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Occupational safety and health in the formal and informal sectors: a workplace-based survey in Freetown, Sierra Leone (2023)

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Abstract

Background In Sierra Leone, poor access to health and safety measures remains among the causes of occupational hazards. Further understanding is required regarding how to enhance safety and well-being in the workplace. This study aimed to assess occupational health and safety (OHS) in both the formal and informal sectors while adjusting for sociodemographic characteristics and compliance by sector.

Methods A cross-sectional survey was conducted among 516 participants. Using a multistage stratified sampling approach, data were collected with a validated, semi-structured questionnaire. This instrument measured sociodemographic characteristics, workplace safety policies, safety factors, and primary outcome variables such as compliance. Multivariable logistic regression analyses were used at a significant level ($p < 0.05$) to examine associations between independent and outcome variables. Cross-sectional design captures a moment in time, not a trend, while self-reported data may overstate positive practices.

Results A significantly greater percentage of the formal sector (76.9%) had safety policies than did the informal sector (23.7%). Most participants (81.8%) acknowledged the significance of emergency exits, with a higher level of recognition observed in the formal sector compared to the informal sector (92.9% versus 72.3%, respectively). Poor ergonomics was prevalent (54.5%), especially in the formal sector (62.9%). Male sex was significantly associated with lower odds of OHS compliance than female sex was ($OR = 0.1$; 95% CI 0.02–0.38; $p < 0.001$). Regression analysis revealed key factors associated with OHS compliance: awareness of national OHS policy in the workplace ($aOR = 10.4$; 95% CI 1.76–61.20; $p < 0.010$).

Conclusion The study revealed a significant disparity in OHS measures between the formal and informal sectors, with the formal sector showing better compliance with OHS procedures. We recommend that employers establish inclusive workplace policies and tailor training programmes and that the Ministry of Labour and Social Security implement comprehensive OHS policies.

Keywords Occupational health, Informal sector, Safety management, Sierra Leone, Cross-sectional studies



1 Background

Occupational safety and health (OSH) standards are guidelines and measures aimed at preventing and controlling workplace hazards for workers and their physical and social well-being [1]. Inadequate occupational safety and health standards in a work environment and workers' exposure to work-related hazards are more obvious in workplaces [2]. The workplace serves as a setting where health and safety information can be disseminated to assist workers in improving their own health and well-being [3]. Work-related diseases and injuries create more pressure on health systems, reduce productivity, and impact household incomes [4]. Protecting and promoting health and safety require actions to prevent occupational risk factors in the workplace [5]. Globally, access to health and safety has had a delayed and complex conveyance in the workplace [1]; millions of workers worldwide are at risk of various work-related diseases/injuries [6]. According to the recent joint estimates from the International Labour Organisation (ILO) and the World Health Organisation (WHO), work-related diseases and injuries caused about 1.9 million deaths around the world in 2016. Occupational injuries accounted for about 360,000 of these deaths [7, 8].

The cost of this systemic lack of safeguard for the health, safety, and well-being of workers has increased due to coronavirus disease [9]. In sub-Saharan Africa, healthcare workers are exposed to occupational hazards with a relatively high rate of infectious diseases [2, 10]. The effects of occupational hazards on healthcare worker shortages in the region have had dire implications for patient health outcomes, productivity, and life expectancy [2, 11]. In a study conducted in southeastern Ethiopia, 43.2% of the participants reported having occupational injuries [12].

Formal sector has an organised system of employment with clear written rules of recruitment, agreement and job responsibilities and has a standardised relationship between the employer and the employee. While the Informal sectors are where people engaged in the economy of unregistered establishments, unregistered employment in the formal economy, paid and unpaid apprentices, unpaid family workers and those who have worked before but are currently looking for work [13]. The informal sector is increasing fast, with several hazardous working conditions and particularly threats for women and children. Workers in the informal sector face life-threatening events that increase their risk of disease and injury [12]. Social, environmental, and enablers are essential in the informal sector because of the substandard working conditions of employees [14]. In the formal sector, OSH knowledge is formalised and disseminated through compulsory training and regulations [15–18]. On the other hand, people who work in the informal sector learn by doing, which means they don't know about many dangers or their rights [19, 20]. This creates a fundamental gap in preventive safety understanding. Accountability and compliance culture shape how people in the formal sector think about OSH [16, 17]. In stark contrast, informal sector attitudes are characterised by a surviving mentality, perceiving safety as an expensive luxury and often embracing risk with fatalism [21]. Formal sector practices involve executing documented protocols, yet often deviate due to production pressure [22, 23]. Informal sector work is defined by improvisation with inadequate PPE and unsafe environments, rarely meeting basic OSH standards [19, 24].

Norms, standards, and surveillance systems are set up by international and national organisations are what shape the global framework for occupational safety and health

[13, 25]. The World Health Organisation (WHO) has a Global Plan of Action on Workers' Health, and the International Labour Organisation (ILO) has conventions on occupational safety and fundamental principles and rights at work. These are the basic policies that make up the policy architecture [25–27]. Regional agencies like the European Agency for Safety and Health at Work (EU-OSHA), which drives research and preventive strategies within the European Union, and research bodies like the National Institute for Occupational Safety and Health (NIOSH) in the United States, which sets evidence-based exposure limits and does important surveillance [28, 29], help make that structure work. These groups work together to set global standards for worker safety, decent work, and hazard assessment.

It is therefore important to put a local socio-labour reality, like the formal and informal sectors in Sierra Leone, in this global institutional context. The ILO, WHO, and other related agencies set the rules and diagnostic tools that directly affect the professional growth of OSH practitioners and the enforcement of national laws. Examining the workforce in relation to these established frameworks that evaluate deficiencies in ILO convention ratification, conformity with WHO health promotion models, or the relevance of EU-OSHA risk assessment tools offers a crucial, standardised benchmark [30, 31]. An effective mechanisms should be put in place to ensure continuous collaboration between employers, managers and workers, with the aim of improving safety in workplaces [32, 33]. In Sierra Leone, a study conducted in 2020 revealed that 39.0% of workers had occupational accidents ($\chi^2 = 9.88$, p value = 0.02) [34]. Occupational safety and health (OSH) remain a critical global public health challenge. The most recent joint estimates by the International Labour Organization (ILO) and the World Health Organization (WHO) indicate that work-related fatalities remain staggeringly high, with approximately 1.9 million deaths annually attributed to work-related diseases and injuries (ILO/WHO, 2021). Despite decades of regulatory frameworks and technological advances, a significant portion of the global workforce continues to face substantial risks. This persistent burden demonstrates the need for a renewed research focus, particularly on understanding the root causes in the sectors like construction, evaluating the effectiveness of safety interventions in the modern workplaces. However, there is a disconnect between OSH and human resource management in workplaces and limited or no detailed information on OSH in both the formal and informal sectors in Sierra Leone. The rationale for the present study is to address this gap by conducting research that provides updated evidence to inform targeted prevention strategies and policy updates. This study assessed OHS policies, practices, and compliance in formal and informal workplaces in Freetown, Sierra Leone. The findings of this study provide information that can be used in safety improvement in the workplaces and informed decision-making, increase awareness, and promote a safe culture.

2 Methods

2.1 Study design and period

We conducted a cross-sectional study among workers in the formal and informal sectors in Freetown, Sierra Leone—A workplace-based survey from July 2023 to September 2023.

2.2 Study area

Sierra Leone is located in West Africa and has a tropical climate and diverse environment. The city is divided into five regions (eastern, northern, northwestern, southern, and western areas), with 7,701,185 and 59% of the population living in rural areas and 41% living in urban areas [35]. This study was conducted in Freetown, the capital city of Sierra Leone. Freetown is Sierra Leone's major urban, economic, financial, cultural, educational, and political center, as it is the seat of the Government of Sierra Leone, and its population is 1,055,964 [35].

2.3 Study population

The study participants for this study were trainees, volunteers, and gainfully employed individuals selected from both the formal and informal sectors in Freetown. Those individuals who were present in the workplace were interviewed after providing informed consent.

2.4 Inclusion criteria

All workers who had worked for six months or more and consented to participate in the study and were present during the data collection were included in the study and interviewed.

2.5 Exclusion criteria

A worker who was on maternity/paternity leave and/or refused informed consent was excluded from the study.

2.6 Sample size estimation

We determined the sample size using the Western Area population of 1,055,964. We used a prevalence of occupational illness/injuries of 18.3% for workers in the formal and informal sectors each [35]. Using the epi.info 7.2.5 StatCalc Appendix 1: <http://www.cdc.gov/epiinfo>, we calculated the sample sizes (n) for the formal and informal sectors on the basis of the following presumptions: expected percentage frequency (p): 18.3% in both the formal and informal sectors; design effect: 1.0; confidence interval: 95%; margin of error (d): 5%. The sample size (n) was 230 for each of the formal and informal sectors. A 10% nonresponse rate was considered. We calculated the nonresponse rate adjustment via the formula $N = n / (1 - R)$, where "N" represents the final sample size and "R" represents the anticipated nonresponse rate. A 10% nonresponse rate of 26 for each formal and informal sector was calculated, and 2 participants were added together during the data collection, and the final total sample size of 516 respondents was interviewed.

Despite the substantial workforce population in Freetown, the final analytical sample comprised 238 formal and 278 informal workers. This sample size was determined by predefined eligibility criteria, logistical challenges in accessing informal sector workers, and survey non-response rates. Participants were selected from the Western Area using a simple stratified sampling technique, which facilitated targeted representation across key occupational sectors while maintaining practical feasibility.

2.7 Sample size justification and power

The "StatCalc" module in Epi Info™ version 7.2 was used to figure out the a priori sample size for a comparison of two proportions. The main goal was to compare the rates of "adequate knowledge" between sectors. We used 95% power, a two-sided alpha of 0.05, and a 1:1 allocation. This calculation gave us $n = 230$ participants in each sector. The final analytic samples of 238 (formal) and 278 (informal) workers both meet or exceed this goal. The imbalance in the sample size was unintentional wherein the data collectors collected more than expected sample size. And the study investigators decided to maintain the additional number of the participants. This will not affect the precision of the study.

The obtained sample yields over 85% power for the primary sectoral comparison. We recognised that the limited size of the smaller group ($n = 238$) constrains the number of covariates in multivariable models, which will be maintained in a parsimonious manner. The study lacks sufficient power for comprehensive within-sector subgroup analyses (e.g., by specific job position).

2.8 Sampling technique

We applied a stratified multistage sampling technique. First, Freetown was split into three regions (East End, Central, and West End), each region was subdivided into three zones based on administrative and economic maps of the Western Area, for a total of nine zones [36]. The sampling frame of workplaces was then developed using municipal business registries and local government data, stratified by formal and informal sector within each zone [37, 38].

We randomly selected sample of 66 formal workplaces and 73 informal workplaces from the stratified zones list. Then, within each workplace (formal and informal workplaces), 2–3 workers were randomly selected for interview using a simple random sampling technique. The respond rate was 90.9% in the formal sectors and 93.2% in the informal sectors (see Fig. 1. Participant recruitment flow diagram) below. While high response rates were achieved within the selected clusters, it is important to note that the final sample of 516 workers represents a small fraction of Freetown's substantial

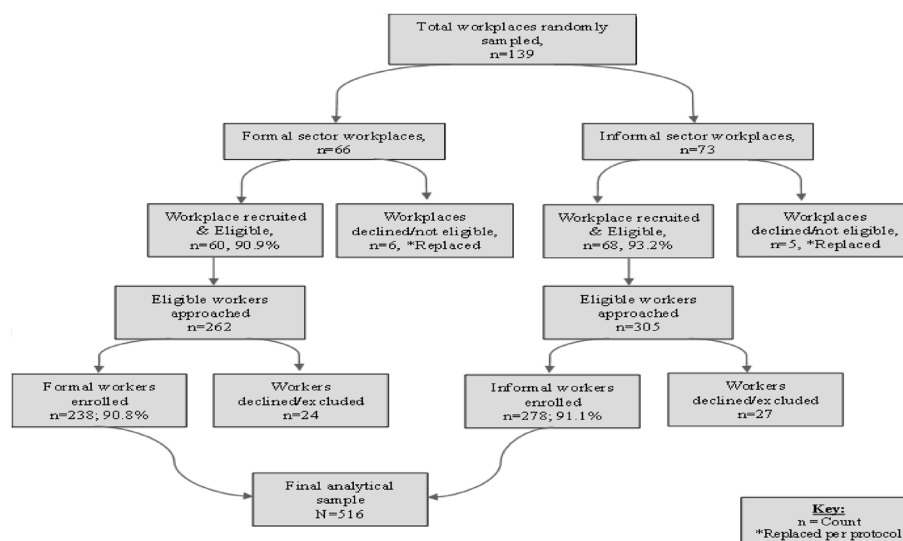


Fig. 1 Participant recruitment flow diagram

workforce. The results are representative of workers within the sampled economic clusters of the nine zones but should be generalized to the entire citywide workforce with caution, as isolated or home-based informal enterprises may be under-represented in the municipal registries that formed the sampling frame. To maintain the target sample size, any selected workplace that declined was replaced by the next workplace on the randomised list for that zone.

2.9 Data collection tools and procedure

The study used the Kobo Collect tool to design a semi-structured questionnaire for interviews, collected demographic data and compliance with OSH procedures. This questionnaire was adapted from the World Health Organization (WHO) and International Labour Organization (ILO) Joint Toolkit for Developing National Programmes on Occupational Health and Safety for Workers [39–41], incorporated workplace safety policies, safety factors, and primary outcome variables such as compliance knowledge, practice, and risk perception. A pre-tested of the tool on 5% of the total sample size (13 per sector) in non-participating sites to ensure clarity and validity. We modified the tool based on pilot feedback, including simplifying technical terms and adding locally relevant examples of workplace hazards and procedures. The data collection teams included technical officers from the Ministry of Health who were trained on electronic-based data collection and informed consent. A face-to-face interview was conducted and the question were translated into local language (Krio). The principal investigator and research supervisor supervised the data collection process for quality assurance. Data was then downloaded for further analysis.

2.10 Study limitation

This study has several limitations. First, while the sample size was sufficient for initial exploratory analysis, it may not comprehensively reflect the full heterogeneity of Free-town's workforce. Second, the higher representation of specific informal sector sub-groups could constrain the generalizability of the findings. thirdly, non-response bias may have influenced the results, as individuals who declined or were unavailable to participate might differ systematically from those included in the study. Finally, a cross-sectional design captures a moment in time, not a trend. Self-reported data may overstate positive practices. Participants may have altered behavior during observation. To mitigate information bias, the questionnaire was pre-tested and piloted to ensure clarity and validity. For each, we suggested a mitigation strategy for future research, such as random sampling of informal worksites or communities, longitudinal designs, and mixed-methods approaches to enhance validity.

2.11 Data management and analysis

The data was retrieved from the Kobo collection server, stored, and cleaned, and the database was stored on a password-protected computer. We analyzed the data using Epi-Info 7.2.5 and SPSS version 23. Descriptive statistics such as medians and ranges for age and proportions and ratios for categorical variables such as sex and education level and among others were computed. To build the multivariate model, covariates was selected based on the available literature. The measure of association, odds ratio (OR) and adjusted odds (aOR) analysis were performed to test for significant associations.

The covariates include: safety compliance, workplace type, educational attainment, awareness of health and safety measures. The outcome variable were compliance and non-compliance, controlling for confounders (e.g., age, sex, education, sector type, job position). For all of the analyses, the variables were considered statistically significant at $p < 0.05$. The analysis tested a priori hypothesis. Variance Inflation Factors confirmed no multicollinearity (all VIFs < 2). Model fit was good (H-L $p = 0.42$, AUC = 0.78). A pre-specified interaction was tested and excluded ($p = 0.15$). The reported adjusted Odds Ratios (ORs) for the primary exposure can therefore be interpreted as estimates accounting for the identified confounding structure, with reasonable confidence in model specification and stability.

2.12 Measurement of outcomes and validation

The compliance analysis was conducted on the subsample of directly observed participants ($n = 139$; (compliance = 63; Non-compliance = 76) to ensure methodological rigour and relevant findings. This approach provided objective behavioural data on high-risk tasks, thereby minimising self-report bias and strengthening the internal validity of the compliance measure. This strategy shifts the focus from reported knowledge to enacted behaviour, yielding actionable insights into the real-world determinants of safety protocol adherence in Sierra Leone's workplaces.

In this study, the mean scores were determined from the total responses of the subsample size and were used to ascertain the outcome variables, categorised as either compliance or non-compliance. The average cutoff point for compliance was determined as 39.3. Seventeen questions were asked to see how well workers followed OSH rules during work time. For each 'yes' response, a score of 1 was recorded, and for each 'no' response, a score of 0, for a total of 17 points. Respondents with a compliance mean score of ≥ 39.3 were assigned a code of 1 and categorised as compliant, while those with a compliance mean score of < 39.3 were assigned a code of 0 and categorised as non-compliant.

This mean-based cutoff represents a possible operationalisation of compliance. We selected it to ensure a balanced and interpretable partition of the sample for causal estimation.

For our compliance average causal effect analysis, we required a dichotomous threshold to define compliance levels. The continuous compliance scale demonstrated good internal consistency (Cronbach's $\alpha = 0.84$), with the full sample scoring a mean of 35.2 (SD = 4.1, range = 17–48). To identify meaningfully higher engagement, we set the threshold at one standard deviation above this sample mean (≥ 39.3), a data-driven method supported by scale development literature [42–44]. This cut-off serves as an analytical tool to distinguish higher from lower programme engagement for effect estimation and should not be interpreted as a clinical benchmark.

2.13 Operational terms definition

This study defines the 'Factory' sector as a broad category that encompasses productive, goods-based industries that physically transform, fabricate, or assemble materials. It includes manufacturing, construction, and artisanal workshops, such as civil construction, metalwork, automotive repair, woodworking, and cement or paint production. This classification captures the range of formal and informal production activities prevalent in the economy of Sierra Leone.

Conversely, in this context, the '**Hospitality**' sector primarily refers to service-orientated industries, with the overwhelming majority of entries specifically from the health industry (e.g., hospitals and clinics), while traditionally including hotels and tourism; thus, the term is effectively synonymous with health and medical services, hotels, motels, and guest houses within this dataset.

3 Results

3.1 Demographic characteristics of the respondents

A total of 516 study participants (238 in the formal sector and 278 in the informal sector) were surveyed. A total of 435 (84.3%) patients were male, and the median age was 32.0 years (range: 12–67 years). The educational level was 130 (25.2%) senior secondary, 122 (23.6%) tertiary, and 24 (4.7%) nonformal (Table 1).

3.2 Health and safety, policy/SOPs/guidelines and measures

Among the 516 study participants, 249 (48.3%) had a national policy used to protect and promote health and safety, with formal and informal sectors (76.9% versus 23.7%, respectively). Among the 139 workplaces (66 in the formal sector and 73 in the informal sector), 77.3% in the formal sector, compared with only 15.1% in the informal sector, adhered to health and safety policies, protocols, and standard operating procedures. A total of 422 (81.8%) reported the importance of emergency exits as safety infrastructure for formal and informal sectors (92.9% versus 72.3%, respectively). A total of 434 (84.1%) reported that taking breaks reduces exposure to hazards in the formal and informal sectors (90.8% versus 78.4%, respectively) (Table 2).

Table 1 Demographic information

	Formal (n = 238)	Informal (n = 278)	Total (n = 516)
	Count n (%)		
Sex of the study participant			
Female	68 (28.6%)	13 (4.7%)	81 (15.7%)
Male	170 (71.4%)	265 (95.3%)	435 (84.3%)
Age (in years)			
Median	35	30	32.0 years
Range			12–67 years
Highest education level attained			
Junior secondary	12 (5.0%)	62 (22.3%)	74 (14.3%)
Nonformal education	5 (2.1%)	19 (6.8%)	24 (4.7%)
Primary	8 (3.4%)	59 (21.2%)	67 (13.0%)
Senior secondary	42 (17.6%)	88 (31.7%)	130 (25.2%)
Tertiary	96 (40.3%)	26 (9.4%)	122 (23.6%)
University	61 (25.6%)	8 (2.9%)	69 (13.4%)
Vocational institute	14 (5.9%)	16 (5.8%)	30 (5.8%)
Workplace ownership			
Private	213 (89.5%)	278 (100.0%)	491 (95.2%)
Government	25 (10.5%)	0 (0.0%)	25 (4.8%)
How many years have you being doing this kind of work?			
0–9	181 (76.1%)	184 (66.2%)	365 (70.7%)
10–19	44 (18.5%)	56 (20.1%)	100 (19.4%)
20–29	9 (3.8%)	33 (11.9%)	42 (8.1%)
30–39	4 (1.7%)	4 (1.4%)	8 (1.6%)

Table 2 Health and safety policies, SOPs, guidelines and measures

Variable	Formal (n = 238) Count (%)	Informal (n = 278)	Total (n = 516)
Is there any national policy that protects and promotes workers' health and safety in the workplace?			
Yes	183 (76.9%)	66 (23.7%)	249 (48.3%)
No	49 (20.6%)	199 (71.6%)	248 (48.1%)
Do not know	6 (2.5%)	13 (4.7%)	19 (3.7%)
Health and safety policy/procedure/SOPs are strictly followed by workers			
Yes	51 (77.3%)	11 (15.1%)	62 (44.6%)
No	15 (22.7%)	62 (84.9%)	77 (55.4%)
Are emergency exits important in any workplace?			
Yes	221 (92.9%)	201 (72.3%)	422 (81.8%)
No	15 (6.3%)	71 (25.5%)	86 (16.7%)
Do not know	2 (0.8%)	6 (2.2%)	8 (1.6%)
Taking break time during work can reduces your exposure to hazards?			
Yes	216 (90.8%)	218 (78.4%)	434 (84.1%)
No	10 (4.2%)	45 (16.2%)	55 (10.7%)
Do not know	12 (5.0%)	15 (5.4%)	27 (5.2%)

3.3 Personal protective equipment, first aid, hazards, fire prevention and hygiene practices

Among the total 516 respondents, 251 (48.6%) indicated that all PPE types offered the same level of protection (59.2% formal versus 39.6% informal sector). Additionally, 196 (82.4%) formal sectors had first aid services, whereas 85 (30.6%) informal sectors did. Furthermore, 369 (71.5%) recognized occupational hazards in their workplaces (71.4% formal versus 71.6% informal sectors).

Among the study participants, 369 were analyzed (170 from the formal sector and 199 from the informal sector); 201 (54.5%) reported poor ergonomic conditions, including the formal and informal sectors (62.9% versus 47.2%, respectively). Moreover, of the total 516 study participants, 315 (61.0%) had fire extinguishers and were accessible (92.4% in the formal sector versus 34.2% in the informal sector). Additionally, 245 (47.5%) had handwashing facilities in workplaces in the formal or informal sector (76.9% versus 22.3%, respectively) (Table 3).

3.4 Health and safety information, safety communication and accident investigation

Among the total 516 study participants, 249 (48.3%) had received safety information prior to the survey in the last six months, with a high proportion in the formal sector compared with the informal sector (79.0% versus 21.9%, respectively). Among the total 249 participants, 135 (54.2%) of them said their main source of health and safety information was from healthcare workers. Moreover, 189 (36.6%) participants had safety signs, with substantial differences between the formal and informal sectors (71.8% versus 6.5%, respectively). A total of 127 (53.4%) of the formal sector conducted accident investigations, whereas 68 (24.5%) of the informal sector did (Table 4).

3.5 Bivariate analysis of factors associated with OHS measures and compliance

The study findings revealed that the odds of compliance with OHS measures among male study participants were 0.10 times lower than those among female study participants (OR = 0.10, 95% CI 0.02–0.39; $p < 0.001$). The odds of OHS compliance among informal sector workers were 0.02 less times than those among formal sector workers (OR = 0.02; 95% CI 0.01–0.07; $p < 0.001$). Furthermore, the odds of OHS compliance

Table 3 Personal protective equipment, first aid, hazards, fire prevention and hygiene practices

Variable	Formal (n = 238) Count (%)	Informal (n = 278) Count (%)	Total (n = 516) Count (%)
Are areas set for PPE usage being properly seen/identified by warning signs			
Yes	150 (63.0%)	13 (4.7%)	163 (31.6%)
No	77 (32.4%)	261 (93.9%)	336 (65.5%)
Do not know	11 (4.6%)	4 (1.4%)	15 (2.9%)
Are all PPEs having the same level of protection for any work?			
Yes	141 (59.2%)	110 (39.6%)	251 (48.6%)
No	62 (26.1%)	102 (36.7%)	164 (31.8%)
Do not know	35 (14.7%)	66 (23.7%)	101 (19.6%)
Is there any First Aid or medical services available in this workplace?			
Yes	196 (82.4%)	85 (30.6%)	281 (54.5%)
No	42 (17.6%)	193 (69.4%)	235 (45.5%)
Any occupational hazards in this workplace?			
Yes	170 (71.4%)	199 (71.6%)	369 (71.5%)
No	61 (25.6%)	66 (23.7%)	127 (24.6%)
Do not know	7 (2.9%)	13 (4.7%)	20 (3.9%)
If yes, which kind of occupational hazard?	(n = 170)	(n = 199)	(n = 369)
Slip and fall	73 (42.9%)	47 (23.6%)	120 (32.5%)
Fall from height	28 (16.5%)	23 (11.6%)	51 (13.8%)
Poor ergonomic position	107 (62.9%)	94 (47.2%)	201 (54.5%)
Needle prick	45 (26.5%)	61 (30.7%)	106 (28.7%)
Liquid/chemical splash	55 (32.4%)	45 (22.6%)	100 (27.1%)
Workplace violence	34 (20.0%)	54 (27.1%)	88 (23.8%)
Is this workplace dealing with hazardous materials like flammables, explosive, metal, sharps etc.?			
Yes	183 (76.9%)	204 (73.4%)	387 (75.0%)
No	55 (23.1%)	74 (26.6%)	129 (25.0%)
Are fire extinguishers available accessible in this workplace?			
Yes	220 (92.4%)	95 (34.2%)	315 (61.0%)
No	18 (7.6%)	183 (65.8%)	201 (39.0%)
Is there a hand-washing facility available in this workplace?			
Yes	183 (76.9%)	62 (22.3%)	245 (47.5%)
No	55 (23.1%)	216 (77.7%)	271 (52.5%)

among participants with a basic level of education were 0.05 times less than those among participants with a higher level of education (OR = 0.05; 95% CI 0.02–0.15; $p < 0.001$). Additionally, the odds of OHS compliance among participants who were aware of the national OHS policy were 32.7 times greater than those among participants who were not aware of the OHS policy (OR: 32.7, 95% CI 11.61–96.22, $p < 0.001$).

3.6 Multivariate analysis of factors associated with OHS measures and compliance

Factors that were statistically significant at the bivariate level were selected for analysis at the multivariate level, among which nine factors were observed to be statistically significant in influencing compliance with OHS measures. These large effect sizes should be interpreted with extreme caution, as they may reflect statistical anomalies, residual confounding, or data sparsity in certain subgroups. The focus will shift to the overall pattern of a significant and clinically meaningful positive association, rather than the precise magnitude of the most extreme estimate. The odds of OHS compliance among participants who work in factory were 46.8 times higher than those workers in the hospital (aOR = 46.8; 95% CI 3.81–574.45; $p < 0.003$). Also, the adjusted odds of OHS compliance among participants who had a national policy were 10.4 times greater than

Table 4 Health and safety information, safety communication and accident investigation

Variable	Formal (n=238)	Informal (n=278)	Total (n=516)
Count (%)			
In the last six months did you receive any health and safety information from any source?			
Yes	188 (79.0%)	61 (21.9%)	249 (48.3%)
No	50 (21.0%)	217 (78.1%)	267 (51.7%)
If yes, what was the main source of health and safety information?	(n = 188)	(n = 61)	(n = 249)
Fire Force	0 (0.0%)	1 (1.6%)	1 (0.4%)
Health worker	101 (53.7%)	34 (55.7%)	135 (54.2%)
Internet	6 (3.2%)	1 (1.6%)	7 (2.8%)
Meeting	1 (0.5%)	0 (0.0%)	1 (0.4%)
Poster/flyers/leaflet	1 (0.5%)	0 (0.0%)	1 (0.4%)
Radio/TV	7 (3.7%)	6 (9.8%)	13 (5.2%)
Senior worker	12 (6.4%)	5 (8.2%)	17 (6.8%)
Social media	1 (0.5%)	1 (1.6%)	2 (0.8%)
Training institution	5 (2.7%)	1 (1.6%)	6 (2.4%)
Training workshop	54 (28.7%)	12 (19.7%)	66 (26.5%)
Health and safety IEC materials are pasted in strategic locations in the workplace			
Yes	36 (54.5%)	2 (2.7%)	38 (27.3%)
No	30 (45.5%)	71 (97.3%)	101 (72.7%)
Are safety signs/warnings posted were placed appropriately in this workplace?			
Yes	171 (71.8%)	18 (6.5%)	189 (36.6%)
No	67 (28.2%)	260 (93.5%)	327 (63.4%)
Is there an accident investigation and reporting procedure in place and operational?			
Yes	127 (53.4%)	68 (24.5%)	195 (37.8%)
No	96 (40.3%)	204 (73.4%)	300 (58.1%)
Do not know	15 (6.3%)	6 (2.2%)	21 (4.1%)

those participants who did not have a policy (aOR = 10.4; 95% CI 1.76–61.20, $p < 0.010$). Similarly, the adjusted odds of OHS compliance among participants who had first aid or medical services were 8.7 times greater than those among participants who did not have first aid or medical services (aOR = 8.7; 95% CI 1.28–59.06; $p < 0.027$) (Table 5).

4 Discussion

This study assessed occupational health and safety (OHS) in the formal and informal sectors in Freetown, Sierra Leone.

The study findings revealed that the majority of the informal sector lacked a national health and safety policy. This implies that OHS discipline and practice primarily cover worker in the formal workplaces, unlike informal workplaces with restricted information and resources [45]. This finding is congruent with that of Pakistan's study, which revealed that informal workers are uninformed of OHS rules and norms [19].

Safety infrastructure, such as emergency exits, was more present in the formal sector. These findings are in agreement with a study conducted in low- and middle-income countries, which reported that well-trained workers had high compliance levels [46]. Additionally, taking breaks reduces exposure to hazards; this is less common in the informal sector. This is particularly relevant in high-stress environments such as restaurants or retail stores, where such workers might skip break time to meet demands, ignoring health risks. This finding is similar to that of a study conducted by Randolph,

Table 5 Factors associated with compliance with occupational health and safety measures; (N) = 139

Variable	Category	Compliance, n=63; n (%)	Non-compliance, n=76; n (%)	OR; (95% CI)	p-value	aOR (95% CI)	p-value
Sex	Male	45 (71.4%)	73 (96.1%)	0.10 (0.02–0.39)	< 0.001	0.4 (0.04–5.13)	0.509
	Female*	18 (28.6%)	3 (3.9%)	Ref		Ref	
Age (years)	0–45	42 (66.7%)	55 (72.4%)	0.77 (0.35–1.68)	0.578	–	–
	≥ 46*	21 (33.3%)	21 (27.6%)	Ref		Ref	
Education attainment	Basic	7 (11.1%)	53 (69.7%)	0.05 (0.02–0.15)	< 0.001	4.0 (0.48–33.13)	0.201
	High*	56 (88.9%)	23 (30.3%)	Ref		Ref	
Work experience (years)	1–21	57 (90.5%)	59 (77.6%)	2.69 (0.94–9.04)	0.065	–	–
	≥ 22*	6 (9.5%)	17 (22.4%)	Ref		Ref	
Sector type	Informal	8 (12.7%)	65 (85.5%)	0.02 (0.01–0.07)	< 0.001	3.4 (0.49–22.99)	0.217
	Formal*	55 (87.3%)	11 (14.5%)	Ref		Ref	
Workplace Type	Factory	18 (28.6%)	74 (97.4%)	0.01 (0.00–0.05)	< 0.001	46.8 (3.81–574.45)	0.003
	Hospitality*	45 (71.4%)	2 (2.6%)	Ref		Ref	
Category of ownership	Private	56 (88.9%)	75 (98.7%)	0.10 (0.00–0.88)	0.023	0.2 (0.01–4.79)	0.302
	Government*	7 (11.1%)	1 (1.3%)	Ref		Ref	
Is there any national policy that protect and promote workers health and safety in the workplace	Yes	50 (79.4%)	8 (10.5%)	32.7 (11.61–96.22)	< 0.001	10.4 (1.76–61.20)	0.010
	No*	13 (20.6%)	68 (89.5%)	Ref.		Ref.	
Is there any First Aid or medical services available in this workplace	Yes	58 (92.1%)	17 (22.4%)	40.3 (12.98–143.72)	< 0.001	8.7 (1.28–59.06)	0.027
	No*	5 (7.9%)	59 (77.6%)	Ref.		Ref.	
Are fire extinguishers available accessible in this workplace	Yes	59 (93.7%)	26 (34.2%)	28.4 (8.82–116.08)	< 0.001	2.4 (0.31–18.73)	0.404
	No*	4 (6.4%)	50 (65.8%)	Ref.		Ref.	
Is there hand-washing facility available in this workplace	Yes	48 (76.2%)	10 (13.2%)	21.1 (8.11–56.66)	< 0.001	5.1 (0.82–33.10)	0.080
	No*	15 (23.8%)	66 (86.8%)	Ref.		Ref.	

OR Odds Ratio, aOR Adjusted Odds Ratio, CI Confidence Interval, Ref. Reference category. Significance: Bolded p-values (p < 0.05) indicate statistical significance. *: Reference category for Odds Ratio (OR) calculation

which reported that employees lack OHS regulations, leading to gaps in safety practices [47].

The study revealed that nearly half of the participants in the formal sector indicated that all PPE types offered the same level of protection. This finding is similar to that of a study performed by Dean & Bundon, who noted that safety measures depend on the nature of the risks involved (29). The majority of the formal sectors have first aid kit services. These findings suggest strong adherence to safety protocols. The study findings revealed almost equal proportions of occupational hazards present in the workplace

between formal and informal hazards. This indicates progress in hazard recognition but triggers targeted OHS education (25). The study revealed significant ergonomic issues within the formal sector compared to informal counterparts. The formal sector's adherence to rudimentary, often imported, operational standards may inadvertently institutionalise static postures and repetitive tasks without integrating ergonomic assessments, a recognised gap in regional occupational health systems [48–50]. Also, a deficit noted in manufacturing and agro-processing sectors across the region [51, 52]. Conversely, the informal sector's inherent flexibility may allow for postural variation, though such flexibility is not a substitute for designed safety.

The presence of fire extinguishers in most formal enterprises highlights a selective application of the national safety framework, where visible, single-item compliance is prioritised over holistic risk management, often driven by municipal bylaws and insurance requirements [53–55]. This aligns with analyses of Sierra Leone's regulatory environment, which note that enforcement in the formal sector often focuses on tangible equipment checks, while systematic risk assessments and worker training remain underdeveloped [56, 57]. In the informal sector, the almost complete absence of such equipment underscores their effective exclusion from these regulatory frameworks and support systems, reflecting a critical inequality in safety resource distribution [58].

Approximately three-fourths of all the formal sectors have hygiene facilities. This finding is not in agreement with a study conducted in Sierra Leone, which reported that almost all the participants reported washing or sanitizing their hands regularly (98.8%) [59, 60].

Our study revealed that more than half of the informal sector in Sierra Leone lacks access to safety information. This gap is consistent with broader regional challenges, as highlighted by a recent International Labour Organization report which found that informality remains a major barrier to the extension of occupational safety and health protections in Sub-Saharan Africa [61, 62]. The implication for the sector and workplaces in Sierra Leone is profound. This critical information deficit directly undermines worker well-being, contributing to preventable accidents, illnesses, and economic vulnerability.

The reliance on health workers as the primary source of OHS information is consistent with the findings of the Ethiopian study, which revealed that health workers play a critical role in the dissemination of OHS information [12]. The study highlights that safety signage is lacking in the informal sector. This disparity is consistent with regional findings, where the informal sector often lacks basic safety information [63].

The multivariate analysis identified three key factors demonstrating statistically significant associations with the outcome variables. While factory setting emerged as the most predictive factor after adjustment, the extraordinarily large adjusted odds ratio was interpreted with caution. This point estimate suggests a nearly 47-fold increase in compliance compared to the hospitality sector, which may reflect instability due to data sparsity, residual confounding, or other statistical artefacts rather than a precise mechanistic effect. The focus remains on the consistent direction of a strong positive association, rather than the exact magnitude of this specific estimate. This result likely reflects the intrinsic, high-intensity hazards present in manufacturing environments, such as heavy machinery, complex processes, and exposure to industrial chemicals, which are

structurally different from the ergonomic and slip-trip-fall risks more common in hospitality [61, 64, 65].

The presence of a national policy protecting workers' health and safety was a significant enabling factor. The availability of OSH policy in the workplace was tenfold to comply with safety measures than those that do have it. This finding underscores that a supportive regulatory framework at the national level is strongly associated with better workplace outcomes. It suggests that such policies may create an enabling environment for enforcement, resource allocation, and a culture of safety, trickling down to the enterprise level. Recent studies emphasise that robust national OHS policies are foundational for reducing occupational injuries and fostering preventive cultures, especially in developing economies [45, 66–68].

Furthermore, the analysis identified a significant resource gap in emergency preparedness. In the formal sector, the chances of having first aid services were ninefold higher than in the informal sector. These disparities highlight the profound resource and infrastructural gaps that characterise informal work settings, a challenge consistent with findings from other regional contexts [69, 70]. Workplaces with these provisions are not only better prepared to mitigate the consequences of incidents but also likely demonstrate a broader commitment to employee welfare and systematic safety management, which correlates with better overall safety performance [61, 71, 72].

The study's findings exposed a fragmented, selectively enforced, and ultimately exclusionary regulatory model, necessitating significant reform. The stark disparities revealed between Sierra Leone's formal and informal sectors indicate a major failure to translate these global norms into an inclusive, functional national system. The global occupational safety and health (OSH) architecture, defined by ILO conventions and WHO action plans, provides a normative framework for national systems [9, 26, 27, 39, 73].

5 Conclusion

This study demonstrates a profound systemic deficit in occupational health and safety (OHS) within Freetown's informal sector, characterised by severe gaps in protective OSH policies, infrastructure, information, and resources when compared to formal workplaces. The analysis identifies key modifiable drivers of safety compliance, most notably awareness of national OHS policy and access to first aid services, offering clear targets for intervention. While gender, education level, and sector type are significant background factors, the findings ultimately emphasise that strategic, resource-sensitive actions such as disseminating simplified safety codes, launching targeted awareness campaigns, and facilitating access to basic protective equipment and first aid are urgently needed to address this critical public health inequity. Therefore, we recommend improving occupational safety in the informal sectors, implementing a strategy that creates a simplified OSH code, launching targeted awareness campaigns through trusted community channels, tailor training programs for individuals with diverse educational backgrounds and genders, and facilitating access to affordable safety solutions via supportive partnerships with the Ministry of Labour and Social Security and employers. Policymakers should ensure safety policy reform and launch a national programme to deliver simplified pictorial safety guides in local languages to workers in the informal sector. Concurrently, researchers must design and rigorously evaluate these specific

interventions to measure how increasing practical policy knowledge and resource access directly impacts safety compliance within these vulnerable workplaces.

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Author contributions

Bockarie Pompay Sesay conceived the ideas, conducted the literature review, conducted the conceptualization, methodology, data collection, analysis, manuscript drafting, manuscript review, and final approval. Alhaji Brima Gogra conceptualized the ideas, methodology, and manuscript review, provided overall leadership, and provided final approval. Mohamed Kemoh Rogers: conceptualization, methodology, manuscript review, and final approval. Adel H. ELDUMA: conceptualized, methodology, analysis, and manuscript review. Gebrekstos N. Gebru: Conception, methodology, and manuscript review. Mohamed S. Kobbay: conceptualization, methodology, data collection, and analysis.

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Data availability

The study's data will be made available upon reasonable written request to the corresponding author and the unidentified data will be shared.

Declarations

Ethics approval and consent to participate

The project protocol was submitted to the Sierra Leone Research Ethical Committee for their review and approval before commencing the study. An ethical approval was obtained from the Sierra Leone Ethics and Scientific Review Committee and a research number was allocated as such: (SLESRC No: 020/02/2023). All workers who were present during the survey and of any age category were asked to give a verbal or written informed consent and signed a consent form before participating in the study. Participants who cannot read or write, the consent form was read for them and a co-worker or friend designated by the participant signed the consent form. Respondents were informed to decline any questions they found uncomfortable. The workplace managers or supervisors were informed about the study. Confidentiality was assured, under no circumstances was the questionnaires with identifiers shared with anyone not involved in the study. Once the information is entered into the main database, personal identifiers (names and workplace addresses) were removed. The electronic database was stored in password-protected computer.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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