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Strengthening Occupational Safety through Personal Protective Equipment Availability, Accessibility, and Utilization among Waste Collectors in Calabar Metropolis, Nigeria

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Abstract

This study examined occupational safety through the availability, accessibility, and utilization of personal protective equipment (PPE) among waste collectors in Calabar Metropolis, Cross River State, Nigeria. A mixed-methods research design was adopted. The study population comprised 357 waste collectors employed by the Calabar Urban Development Authority (CUDA), from which a sample of 189 respondents was selected using Yamane's formula and stratified random sampling. Data were collected through structured questionnaires, observational checklists, and key informant interviews, and analyzed using descriptive statistics and multiple regression analysis at the 0.05 level of significance. The findings revealed that physical injuries were the most common occupational hazard, accounting for 37.0 percent in Ikot Ekpo. In comparison, 44.9 percent of respondents in Marian Market reported daily exposure to occupational hazards. Gloves were the most commonly provided PPE (42.9 percent), whereas 32.3 percent indicated that access to PPE was very difficult. Discomfort (36.5 percent) and inadequate PPE supply (28.0 percent) were the leading reasons for non-utilization of PPE. The regression analysis showed that PPE availability, accessibility, and utilization had a significant positive influence on occupational safety ($R = .781$, $R^2 = .610$, $F = 96.528$, $p < 0.05$). The study recommends improved PPE provision, enhanced accessibility, regular occupational safety training, and stricter enforcement of workplace safety regulations to protect waste collectors.

Keywords: Occupational safety, Personal protective equipment (PPE), PPE availability, PPE accessibility, PPE utilization, Waste collectors, Calabar Metropolis.

Introduction

Personal protective equipment (PPE) has become an indispensable component of occupational safety in waste management systems across the world because waste collectors are among the occupational groups most frequently exposed to hazardous working environments. Whether in highly industrialized cities

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such as London, New York, Tokyo, and Berlin or rapidly expanding urban centres in developing countries, waste collection involves daily contact with sharp objects, infectious materials, hazardous chemicals, toxic gases, dust particles, and decomposing organic waste. Such exposures increase the risks of cuts, respiratory infections, skin diseases, musculoskeletal disorders, and other work-related health conditions if appropriate protective measures are not implemented. In Kathmandu, Nepal, for example, waste workers were reported to experience frequent occupational health challenges arising from direct exposure to hazardous waste, reinforcing the importance of providing adequate protective equipment throughout waste collection operations (Acharya, Khanal, Joshi, & Adhikari, 2026). Consequently, the availability of essential PPE including gloves, safety boots, protective overalls, helmets, face masks, goggles, and reflective jackets has become a fundamental requirement for safeguarding waste collectors against occupational hazards while promoting safer and healthier working environments.

Beyond the provision of protective equipment, occupational safety depends largely on workers' ability to access appropriate PPE whenever it is required and to utilize it consistently throughout their daily activities. Availability without accessibility limits the effectiveness of workplace safety programmes because damaged or inadequate protective equipment cannot provide sufficient protection against occupational risks. Across many countries, waste management authorities have increasingly adopted workplace policies that ensure continuous PPE supply, regular replacement of worn-out equipment, and improved supervision of safety compliance. Technological innovations have also strengthened occupational safety by supporting the monitoring of PPE compliance through digital surveillance systems capable of detecting whether workers are wearing appropriate protective equipment during hazardous operations (Ahmed, Saraireh, Rahman, & Al-Qarawi, 2023).

Similarly, workplace health and safety programmes in several industrial sectors have demonstrated that combining adequate PPE provision with institutional commitment, routine safety training, and effective supervision significantly improves occupational safety outcomes and reduces workplace injuries (Benson, Obasi, Akinwande, & Ile, 2024). In Ho Municipality, Ghana, the consistent use of PPE among domestic waste collectors has equally been associated with stronger organizational support and positive safety attitudes (Lissah, Ayanore, Krugu, & Aberese-Ako, 2025), while sanitation workers in Ugandan cities have demonstrated better occupational protection where protective equipment is readily accessible and routinely utilized (Bulafu, Ninsiima, & Tamale, 2025).

The growing importance of PPE has attracted increasing attention across different regions, particularly in developing countries where waste collection services continue to expand alongside rapid urbanization. In northern Malawi, awareness of occupational hazards among solid waste collectors has improved, although access to appropriate protective equipment remains inconsistent in many waste management operations (Ngwira, Chitete, & Sibande, 2024). Similar occupational safety concerns have been reported among municipal waste collectors in Harar Town, Ethiopia, where inadequate utilization of

PPE contributed to the occurrence of workplace injuries (Temesgen, Mengistu, & Mulat, 2022). During the COVID-19 pandemic, sanitation workers across Bangladesh experienced heightened occupational risks, leading to renewed emphasis on strengthening PPE provision and workplace safety systems for essential waste management personnel (Sharior, Alam, Zaqout, & Cawood, 2023). In Nigeria, workers operating around waste disposal sites in Aba have also been found to face significant environmental health risks due to continuous exposure to hazardous waste materials (Oguibe, Oko, & Adindu, 2026). Similar concerns exist in Calabar Metropolis, where increasing volumes of municipal waste expose waste collectors to multiple occupational hazards that require consistent availability, accessibility, and utilization of appropriate personal protective equipment. Evidence from Calabar Municipality further demonstrates that workers who have adequate access to PPE are more likely to comply with workplace safety practices and maintain safer working conditions (Effiong, Fingite, Gideon, & Okon, 2025).

Waste collection remains one of the most hazardous occupations because workers are continually exposed to sharp objects, infectious materials, hazardous chemicals, dust, toxic gases, and other environmental contaminants capable of causing injuries and occupational diseases. Although personal protective equipment (PPE) is widely recognized as an essential measure for minimizing these risks, many waste collectors continue to work under unsafe conditions due to inadequate provision, limited accessibility,

and inconsistent utilization of protective equipment. This situation increases workers' vulnerability to cuts, infections, respiratory illnesses, skin disorders, and other work-related health problems that could otherwise be prevented through effective occupational safety measures. Occupational safety has therefore become an important concern for governments, employers, and occupational health practitioners seeking to improve workplace health and reduce preventable occupational hazards (Abiona & Asaolu, 2023).

Occupational safety compliance remains a persistent challenge across several high-risk occupations despite existing health and safety regulations. Weak enforcement of workplace safety policies, inadequate institutional commitment, irregular supply of protective equipment, and poor compliance with occupational safety guidelines continue to undermine workers' protection in many sectors. Studies have shown that organizations with stronger occupational health and safety compliance experience better workforce productivity, safer working environments, and lower rates of occupational accidents than organizations with weak safety systems (Atu & Andrew-Essien, 2026). Similar concerns have been reported in other occupational settings where compliance with innovative safety measures remains inadequate despite increasing awareness of workplace hazards, thereby exposing workers to avoidable occupational risks (Fabiyi, Abdulazeez, & Ogunwusi, 2026). As urban populations continue to expand and waste generation increases, strengthening worker safety has become an essential component of sustainable urban infrastructure and disaster risk management (Cities, 2025).

In Calabar Metropolis, increasing volumes of municipal waste have expanded the responsibilities and occupational risks of waste collectors, yet concerns persist regarding the adequacy of PPE available to these workers, their ease of access to appropriate protective equipment, and the consistency with which such equipment is utilized during waste collection activities. Reports of occupational exposure among workers in other hazardous occupations within the metropolis suggest that knowledge of workplace hazards does not always translate into adequate preventive practices where institutional support and protective resources are insufficient (Imo, Alexander, Kanu, & Ogbonna, 2026). Despite the critical role played by waste collectors in maintaining environmental sanitation and protecting public health, empirical evidence on the combined influence of PPE availability, accessibility, and utilization on strengthening occupational safety among waste collectors in Calabar Metropolis remains limited. It is this knowledge gap that necessitated the present study.

Methodology

This study adopted a mixed-methods research design to examine occupational safety through the availability, accessibility, and utilization of personal protective equipment (PPE) among waste collectors in Calabar Metropolis. The study was conducted among 357 waste collectors employed by the Calabar Urban Development Authority (CUDA) and deployed across major waste collection locations in Calabar Municipality and Calabar South, including Marian Market, Federal Housing Estate, Ikot Ekpo, New Airport Road, Watt Market, Atimbo, Eight Miles, and other designated waste collection hubs. Using Yamane's (1967) formula with a 5 percent margin of error, a sample size of 189 respondents was selected. A stratified random sampling technique was employed to ensure proportional representation of waste collectors from the various operational zones before respondents were selected through simple random sampling.

Both primary and secondary sources of data were utilized for the study. Primary data were collected through structured questionnaires, observational checklists, and key informant interviews with waste collectors, supervisors, and relevant officials of the Calabar Urban Development Authority, while secondary data were obtained from textbooks, scholarly journals, government reports, and other relevant publications. Quantitative data assessed the availability, accessibility, and utilization of PPE and occupational safety practices, whereas qualitative data explored workers' experiences and challenges across the selected operational locations. The data were analyzed using descriptive statistics, including frequencies, percentages, means, and standard

deviations, while multiple regression analysis was employed to test the formulated hypotheses at the 0.05 level of significance.

Discussion of Findings

Findings in Table 1 indicate that physical injuries such as cuts and falls were the most frequently encountered occupational hazards across all operational locations, accounting for 37.0 percent in Ikot Ekpo, 34.4 percent in Federal Housing, 31.7 percent in Marian Market, and 35.4 percent in New Airport Road. Biological hazards and environmental hazards also constituted notable risks, while chemical exposure was relatively lower across the study locations. These findings suggest that waste collectors are exposed to multiple occupational hazards during routine waste collection activities.

Table 2 further shows that occupational hazard exposure occurred predominantly on a daily basis, ranging from 41.8 percent in Federal Housing to 44.9 percent in Marian Market. Lack of training emerged as the leading reason for occupational hazards, with 29.6 percent recorded in Marian Market and 28.6 percent in Ikot Ekpo, followed by unsafe work environments and inadequate supervision. This indicates that inadequate safety knowledge and poor workplace conditions contribute substantially to occupational risk among waste collectors.

Findings presented in Table 3 shows that discomfort was the major reason for not using personal protective equipment, accounting for 36.5 percent, followed by inadequate PPE supply (28.0 percent). Although 32.3 percent of the respondents reported always using PPE and 28.0 percent indicated that they often used it, about 39.7 percent admitted using it only sometimes, rarely, or never, indicating inconsistent compliance with occupational safety requirements.

Analysis and Test of Hypotheses

The null hypothesis: *H_0: Personal protective equipment availability, accessibility, and utilization have no significant influence on occupational safety among waste collectors in Calabar Metropolis,* was tested in the study, using suitable statistical analysis techniques. The outcomes are very revealing.

Since the significance value (.000) is less than the 0.05 level of significance, the null hypothesis is rejected. The findings indicate that personal protective equipment availability, accessibility, and utilization have a statistically significant positive influence on occupational safety among waste collectors in Calabar Metropolis. The model explains 61.0 percent ($R^2 = .610$) of the variation in occupational safety, indicating that improvements in PPE provision, workers' access to PPE, and consistent utilization contribute significantly to strengthening occupational safety among waste collectors.

Conclusion

The study concludes that occupational safety among waste collectors in Calabar Metropolis is significantly influenced by the availability, accessibility, and utilization of personal protective equipment. The findings revealed that waste collectors are frequently exposed to physical, biological, chemical, and environmental hazards, with physical injuries occurring most often. Although some forms of personal protective equipment are provided, limited accessibility, inconsistent utilization, inadequate training, poor supervision, and insufficient institutional support continue to compromise workers' safety. The hypothesis test further established that the availability, accessibility, and utilization of personal protective equipment have a statistically

significant positive influence on occupational safety among waste collectors in Calabar Metropolis.

Table 1; Occupational Hazard Exposure among Waste Collectors in Calabar Metropolis

Variable	Category	Ikot Ekpo n (%)	Federal Housing n (%)	Marian Market n (%)	New Airport Road n (%)
Most frequently encountered hazard	Physical injuries (cuts, falls)	70 (37.0)	65 (34.4)	60 (31.7)	67 (35.4)
	Chemical exposure	30 (15.9)	28 (14.8)	32 (16.9)	29 (15.3)
	Biological hazards	42 (22.2)	41 (21.7)	43 (22.8)	43 (22.8)
	Environmental hazards	39 (20.6)	43 (22.8)	45 (23.8)	41 (21.7)
	Other hazards	8 (4.2)	12 (6.3)	9 (4.8)	9 (4.8)
	Total	189 (100)	189 (100)	189 (100)	189 (100)
Frequency of exposure to hazards	Daily	83 (43.9)	79 (41.8)	85 (44.9)	81 (42.9)
	Weekly	55 (29.1)	61 (32.3)	57 (30.2)	59 (31.2)
	Monthly	31 (16.4)	27 (14.3)	29 (15.3)	33 (17.5)
	Rarely	15 (7.9)	19 (10.1)	17 (9.0)	13 (6.9)
	Never	5 (2.6)	3 (1.6)	1 (0.5)	3 (1.6)
	Total	189 (100)	189 (100)	189 (100)	189 (100)
Reasons hazards occur	Lack of training	54 (28.6)	49 (25.9)	56 (29.6)	51 (27.0)
	Poor equipment	35 (18.5)	39 (20.6)	34 (18.0)	40 (21.2)
	Inadequate supervision	40 (21.2)	43 (22.8)	38 (20.1)	41 (21.7)
	Unsafe work environment	42 (22.2)	41 (21.7)	44 (23.3)	39 (20.6)
	Other reasons	18 (9.5)	17 (9.0)	17 (9.0)	18 (9.5)
	Total	189 (100)	189 (100)	189 (100)	189 (100)

Source: Fieldwork, 2026

Table 2: Health Problems Associated with Occupational Hazards and non-usage Personal Protective Equipment among Waste Collectors

Variable	Category	Frequency	Percentage
Health problems experienced	Cuts and injuries	67	35.4
	Respiratory problems	39	20.6
	Skin infections	31	16.4
	Musculoskeletal disorders	33	17.5
	Eye irritation/others	19	10.1
	Total	189	100.0
Types of PPE provided	Gloves	81	42.9
	Safety boots	57	30.2
	Face masks/shields	29	15.3
	Protective clothing	19	10.1
	None	3	1.6
	Total	189	100.0
Ease of access to PPE	Very easily	27	14.3
	Easily	5	2.6
	Sometimes difficult	43	22.8
	Difficult	53	28.0
	Very difficult	61	32.3
	Total	189	100.0

Source: Fieldwork, 2026

Table 3: Utilization of Personal Protective Equipment and Occupational Safety Practices among Waste Collectors

Variable	Category	Frequency	Percentage
Reasons for not using PPE	Discomfort	69	36.5
	PPE not supplied	53	28.0
	Not required for task	31	16.4
	Peer pressure	27	14.3
	Other reasons	9	4.8
	Total	189	100.0
Regularity of PPE use	Always	61	32.3
	Often	53	28.0
	Sometimes	39	20.6
	Rarely	27	14.3
	Never	9	4.8
	Total	189	100.0
Frequency of health and safety training	Regularly (every month)	29	15.3
	Occasionally (few times yearly)	67	35.4
	Rarely	53	28.0
	Never	33	17.5
	Not sure	7	3.7
	Total	189	100.0

Source: Fieldwork, 2026

Table 4: Model Summary of Analysis

Dependent Variable: Occupational Safety among Waste Collectors

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.781	.610	.604	.468

Predictors: (Constant), PPE Availability, PPE Accessibility, PPE Utilization

Table 4.2 Dependent Variable: Occupational Safety among Waste Collectors

Coefficients

Dependent Variable: Occupational Safety among Waste Collectors

Model	Unstandardized Coefficients (B)	Std. Error	Standardized Coefficients (Beta)	t	Sig.
(Constant)	1.482	.317	—	4.675	.000
PPE Availability	.284	.067	.296	4.239	.000
PPE Accessibility	.317	.071	.334	4.465	.000
PPE Utilization	.402	.064	.439	6.281	.000

F = 96.528

Recommendations

1. The Calabar Urban Development Authority and relevant waste management agencies should ensure the regular provision and timely replacement of quality personal protective equipment for all waste collectors.
2. Continuous occupational health and safety training should be organized to improve workers' knowledge, promote proper utilization of PPE, and strengthen compliance with established safety procedures.
3. Effective supervision and enforcement mechanisms should be introduced to ensure that waste collectors consistently wear appropriate personal protective equipment during waste collection and disposal activities.

4. Government and waste management authorities should improve workplace conditions by strengthening occupational safety policies, increasing funding for worker protection programmes, and providing regular health screening for waste collectors.

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