 294 QY, United Kingdom as described by [10] was adopted.

2.14. Measurement of aspartate aminotransferase

Colorimetric method of Randox Laboratories Limited, 55, Diamond Road, Crumlin, County, Antrim, BT 294 QY, United Kingdom as described by [10] was adopted.

2.15. Measurement of alkaline phosphatase

Colorimetric endpoint method of Randox Laboratories Limited, 55, Diamond Road, Crumlin, County, Antrim, BT 294 QY, United Kingdom as described by [10] was adopted.

2.16. Measurement of creatinine

Jaffe reaction method of Randox Laboratories Limited, 55, Diamond Road, Crumlin, County, Antrim, BT 294 QY, United Kingdom as described by [10] was adopted.

2.17. Measurement of urea

Urease Berthelot's method of Randox Laboratories Limited, 55, Diamond Road, Crumlin, County, Antrim, BT 294 QY, United Kingdom as described by [10] was adopted.

2.18. Measurement of troponin-1

The dual vial liquid stable immune turbidimetric method of cardiac troponin-1 assay reagents manufactured by Diazyme with catalogue no DZ145A USA as described by [12] was adopted.

2.19. Measurement of creatine-kinase-MB

The immune- inhibition method of Atlas Medical reagents manufactured by Atlas Medical unit 4, William James House, Cowley Road, Cambridge, CB40WX as described by [13] was adopted

2.20. Measurement of glutathione peroxidase

The immune- inhibition method of Atlas Medical reagents manufactured by Atlas Medical unit 4, William James House, Cowley Road, Cambridge, CB40WX as described by [13] was adopted.

2.21. Measurement of malondialdehyde

The thiobabituric acid method as described by [14] was adopted.

2.22. Statistical analysis

SPSS version 20.0 was used for all statistical analysis. The data were grouped into control, < 2 years waste pickers, 2-5 years waste pickers and > 5 years waste pickers (experimental groups). The Kolmogorv-Smirnov test was used to determine normality. ANOVA was used to measure differences between the groups. Data were expressed as means and standard deviation. Differences in means between groups were considered significant at $p < 0.05$

3. Results and discussion

Wastes are disposable items that are no longer required or helpful [15]. The mean values of the following biochemical parameters: lead, cadmium, C-reactive protein, interleukin-6, alanine aminotransferase, aspartate aminotransferase, alkaline phosphatase, creatinine, urea, troponin-1, creatinekinase-MB, glutathione peroxidase and malondialdehyde in waste pickers (experimental groups one, two and three) were compared to those of the control group respectively.

In this study, comparison was made between the mean values of lead, cadmium (toxic heavy metals), C-reactive protein and interleukin-6 (inflammatory biomarkers) in wastes pickers with < 2 years, 2-5 years and > 5 years working experiences (experimental groups) with those that are not wastes pickers (control group)

Lead and cadmium were measured in an effort to assess the poisoning potential of these toxic heavy metals that may be linked to waste chosen from among roadside rubbish in waste pickers with working histories ranging from < 2 to > 5 years, respectively.

As shown in Table 1, the mean plasma lead concentrations in roadside waste pickers with < 2 years of experience (0.95 ± 0.21) $x10^{-2}$ ppm compared to the control group (0.21 ± 0.07) $x10^{-2}$ ppm, 2-5 years of experience (1.27 ± 0.74) $x10^{-2}$ ppm compared to the control group (0.21 ± 0.07) $x10^{-2}$ ppm, and > 5 years of experience (2.87 ± 0.81) $x10^{-2}$ ppm compared to the control group (0.21 ± 0.07) $x10^{-2}$ ppm, revealed significant elevations (p= 0.00).

Significant differences were observed between > 5 years working experience waste pickers and each of control, < 2 years working experience waste pickers and 2-5 years experienced waste pickers p = 0.00, respectively

The elevated mean plasma lead level in this group of waste pickers may indicate lead poisoning, which could be brought on by daily exposure to different wastes some of which may be tainted with lead material. This result is consistent with [16] earlier research.

Table 1 Mean ± SD of toxic heavy metals and inflammatory biomarkers measured among waste pickers with < 2 years, 2-5 years and > 5 years working experience (experimental groups) compared with the non-waste pickers (control group)

Group	Lead (x10-^{2}ppm)	Cadmium (x10-^{2}ppm)	CRP (mg/L)	IL-6 (pg/ml)
Control (n=30)	0.21 ± 0.07	0.16 ± 0.03	3.52 ± 0.71	10.21 ± 1.87
< 2 years (n=30)	0.95 ± 0.21	0.96 ± 0.27	8.56 ± 2.72	14.72 ± 2.11
2-5 years (n=30)	1.27 ± 0.74	1.20 ± 0.85	12.28 ± 2.85	17.24 ± 2.63
> 5 years (n=30)	2.87 ± 0.81	2.15 ± 0.89	20.15 ± 3.17	21.67 ± 2.98
F-value	73.46	61-87	93.85	88.91
P-value	0.00	0.00	0.00	0.00

KEYS: CRP = C-reactive protein, IL-6 = Interleukin-6

As seen further in Table 1, there was significant elevation (p = 0.00) in the mean cadmium level among the roadside wastes pickers with < 2 years of experience (0.96 ± 0.27) x10^{-2} ppm.,2-5 years of experience (1.20 ± 0.85) x10^{-2} ppm and > 5 years of experience (2.15 ± 0.89) x10^{-2} ppm compared to the control group (0.16 ± 0.03) x10^{-2} ppm respectively.

The increased plasma cadmium mean value in these groups of rubbish pickers may indicate risk of cadmium poisoning. This finding is in agreement with the previous work of [16].

Also, in this study, as shown in Table 1, roadside rubbish pickers with < 2 years, 2–5 years, and >5 years of job experience were evaluated for C-reactive protein and interleukin-6 biochemical parameters in an effort to identify inflammatory disorders. The mean levels of plasma C-reactive protein among roadside garbage collectors with < 2 years of working experience (8.56 ± 2.72) mg/L, 2–5 years of working experience (12.28 ± 2.85) mg/L and > 5 years of working experience (20.15 ± 3.17) mg/L as compared respectively to the control group (3.52 ± 0.71) mg/L were significantly elevated (p=0.00). Also, the mean levels of plasma interleukin-6 among the roadside garbage collectors with < 2 years of working experience (14.72 ± 2.11) pg/ml as compared to the control group (10.21 ± 1.87) pg/ml, 2–5 years of working experience (17.24 ± 2.63) pg/ml as compared to the control group (10.21 ± 1.87) pg/L, and >5 years of working experience (21.67 ± 2.98) pg/ml as compared to the control group (10.21 ± 1.87) pg/ml were significantly elevated (p=0.00). These biochemical results, which are consistent with earlier research by [18], may point to an inflammatory condition related to this line of work.

Table 2 Mean ± SD of hepato-renal biochemical parameters measured among waste pickers with < 2 years, 2-5 years and > 5years working experience (experimental groups) compared with the non-waste pickers (control group)

Groups	ALT (U/L)	AST (U/L)	ALP (U/L)	Creatinine (µmol/L)	Urea (mmol/L)
Control (n=30)	9.20 ± 1.80	8.48 ± 1.74	20.20 ± 1.40	75.00 ± 4.79	6.06 ± 1.68
<2years (n=30)	9.22 ± 1.81	8.50 ± 1.74	20.21 ± 1.49	75.02 ± 4.82	6.08 ± 1.70
2-5 years (n=30)	9.24 ± 1.85	8.51 ± 1.72	20.24 ± 1.43	75.05 ± 4.84	6.10 ± 1.72
>5years (n=5)	20.10 ± 2.75	18.54 ± 1.79	20.25 ± 1.44	75.06 ± 4.85	6.12 ± 1.72
F-value	51.92	39.80	46.02	197.44	46.41
P-value	0.02	0.02	0.02	0.96	0.92

KEYS: ALT= alanine aminotransferase, AST = aspartate aminotransferase, ALP=alkaline phosphatase, n=number of participants

In this study, comparison was also made between the mean values of alanine aminotransferase, aspartate aminotransferase, alkaline phosphatase (liver enzyme biomarkers), creatinine and urea (renal biomarkers) in wastes pickers with < 2 years, 2-5 years and > 5 years working experiences (experimental groups) with those that are not wastes pickers (control group) in an attempt to assess the liver and kidney status of these waste pickers as shown in Table 2

In this study, the liver health of roadside rubbish pickers with working experience of < 2 years, 2-5 years, and > 5 years was assessed using measurements of alanine aminotransferase, aspartate aminotransferase, and alkaline phosphatase as shown in Table 2. The mean values of these hepatic enzymes in the wastes pickers with < 2 years working experience versus the control group: alanine aminotransferase (9.22 ± 1.81 versus 9.20 ± 1.80) U/I, aspartate aminotransferase (8.50 ± 1.74 versus 8.48 ± 1.74) U/I, alkaline phosphatase (20.21 ± 1.41 versus 20.20 ± 1.40) U/I, wastes pickers with 2-5 years working experience versus the control group: alanine aminotransferase (9.24 ± 1.85 versus 9.20 ± 1.80) U/I, aspartate aminotransferase (8.51 ± 1.72 versus 8.48 ± 1.74) U/I, alkaline phosphatase (20.24 ± 1.43 versus 20.20 ± 1.40) U/I, revealed no statistical alterations ($p>0.05$). Wastes pickers with > 5 years working experience versus the control group: alanine aminotransferase (20.10 ± 2.75 versus 9.20 ± 1.80) U/I, aspartate aminotransferase (18.54 ± 1.79 versus 8.48 ± 1.74) U/I, alkaline phosphatase (20.25 ± 1.44 versus 20.20 ± 1.40) U/I, revealed statistical alterations ($p = 0.02$).

Alanine aminotransferase: Significant elevations were observed between > 5 years working experience waste pickers and each of < 2 years and between 2-5 years working experience and control group ($p= 0.02$)

Aspartate aminotransferase: Significant elevations were observed between > 5 years working experience waste pickers and each of < 2 years and between 2-5 years working experience and control group ($p= 0.02$).

Alkaline phosphatase: Significant elevations were observed between > 5 years working experience waste pickers and each of < 2 years and between 2-5 years working experience and control group ($p= 0.02$).

The mean values of these biochemical liver markers in the wastes pickers with < 2 years and between 2-5 years working experience showed normal liver status. This research supports [17] earlier's findings. However, as established in this study the wastes pickers with > 5 years working experience revealed abnormal liver status

In this study, creatinine and urea levels were measured to assess the kidney health of roadside rubbish pickers with working experience of < 2 years, 2-5 years and > 5 years, respectively.

As shown in Table 2 there was no discernible difference between the experimental group and the control group ($p = 0.96$). The mean plasma creatinine values for roadside waste pickers with < 2 years of experience are (75.02 ± 4.82) µmol/L as compared to the control group (75.00 ± 4.79) µmol/L, those with 2-5 years of experience are (75.05 ± 4.84) µmol/L as compared to the control group (75.00 ± 4.79) µmol/L, and those with > 5 years of experience are (75.06 ± 4.85) as compared to the control group (75.00 ± 4.79) µmol/L

The mean plasma urea levels in the roadside waste pickers with < 2 years of experience (6.08 ± 1.70) mmol/L compared to the control group (6.06 ± 1.68) mmol/L, 2-5 years of experience (6.10 ± 1.72) mmol/L compared to the control group (6.06 ± 1.68) mmol/L, and > 5 years of waste picking experience (6.12 ± 1.72) mmol/L compared to the control group (6.06 ± 1.68) mmol/L revealed no significant alterations ($p=0.92$)

The roadside garbage collectors in the corresponding experimental groups' mean results for these biochemical parameters point to normal renal function. This result is consistent with the earlier research by [17].

In order to assess the heart health and level of oxidative stress among roadside rubbish pickers with working experience of < 2 years, 2-5 years, and > 5 years, respectively, troponin-1 and creatinekinase-MB (cardiac biomarkers) and glutathione peroxidase as well as malondialdehyde (oxidative stress markers) were respectively measured in this study as shown in Table 3.

Table 3 Mean ± SD of cardio-oxidative-stress biomarkers measured among waste pickers with < 2 years 2-5 years and > 5 years working experience (experimental groups) compared with the non-waste pickers (control group)

Groups	Trop-1 ($x10^{-2}$ lU/L)	CKMB (IU/L)	GPX (µmol/L)	MDA (µmol/L)
Control (n=30)	1.60 ± 0.70	9.21 ± 1.22	4.02 ± 0.41	3.85 ± 0.36
<2years (n=30)	1.62 ± 0.71	9.23 ± 1.25	6.03 ± 0.40	5.07 ± 0.34
2-5 years (n=30)	1.63 ± 0.72	9.24 ± 1.23	7.05 ± 0.43	6.88 ± 0.37
>5years (n=30)	1.64 ± 0.74	9.24 ± 1.24	7.45 ± 0.51	7.72 ± 0.62
F-value	0.20	0.17	57.11	102.70
P-value	0.80	0.74	0.02	0.03

Roadside waste pickers with < 2 years of experience had plasma troponin-1 levels of (1.62 ± 0.71) $x10^{-2}$ lU/L that were not significant when compared with that of the control group (1.60 ± 0.70) $x10^{-2}$ lU/L, while those with 2-5 years of experience had plasma troponin-1 levels of (1.63 ± 0.72) $x10^{-2}$ lU/L that were not significant as compared with the control group (1.60 ± 0.71) and those with > 5 years of experience had insignificant plasma troponin-1 level of (1.64 ± 0.74) $x10^{-2}$ lU/L compared to the control group (1.60 ± 0.70) $x10^{-2}$ lU/L. There were no significant alterations between the experimental and control groups (p = 0.80).

The mean plasma creatinekinase-MB (CK-MB) levels in roadside garbage collectors with < 2 years of experience revealed (9.23 ± 1.25) IU/L compared to the control group (9.21 ± 1.22) IU/L, 2-5 years working experience (9.24 ± 1.23) IU/L compared to the control group (9.21 ± 1.22) IU/L, and > 5 years working experience (9.24 ± 1.24) IU/L compared to the control group (9.21 ± 1.22) IU/L. There were no significant alterations between the experimental and control groups (p = 0.74).

The mean values of these biochemical parameters among the roadside rubbish collectors in the corresponding experimental groups point to a normal cardiac state. This finding is as established in this study.

In order to determine the level of oxidative stress among roadside rubbish pickers with < 2 years, 2–5 years, and > 5 years of work experience, respectively, glutathione peroxidase and malondialdehyde were assessed. As demonstrated in Table 3, there was significant elevation (p = 0.02) between the mean plasma glutathione peroxidase levels of roadside waste pickers with < 2 years of experience (6.03 ± 0.40) µmol/L, 2-5 years of experience (7.05 ± 0.43) µmol/L, and > 5 years of experience (7.45 ± 0.51) µmol/L in comparison to the control group (4.02 ± 0.41) µmol/L.

The roadside rubbish pickers' mean plasma malondialdehyde level with < 2 years of job experience (5.07 ± 0.34), 2-5 years of work experience (6.88 ± 0.37), and > 5 years of work experience (7.72 ± 0.62), compared to the control group (3.85 ± 0.36) indicated a significant rise (p=0.03).

The raised mean values of these oxidative-stress biomarkers which are consistent with the earlier research by [17] may indicate that the roadside garbage collectors in the relevant experimental groups are under oxidative stress.

4. Conclusion

Roadside waste pickers may be prone to the risks of heavy metals poisoning, inflammatory disorder, hepatotoxicity and oxidative stress due to prolonged exposure to some hazardous substances in wastes.

Recommendations

- Wastes should be segregated into different categories before proper disposal
- Government should embrace roadside waste pickers and incorporate them into the organizational structure of solid wastes management system in order to ensure health and operational well-being.

Compliance with ethical standards

Acknowledgments

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Statement of ethical approval

All the procedures employed in this study were strictly in compliance with the ethical standards of Helsinki Principle of 1975 as revised in 2008. All the authors were responsible for the entire work.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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