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Research Article

OCCUPATIONAL HEALTH RISKS AND SAFETY PRACTICES AMONG INFORMAL CEMENT VENDORS IN WARRI AND ENVIRONS DELTA STATE NIGERIA

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Abstract

Informal cement vending is associated with substantial occupational hazards due to frequent exposure to cement dust, manual material handling, and inadequate workplace safety measures. This study assessed occupational hazards and safety practices among informal cement vendors in Warri and Environs, Delta State, Nigeria. A cross-sectional descriptive design was employed involving 30 purposively selected vendors. Data were collected using structured questionnaires and workplace observation checklists and analysed using descriptive statistics, Chi-square test, independent t-test, Pearson correlation, and multiple regression at a 5% level of significance. Most respondents were male (73.3%) and demonstrated high awareness of occupational hazards (grand mean = 4.38 ± 0.15). However, utilisation of personal protective equipment (PPE) was generally poor, with only 16.7% reporting consistent use. Workplace assessments revealed widespread environmental deficiencies, including visible cement dust accumulation (86.7%), inadequate ventilation (70.0%), and absence of safety signage (83.3%). Frequently reported health complaints included general body pain (43.3%), back pain (40.0%), coughing (33.3%), and sneezing (26.7%). Urban vendors exhibited significantly higher PPE utilisation than their peri-urban counterparts ($\chi^2 = 4.82$, $p = 0.028$). PPE utilisation was negatively correlated with coughing ($r = -0.61$, $p = 0.001$), difficulty breathing ($r = -0.54$, $p = 0.003$), and eye irritation ($r = -0.49$, $p = 0.007$). Multiple regression identified dust exposure ($\beta = 0.57$, $p = 0.002$) as the strongest predictor of adverse health outcomes, while PPE use ($\beta = -0.48$, $p = 0.001$) significantly reduced symptom burden. The study concludes that informal cement vendors experience considerable occupational health risks despite relatively high hazard awareness. Improved access to PPE, strengthened occupational safety education, and effective dust-control interventions are recommended to promote safer and more sustainable working environments.

Keywords: Functional rehabilitation, Glucagon-like peptide-1 agonists, Liraglutide, Metabolic health, Multidisciplinary care, Obesity, Physiotherapy, Weight management.

Introduction

The informal economy constitutes a significant component of employment in many developing countries, providing livelihoods for millions of people who operate outside formal labour regulations and occupational health protection frameworks. In Nigeria, informal occupations account for a substantial proportion of the workforce, particularly in the construction and building materials sector, where activities such as cement vending, block production, sand supply, and manual material handling support rapid urbanisation and infrastructure development (Adeyemi & Osuoha, 2026). Although these enterprises contribute meaningfully to economic growth and employment generation, they are often characterised by inadequate workplace safety measures, poor regulatory oversight, and limited access to occupational health services, thereby exposing workers to numerous preventable hazards (Sharma et al., 2026).

Among these occupations, informal cement vending has become increasingly common in urban and peri-urban communities due to the growing demand for construction materials driven by population expansion and infrastructural development. Cement vendors are involved in unloading, transporting, stacking, storing, and retailing cement bags, activities that require repetitive manual lifting and prolonged exposure to cement dust. These operations are frequently conducted in open markets, roadside shops, and temporary storage facilities where engineering controls and occupational safety measures are largely absent. Consequently, workers experience continuous exposure to airborne particulate matter and physically demanding work conditions that may adversely affect their health and productivity (Adeyemi et al., 2026; Adeyemi & Otofia, 2026)

Cement is composed primarily of calcium oxide, silicon dioxide, aluminium oxide, iron oxide, and other trace metallic compounds. During handling, transportation, and repackaging, fine cement particles become airborne, increasing the likelihood of inhalation and dermal exposure. Cement dust contains respirable particles capable of penetrating the lower respiratory tract, where prolonged exposure may induce chronic inflammation, impaired pulmonary function, bronchitis, asthma-like symptoms, and pneumoconiosis in susceptible individuals. In addition, the alkaline nature of cement can cause skin irritation, dermatitis, conjunctivitis, and ocular discomfort following repeated contact. These adverse effects are exacerbated in poorly ventilated workplaces lacking effective dust suppression mechanisms or appropriate personal protective equipment (PPE) (Gigir et al., 2025; Sri et al., 2024)

Beyond respiratory and dermatological hazards, cement vending also presents substantial ergonomic risks. Manual lifting of cement bags weighing approximately 50 kg, repetitive bending, twisting, prolonged standing, and awkward body postures contribute significantly to musculoskeletal disorders involving the lower back, shoulders, knees, and upper limbs. Such disorders reduce physical productivity, increase absenteeism, and may lead to long-term disability among workers. Despite these recognised occupational risks, many informal vendors continue to work without adequate training in safe lifting techniques or access to mechanical handling equipment (Bhavana, 2025; Frank et al., 2025)

The use of personal protective equipment remains one of the most effective strategies for reducing occupational exposure to cement dust and associated health risks. Respirators or nose masks, protective gloves, safety boots, goggles, and protective clothing substantially minimise inhalation, dermal, and ocular exposure. However, PPE utilisation among informal workers is frequently constrained by limited awareness, financial barriers, discomfort during use, poor availability, and weak enforcement of occupational safety regulations. Consequently, a discrepancy often exists between workers' knowledge of occupational hazards and their actual safety practices, resulting in continued exposure to preventable health risks.

Workplace environmental conditions further influence the magnitude of occupational exposure experienced by cement vendors. Factors such as poor ventilation, excessive dust accumulation, inadequate sanitation facilities, overcrowded workspaces, and improper cement storage increase the concentration of airborne particulates and prolong worker exposure. The absence of safety signage, routine workplace inspections, and occupational health

education further compounds these challenges. These environmental deficiencies are often more pronounced in informal settings, where business operations occur outside formal occupational health monitoring systems (Adeyemi & Ekohwo, 2026; Sesay et al., 2026)

Occupational health and safety within the informal sector have received increasing attention from governments, international organisations, and public health researchers because informal workers constitute one of the most vulnerable occupational groups globally. Despite this growing recognition, research has largely focused on construction workers, factory employees, and industrial cement manufacturing personnel, whereas relatively little attention has been devoted to informal cement vendors who experience continuous occupational exposure under less regulated conditions. This knowledge gap limits the development of evidence-based interventions tailored to this population.

In Warri and Environs, Delta State, Nigeria, rapid urban growth and sustained construction activities have expanded the informal cement retail market, leading to increased numbers of individuals engaged in cement handling and sales (Adeyemi & Pronen, 2025). Nevertheless, information regarding workplace hazards, safety practices, and associated health outcomes among these workers remains scarce. Local evidence is required to characterise occupational exposure patterns, identify deficiencies in workplace safety practices, and provide scientific data for developing targeted occupational health interventions.

Therefore, this study assesses occupational hazards and safety practices among informal cement vendors in Warri and Environs, Delta State, Nigeria. Specifically, it evaluates workers' awareness of occupational hazards, utilisation of personal protective equipment, workplace environmental conditions, and self-reported health symptoms while comparing safety practices across different operational settings. The findings are expected to provide valuable evidence for strengthening occupational health policies, promoting safer work environments, and supporting sustainable occupational health management within Nigeria's informal construction materials sector.

Materials and Methods

Study Area

The study was conducted among informal cement vendors operating in selected locations within Warri and Environs, Delta State, Nigeria. The study area comprised Warri, Ekpan, and Agbarho, which represent major commercial and residential communities characterised by active building material markets and roadside cement retail outlets. These locations experience sustained construction activities, resulting in increased demand for cement and a corresponding concentration of informal cement vendors. Most vending activities are carried out in open spaces or temporary structures with minimal occupational safety infrastructure.

Study Design

A descriptive cross-sectional survey design was adopted to assess workplace hazards and safety practices among informal cement vendors. The design enabled the collection of quantitative data on occupational exposures, safety awareness, personal protective equipment (PPE) utilisation, workplace conditions, and self-reported health outcomes at a single point in time. The cross-sectional approach was considered appropriate because it permits the evaluation of the prevalence of occupational hazards and associated safety practices within the study population.

Study Population

The study population consisted of informal cement vendors involved in the loading, offloading, transportation, storage, and retail sale of bagged cement in selected locations within Warri and Environs. Eligible participants were adults aged 18 years and above who had been actively engaged in cement vending for at least one year and voluntarily consented to participate in the study.

Sample Size and Sampling Technique

A total of thirty (30) informal cement vendors participated in the study, comprising fifteen (15) vendors from urban locations and fifteen (15) vendors from peri-urban locations within Warri and Environs. Participants were selected using purposive sampling based on their active involvement in cement vending and willingness to participate. This sampling technique was considered appropriate because informal cement vendors are not organised into formal occupational registers, making probability sampling impracticable.

Data Collection Instrument

Data were collected using a structured questionnaire developed from previous occupational health and safety studies and modified to suit the objectives of the present study. The questionnaire comprised six sections:

- Section A: Socio-demographic characteristics.
- Section B: Awareness of occupational hazards.
- Section C: Utilisation of personal protective equipment.
- Section D: Workplace environmental conditions.
- Section E: Self-reported occupational health symptoms.
- Section F: Occupational safety practices and intervention measures.

Most questionnaire items were measured using five-point Likert scales, while symptom frequency and demographic variables were assessed using categorical response options.

Observation Checklist

A structured workplace observation checklist was used to complement questionnaire responses. During field visits, the researcher assessed workplace conditions including visible cement dust accumulation, adequacy of ventilation, availability and use of PPE, handwashing facilities, workspace organisation, overcrowding, and availability of safety signage. The observations provided objective verification of workplace safety conditions reported by respondents.

Validity and Reliability of the Instrument

Content validity of the questionnaire was established through expert review by specialists in occupational health, environmental management, and toxicology. Their recommendations were incorporated to improve clarity, relevance, and comprehensiveness of the instrument. A pilot study involving five informal cement vendors outside the study locations was conducted to assess the suitability of the questionnaire. Responses obtained during the pilot study were excluded from the final analysis. Internal consistency of the questionnaire was evaluated using Cronbach's alpha coefficient, yielding an overall reliability coefficient of 0.84, indicating good reliability.

Data Collection Procedure

Following informed consent, questionnaires were administered directly to respondents through face-to-face interviews to minimise non-response and accommodate participants with limited literacy. The researcher simultaneously completed the observation checklist during visits to each vending location. Completed questionnaires were examined daily for completeness and consistency before data entry.

Data Analysis

Data were coded and analysed using the Statistical Package for the Social Sciences (SPSS) version 26. Descriptive statistics including frequencies, percentages, means, and standard errors of the mean (SEM) were used to summarise respondents' characteristics and study variables. Inferential statistics included the Chi-square test to compare PPE utilisation between locations, the independent samples *t*-test to compare mean hazard awareness scores, Pearson's correlation analysis to determine relationships between PPE utilisation and occupational health symptoms, and multiple linear regression to identify predictors of occupational health outcomes. Statistical significance was established at $\mathbf{p < 0.05}$.

Ethical Considerations

Ethical approval for the study was obtained from the appropriate institutional authority before commencement of the research. Permission was also obtained from cement vendors prior to data

collection. Participation was entirely voluntary, and informed consent was obtained from each respondent before questionnaire administration. Participants were assured of confidentiality and anonymity, and all information collected was used solely for research purposes. Respondents retained the right to withdraw from the study at any stage without any consequences.

Study Limitations

The study relied on self-reported information regarding occupational exposure, health symptoms, and safety practices, which may be subject to recall and reporting bias. In addition, the relatively small sample size limits the generalisability of the findings beyond the study area. Nevertheless, the combined use of questionnaire responses and direct workplace observations enhanced the reliability of the findings and provided valuable baseline information on occupational hazards among informal cement vendors in Warri and Environs, Delta State.

Results

The socio-demographic analysis (Table 1) revealed that the majority of informal cement vendors were males (73.3%), indicating that cement vending remains a predominantly male occupation due to the physical demands associated with loading, lifting, and transporting cement bags. Respondents aged 26–35 years constituted the highest proportion (36.7%), suggesting that economically active young adults dominate the informal cement trade. Most respondents were married (60.0%), indicating dependence on the occupation as a major source of family income. Secondary education was the most common educational level attained (46.7%), while only a small proportion possessed tertiary education (16.7%).

The occupational activity profile (Table 2) showed that offloading (90.0%) and loading (83.3%) of cement bags were the most frequently performed tasks, highlighting the physically intensive nature of the occupation. Transportation and storage activities were also common, further predisposing workers to musculoskeletal strain and dust exposure.

Table 1: Socio-Demographic Characteristics of Informal Cement Vendors (n = 30)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	22	73.3
	Female	8	26.7
Age Group	18–25 years	5	16.7
	26–35 years	11	36.7
	36–45 years	8	26.7
	46–55 years	4	13.3
	Above 55 years	2	6.6
Marital Status	Single	9	30
	Married	18	60
	Divorced	2	6.7
	Widowed	1	3.3
Educational Qualification	No formal education	4	13.3
	Primary education	7	23.3
	Secondary education	14	46.7
	Tertiary education	5	16.7
Location	Urban	15	50
	Peri-urban	15	50
Years of Experience	Less than 1 year	3	10
	1–5 years	12	40
	6–10 years	9	30
	Above 10 years	6	20

Table 2: Occupational Activities Commonly Performed by Respondents

Occupational Activity	Frequency (n)	Percentage (%)
Loading of cement bags	25	83.3
Offloading of cement bags	27	90
Cement storage arrangement	18	60
Retail selling	21	70
Transportation of cement bags	16	53.3

Figure 1 presents the gender distribution of the informal cement vendors who participated in the study. The majority of the respondents were **male (73.3%)**, while **26.7%** were **female**.

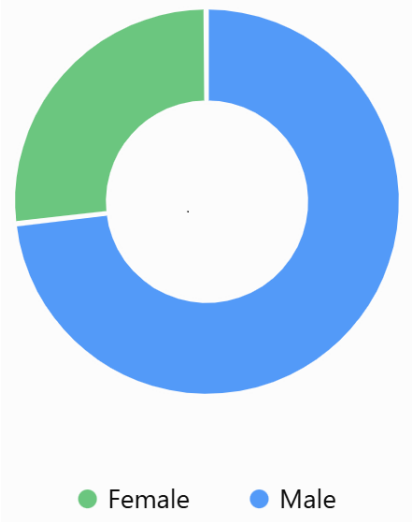


Figure 1: Distribution of Respondents by Gender

The respondents demonstrated a generally high level of awareness regarding occupational hazards associated with cement vending (Table 3), with a grand mean score of 4.38 ± 0.15. Most respondents strongly acknowledged that cement dust adversely affects health and may contribute to respiratory disorders. The high awareness scores indicate that workers are generally informed about occupational risks despite operating within the informal sector.

However, PPE utilisation remained relatively poor despite this awareness (Table 4). Safety boots were the most commonly used PPE (50.0%), whereas eye goggles had the lowest usage rate (13.3%). Nose masks, which are critical for reducing inhalation exposure to cement dust, were used by only 40.0% of respondents. Furthermore, only 16.7% reported always using PPE during work activities (Table 4). These findings suggest a substantial gap between hazard awareness and actual safety practice

Table 3: Awareness of Occupational Hazards Among Informal Cement Vendors

Hazard Awareness Statement	**Mean ± SEM**	**Decision**
Cement dust can affect human health	4.63 ± 0.11	Agree
Long-term exposure can cause respiratory problems	4.51 ± 0.13	Agree
Carrying cement bags repeatedly causes body pain	4.42 ± 0.15	Agree
Poor ventilation increases dust exposure	4.18 ± 0.18	Agree
Skin contact with cement may cause irritation	4.07 ± 0.19	Agree
Occupational hazards reduce productivity	4.11 ± 0.17	Agree
Safety practices are important in cement vending	4.72 ± 0.10	Agree
Grand Mean	4.38 ± 0.15	High Awareness

Table 4. Personal Protective Equipment Utilisation and Frequency of Use Among Informal Cement Vendors (n = 30)

Variable	**Category**	**Frequency (n)**	**Percentage (%)**
PPE Utilised	Nose mask/Respirator	12	40
	Hand gloves	10	33.3
	Safety boots	15	50
	Protective clothing	8	26.7
	Eye goggles	4	13.3
Overall Frequency of PPE Use	Always	5	16.7
	Often	7	23.3
	Sometimes	8	26.7
	Rarely	6	20
	Never	4	13.3

Figure 2 illustrates the level of occupational hazard awareness among the informal cement vendors. The majority of the respondents (**70.0%**) demonstrated a **high level of awareness** regarding the occupational hazards associated with cement vending. Approximately **23.3%** exhibited a **moderate level of awareness**, while only **6.7%** had a **low level of awareness**. Figure 3 presents the frequency of personal protective equipment (PPE) use among the respondents. The largest proportion of respondents (**26.7%**) reported **sometimes** using PPE during work activities, followed by **23.3%** who reported using PPE **often**. Respondents who **rarely** used PPE accounted for **20.0%**, while **16.7%** indicated that they **always**

wore PPE. Notably, **13.3%** of the respondents reported **never** using PPE.

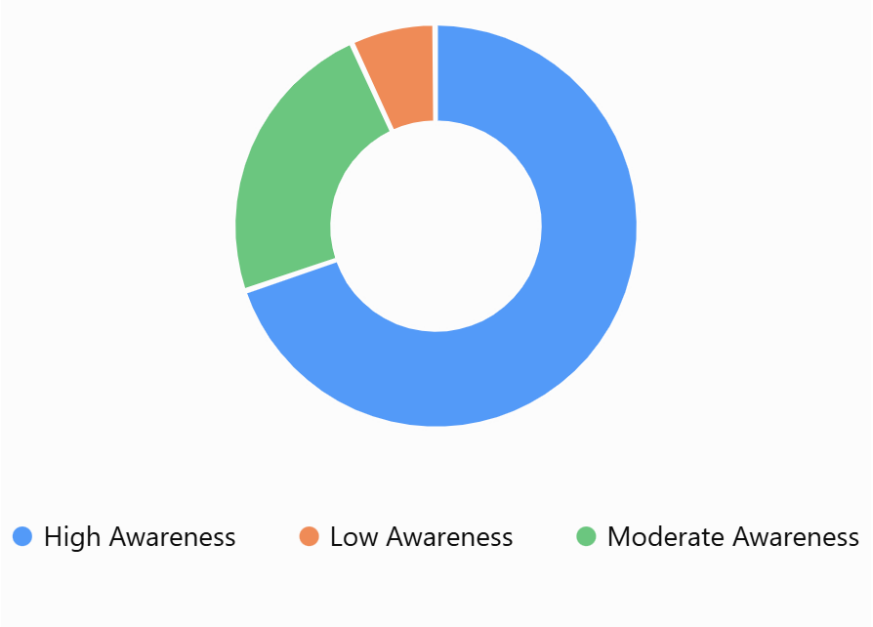


Figure 2: Awareness Level of Occupational Hazards among Respondents

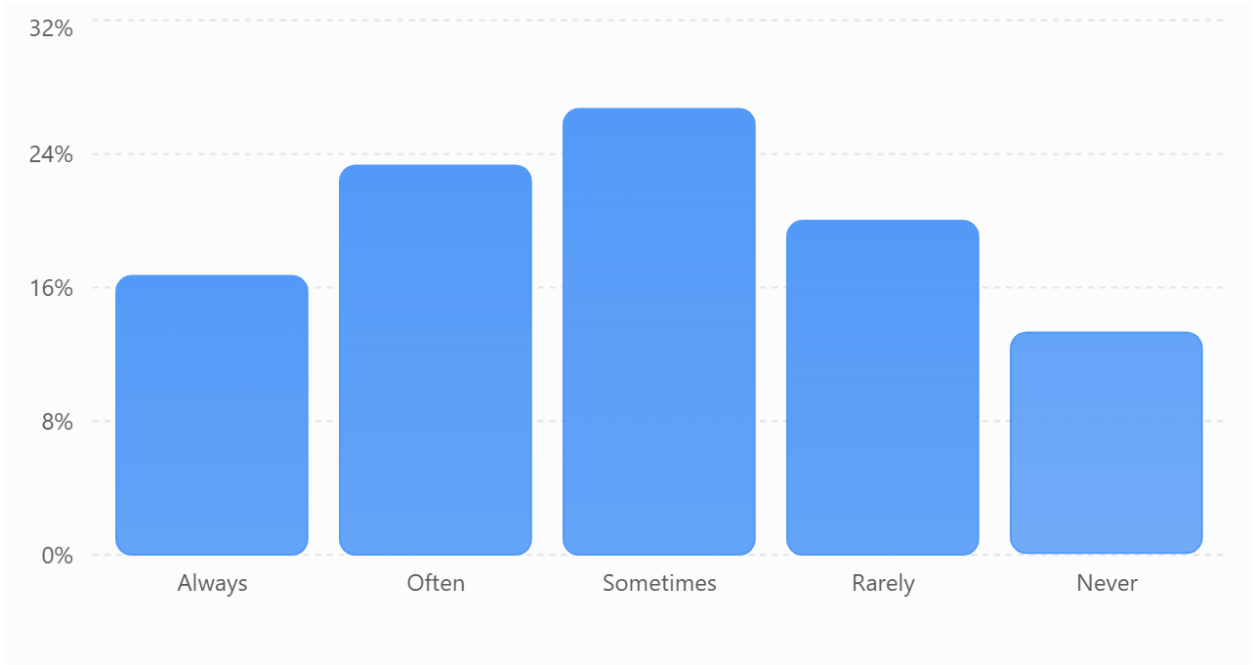


Figure 3: Frequency of PPE Usage among Informal Cement Vendors

Assessment of workplace environmental conditions (Table 5) showed that most vending locations possessed inadequate occupational safety structures. Ventilation was generally poor, with a mean score of 2.48 ± 0.21, while dust control measures recorded the lowest mean score (2.11 ± 0.15). These findings indicate substantial exposure to airborne cement particulates within the work environment.

The observational checklist (Table 5) further revealed that 86.7% of vending sites had visible cement dust accumulation, while only 30.0% demonstrated adequate ventilation. Safety signage was almost completely absent (16.7%), and only 26.7% of worksites had handwashing facilities. Overcrowding was observed in 60.0% of locations, suggesting constrained workspaces that may predispose workers to ergonomic and respiratory hazards.

Table 5. Perceived and Observed Workplace Environmental Conditions Among Informal Cement Vendors (n = 30)

Environmental Condition	Assessment	Mean ± SEM / n (%)	Decision
Respondents' Assessment	Ventilation at worksite	2.48 ± 0.21	Poor
	Cleanliness of work environment	2.71 ± 0.18	Fair
	Availability of space for movement	2.93 ± 0.17	Fair

	Dust control measures	2.11 ± 0.15	Poor
	General safety condition	2.36 ± 0.19	Poor
	Grand Mean	**2.52 ± 0.18**	**Fair/Poor**
Workplace Observation	Visible cement dust accumulation	26 (86.7)	Present
	Adequate ventilation present	9 (30.0)	Present
	PPE observed during work	13 (43.3)	Present
	Handwashing facility available	8 (26.7)	Present
	Proper cement storage arrangement	11 (36.7)	Present
	Overcrowded workspace	18 (60.0)	Present
	Safety signage available	5 (16.7)	Present

Figure 4 presents the key workplace environmental hazards identified through direct observation of the informal cement vending sites. The most prevalent hazard was visible cement dust accumulation, observed in 86.7% of the workplaces, indicating widespread exposure to airborne cement particulates. A substantial proportion of the worksites (70.0%) exhibited poor ventilation, which could further increase the concentration of inhalable dust and adversely affect respiratory health. Additionally, 73.3% of the workplaces lacked handwashing facilities, limiting workers' ability to maintain personal hygiene following exposure to cement dust. The absence of safety signage was noted in 83.3% of the sites, suggesting inadequate communication of workplace hazards and safety procedures. Furthermore, 60.0% of the observed workplaces were overcrowded, potentially increasing the risk of occupational accidents and limiting safe movement during work activities.

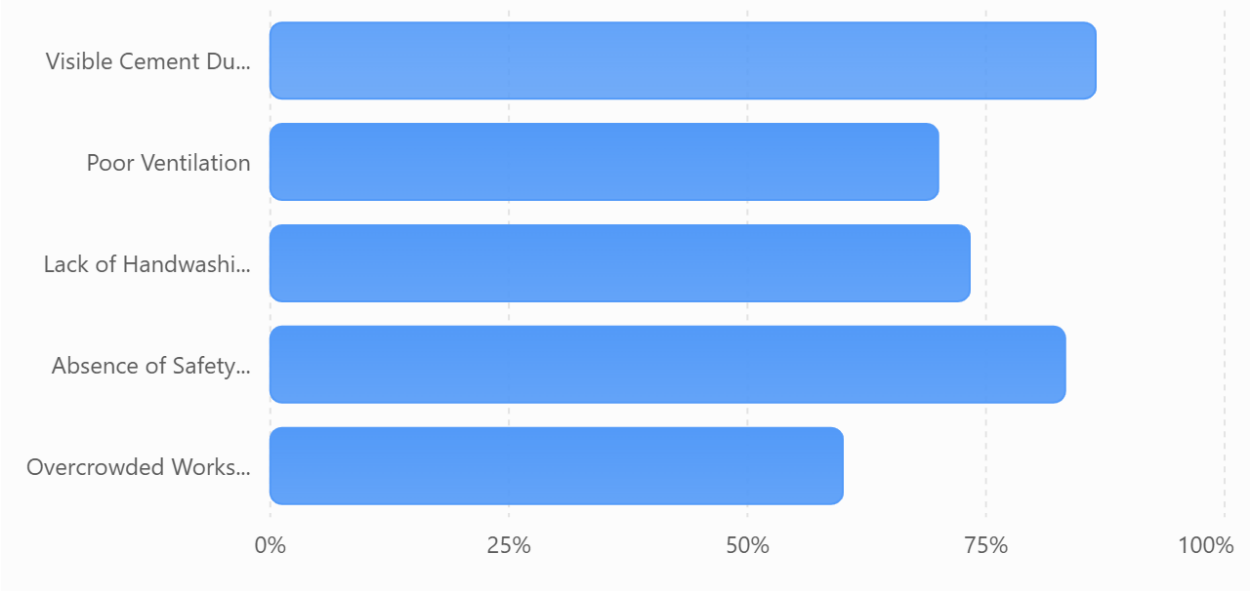


Figure 4: Observed Workplace Environmental Hazards

Self-reported health complaints among respondents (Table 6) indicated a considerable occupational health burden associated with cement vending activities. General body pain (43.3%) and back pain (40.0%) were the most frequently reported symptoms, reflecting the physically demanding nature of repetitive cement lifting and transportation.

Respiratory-related symptoms (Table 6) were also highly prevalent. Frequent coughing was reported by 33.3% of respondents, while 26.7% frequently experienced sneezing. Difficulty breathing and eye irritation were also commonly reported, suggesting chronic exposure to airborne cement particulates.

More than half of the respondents (56.7%) reported hospital visitation due to work-related illness (Table 6). Respiratory irritation emerged as the most commonly diagnosed condition (35.3%), followed by musculoskeletal pain (29.4%). These findings suggest that occupational exposures within informal cement vending may contribute substantially to adverse respiratory and musculoskeletal health outcomes.

Table 6. Self-Reported Occupational Health Symptoms, Hospital Visitation, and Diagnosed Work-Related Conditions Among Informal Cement Vendors (n = 30)

Variable	Category	Never n (%)	Rarely n (%)	Sometimes n (%)	Frequently n (%)
Self-Reported Health Symptoms	Coughing	3 (10.0)	6 (20.0)	11 (36.7)	10 (33.3)
	Sneezing	4 (13.3)	5 (16.7)	13 (43.3)	8 (26.7)
	Difficulty breathing	8 (26.7)	7 (23.3)	10 (33.3)	5 (16.7)
	Chest pain	11 (36.7)	8 (26.7)	7 (23.3)	4 (13.3)
	Eye irritation	5 (16.7)	6 (20.0)	12 (40.0)	7 (23.3)

	Skin irritation	7 (23.3)	8 (26.7)	10 (33.3)	5 (16.7)
	Back pain	2 (6.7)	4 (13.3)	12 (40.0)	12 (40.0)
	General body pain	1 (3.3)	5 (16.7)	11 (36.7)	13 (43.3)
Hospital Visitation Due to Work-Related Illness	Yes	-	-	17 (56.7)	-
	No	-	-	13 (43.3)	-
Diagnosed Work-Related Conditions *(n = 17)*	Respiratory irritation	-	-	6 (35.3)	-
	Persistent cough	-	-	4 (23.5)	-
	Musculoskeletal pain	-	-	5 (29.4)	-
	Skin allergy/Dermatitis	-	-	2 (11.8)	-

Hospital visitation refers to respondents who sought medical attention for work-related illnesses. Diagnosed conditions are based on the 17 respondents who reported hospital visitation due to occupational health problems.

Figure 5 illustrates the most frequently reported health symptoms experienced by the informal cement vendors. General body pain was the most commonly reported symptom, affecting 43.3% of the respondents, followed by back pain, reported by 40.0%. Respiratory symptoms were also prevalent, with 33.3% of the respondents frequently experiencing coughing, while 26.7% reported frequent sneezing. Eye irritation was reported by 23.3% of the respondents, reflecting the irritant effects of airborne cement dust on the eyes. Difficulty breathing was the least frequently reported among the highlighted symptoms but still affected 16.7% of the respondents.

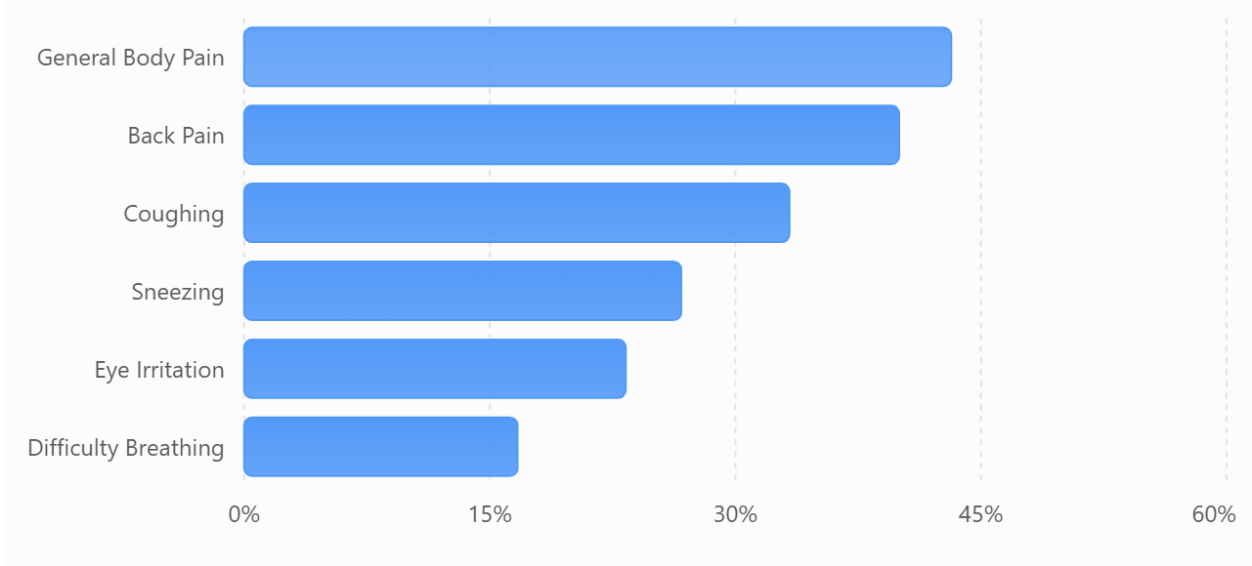


Figure 5: Frequently Reported Health Symptoms among Respondents

A statistically significant difference was observed in PPE utilisation between urban and peri-urban cement vendors ($\chi^2 = 4.82$, $p = 0.028$). Urban vendors demonstrated relatively higher PPE usage compared with peri-urban vendors (Table 7). This may be associated with improved access to safety information, greater regulatory exposure, or better economic capacity among urban vendors.

Table 7. Comparison of Occupational Safety Indicators Between Urban and Peri-Urban Informal Cement Vendors (n = 30)

Variable	Urban (n = 15)	Peri-Urban (n = 15)	Test Statistic	p-value
Adequate PPE use, n (%)	10 (66.7)	4 (26.7)	$\chi^2 = 4.82$	0.028*
Inadequate PPE use, n (%)	5 (33.3)	11 (73.3)		
Hazard awareness score (Mean ± SEM)	4.58 ± 0.13	4.17 ± 0.16	$t = 2.11$	0.043*

χ^2 = Chi-square statistic; t = independent samples t-test; SEM = standard error of the mean. Values marked with an asterisk () are statistically significant at $p < 0.05$.*

Figure 6 compares the proportion of informal cement vendors who reported adequate use of personal protective equipment (PPE) between urban and peri-urban locations. Adequate PPE usage was substantially higher among urban vendors, with 66.7% reporting adequate utilisation, compared with only 26.7% of peri-urban vendors.

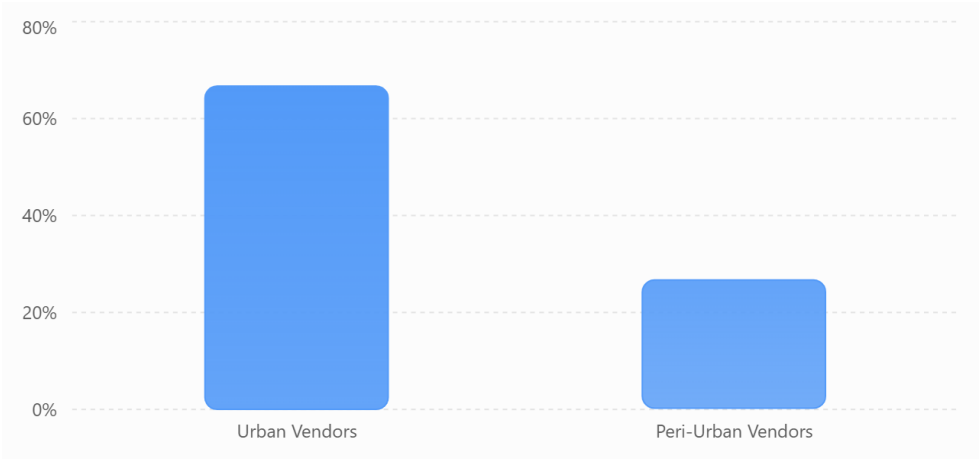


Figure 6: Comparison of PPE Usage between Urban and Peri-Urban Vendors

Pearson correlation analysis demonstrated significant negative relationships between PPE usage and respiratory-related symptoms among respondents. Increased use of PPE was associated with lower frequencies of coughing ($r = -0.61$, $p = 0.001$), difficulty breathing ($r = -0.54$, $p = 0.003$), and eye irritation ($r = -0.49$, $p = 0.007$). These findings suggest that consistent utilisation of PPE may substantially reduce inhalation-related health risks among informal cement vendors. However, correlations between PPE usage and musculoskeletal symptoms such as back pain and general body pain were weak and statistically non-significant, indicating that ergonomic stressors may persist independently of respiratory protective practices. Multiple regression analysis revealed that PPE usage (Table 8), dust exposure level, workplace ventilation, and years of occupational exposure significantly predicted health symptom burden among respondents. Dust exposure emerged as the strongest predictor ($\beta = 0.57$, $p = 0.002$), indicating that increased dust levels significantly worsened occupational health outcomes.

Table 8. Correlation and Multiple Regression Analyses of Occupational Safety Factors Associated with Health Outcomes Among Informal Cement Vendors

A. Pearson Correlation Analysis

Variables Correlated	Correlation Coefficient (r)	p-value	Decision
PPE usage vs. Coughing frequency	-0.61	0.001*	Significant
PPE usage vs. Difficulty breathing	-0.54	0.003*	Significant
PPE usage vs. Eye irritation	-0.49	0.007*	Significant
PPE usage vs. General body pain	-0.33	0.072	Not significant
PPE usage vs. Back pain	-0.29	0.094	Not significant

B. Multiple Regression Analysis Predicting Occupational Health Symptoms

Predictor Variable	β Coefficient	Standard Error	t-value	p-value
PPE usage	-0.48	0.11	-4.36	0.001*
Dust exposure level	0.57	0.14	4.08	0.002*
Workplace ventilation	-0.39	0.13	-3	0.006*
Years of occupational exposure	0.21	0.1	2.1	0.044*

C. Regression Model Statistics

Statistic	Value
R^2	0.68
Adjusted R^2	0.63
F-statistic	13.42
Model p-value	0.000*

β = standardized regression coefficient; r = Pearson correlation coefficient; R^2 = coefficient of determination. Negative coefficients indicate that increased PPE use or improved workplace ventilation is associated with fewer occupational health symptoms, whereas positive coefficients indicate an increased likelihood of adverse health outcomes. Values marked with an asterisk (*) are statistically significant at $p < 0.05$.

Discussion

The socio-demographic characteristics of the respondents (Table 1; Figure 1) indicate that informal cement vending is predominantly undertaken by young adult males, reflecting the physically demanding nature of loading, unloading and transporting cement bags. Similar demographic patterns have been reported among informal construction workers and cement handlers in sub-Saharan Africa, where manual material handling remains largely male-dominated because of the physical demands associated with such

occupations (Adeyemi & Adeyemo, 2025). The predominance of economically active workers suggests prolonged occupational exposure during productive working years, thereby increasing the cumulative risk of respiratory and musculoskeletal disorders.

Although most respondents possessed at least secondary education (Table 1) and demonstrated a high level of occupational hazard awareness (Table 3; Figure 2), this knowledge did not translate into consistent adoption of preventive measures, particularly the use of personal protective equipment (Table 4; Figure 3). Similar discrepancies between occupational hazard awareness and safety practices have been reported among informal workers, where financial limitations, inadequate occupational health training and weak regulatory oversight impede effective implementation of preventive measures (Sesay, Conteh, et al., 2026; Sesay, Rogers, et al., 2026). Comparable findings among construction workers further indicate that awareness alone is insufficient to improve occupational safety without supportive workplace policies and access to protective resources (Ahmad et al., 2025; Haganta et al., 2026).

The occupational activity profile (Table 2) shows that respondents were primarily engaged in loading and offloading cement bags, activities characterised by repetitive manual handling and sustained biomechanical stress. These work demands have consistently been associated with work-related musculoskeletal disorders among cement handlers and manual labourers (Alghadir et al., 2025; Ijaz et al., 2024), providing a plausible explanation for the predominance of musculoskeletal symptoms observed in the present study (Table 6; Figure 5).

The workplace assessment (Table 5; Figure 4) revealed poor ventilation, inadequate dust control, limited hygiene facilities and insufficient workplace safety infrastructure. Direct observations confirmed that these deficiencies represented actual workplace conditions rather than respondents' perceptions. Similar workplace environments have been associated with increased respiratory morbidity among cement workers, particularly where engineering controls and dust suppression systems are lacking (Mkulisi et al., 2024; Rachiotis et al., 2017; Saima et al., 2024). The widespread absence of handwashing facilities and safety signage further reflects deficiencies in occupational hygiene and safety management that may increase inhalation and dermal exposure to cement dust.

The health outcomes reported by respondents (Table 6; Figure 5) are consistent with the occupational demands of cement vending. Frequent musculoskeletal complaints are likely attributable to repetitive lifting, awkward working postures and prolonged physical exertion, while respiratory and ocular symptoms reflect chronic exposure to airborne cement dust. Similar symptom profiles have been reported among construction workers, warehouse employees and cement handlers (Dwiseli & Wenas, 2025; Rodríguez-Pulido et al., 2025). Likewise, previous epidemiological studies have documented increased respiratory symptoms among workers chronically exposed to cement dust (Aydın et al., 2026; Maher, 2023). The occurrence of clinically diagnosed respiratory irritation, musculoskeletal disorders and dermatitis further demonstrates that occupational exposure extends beyond transient symptoms to medically significant conditions requiring healthcare intervention (Butt & Thompson, 2023; Lejding et al., 2023).

The comparison between urban and peri-urban respondents (Table 7; Figure 6) showed significantly better occupational safety practices and hazard awareness among urban vendors. Similar geographical disparities have been reported among informal workers in low- and middle-income countries, where occupational health services, regulatory oversight and access to protective equipment are generally more available in urban than peri-urban settings (Sesay et al., 2026). These findings highlight the need for targeted interventions aimed at improving occupational health resources in peri-urban informal workplaces.

Inferential analyses (Table 8) demonstrated that increased PPE utilisation was associated with lower frequencies of respiratory and ocular symptoms, reinforcing the protective role of PPE in reducing cement dust exposure. Comparable inverse relationships between PPE use and respiratory morbidity have been reported among cement factory workers, quarry workers and construction labourers (Bogale et al., 2025; Saima et al., 2024). However, PPE utilisation showed no significant association with musculoskeletal symptoms, suggesting that these disorders are driven primarily by ergonomic stressors rather than inhalation exposure. Similar conclusions have been drawn by Rahgoshay et al. (2025) and Tamale et al. (2024), who emphasised that prevention of work-related musculoskeletal disorders requires ergonomic improvements and safer manual handling practices in addition to conventional protective measures.

The regression model (Table 8) identified dust exposure as the strongest predictor of adverse occupational health outcomes, whereas PPE utilisation and workplace ventilation exerted significant protective effects. These findings support the hierarchy of hazard control, which advocates integrating engineering controls with personal protective measures to minimise occupational exposure. The positive relationship between years of occupational exposure and symptom burden further supports the cumulative dose–response relationship widely recognised in occupational toxicology, whereby prolonged exposure to respirable cement dust progressively increases the risk of chronic respiratory disease and other work-related disorders (Bogale et al., 2025; Çetintepe et al., 2025).

Overall, the findings indicate that the occupational health risks experienced by informal cement vendors result from the interaction of poor workplace conditions, persistent cement dust exposure, physically demanding manual handling tasks and inadequate utilisation of personal protective equipment. Addressing these challenges requires integrated interventions that combine engineering controls, improved workplace ventilation, effective dust suppression, ergonomic improvements, greater access to affordable PPE and continuous occupational health education to promote safer and healthier working environments.

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