

Assessment of occupational risks of waste scavenging in Ilorin metropolis

Yusuf Olanrewaju Raufu¹ Adewoye Solomon Olayinka²

Morufu Olalekan Raimi³ Sawyerr Henry Olawale¹

Oladimeji Lateefah Olabisi⁴

¹Department of Environmental Health Science, Kwara State University, Malete, Nigeria.,

²Department of Pure and Applied Biology, Ladoke Akintola University of Technology, Ogbomosho, Nigeria.,

³Department of Environmental Health Science, Kwara State University, Malete & Department of Environmental Management and Toxicology, Faculty of Sciences, Federal University, Otuoke, Bayelsa State, Nigeria.,

⁴Department of Public Health, Al-Hikmah University, Ilorin, Nigeria.

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ABSTRACT

Background: Economic situations in the third world nations had made waste scavenging a means of sustenance for millions of youth and women. Poor source segregation of wastes in developing countries has increased the potential for exposure to infections and other occupational hazards. **Objectives:** This study addressed issues relating to the potential occupational risks among scavengers in Ilorin metropolis. **Methods:** A cross-sectional study was conducted among the scavengers working on wastes dumpsite in Ilorin metropolis, Kwara State and 109 respondents were administered with questionnaires. The data was analysed using statistical package for social science for descriptive and inferential (t-test) at 5% level of significance. **Results:** Scavenging was found to be male dominated venture with over 90 percent respondents being of male gender and most respondents are in their prime as they are mostly between ages 21 – 30years and usage of PPE among scavengers was found to be very low. Most scavengers had not undergone any training prior to commencement of the job and prevalent diseases among them are fever, diarrhoea, cough and skin diseases with fever having highest occurrence. **Conclusions:** Regular trainings on occupational safety for scavengers, enforcement of personal hygiene practices, proper monitoring by regulatory agency and inclusion of scavengers in mandatory health insurance scheme will help to improve health status of scavengers.

Keywords: Hepatitis B Virus, Scavengers, Prevalence, Personal Protective Equipment (PPE), Ilorin metropolis, Health Insurance Scheme.

Introduction

Scavenging is an economic activity that provides employment for more than 15 million people worldwide [1-5]. In Nigeria, scavenging is a major source of income and generation of employment for unemployed youth [3-5]. It also serves as a major source of raw material for industries, bottling plants and plastic manufacturers [5, 6]. Wastes are materials considered unfit, unwanted or discarded due to economic reasons or ignorance of alternative technologies to re-use them [7, 8]. Wastes are generally inevitable remains from activities of human and animal and actions are required to manage the wastes from its inception to its final disposal [9-14]. International Labour Organisation (ILO) has defined wastes scavenging as physical selection of recyclable matter from muddled waste discarded at landfills, dumpsites, and places where waste is collected [15]. People who recover materials to sell for reuse or recycling and these individuals are generally known as ‘scavengers’ or rag pickers and the activity they undertake are called ‘scavenging’ [16]. Furthermore, Medina [1, 16] cites waste-picking as an example of sustainable development, emphasising that waste-picking activity enhances environmental protection by increasing the amount of waste collected, reused, and recycled, resulting in high indicators for energy saving, pollution prevention and pollution reduction. The system of waste salvaging, reclaiming or recycling is fast gaining ground in most cities today [17]. Poverty and lack of environmental regulations and enforcement in many developing countries made disposal to remain predominately by open dumping, often with associated open burning [14, 18], which creates thick smoke that contains carbon

monoxide, carbon dioxide, soot and nitrogen oxides, all of which are hazardous to human health, degrade air quality and contribute to global warming [19-25]. The generation of waste and the collection, processing, transport and disposal is important for both the health of the public and aesthetic, and environmental reasons [26, 27].

Health risk assessment remain a systematic approach in response to public health concern about the increasing incidences of health effects associated with occupational hazards due to industrialisation, urbanization and agricultural activities [28-32]. Thus, occupational exposure can be proximate exposure or directly leading to health conditions (such as physical, chemical and microbiological agents) and distal exposure or indirectly leading to health conditions (such as socioeconomic conditions, climate change and other broadly scale environmental issues). Proximate exposure occurs through inhalation, ingestion and skin contact. Whereas, distal exposure can cause adverse health issues directly by changing proximate exposure and indirect through change in ecosystems and other support systems for human health [14, 33-44].

Lack of proper municipal waste segregation and transportation techniques has increased the potential for the transmission of pathogens such as hepatitis B virus (HBV) [2, 3, 14, 45]. In the course of wastes scavenging activities, these individuals are regularly exposed to varying physical, biological and chemical hazards in addition to the dangerous exposure to poisonous gases, chemicals and fire hazards [46, 47]. Indiscriminate sorting of mixed wastes by scavengers has the potential for increased environmental exposure to air pollution [20-23], toxic emissions from combusted or burnt municipal waste, proliferation of vermin and spread of diseases like hepatitis [5, 23, 45, 48]. The use of protective devices has been proven to provide a reasonable measure of protection against accidents and incidents that present health risks to which scavengers are daily exposed in the course of their daily duties [49]. The lack of awareness, provision and none usage of protective equipment coupled with the ignorance of the waste handlers results in occupational health hazards due to different types of external injuries and infectious diseases [50].

There are evidences of occupational exposure in scavenging work because they are exposed to a wide variety of health hazards and risks which can occur via skin contact, injection, ingestion and inhalation [51-53]. The most common routes to some of the hazards includes incineration, skin contact, falling objects and electrocution. However, the hazards addressed in this study are those concerned with dump sites, wastes scavenging and refuse disposal. It is against this backdrop that the author decided to embark on a study to assess the occupational risks of wastes scavenging and the practice of the use of simple personal protective devices among scavengers at dumpsites in Ilorin metropolis.

Methods

Study Area

The city of Ilorin lies on latitude North 8°30' and longitude East 4° 35' near the southern fringe of the savannah and forest zone. It had a population of 777,667 in the 2006 census. It is surrounded by a wall about 10 miles in circumference and as high as 20 feet in some places. A large part of the province is located on grass plains with undulating landscapes which are well watered and highly agricultural. By the southern Nigeria provincial borders, at an elevation of 1,500 feet, there is a watershed with a river generally running from west to east and flowing into the River Niger [45, 46, 48]. The ecology of the region plays an important role in people's decisions to settle in a particular area. It has a mean annual rainfall of 1,318 mm (51.9 inches), which allows inhabitants to practice arable farming. The mild climate has also attracted northern pastoralists to the region. Ilorin city is the commercial and administrative center of Kwara State. It is made up of four local government areas (Ilorin South, Ilorin West, Ilorin East and Asa) [48].

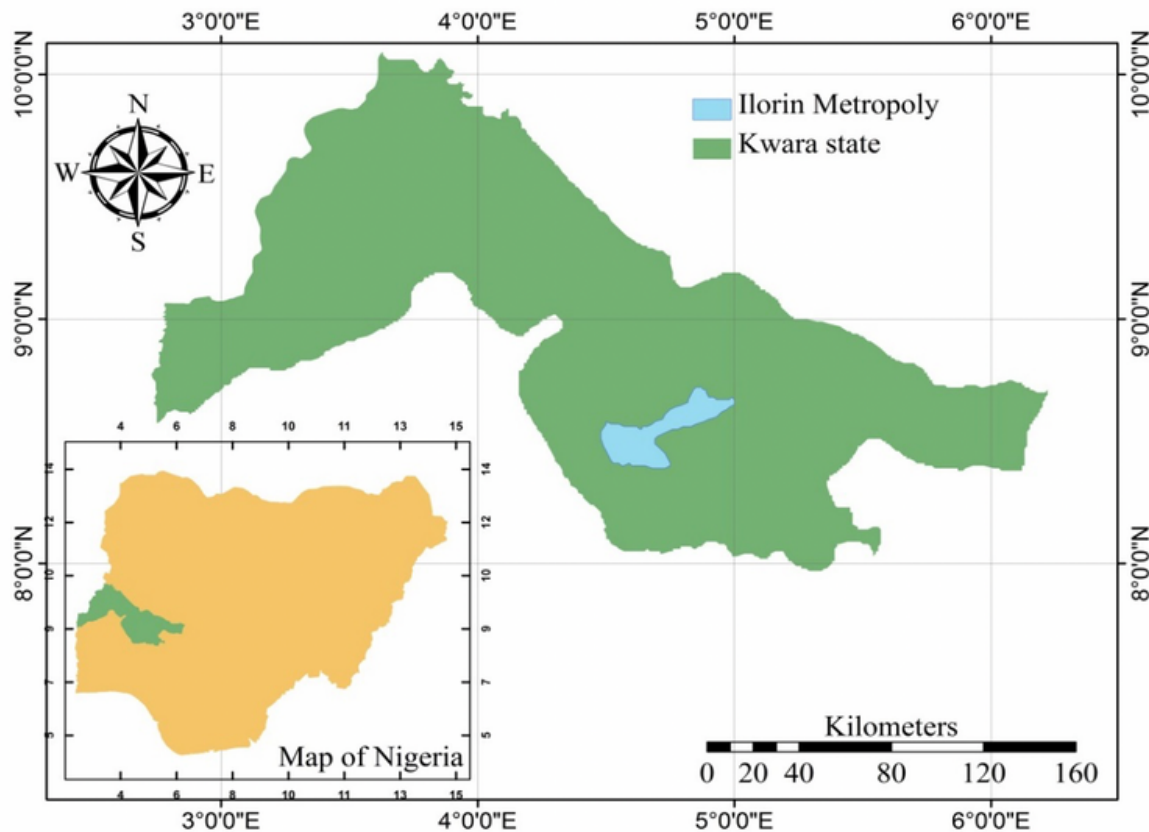


Figure 1: Map of Kwara State showing the study area. Adapted from Sawyerr *et al.*, [45].

Figure 1 above showed the map of Kwara state covering the three senatorial districts, but the research covers only the Ilorin metropolitan areas with the capital city of Kwara state.

Sampling Techniques

The sampling technique employed in the study was purposive, as only those identified as waste scavengers working with major scrap dealers and on the dumpsites were administered with questionnaires. Scavengers were selected from government dumpsites as well as registered scrap dealers through the Kwara State Environmental Protection Agency who oversee the wastes management of the metropolis. The sample size was determined using fishers sample size formula, the total sample size was determined as 110 including 10% non-response rate.

Data Instrument

The instrument used for this study was structured questionnaire. The questionnaires were interviewer-administered to the scavengers and where necessary the questions were translated to Hausa and Yoruba languages. Both open-ended and closed-ended questions were included in the questionnaire. The questionnaire was administered to the scavengers both on the dumpsites and in the evening at the scrap dealers' sites where the scavengers' gather after the day's work to sell their materials. All the participants were informed of the field research aims before the study, this was done to facilitate the data collection processes and to obtain their consents.

Data Analysis

Data was analysed using SPSS 23, using descriptive statistic such as mean, frequencies, charts and graphs.

Ethical Approval

Ethical clearance for this study was obtained from the Kwara State Ministry of Health Ethical Review Committee. Informed consent of participants were sought before taking part in the study.

Results

Socio-Demographic Characteristics of respondents

Presented below are the results of the respondents based on their age, marital status, educational level and tribal status respectively.

Table 1: Socio-demographic Characteristics of Respondents

Age	Frequency	Percent
10 – 20	29	26.4
21 – 30	42	38.2

31 – 40	20	18.2
41- 50	11	10
51-Above	8	7.2
Total	110	100.0
Gender	Frequency	Percent
Male	103	93.7
Female	7	6.3
Total	110	100.0

Tribe	Frequency	Percent
Hausa	96	87.3
Yoruba	14	12.7
Total	110	100.0
Marital Status	Frequency	Percent
Single	63	57.3
Married	47	42.7
Total	110	100.0
Educational Qualification	Frequency	Percent
None	34	30.9
Primary level	43	39.1
Secondary level	18	16.4
Tertiary level	1	0.9

Islamiyah	14	12.7
Total	110	100.0

Source: Authors' field survey, 2022

In table 1 above, the socio-demographic characteristics of scavengers revealed that majority of respondents are able-bodied individual with majority in the ages 21 – 30years with 38.2% with the least being ages 51years and above constitute the least age bracket with 7.2%. The gender distribution of respondents showed scavenging to be male dominated occupation with the population of male scavengers being 103 which constitute 93.7% of the total respondents. Tribal or ethnic distribution of respondents showed that majority of them are immigrants Hausa by tribe with 87.3% of total respondents and vast majority are unmarried with population of single respondents being 57.3% while the constitute 42%. Majority of the scavengers, 39.1% are with primary education while closely followed by those without formal education with 30.9%.

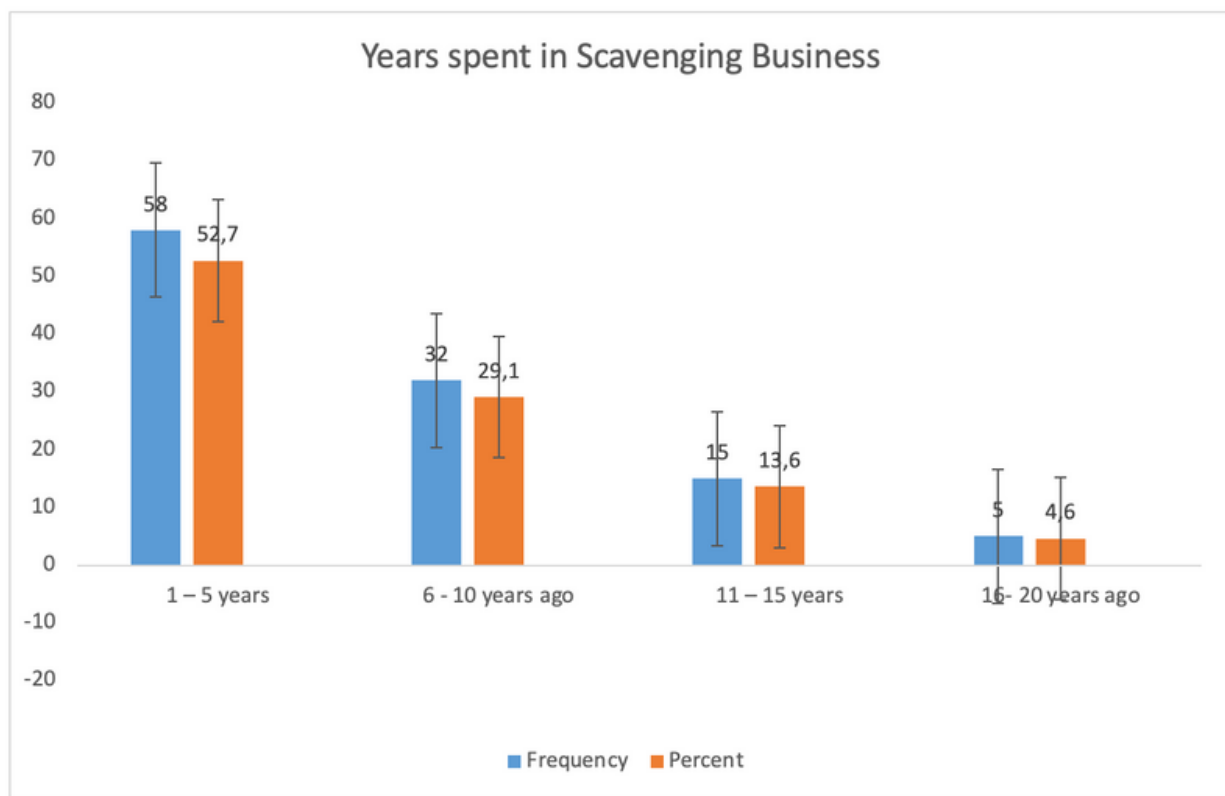


Figure 2: Duration of scavenging work among the respondents

Assessment of years spent in scavenging occupation showed in figure 2 above and majority of the respondents has been scavenging for 1-5 years and that made up of 52.7% with the least being 16-20 years with 4.6%.

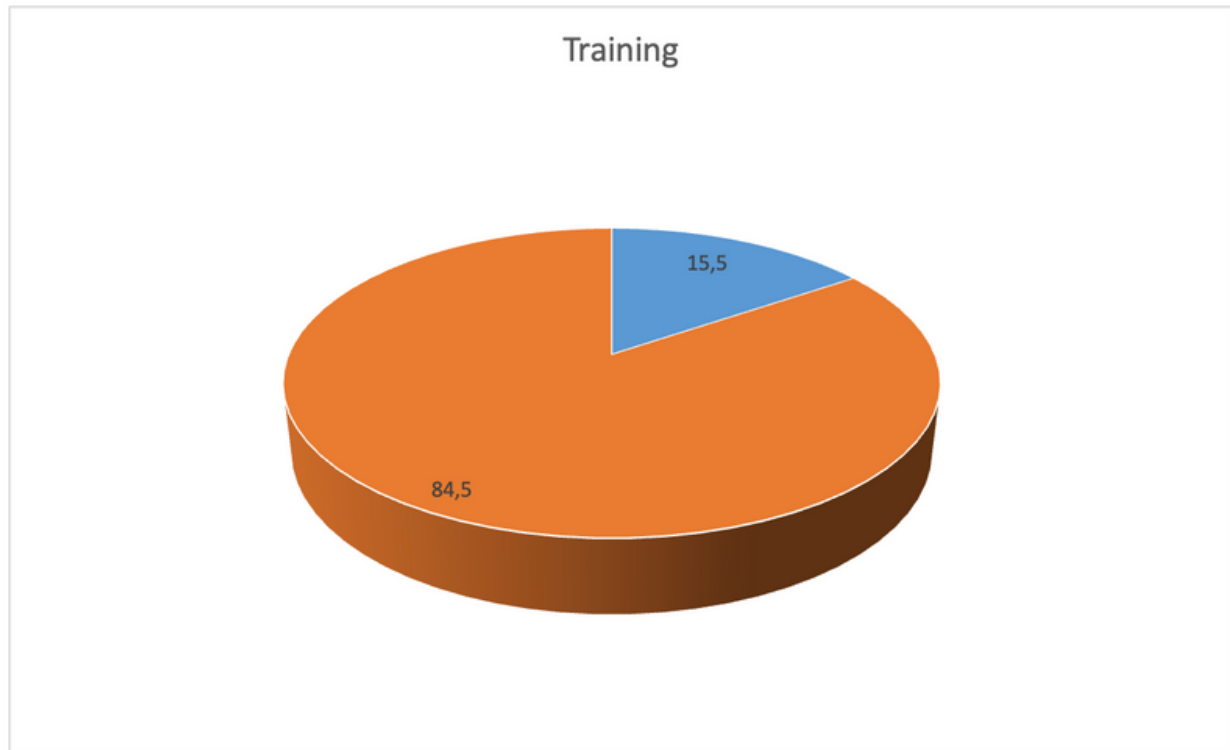


Figure 3: Attendance of any form of training on scavenging work

Figure 3 above assess training in wastes handling and occupational health among the wastes scavengers and it showed that majority of scavengers 84.5% have never received any training in wastes handling and safety procedures in terms of occupation health. Handful number 15.5% of scavengers indicated that they have attended a training.



Plate 1: Cross-section of scavengers at work on government dumpsite at Sokoto-Aiyekale
Source: Authors' field survey, 2022

Plate 1 above showed a cross-section of scavengers working on the government owned dumpsite, they can be seen scouting for recyclables within the co-mixed wastes stream entering into the dumpsites via different wastes disposal vehicles. This gives glimpse of occupational and health hazards exposed to by scavengers as most of them are not wearing protective gears.

Table 2: Unsafe Practices and Risks in Scavenging Work

Variables		Frequency	Percentage
Burning of Waste	No	26	23.6
	Yes	84	76.4
Total		110	100.0
Inhaling Smoke	No	33	30
	Yes	77	70
Total		110	100.0
Injuries during Scavenging	Always	20	18.2
	some time	83	75.5
	at no time	7	6.3
Total		110	100.0
Treatment of Injuries	leave to heal	17	15.4
	Self- treatment	35	31.8
	Clinic	29	26.4
	Chemist	29	26.4
Total		110	100

Usage of PPE	Yes	47	42.7
	No	63	57.3
Total		110	100.0

Source: Authors' field survey, 2022

Table 2 above displayed information concerning unsafe practices and risks in wastes scavenging, burning of wastes was found to be rampant as majority 76.4% indicated that they burn wastes to remove recyclables they needed. Also, most respondents 70% revealed they inhale smoke from the wastes burning. In terms of injuries during scavenging, it was found that 75.5% revealed that sometimes get injured during work while 18.2% said they always get injured during the course of their daily activities and those that said they don't get injured are just 6.3%. Treatment of injuries sustained during scavenging are mostly by self-treatment which 31.8% followed by clinic and chemist which are 26.4% each while the least to leave the wound to self-heal is 15.4%. Usage of personal protective equipment (PPE) is found to be 42.7%.

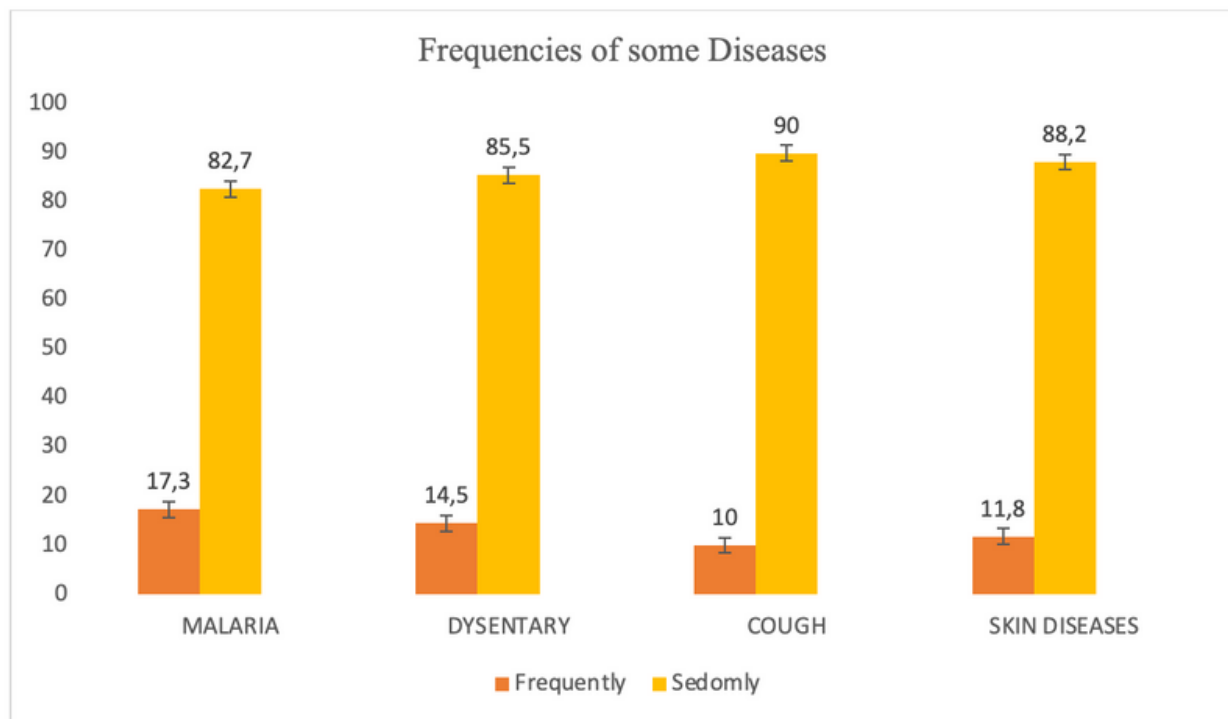


Figure 4: Prevalent diseases among scavengers and their frequencies of occurrence

Figure 4 showed diseases that are common among scavengers and the rate of occurrence of malaria is the most frequently occurred with 17.3% and malaria sedonly occurred 82.7%, this is closely followed by dysentery

which occurred at 14.5% and sedomly occurred at 85.5% and the least frequent disease is cough with occurrence of 10%.

Discussion

Scavengers are exposed to numerous hazards: such as infectious waste from hospitals, smoke and fumes from burning waste faeces, contaminated needles, toxic paper, heavy metals from batteries [54], bottles, chemical waste containers and harsh weather conditions [55]. As one author has noted, “In every session of the UN Permanent Forum on workers’ safety, since it was created in 2002, occupational safety has presented reports on how industries’ corporations have caused occupational hazards, environmental degradation [56-60], cultural ethnocide, and gross human rights violations” [61]. The results of this study revealed that majority of the respondents are able-bodied youths with highest percentage within 21 – 30years age bracket. This is in agreement with the findings of Irabor [62] that concluded that the highest population of scavengers i.e. 36% are in the age bracket 20 - 29 years and Yusuf *et al.*, [48, 63] in their study that revealed that the majority of the scavengers in their study are in the age bracket 21-30 years which is 45.4%. Scavenging is a male dominated occupation as seen in the results with male constituting 93.7% of respondents. This is in line with many studies among which are Mustafa [64], Oteng-Ababio [65] which stated that about 90% of the scavenger population are male while female scavengers constitute approximately 10% in Kumasi. Similarly, in another study male made up 86% of e-waste scavengers found at the Agbogboshie e-waste scrap yard in Accra as reported by Rankokwane and Gwebu [66]. Also, Yusuf *et al.*, [48], concluded that Scavenging job was found to be male dominated because 93.6% of respondents are male, while Afon [67] also corroborated the submission. Educational attainment of respondents showed that the highest number of scavengers are primary school certificate holders with 39.1% of respondents, this also conform with the Adebola, [68] in his work on wastes worker and scavengers where he found that majority (51.1%) of scavengers in Ibadan are primary school leavers. Yusuf *et al.*, [48] also concluded that majority of respondents are primary school leavers and Sawyerr *et al.*, [45] which also corroborated the other findings. The years spent in scavenging was examined and it was found that most respondents have spent between 1-5 years on the job and that constitute of 52.7% of the scavengers and this agreed with the findings of Asibor and Edjere [69] in which majority of scavengers had also worked for similar durations.

Training on wastes handling and occupational safety was found to be very low as majority 84.5% have never received any training in wastes handling and safety procedures before commencing scavenging and after starting the job. Unsafe practices and risks exposed to by scavengers during the course of their daily activities were examined and it was found that scavengers engaged in unsafe practises like wastes burning to remove precious components like copper from electric wires and to harvest some valuable recyclables embedded in the mixed wastes. The results showed that 76.4% of the respondents engaged in wastes burning and which those that said they inhale the smoke are 70% of the respondents which agreed with conclusion of Hashim *et al.*, [70] that said scavengers set fire on wastes but never utilized dust or smoke mask while picking and sorting

materials in their respective work place. The incidence of occupational injuries was found to be cumulatively high with 93.7% among which those that said they frequently get injured among them are 18.2% and those that seldomly sustained injuries are 75.5% this aligned with the findings of Adekiya [71] that said majority (90 %) of scavengers have sustained injuries from glass and sharp objects and about 71 % from nails and also in agreement with Ali and Yusuf [72] which found total of 78.6% scavengers sustained different kind of injuries during their scavenging activities. Majority of the respondent in this study relied on self-treatment which is similar to conclusion of Ali and Yusuf [72], Yusuf *et al.*, [48] Hashim *et al.*, [70] who also found that scavengers mostly treat their wounds by themselves.

Usage of Personal protective equipment was found to be 42.7% which pointed to deficiency of safety information and occupational sensitization. Those that make use of PPE are not properly making use of the safety gadgets. This finding is similar to the conclusion of Osunkalu [46] who stated that high level of awareness of impending health risk associated with the non-use of protective devices at dump sites did not translate to increase in the actual use of these protective devices. Some prevalent diseases were examined and it found that fever constituted the most reported complaint among the respondents, this is similar to the findings of Osunkalu [46] which concluded that it is apparent that the protective device usage among scavengers is still poor. The finding has also been supported by other study on some scavenger population in Nigeria by Nzeadibe [73-75]. Though occurrence of malaria fever in the Nigerian population is relatively high but high cases among the respondents may be connected to exposure to wide array of infectious pathogens and constant mosquito bites on the dumpsites.

Conclusion

Scavenging is becoming an occupation for all, male, female, old or young, especially with the current economic realities in the third world nations. The study revealed that scavengers are exposed to risk due to inhalation of smoke and dusts and they mostly suffered from malaria fever, cough, diarrhoea and skin rashes. It was also found that the majority of scavengers do not use personal protective devices and there is lack of knowledge on the dangers and health risks associated with scavenging among them which also contributed to them being prone to diseases. The researchers hereby recommend that scavenging be legalised, supervised and regulated with proper registration and clear guidelines for operatives. It is also advised that the government or nongovernmental organisations help educate scavengers and institute strict measures to ensure compliance to safety procedures. Efforts should be made by the government and other stakeholders to provide scavengers with PPE, thorough instructions on usage and enforcement of PPE usage among scavengers by relevant agencies of the government. In addition, educational campaigns, regular training on occupational health and safety programs, emphasis on good work practices and immunization of members of this occupational group against some infectious diseases like Hepatitis B Virus and compulsory enrolment in health insurance scheme of the government.

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Email: deentech06@gmail.com; morufuolalekan.raimi@gmail.com; raimimo@fuotuoike.edu.ng.

References

1. Medina, M. (2010) Scrap and Trade: Scavenging Myths. United Nations University; Our world 2.0 [online] New York: UNU (Published 2010) Available at: <http://ourworld.unu.edu/en/scavenging-from-25-waste/>.
2. Rauf, YO., & Raimi, MO. (2023). Wastes, Wastes, Everywhere Not A Place to Breathe: Redressing and Undressing Ilorin and Yenagoa City. *AfricArXiv*. <https://doi.org/10.21428/3b2160cd.52bfd7dd>.
3. Yusuf OR, Adewoye SO, Sawyerr HO, Morufu OR (2022) Incidence of Hepatitis B and C Viruses among the Scavengers in Kwara State, Nigeria. medRxiv preprint doi: <https://doi.org/10.1101/2022.01.26.22269849>.
4. Koleayo OO, Morufu OR, Temitope OW, Oluwaseun EO, Amos LO (2021) Public Health Knowledge and Perception of Microplastics Pollution: Lessons from the Lagos Lagoon, 10 May 2021, PREPRINT (Version 1) available at Research Square [<https://doi.org/10.21203/rs.3.rs-506361/v1>].
5. Raufu YO, Olayinka AS, Olawale SH, Raimi MO (2022). Incidence of hepatitis B and C viruses among the scavengers in Kwara State, Nigeria. *Microbes Infect Dis* 2022; Article-In-Press, DOI: 10.21608/mid.2022.118313.1241.
6. Asibor, I., and Edjere, O., (2017). Assessment of the Activities of Scavengers and their Economic Impacts on Waste Recovery in Warri Metropolis, Delta State Nigeria. *International Research Journal of Public and Environmental Health*, 4(2):22-29.
7. Okebukola, P.A.O (2001): *Our Environment, Our Destiny. A paper delivered at the distinguished lecture series of Adeniran Ogunsanya College of Education cited in STAN Environmental Education Series*, No. 5. P 1.

8. Ikechukwu, E. (2015) Assessment of the Activities of Scavengers in Obio/Akpor Local Government, Rivers State, Nigeria. *Journal of Environmental Protection*, 6, 272-280. doi: [10.4236/jep.2015.63027](https://doi.org/10.4236/jep.2015.63027).
9. Deinkuro NS, Charles WK, Raimi MO, Nimlang HN (2021) Environmental Fate of Toxic Volatile Organics from Oil Spills in the Niger Delta Region, Nigeria. *International Journal of Environment, Engineering and Education*, 3(3), pp.89-101.
10. Olalekan MR, Albert O, Iyingiala AA, Sanchez DN, Telu M (2022) An environmental/scientific report into the crude oil spillage incidence in Tein community, Biseni, Bayelsa state Nigeria. *J Environ Chem Toxicol*. 2022;6(4):01-06., doi:10.37532/pulject.2022.6(4);01-06.
11. Raimi OM, Sawyerr OH, Ezekwe CI, Gabriel S (2022) Many oil wells, one evil: comprehensive assessment of toxic metals concentration, seasonal variation and human health risk in drinking water quality in areas surrounding crude oil exploration facilities in rivers state, Nigeria. *International Journal of Hydrology*. 2022;6(1):23–42. DOI: 10.15406/ijh.2022.06.00299.
12. Olalekan MR, Abiola I, Ogah A, Dodeye EO (2021) Exploring How Human Activities Disturb the Balance of Biogeochemical Cycles: Evidence from the Carbon, Nitrogen and Hydrologic Cycles. *Research on World Agricultural Economy*. Volume 02, Issue 03. DOI: <http://dx.doi.org/10.36956/rwae.v2i3.426>.
<http://ojs.nassg.org/index.php/rwae>.
13. Okoyen E, Raimi M O, Omidiji A O, Ebuete A W (2020). Governing the Environmental Impact of Dredging: Consequences for Marine Biodiversity in the Niger Delta Region of Nigeria. *Insights Mining Science and technology* 2020; 2(3): 555586. DOI: 10.19080/IMST.2020.02.555586.
<https://juniperpublishers.com/imst/pdf/IMST.MS.ID.555586.pdf>.
14. Suleiman RM, Raimi MO and Sawyerr HO (2019) A Deep Dive into the Review of National Environmental Standards and Regulations Enforcement Agency (NESREA) Act. *International Research Journal of Applied Sciences*. pISSN: 2663-5577, eISSN: 2663-5585. DOI No. Irjas.2019.123.123.
www.scirange.com. <https://scirange.com/abstract/irjas.2019.108.125>.
15. ILO (International Labour organisation) (2004), Addressing the Exploitation of Children in Scavenging (Waste Picking): A Sematic Evaluation of Action in Child Labour. A Global Report for the ILO, ILO, Geneva, Switzerland.
16. Medina, M. (2007) *The World's Scavengers; Salvaging Sustainable Consumption and Production*, Indiana: Globalization and the Environment.
17. Bisong EF, Ajake A (2001): *Solid Waste Management for sustainable Rural Development* in Bisong, E. F. (ed): *Natural Resources Use and Conservation for sustainable Rural Development* (pp 101-145). BAAS International Company: Lagos.

18. Cointreau, S. (2006). Occupational and Environmental Health Issues of Solid Waste Management. Special Emphasis on Middle- and Lower- Income Countries. The World Bank, Washington D.C.
19. Rushton, L. (2003). Health Hazards and Waste Management. *British Medical Bulletin*. 68, 183-197.
20. Morufu OR, Tonye VO & Adedoyin OO (2021) Creating the Healthiest Nation: Climate Change and Environmental Health Impacts in Nigeria: A Narrative Review. *Scholink Sustainability in Environment*. ISSN 2470-637X (Print) ISSN 2470-6388 (Online) Vol. 6, No. 1, 2021 www.scholink.org/ojs/index.php/se. URL: <http://dx.doi.org/10.22158/se.v6n1p61>. <http://www.scholink.org/ojs/index.php/se/article/view/3684>.
21. Raimi MO, Adeolu AT, Enabulele CE, Awogbami SO (2018) Assessment of Air Quality Indices and its Health Impacts in Ilorin Metropolis, Kwara State, Nigeria. *Science Park Journals of Scientific Research and Impact* Vol. 4(4), pp. 060-074, September 2018 ISSN 2315-5396, DOI: 10.14412/SRI2018.074. http://www.scienceparkjournals.org/sri/pdf/2018/September/Olalekan_et_al.pdf. <http://www.scienceparkjournals.org/sri/Content/2018/September/2018.htm>.
22. Raimi MO, Adio ZO, Odipe OE, Timothy KS, Ajayi BS & Ogunleye TJ (2020) Impact of Sawmill Industry on Ambient Air Quality: A Case Study of Ilorin Metropolis, Kwara State, Nigeria. *Energy and Earth Science* Vol. 3, No. 1, 2020. URL: <http://dx.doi.org/10.22158/ees.v3n1p1>. www.scholink.org/ojs/index.php/ees ISSN 2578-1359 (Print) ISSN 2578-1367 (Online).
23. Raimi, O M., Samson, TK., Sunday, AB., Olalekan, AZ., Emmanuel, OO., & Jide, OT. (2021). Air of Uncertainty from Pollution Profiteers: Status of Ambient Air Quality of Sawmill Industry in Ilorin Metropolis, Kwara State, Nigeria. *Research Journal of Ecology and Environmental Sciences*, 1(1), 17–38. DOI: 10.31586/rjees.2021.010102. Retrieved from <https://www.scipublications.com/journal/index.php/rjees/article/view/60>.
24. Raimi MO, Tonye VO, Omidiji AO, Oluwaseun EO (2018) Environmental Health and Climate Change in Nigeria. World Congress on Global Warming. Valencia, Spain. December 06-07, 2018.
25. Raimi MO (2019) 21st Century Emerging Issues in Pollution Control. 6th Global Summit and Expo on Pollution Control May 06-07, 2019 Amsterdam, Netherlands.
26. Adeolu T., Odipe OE. and Raimi MO. (2018). Practices and Knowledge of Household Residents to Lead Exposure in Indoor Environment in Ibadan, Oyo State, Nigeria. *Journal of Scientific Research & Reports* 19(6): 1-10, 2018; Article NO. JSRR.43133 ISSN: 2320-0227.
27. El-Wahab, EWA., Eassa, SM., Lotfi, SE., Masry, SAE., Shatat, HZ., and Kotkat, AM., (2014). Adverse health problems among municipality workers in Alexandria (Egypt). *Int. J. Prevent. Med.* 5 (5), 545–556.

28. Saliu, AO., Komolafe, OO., Bamidele, CO., Raimi, MO. (2023). The Value of Biodiversity to Sustainable Development in Africa. In: Izah, S.C., Ogwu, M.C. (eds) Sustainable Utilization and Conservation of Africa's Biological Resources and Environment. Sustainable Development and Biodiversity, vol 888. Springer, Singapore. https://doi.org/10.1007/978-981-19-6974-4_10.
29. [Raimi MO](#), [Abiola OS](#), Atoyebi B, [Okon GO](#), [Popoola AT](#), [Amuda-KA](#), [Olakunle L](#), [Austin-AI](#) & [Mercy T](#). (2022). The Challenges and Conservation Strategies of Biodiversity: The Role of Government and Non-Governmental Organization for Action and Results on the Ground. In: Chibueze Izah, S. (eds) Biodiversity in Africa: Potentials, Threats, and Conservation. Sustainable Development and Biodiversity, vol 29. Springer, Singapore. https://doi.org/10.1007/978-981-19-3326-4_18.
30. [Raimi MO](#), [Austin-AI](#), [Olawale HS](#), [Abiola OS](#), [Abinotami WE](#), [Ruth EE](#), [Nimisingha DS](#) & [Walter BO](#) (2022). Leaving No One Behind: Impact of Soil Pollution on Biodiversity in the Global South: A Global Call for Action. In: Chibueze Izah, S. (eds) Biodiversity in Africa: Potentials, Threats and Conservation. Sustainable Development and Biodiversity, vol 29. Springer, Singapore. https://doi.org/10.1007/978-981-19-3326-4_8.
31. Raheem WB, Fadina OO, Idowu OO, Raimi MO, Austin-Asomeji I (2023) The Application of Biomaterials in Ecological Remediation of Land Pollution: Bioremediation of Heavy Metals in Cement Contaminated Soil Using White-Rot Fungus *Pleurotus sajor-caju*, 11 January 2023, PREPRINT (Version 1) available at Research Square [<https://doi.org/10.21203/rs.3.rs-2459820/v1>].
32. Glory R, Sylvester CI, Morufu OR and AustinAsomeji I (2023) Public and environmental health implications of artisanal petroleum refining and risk reduction strategies in the Niger Delta region of Nigeria. *Journal of Biological Research & Biotechnology*. Vol. 21 No.1; pp. 1836-1851. ISSN (print):1596-7409; eISSN (online):2705-3822. <https://dx.doi.org/10.4314/br.v20i3.6>. <http://www.bioresearch.com.ng>. Publisher: Faculty of Biological Sciences, University of Nigeria, Nsukka, Nigeria.
33. Oshatunberu, MA., Oladimeji, A., Sawyerr, OH., & Raimi, MO. (2023). Searching for What You Can't See - Evaluation of Pesticide Residues in Grain Sold at Selected Markets of Southwest Nigeria. *Current Research in Public Health*, 3(1), 10–36. Retrieved from <https://www.scipublications.com/journal/index.php/crph/article/view/566>.
34. Asiegbu OV, Ezekwe IC, Raimi MO (2022). Assessing pesticides residue in water and fish and its health implications in the Ivo river basin of South-eastern Nigeria. *MOJ Public Health*. 2022;11(4):136–142. DOI: 10.15406/mojph.2022.11.00390.
35. Clinton-Ezekwe IC, OSU IC, Ezekwe IC, Raimi MO (2022). Slow death from pollution: potential health hazards from air quality in the mgbede oil fields of south-south Nigeria. *Open Access J Sci*. 2022;5(1):61–69. DOI: 10.15406/oajs.2022.05.00177

36. Omoyajowo K., Raimi M., Waleola T., Odipe O., Ogunyebi A (2022) Public Awareness, Knowledge, Attitude and Perception on Microplastic Pollution around Lagos Lagoon. *Ecological Safety and Balanced use of Resources*, 2(24), 35-46. [https://doi.org/10.31471/2415-3184-2021-2\(24\)-35-46](https://doi.org/10.31471/2415-3184-2021-2(24)-35-46).
37. Hussain MI, Morufu OR, Henry OS (2021). Probabilistic Assessment of Self-Reported Symptoms on Farmers Health: A Case Study in Kano State for Kura Local Government Area of Nigeria. *Environmental Analysis & Ecology Studies* 9(1). EAES. 000701. 2021. DOI: 10.31031/EAES.2021.09.000701. Pp. 975- 985. ISSN: 2578-0336.
38. Hussain MI, Morufu OR, Henry OS (2021) Patterns of Chemical Pesticide Use and Determinants of Self-Reported Symptoms on Farmers Health: A Case Study in Kano State for Kura Local Government Area of Nigeria. *Research on World Agricultural Economy*. Vol 2, No. 1. DOI: <http://dx.doi.org/10.36956/rwae.v2i1.342>. <http://ojs.nassg.org/index.php/rwae/issue/view/31>
39. Morufu OR, Tonye VO, Ogah A, Henry AE, Abinotami WE (2021) Articulating the effect of Pesticides Use and Sustainable Development Goals (SDGs): The Science of Improving Lives through Decision Impacts. *Research on World Agricultural Economy*. Vol 2, No. 1. DOI: <http://dx.doi.org/10.36956/rwae.v2i1.347>. <http://ojs.nassg.org/index.php/rwae/issue/view/31>
40. Morufu OR (2021). "Self-reported Symptoms on Farmers Health and Commonly Used Pesticides Related to Exposure in Kura, Kano State, Nigeria". *Annals of Community Medicine & Public Health*. 1(1): 1002. <http://www.remedypublications.com/open-access/self-reported-symptoms-on-farmers-health-and-commonly-used-pesticides-related-6595.pdf>. <http://www.remedypublications.com/annals-of-community-medicine-public-health-home.php>.
41. Isah, HM., Sawyerr, HO., Raimi, MO., Bashir, BG., Haladu, S. & Odipe, OE. (2020). Assessment of Commonly Used Pesticides and Frequency of Self-Reported Symptoms on Farmers Health in Kura, Kano State, Nigeria. *Journal of Education and Learning Management (JELM)*, HolyKnight, vol. 1, 31-54. doi.org/10.46410/jelm.2020.1.1.05. <https://holynight.co.uk/journals/jelm-articles/>.
42. Olalekan RM, Muhammad IH, Okoronkwo UL, Akopjubaro EH (2020). Assessment of safety practices and farmer's behaviors adopted when handling pesticides in rural Kano state, Nigeria. *Arts & Humanities Open Access Journal*. 2020;4(5):191–201. DOI: 10.15406/ahoaj.2020.04.00170.
43. Isah HM, Raimi MO, Sawyerr HO, Odipe OE, Bashir BG, Suleiman H (2020) Qualitative Adverse Health Experience Associated with Pesticides Usage among Farmers from Kura, Kano State, Nigeria. *Merit Research Journal of Medicine and Medical Sciences* (ISSN: 2354-323X) Vol. 8(8) pp. 432-447, August, 2020. DOI: 10.5281/zenodo.4008682. <https://meritresearchjournals.org/mms/content/2020/August/Isah%20et%20al.htm>.

44. Raimi MO, Sawyerr HO and Isah HM (2020) Health risk exposure to cypermethrin: A case study of kano state, Nigeria. *Journal of Agriculture*. 7th International Conference on Public Healthcare and Epidemiology. September 14-15, 2020 | Tokyo, Japan.
45. Sawyerr, HO, Yusuf, OR. and Adeolu AT (2016). Risk Factors of Hepatitis B Virus infection among Municipal Waste Management Workers and Scavengers in Ilorin, Kwara State, Nigeria.
46. Osunkalu VO, Onajole AT, Alalade TO, Akanmu ON (2007): Use of Protective Devices: Awareness and Practice among Scavengers at Dump sites in Lagos, Nigeria. *Journal of Clinical Sciences*, 7(2) July–December.
47. Raimi MO, Ayinla LO, Ogah A (2021) First to Respond, Last to Leave: The Role of Para-Military Agencies in Disaster Management: Evidence from Nigeria. *Sumerianz Journal of Medical and Healthcare*, 2021, Vol. 4, No. 2, pp. 96-100 ISSN(e): 2663-421X, ISSN(p): 2706-8404 Website: <https://www.sumerianz.com> DOI: <https://doi.org/10.47752/sjmh.42.96.100>. <https://www.sumerianz.com/?ic=journal-home&journal=31&info=archive-detail&month=06-2021&issue=2&volume=4>.
48. [Yusuf OR](#), [Sawyerr HO](#), [Adeolu AT](#), [Habeeb LM](#), and [Abolayo TT](#). (2018). Seroprevalence of Hepatitis B Virus and Compliance to Standard Safety Precautions among Scavengers in Ilorin Metropolis, Kwara State, Nigeria. *JHealthPollu*; 8(19): 180914. Published online doi: [10.5696/2156-9614-8.19.180914](https://doi.org/10.5696/2156-9614-8.19.180914)
49. Bamgbose O, Arowolo TA, Oresanya O, Yussuf AA (2000). Assessment of Urban Solid Waste Management Practices in Lagos, Nigeria. *African Scientist*; 1(1): 23–34.
50. Thakur, P., Ganguly, R., and Dhulia, A. (2018). Occupational Health Hazard Exposure among municipal solid waste workers in Himachal Pradesh, India. *Waste Management* 78, 483-489.
51. Health and Safety Executive (2007). Health hazards in the waste and recyclable industry. Waste15. Retrieved on 23 September, 2013 at [waste15.pdf](http://www.waste15.pdf).
52. Tchobanoglous, G. and Kreith, F. (2002). Handbook of Solid Waste Management. Second Edition. McGraw-Hill Inc., New York. Thakur, P., Ganguly, R., and Dhuli.
53. Suleman, Y., Darko, E.T., and Agyemang-Duah, W. (2015). Solid Waste Disposal and Community Health Implications in Ghana: Evidence from Sawaba, Asokore Mampong Municipal Assembly. *J Civil Environ Eng*. 5 (6), 202- 222
54. Henry OS, Morufu OR, Adedotun TA & Oluwaseun EO (2019) Measures of Harm from Heavy Metal Pollution in Battery Technicians' Workshop within Ilorin Metropolis, Kwara State, Nigeria. *Scholink Communication, Society and Media* ISSN 2576-5388 (Print) ISSN 2576-5396 (Online) Vol. 2, No. 2, 2019 www.scholink.org/ojs/index.php/csm. DOI: <https://doi.org/10.22158/csm.v2n2p73>.

55. Al-Khatib IA, Al-Sari MI, and Kontogianni S (2020) Assessment of Occupational Health and Safety among Scavengers in Gaza Strip, Palestine. *Journal of Environmental and Public Health*. Vol. 2020 <https://doi.org/10.1155/2020/3780431>
56. Raimi MO, Bilewu OO, Adio ZO, Abdulrahman H (2019) Women Contributions to Sustainable Environments in Nigeria. *Journal of Scientific Research in Allied Sciences*. 5(4), 35-51. ISSN NO. 2455-5800. DOI No. 10.26838/JUSRES.2019.5.4.104.
57. Raimi MO, Suleiman RM, Odipe OE, Salami JT, Oshatunberu M, *et al* (2019). Women Role in Environmental Conservation and Development in Nigeria. *Ecology & Conservation Science*; 1(2): DOI: 10.19080/ECO.A.2019.01.555558. Volume 1 Issue 2 - July 2019. <https://juniperpublishers.com/ecoa/pdf/ECO.A.MS.ID.555558.pdf>
58. Raimi MO, Odubo TR, Ogah A (2022) Women, Water and Development in the Global South. Oral Presentation Presented at the Multidisciplinary International Conference on Water in Africa (ICWA 2022) on the theme: Towards Successful Delivery of SDGs 3 & 6, which held February 09 – 11, 2022.
59. Raimi MO, Odubo TR, Odubo TV, Omidiji AO (2022) Gender and Sustainability in the Niger Delta. Oral Presentation Presented at the Multidisciplinary International Conference on Water in Africa (ICWA 2022) on the theme: Towards Successful Delivery of SDGs 3 & 6, which held February 09 – 11, 2022.
60. Olalekan RM, Omidiji AO, Williams EA, Christianah MB, Modupe O (2019). The roles of all tiers of government and development partners in environmental conservation of natural resource: a case study in Nigeria. *MOJ Ecology & Environmental Sciences* 2019;4(3):114–121. DOI: 10.15406/mojes.2019.04.00142.
61. Efiok, J.N, Oluseye, O, Uduak, T and Olalekan, R (2015) Safety Culture, Policies and Practices in Nigeria Maritime Industry: The Exxon – Mobil Experience. *Open Journal of Safety Science and Technology*, 5, 69-76. <http://dx.doi.org/10.4236/ojsst.2015.53009>.
62. Irabor GA and Oghenekohwiro E (2017) Assessment of the activities of scavengers and their economic impacts in waste recovery in Warri metropolis, Delta State Nigeria. *International Research Journal of Public and Environmental Health* Vol.4 (2),pp. 22-29, February 2017 Available online at <https://www.journalissues.org/IRJPEH/> <https://doi.org/10.15739/irjpeh.17.003>.
63. Yusuf OR, Adewoye SO, Sawyerr HO (2022) Residents' Perception on Central Storage of Solid Wastes in Ilorin Metropolis, Kwara State. Nigeria, February 15, 2022 medRxiv preprint doi: [https://doi.org/10.1101/2022.02.14.22270939].
64. Mustafa N (1993). *Plastics waste management: disposal, recycling and reuse*. New York: M. Dekker. 413 p.

65. Oteng-Ababio M (2012). When Necessity Begets Ingenuity: E-Waste Scavenging as a Livelihood Strategy in Accra, Ghana. *African Studies Quarterly*;13.
66. Rankokwane, B., & Gwebu, TD. (2006). Characteristics, threats and opportunities of landfill scavenging: The case of Gaborone-Botswana. *GeoJournal*, 65(3), 151-163.
67. Afon A., (2012) "A survey of operational characteristics, socioeconomic and health effects of scavenging activity in Lagos, Nigeria," *Waste Management and Research*, vol. 30, no. 7, pp. 664–671, 2012.
68. Adebola, O. O (2006). 'The Roles of Informal Private Sector in Integrated Solid Waste Management in the Achievement of Millennium Development Goals (MDG's) in Lagos Nigeria' (Solid Waste, Health & Millennium Development Goals, CWG-WASH Workshop, Kolkata.
69. Asibor, I., and Edjere, O., (2017). Assessment of the Activities of Scavengers and their Economic Impacts on Waste Recovery in Warri Metropolis, Delta State Nigeria. *International Research Journal of Public and Environmental Health*, 4(2):22-29.
70. Hashim M, Paul N, Robert K, Richard K (2020) Awareness of scavenging waste pickers on occupational hazards in selected dumpsites in Nairobi metropolis, Kenya. *IOSR Journal of Humanities and Social Science (IOSR-JHSS)* Volume 25, Issue 12, Series 2 (December. 2020) 38-46 e-ISSN: 2279-0837, p-ISSN: 2279-0845. www.iosrjournals.org.
71. Adekiya, O. (2021). Assessment of occupational health risk and awareness of scavengers to covid-19 in Abuja municipal area council, Nigeria. *American Journal of Health, Medicine and Nursing Practice*, 6(1), 18 - 31. <https://doi.org/10.47672/ajhmn.658>.
72. Ali AF and Yusuf FI (2021) Prevalence of injuries among waste pickers. A case study in Nigeria. *Detritus / Volume 17 - 2021 / pages 89-96* <https://doi.org/10.31025/2611-4135/2021.15144> © 2021 Cisa Publisher. Open access article under CC BY-NC-ND license.
73. Nzeadibe TC (2009). Solid waste reforms and informal recycling in Enugu urban area, Nigeria. *Habitat International*; 33(1): 93–99.
74. Yusuf OR, Adewoye SO, Sawyerr HO (2022) Residents' Perception on Central Storage of Solid Wastes in Ilorin Metropolis, Kwara State, Nigeria. *ES Journal of Public Health*: www.escientificlibrary.com Volume 3 Issue 1.
75. Yusuf RO, Oyewumi MO (2008). Qualitative assessment of methane generation potential for municipal solid wastes: a case study. *Environmental Research Journal, Medwell Journals* 2(4): 138-144.