

Evaluation of the Occupational Safety of Scavengers at Two Privately Managed Municipal Solid Waste Dumpsites

Erinola, N. G.¹, Eghomwanre, A. F. ^{1*}, and Aighewi, I. T.¹

¹Department of Environmental Management and Toxicology, University of Benin, Benin City, Nigeria

*Corresponding Author Email: frank.eghomwanre@uniben.edu; Tel:+2348078676606

Abstract

The informal waste sector is a vital component of urban waste management in Nigeria, and waste collectors are very susceptible to chemical, biological and physical risks. In this study, occupational hazard prevalence, personal protective equipment (PPE) adoption, and health outcomes among scavengers at two dumpsites in Edo state were evaluated. The study was carried out at two privately operated municipal solid waste (MSW) dumpsites (Wemtap and Anthas) approved by the Edo State Waste Management Board with well-structured questionnaires. A convenience sampling technique was used, and a total of 140 out of 180 questionnaires were returned and analysed by descriptive statistics. Among the scavengers at the two privately operated recycling centers studied, most of the workforce was female (62.9%) and literate (62.1%) and had secondary education. The data revealed that 59.2% of the scavengers worked for more than 8 hours, and 29.3% used bare hands to sort out the waste. The level of personal protective equipment (PPE) compliance was very low: 35.0% of the respondents wore slippers/sandals, and 27.9% did not use any respiratory protection. Malaria was the most common health problem among the study participants (60.2%), followed by chronic headaches (25.4%), cuts (22.0%) and musculoskeletal pain (20.0%). Inferential analysis revealed that across physical trauma and respiratory hazards, high awareness failed to translate into proportional safety practices, creating statistically significant gaps ($p < 0.001$), whereas biological hazard protection aligned closely with awareness, with no statistically significant disparity ($p = 0.201$). Although hazard literacy was high, protective behaviour adoption remained low because of economic constraints, confirming a pronounced awareness–practice gap within this population. It is recommended that the Edo State Government formalises the sector through the provision of PPE, site-based clinics for the vaccination and treatment of injury care, and training in health and safety to integrate these workers into a safer circular economy.

Keywords: Occupational safety, Scavengers, Municipal Solid Waste (MSW), Edo state, Hazard exposure, PPE utilization

Introduction

Manual sorting and collection of recyclable and/or reusable wastes from mixed waste streams, known as scavenging, has become a vital but dangerous part of urban waste management in developing countries (ILO 2002). Kaza *et al.* (2018) predicted that the global amount of waste will increase by 70% in the next 30 years because of the combined effect of global economic development, increasing urbanisation and rapid population growth, which will result in 3.40 billion metric tonnes of waste per year by 2050. This trend is especially alarming for low-income and developing countries, which are expected to experience more than threefold growth in the amount of waste over the same period (Kaza *et al.*, 2018). This growing waste of more than 32 million tonnes per year in Nigeria has exceeded the capacity of formal waste management systems, which constitute between 20 and 30% of the total waste collected (Bakare, 2016). Discarded metals, plastics, paper and glass are among the primary sources of raw materials for various industries, with more than 15 million people globally earning a living from them through waste collection (Asibor and Edjere, 2017; Kodiya *et al.*, 2023). With insufficient funding, low collection rates and a lack of formalized material recovery facilities in Nigeria, this informal sector plays a crucial role in the waste management chain. Scavengers are an important part of the ecosystem, as they help to remove waste that would otherwise

be dumped in landfills; however, they are doing so at the expense of their personal safety and physiological health.

Overall, occupational hygiene policies and implementation in Nigeria (Emetumah *et al.*, 2025) are still generally in their infancy, including the protection of municipal solid waste scavengers. The working environment of the scavengers in Nigerian urban centers, particularly in the state of Edo, is occupied by open dump sites without any engineered landfill. MSW dumpsites are therefore complex stores of physical, chemical and biological stressors to the environment. Typically, scavengers operate with little equipment, often with just iron hooks or bare hands, to move across garbage dumps, which may contain hazardous medical waste, such as contaminated sharp objects, industrial chemicals, and organic waste that has been broken down (Adekiya and Anokwu, 2020). This will give rise to an exposure profile with a high incidence of lacerations and muscular injuries due to the presence of heavy loads and a constant risk of contracting zoonotic or blood-borne infections (Oketola and Adeyemi, 2019). In addition to direct physical injury, the toxicological effects of municipal dumpsites are immense (Al-Khatib *et al.*, 2020). Waste dumping or accidental burning of waste in places such as Benin city emits persistent organic pollutants (POPs) (dioxins and furans) in addition to the large amount of fine particulate matter (PM_{2.5}) (Eghomwanre and Edokpolo, 2025). Chronic inhalation of these combustion byproducts, combined with exposure to bioaerosols from decaying matter, predisposes scavengers to a range of respiratory and dermal ailments (Thirarattanasunthon *et al.*, 2012; Magaji and Darkye, 2011). Despite the reported risks, the safety literacy and protective behaviour of these workers are poor and are usually fuelled by a set of factors, such as socioeconomic marginalization, institutional training inefficiency, and the profound pressure of economic sustenance (Oyelola *et al.*, 2018).

The Edo State Waste Management Board (ESWMB) handles municipal solid waste in Edo State. Nevertheless, like other regional agencies in Nigeria, the emphasis is always on waste collection and disposal as opposed to the occupational protection of informal workers who frequent these dumpsites (Adekola and Ogundipe, 2017). As the state seeks to modernize its environmental policies, it becomes imperative to transition from a purely economic understanding of scavenging to a health-centered “Occupational Safety” framework (Federal Ministry of Environment, 2015). This study, therefore, seeks to evaluate the specific hazard profiles and health risk potentials inherent in the scavenging activities within Edo State, providing the empirical baseline necessary for future safety interventions and policy formulation. Although municipal waste scavengers play crucial roles in the circular economy and waste-to-wealth transformation in Nigeria, they remain the most biologically and chemically vulnerable segment of the informal workforce (Usman and Adubasim, 2026). The proliferation of open-pit dumping and the absence of engineered landfills has resulted in a high-risk occupational environment in Edo state and elsewhere, as the scavengers are exposed to several health risks, such as physical trauma due to the lack of mechanical sorting facilities; frequent fires plumes during spontaneous dumpsite fires (Dabrowska *et al.*, 2023); and odour and high pathogenic loading due to the mixture of medical and faecal waste and municipal solids.

Moreover, there is still profound systemic neglect and an absence of baseline data on occupational safety and health (OSH) guidelines in the South–South region (Ncube and Kanda, 2018). Most available Nigerian studies focus heavily on the Lagos and Abuja corridors, leaving the dumpsite dynamics of Edo State, characterized by high tropical humidity and unregulated waste streams, under documented compared with Lagos and Abuja. (Aderogba and Afelumo, 2012; Adekola *et al.*, 2021; Owolabi *et al.*, 2024). In the absence or paucity of data regarding the prevalence of injuries and the degree of hazard consciousness among these workers, one cannot apply the regulatory interventions and protective structures needed to protect this marginalized population. The need to bridge the gap between theoretical waste management policy and the physical safety of informal workers justifies this study. As Edo State transitions toward modernized waste

management systems, establishing the health risk profile of scavengers is critical to protect human receptors from hazardous working conditions. By determining common occupational injuries and illnesses, this research provides an empirical foundation for formulating targeted personal protective equipment (PPE) requirements and safety guidelines. Furthermore, equipping the Edo State Waste Management Board (ESWMB) with evidence-based data helps mitigate broader public health threats, such as the transmission of zoonotic and blood-borne pathogens into the wider community (Sangkachai *et al.*, 2024), while supporting formalization of the informal recycling sector.

Geographic and methodological gaps persist in the literature, as most waste scavenging research remains concentrated in northern and southwestern Nigeria, leaving Edo State's unique dumpsite dynamics largely uncharacterized. Previous regional studies, such as Asibor and Edjere (2017) and Magaji and Darkye (2011), evaluated income generation and material recovery rates but omitted measurements of injury incidence and PPE compliance. Similarly, *Kodiya et al.* (2023) profiled socioeconomic benefits without linking environmental exposures to clinical health outcomes. This methodological gap leaves safety literacy, hazard perception, and occupational accident frequency empirically unexamined in the South–South region. This study aimed to evaluate the demographic and operational characteristics, PPE compliance levels, occupational injury and illness prevalence, and the relationship between hazard awareness and protective behaviour adoption among waste scavengers across two dumpsites in Edo state.

Materials and Methods

Study area and population

The research was conducted in the capital of Edo state in southern Nigeria. Geographically, the metropolis is located between 6°12'N and 6°33'N and between 5°32'E and 5°45'E, with an average elevation of approximately 80 m above sea level. The study was carried out in August 2023, during the peak of the rainy season in Edo State. This timing was chosen to capture malaria and vector-borne disease prevalence under maximum exposure conditions, but it may overestimate respiratory and infectious disease burdens relative to the dry season (November–March). The data were collected at two popular municipal waste dumpsites, namely, Wemtap and Anthas. They are privately run recycling centers approved by the Edo State Waste Management Board and situated in the Oredo Local Government Area of Benin City. As the target group, informal waste scavengers servicing the abovementioned recycling businesses are taken. They serve key but largely unregulated functions in the circular economy, such as collecting, sorting, recovering and reselling waste materials. The group was chosen because it faces a high risk of exposure to unsanitized environments, without a formal occupational safety and health (OSH) framework of protection.

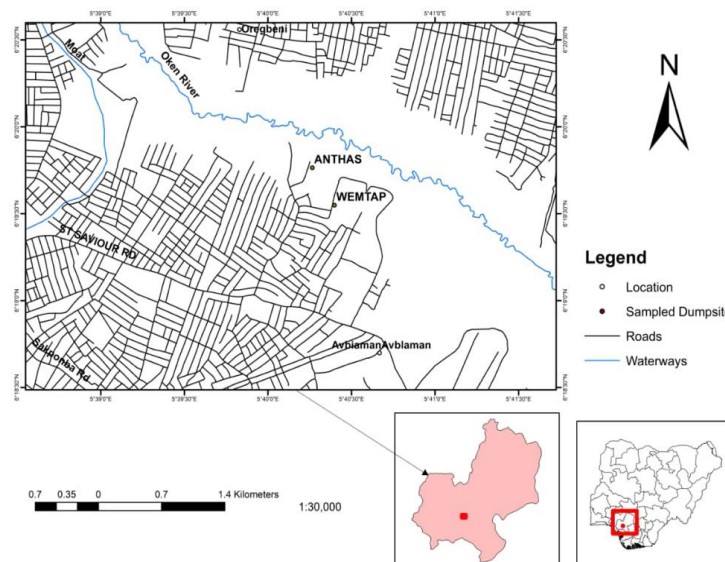


Figure 1: Map of Edo State, showing the study location

Sampling Technique and Sample Size

A definitive and fixed sampling frame was not available because the scavenging activities were highly mobile, fluid and informal. Therefore, a nonprobability convenience sampling technique was used after permission was obtained from the proprietors of the two recycling businesses. This was done to select participants because they were operating at dumpsites and were willing to participate during the study period. This pragmatic approach was a matter of necessity given the logistical constraints and the “hard-to-reach” nature of the marginalised scavenger community but was not required by the need for sampling bias to be accepted as a limitation of the probability sampling methods.

Sample size and participant selection

The required sample size for this study was calculated using Cochran’s formula for unknown or large populations, expressed as Equation 1:

$$n_0 = \frac{(Z^2 p q)}{e^2} \quad (\text{Equation 1})$$

where:

Z is the Z score at the 95% confidence level (1.96).

p is the estimated proportion of the attribute present in the population (set at 0.5 to ensure the maximum possible sample size). q is 1–p (0.5).

e is the desired margin of error (± 0.08 or 8%).

An 8% margin of error was selected to balance statistical precision with the extreme practical constraints of researching an informal, non-enumerated, and transient population. This approach aligns with the methodological guidelines for sampling hard-to-reach or vulnerable occupational groups where complete sampling frames do not exist and fluid working schedules hinder multi-stage sampling protocols (*Johnston et al.*, 2016). With these parameters, the minimum size of the sample calculated was approximately 150. For most broad occupational surveys, a 5% margin of error is applied, but in this instance, an 8% margin of error was applied because of acute logistical constraints, inaccessibility of this marginalised population and limitedness in the scope of the two privately owned dumpsites. Therefore, a total of 180 questionnaires were given in both study areas (Wemtap and Anthas) to explain the non-response or missing data.

Participation was voluntary. To minimize selection bias within an un-enumerated informal workforce, a systematic sampling scheme was layered onto site-based opportunistic recruitment: field researchers approached every k-th scavenger (e.g., every 3rd individual arriving at or operating along active dumping faces) at regular time intervals throughout daily peak scavenging hours. Among the 180 instruments distributed, 140 were retrieved and found to be valid for analysis (77.8% response rate). The 40 excluded cases (22.2% non-response) were due to incomplete forms or non-return. We could not assess whether non-respondents differed systematically from respondents in terms of age, sex, or injury history, which represents a study limitation.

Data collection instrument

A 28-item structured questionnaire was developed on the basis of prior OSH instruments used in Nigerian informal sectors (*Oyelola et al.*, 2018; *Nyathi et al.*, 2018). The instrument was pilot tested with 15 scavengers (not included in the final sample) to ensure clarity and cultural appropriateness. The instrument was administered directly by trained researchers to ensure data integrity, with technical terms translated into local dialects as needed. The questionnaire was divided into 6 thematic areas: (1) sociodemographic and professional profiles; (2) workplace practices and PPE utilization; (3) hygiene and environmental risks; (4) hazard perception and health literacy; (5) reported health outcomes; and (6) psychosocial impact.

Data analysis

Descriptive and inferential statistics were used for quantitative data analysis. Categorical variables, such as sociodemographic characteristics, PPE utilization levels, and reported illness/injury frequencies, are presented as simple frequencies and percentages. To evaluate the relationships and statistical differences between hazard risk perception (awareness) and actual protective behaviour across specific hazard domains (physical, respiratory, and biological risk), the chi-square (χ^2) test of independence was performed. Statistical significance was established at $p < 0.05$.

Results and Discussion

Sociodemographic profile of the respondents

The sociodemographic characteristics of the surveyed municipal waste scavengers ($n=140$) in this study are presented in Figure 2. The results reveal a workforce dominated by females, who constitute 62.9% ($n=88$) of the total sample. Unlike traditional municipal dumpsites across West Africa, which are typically dominated by men, this informal waste workforce is predominantly female (62.9%). This highlights strong regional variations in informal labour across Nigeria compared with male-heavy regions such as Adamawa State (John and Adewole, 2026). The high number of women is driven by the business model of private recycling companies (Wemtap and Anthas). These facilities focus on recovering lightweight, pre-segregated materials (PET bottles, plastics, nylon, paper) rather than heavy scrap metals. This lowers the physical entry barrier and makes it easier for women to participate. While this sorting work provides vital economic survival for women, it creates severe public health risks. Because these women handle waste within a complex human–animal–environment interface (Sangkachai *et al.*, 2024), they face constant exposure to active dumpsite pathogens. The results revealed that the age distribution metrics of the workforce overwhelmingly included individuals in their prime productive years, with 86.4% of the respondents falling within the active demographic bracket of 19 to 50 years (Figure 2). With respect to educational background, most of the scavengers possess a baseline level of formal literacy. Secondary education emerged as the most prevalent milestone, achieved by 62.1% ($n=87$) of the cohort, followed by primary school education at 17.9% ($n=25$). Notably, 11.4% of the respondents held higher education degrees (tertiary and postgraduate). This reveals that a lack of formal employment opportunities drives highly qualified graduates to engage in hazardous, informal waste picking.

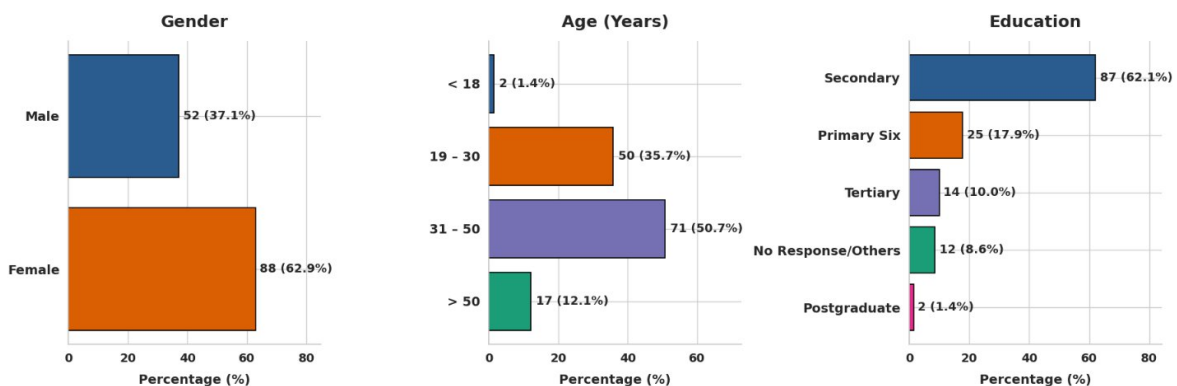


Figure 2: Sociodemographic characteristics of the surveyed municipal waste scavengers

Operational characteristics of the Scavengers

The operational characteristics of the respondents are presented in Figure 3. A key finding of this study is the 20% prevalence of chronic musculoskeletal and waist pain among the workforce, which directly reflects the demanding shifting cycles where 59.2% of the workforce routinely exceeds an 8-hour workday and 17.1% operates for more than 10 hours per day (Figure 3). The high prevalence of musculoskeletal pain is consistent with the absence of mechanical aids and the need for repetitive manual handling, as documented in similar informal waste settings (Pramestuti and Perkasa, 2020; Popoola and Popoola, 2019), although direct ergonomic assessments were not conducted in this study.

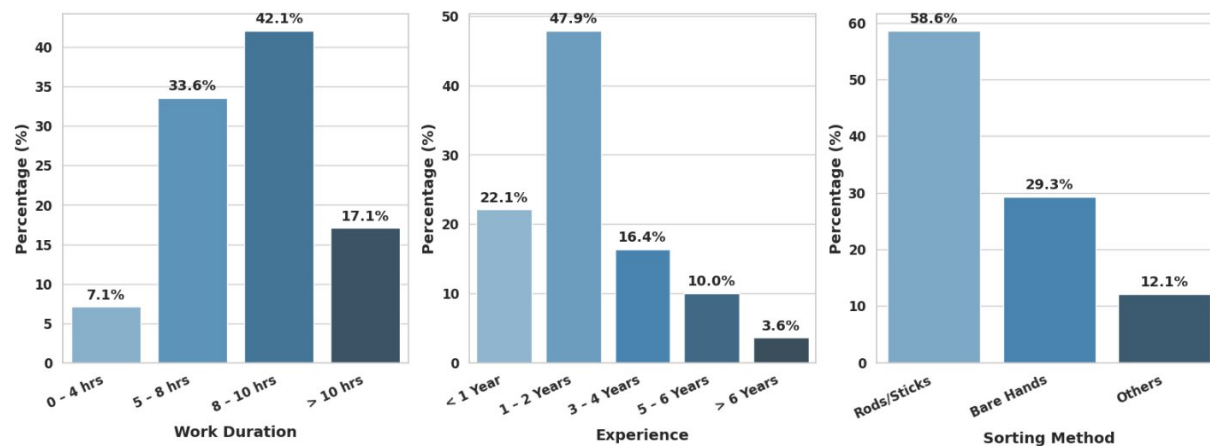


Figure 3: Operational profile of the respondents

According to Pramestuti and Perkasa (2020), unfavourable work environments characterized by high workloads, poor ergonomics, and deficient safety standards function as direct catalysts for heightened occupational stress and sharp declines in physical capacity. In the context of informal scavenging, this continuous physical degradation contributes to severe, long-term physical attrition. This structural toll explains the high level of sector turnover reported in this study, where 70.0% of the respondents reported a career duration of two years or less (Figure 3). These findings are strongly supported by those of Donley (2021), who reported that high-stress, physically demanding, and hazardous work environments directly predict low retention rates and rapid employee exit. The findings of this study are further corroborated by the reports of Popoola and Popoola (2019), who identified ergonomic hazards and work-related musculoskeletal disorders (WMSDs) as leading drivers of long-term physical disability within Nigeria's small-scale informal industries. Furthermore, this vulnerability is likely amplified by local environmental pressure. Although we did not measure on-site temperature or humidity, prior studies in Benin City (Eghomwanre and Edokpolo, 2025) report average August temperatures of 30–32°C with 80–90% relative humidity. Future research should integrate real-time environmental monitoring to quantify the additive effect of heat stress on musculoskeletal and respiratory burdens.

Personal protective equipment (PPE) utilization

The distribution of protective measures among scavengers is shown in Figure 4 (n=140). Over one-third of the workforce (35.7%, n=50, comprising slippers, sandals, or barefoot work) operated without adequate foot protection, while only 4.3% (n=6) utilized specialized puncture-resistant safety boots. Respiratory protection was similarly deficient, with 27.9% (n=39) utilizing no facial coverage and field observations indicating frequent prolonged reuse of unwashed commercial masks (53.6%, n=75). This sharp PPE deficit directly exposes workers to mechanical, chemical, and biological hazards within unsegregated waste streams. These clinical implications align with reports by Pereira-Barriga *et al.* (2024) and Barwick *et al.* (2019), who linked inadequate occupational footwear to preventable dermatological injuries, lacerations, and puncture wounds. When evaluated alongside heavy operational workloads (Pramestuti and Perkasa, 2020), this lack of protective gear accelerates physical exhaustion and injury rates.

Table 1: Distribution of personal protective equipment (PPE) utilization among dumpsite waste scavengers (n = 140)

Protective Equipment Category	Usage Type/Equipment	Frequency (n)	Percentage (%)
Footwear Protection	Standard Leather/Rubber Rain Boots	84	60.00%
	Inadequate Footwear (Slippers, Sandals, or Barefoot)	50	35.70%

Respiratory & Facial Protection	Specialized Steel-toed Safety Boots	6	4.30%
	Commercial Face Masks	75	53.60%
	Improvised Cloths/Handkerchiefs	26	18.50%
	No Facial Protection	39	27.90%
Head & Weather Protection*	Basic Hats/Caps	85	60.70%
	Raincoats/Protective Jackets	80	57.20%

Occupational disease burdens and acute physical trauma

The prevalence of illnesses and physical injuries among scavengers was examined in this study, as presented in Figure 4. Malaria emerged as the most significant health burden, with 60.2% (n=71) of the respondents reporting frequent bouts. This high prevalence is associated with unhygienic conditions and stagnant water at dumpsites, where vectors breed (Eghomwanre *et al.*, 2020). Other common conditions included waist pain (20.0%) and chronic headaches (25.4%), which indicate ergonomic strain and chronic exposure to toxic landfill emissions. Twenty-two percent (n=31) of the respondents reported injuries from cuts and lacerations, whereas 18.0% (n=25) reported injuries from sharp objects.

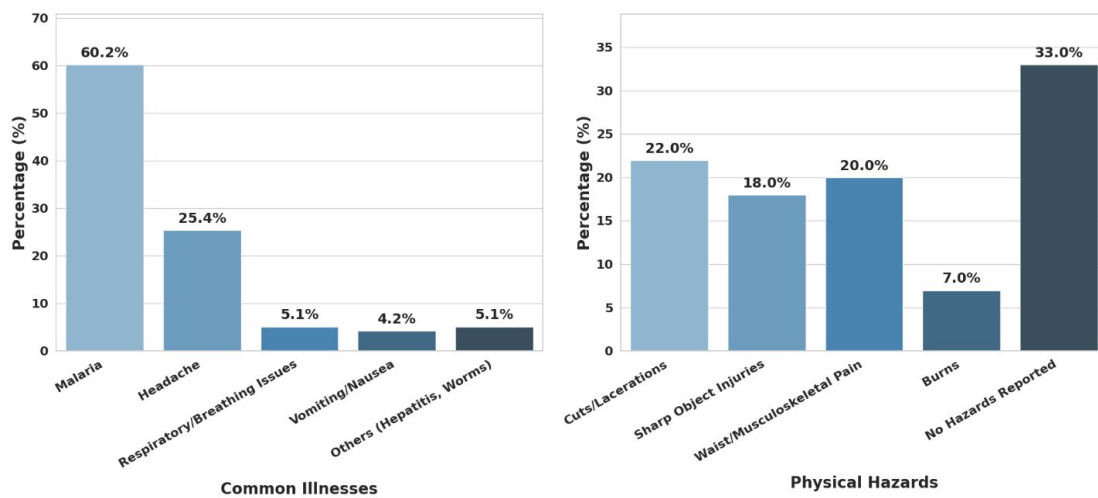


Figure 4: Prevalence of illnesses and physical hazards (n=140)

The high disease burden may be partly attributable to environmental conditions at the dumpsites, although the endemic malaria prevalence in Edo state and other nonoccupational factors were not controlled for in this study. These health outcomes align closely with the reports of Nyathi *et al.* (2018) in South Africa, who reported an identical prevalence of chronic respiratory and musculoskeletal infections among informal waste workers subjected to long-term exposure to hazardous waste streams. The documented 22.0% rate of cuts and lacerations, alongside the 18.0% rate of sharp-object puncture wounds, are direct consequences of hand-picking waste using primitive tools or bare hands. This extreme vulnerability to mechanical injury represents a global constant within informal waste economies (Nyathi *et al.*, 2018). Even when workers understand the structural risks of their environment, the absolute necessity of manual hand-picking—combined with the financial inability to purchase protective gear—makes physical injury an unavoidable part of their daily work. This vulnerability highlights the operational risks noted by Pramestuti and Perkasa (2020) and Pereira-Barriga *et al.* (2024), confirming that when workers lack suitable protective tools and safety footwear, the human body is forced to absorb the direct mechanical impact of a hazardous work environment, leading to high rates of physical trauma.

Risk awareness, perception, and the comparative behavioural gap

The results of the risk awareness and hazard perception profiles of the surveyed waste scavengers (n=140) are presented in Table 2. The results of this study revealed that an overwhelming majority of the scavengers (87.1%, n=122) demonstrated a clear understanding of physical injury risks at the landfill face. Similarly, 83.6% (n=117) recognized the health threats posed by noxious dumpsite odours and airborne fumes. However, cognitive awareness decreased significantly when “invisible” or delayed health threats, such as long-term disease contraction (hepatitis, tetanus, or chronic respiratory infections), were evaluated, with the affirmative response rate decreasing to 63.6% (n=89). In terms of sensory adaptation, 53.6% (n=75) of the cohort reported being actively bothered by the intense smell of rotting waste, while a substantial 46.4% (n=65) expressed no subjective discomfort, indicating a high level of olfactory desensitization due to prolonged, daily occupational exposure.

Table 2: Risk Awareness and Perception Profile (n=140)

Awareness Variable	Response	Frequency (n)	Percentage (%)
Awareness of Injury Risk	Yes	122	87.1
	No	18	12.9
Awareness of Odor-Related Illness	Yes	117	83.6
	No	23	16.4
Awareness of Disease Contraction	Yes	89	63.6
	No	51	36.4
Bothered by Waste Smell	Yes	75	53.6
	No	65	46.4

An analysis of these results alongside actual safety habits reveals a stark, multilayered “awareness–practice–outcome gap” across the key hazard sectors. The overall prevalence of personal protective equipment (PPE) utilization is shown in Figure 5, while the proportion of scavengers aware of each hazard category is directly compared with the proportion of those adopting protective behaviours in Figure 6.

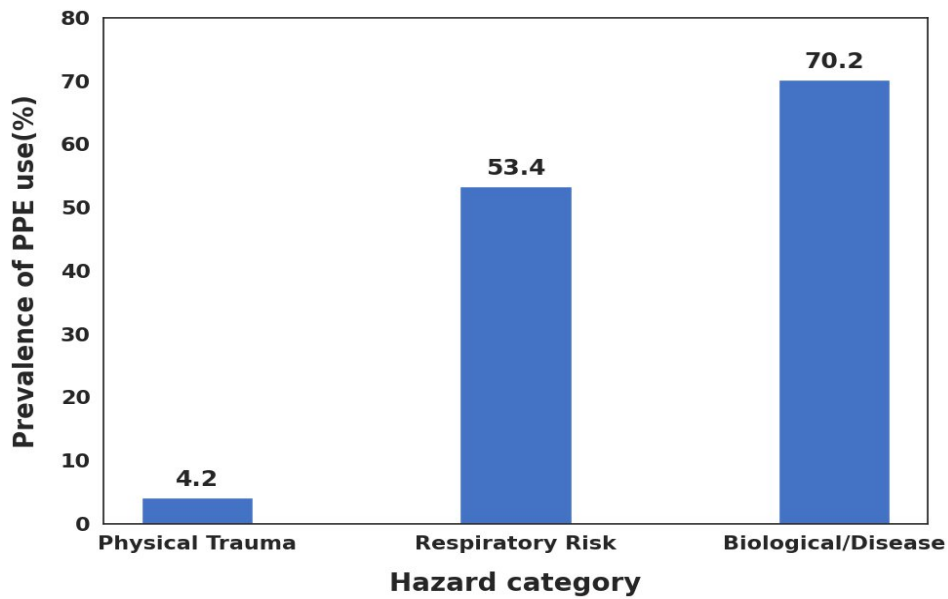


Figure 5: Prevalence of personal protective equipment (PPE) utilization

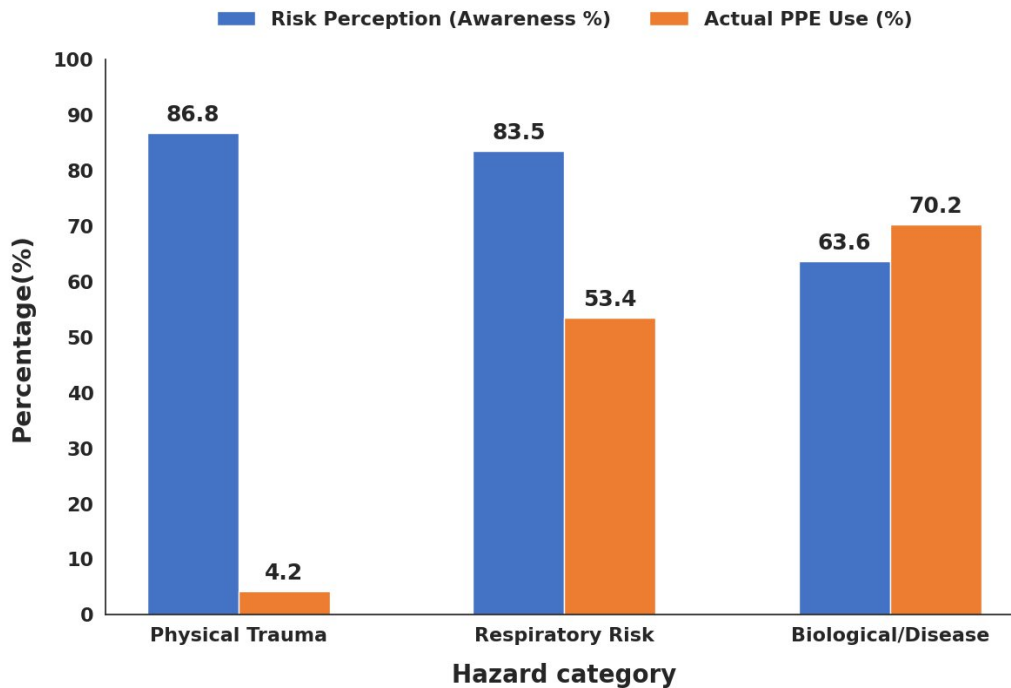


Figure 6: Health risk perception versus actual

PPE utilization Within the physical trauma category, a dramatic disconnect emerges between literacy and protective action. While 87.1% (n=122) of the scavengers explicitly acknowledge the immediate threat of sharp objects and mechanical cuts, compliance with specialized safety gear is statistically negligible, with only 4.3% (n=6) utilizing puncture-resistant steel-toed boots (Table 1). A chi-square test of proportions confirmed that this difference between physical injury awareness and safety boot adoption is statistically significant ($\chi^2 = 192.42$, $df = 1$, $p < 0.001$; Table 3). Interpreted through the health belief model (HBM), this significant gap demonstrates that high risk awareness is heavily suppressed by financial barriers documented in similar informal contexts (Nuripuh *et al.*, 2022; Muiyiwa *et al.*, 2025), although economic constraints were not directly measured in this study. As argued by Nuripuh *et al.* (2022) and supported by the socioeconomic frameworks of Muiyiwa *et al.* (2025), short-term economic survival demands force

informal labourers to prioritize immediate earnings over long-term risk aversion. The consequences of this defensive deficit are severe; without a protective barrier, the human body is forced to absorb the direct mechanical impacts of the landfill environment (Pramestuti and Perkasa, 2020). This leads to a heavy physical toll, directly explaining the high rates of cuts (22.0%) and puncture wounds (18.0%) documented in Figure 4, as well as the rapid physical burnout that drives 70.0% of the workforce out of the sector within two years (Donley, 2021). Conversely, the biological and disease category shows an unconventional trend in which protective practices exceed cognitive awareness. Although awareness of disease contraction was the lowest among all categories at 63.6% (n=89), a greater percentage of scavengers (70.7%, n=99) actively adopted safer sorting habits—using basic rods or sticks rather than their bare hands (Table 2). Inferential testing indicated that this gap was not statistically significant ($\chi^2 = 1.63$, $df = 1$, $p = 0.201$; Table 3). This confirms that while workers may not fully understand the complex microbial or viral risks of unsegregated waste, they adopt rudimentary tools as a practical, tactical measure to expand their reach and shield their hands from immediate, visible filth rather than out of disease risk literacy. Despite thus tactical adaptation, this category recorded the highest overall disease burden, with 60.2% of the participants suffering from frequent bouts of malaria (Figure 4). This trend confirm that using rudimentary tools provides no protection against the deeper environmental risks of the landfill terrain. Mismanaged waste items pool rainwater and create hyperfocal breeding grounds for vectors right next to the active workspace.

Table 3: Inferential comparison between hazard awareness and protective behaviour adoption

Hazard Domain	Hazard Awareness Metric % (n)	Protective Behaviour Metric % (n)	Chi-Square (χ^2)	Degrees of Freedom (df)	p value
Physical Trauma	Awareness of Injury Risk 87.1% (122)	Steel-toed Safety Boots Use 4.3% (6)	192.42	1	< 0.001
Respiratory Hazard	Awareness of Odor/Fume Illness 83.6% (117)	Commercial Face Mask Use 53.6% (75)	29.81	1	< 0.001
Biological Hazard	Awareness of Disease Contraction 63.6% (89)	Sorting Tool Use (Rods/Sticks/Others) 70.7% (99)	1.63	1	0.201

Ultimately, this integrated comparison proves that high hazard literacy alone is structurally insufficient to ensure safety within informal economies. However, because this study did not test the association between literacy and injury using multivariate regression, future research should employ longitudinal or case–control designs to confirm whether economic barriers (such as PPE costs) mediate the awareness–behaviour gap. The vast disparity between risk perception and actual practice will inevitably continue until policy interventions move beyond simple educational campaigns and actively address the underlying financial obstacles by providing subsidized PPE and safer working infrastructure.

Conclusion and Recommendations

In conclusion, this study demonstrates a profound, multilayered “awareness–practice–outcome gap” within the informal waste sector of Benin City, where high risk literacy among a predominantly female (62.9%) and literate workforce fails to translate into protective behaviours because of systemic economic barriers.

The high clinical prevalence of malaria (60.2%), chronic headaches (25.4%), musculoskeletal waist pain (20.0%), and acute physical trauma—including cuts (22.0%) and sharp-object puncture wounds (18.0%)—underscores the systemic failure to integrate informal waste workers into the formal occupational health and safety frameworks of Edo State. Without structural intervention, these marginalized workers remain highly vulnerable and serve as unintended paths for zoonotic and blood-borne pathogens to move from contaminated landfills into the wider community.

To mitigate these immediate public health dangers and improve working conditions, it is recommended that the Edo State Waste Management Board (ESWMB) actively formalizes the sector by subsidizing industrial-grade, puncture-resistant personal protective equipment (PPE) and establishing site-based mobile clinics at the Wemtap and Anthas dumpsites to provide immediate injury care, vector control, and mandatory Tetanus toxoid and hepatitis B vaccination programs. Furthermore, introducing low-cost sorting tables and ergonomic guidelines is essential for minimizing chronic musculoskeletal attrition and eliminating ground-level hazards. Ultimately, transitioning these marginalized scavengers into recognized environmental partners is a vital step toward establishing a safer, healthier, and more inclusive circular economy within Edo State.

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