Ojo *et al. BMC Public Health* (2025) 25:277
https://doi.org/10.1186/s12889-025-21473-5

BMC Public Health

RESEARCH Open Access

Factors associated with occupational injuries among bricklayers and carpenters in Building Construction: insights from a mixed methods study in Osun State, Nigeria

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Abstract

Background Occupational injuries (OI) remains a global health issue, claiming approximately 1000 lives daily. More needs to be known about OI burdens among artisans in low-income settings. Therefore, this study assessed the factors influencing OIs among carpenters and bricklayers, who are informal artisans in Nigeria.

Methods This mixed-methods survey was conducted in Osun state, Nigeria. The quantitative component entailed a comparative cross-sectional study of 421 bricklayers and 425 carpenters selected via simple random sampling. Information on socio-demographics and OI prevalence was obtained using a semi-structured questionnaire. The qualitative aspect comprised 12 focus group discussions (FGD) among artisans who did not participate in the quantitative aspect of the study. Thematic analysis of the qualitative data was conducted to identify pertinent themes and subthemes. Binary logistic regression analysis was conducted to assess the factors influencing OIs, p-value less than 0.05 was taken as statistically significant.

Results All respondents were male. The mean age was 51.3.7 ± 14.7 years for bricklayers and 50.0 ± 11.5 years for carpenters. The 3-month prevalence of OI was 39.9% for bricklayers and 51.8% for carpenters. Factors associated with OI among bricklayers included being aged 20–39 years (AOR:6.9, 95% CI:3.1–15.3) and 40–59 years (AOR:2.9, 95% CI:1.5–5.6), earning less than N50,000 (US$67) monthly (OR:2.3, 95% CI:1.2–4.7), earning N50,000-N99,000 (US$67-US$133) monthly (AOR:2.5, 95% CI: 1.2–5.2), and handling ≥ 200 kg per day at work (AOR:2.1, 95% CI:1.3–3.5). For carpenters, factors associated with OI were being aged 20–39 years (AOR:4.1, 95% CI:2.0-8.5), age 40–59 years (AOR:2.1, 95% CI:1.2–3.6) and handling 100–199 kg per day at work (AOR:1.9, 95% CI:1.02–3.4). FGD findings revealed that the use of substandard building materials, poor use of personal protective equipment and working at heights may predispose to OIs.

Conclusion The burden of OI is high among informal construction artisans in Nigeria. Safety interventions should target persons < 60 years, those handling heavy weights at work (> 100 kg) and bricklayers earning < N100,000

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(< US$134) monthly. Emphasis should also be placed on the use of safety equipment and ensuring standards of building materials.

Keywords Occupational injuries, Determinants, Carpenters, Bricklayers, Informal sector, Artisans, Nigeria

Introduction

Occupational injuries constitute a pressing global health concern, with an estimated 370 million injuries being reported annually [1]. Although high-income countries report the majority of occupational injury cases, the actual burden is likely much higher in low-income countries due to underreporting and data limitations. This gap arises due to inadequate legal frameworks for safeguarding workers' health in low-income settings [2]. Moreover, many workers in low-income nations operate in unsafe conditions, lacking proper safety oversight and protective gear [3]. This is especially common among artisans in the informal construction sector, exposing them to significant safety hazards due to precarious work environments [3, 4].

Generally, injuries occur due to acute bodily exposure to physical agents or forces in amounts or rates beyond the threshold of human tolerance and they may be classified as fatal or non-fatal [5]. The human and economic costs of occupational injuries (OIs) are quite significant [6]. The economic burden of OIs affects the worker and society. The cost to the worker is in the form of direct expenses incurred while seeking care for injuries sustained. Informal sector artisans are often uninsured [7, 8] and therefore bear the cost of treatment for occupational injuries via out-of-pocket spending and this may push them into catastrophic health expenditure. It also includes the cost of treatment and loss of income due to time off work [9].

The cost to society is in the form of loss in productivity, increased cost/burden on public health services and payment for injury compensation among other things [10]. In most low-income countries, basic occupational health services do not exist for artisans. Therefore, artisans who sustain injuries at work and decide to seek care are left to find treatment from diverse sources such as traditional healers and bone setters, patent medicine vendors, private health clinics and public hospitals [11].

Occupational injuries do not occur at random, certain predisposing conditions make them happen. The factors that may influence injury causation as deduced form past literature have been grouped under personal, psychosocial and work-related factors [12]. Poor working conditions have been documented to be a significant factor that influences occupational injuries in construction workers. These poor working conditions include long working hours, night work/shift, fast-paced work, working with vibrating hand tools as well as poor safety training and supervision. Other workplace factors associated with occupational injuries are working at heights, working against vibration and poor housekeeping [13].

Psychosocial factors in the work environment have been implicated in the growing problem of occupational injuries in the general working population [14, 15]. Furthermore, personal factors may also impact injury predisposition. These factors include the socio-demographic and behavioural characteristics of the worker. Past studies suggest that age, sex, substance use, and non-use of personal protective equipment (PPE) are some of the factors that may predispose construction workers to injury [16, 17].

In Nigeria, past research concentrated on workers in the formal construction sector—masons, carpenters, engineers, and architects [11, 16, 18]. These groups typically work for large construction firms, benefiting from comparatively superior working conditions and regulatory oversight. However, there is a significant knowledge gap regarding the health and safety of artisans in the informal sector of the construction industry who often face neglect and underreporting of their occupational health issues. Highlighting the significance of this research gap, a previous report indicated that among International Labour Organization (ILO) member countries, Nigeria had the highest rate of underreporting (99.8%) of occupational injuries, thus underscoring the need for comprehensive studies in this area [2].

The construction industry is globally recognized as one of the sectors with the highest rates of injury [19]. This is particularly true in developing country contexts like Nigeria, where the informal sector is the dominant aspect of the construction industry and artisans sustain themselves with minimal oversight from government agencies [20]. In addition, artisans in the informal sector often have limited educational backgrounds and typically lack safety education or supervision [21]. Occupational injuries have been shown to commonly affect the extremities and lower back among construction workers in other countries [22, 23], but the pattern among informal sector artisans in Nigeria is unknown. Studies in Africa have described common types of injury to be abrasions, bruises, contusions and fractures [16, 24, 25]. The mechanisms of occupational injuries at construction sites have been described in some studies outside Nigeria. For example, some authors have reported that falls, trips and falling objects are common mechanisms of occupational injuries at work sites [26–28].

In Nigeria, the informal sector of the construction industry is characterised by self-employed craftsmen who function as bricklayers, carpenters, plumbers, tilers, iron benders etc. This special group of artisans are often understudied. A review of past studies suggests that bricklaying and carpentry are two vocations with high injury burdens [29–31], and this calls for further scrutiny. Therefore, this study focussed on the gaps identified and determined the pattern and prevalence of occupational injuries and the factors associated with injury prevalence among informal construction artisans, especially bricklayers and carpenters.

The study findings may inform occupational health policies for informal sector employees in the Nigerian construction industry and provide a basis for advocating and planning basic occupational health services for these vulnerable workers. The study also provides recommendations on how to prevent and control occupational injuries and promote safe decent work for all; a key aspect of the Sustainable Development Goals (SDG).

Methods

Study location

This study was conducted in Osun State; one of the 36 states in Nigeria. Osun State has a population of 5.6 million based on projected estimates of the 2006 national census. There are three senatorial districts and 30 local government areas (LGA) in the state. The majority of the inhabitants are traders, artisans, farmers and civil servants. A reasonable number of young persons who are not able to go to school usually learn a trade or engage in vocations as artisans/ craftsmen [32]. These artisans are organised under a self-run association which exists at multiple levels. (From zones to LGA, senatorial district and then state level). Information obtained from the leadership of the artisans' associations revealed that there are about 16,698 registered master carpenters and 19,700 registered master bricklayers in the study location.

Study design

The study adopted a sequential explanatory mixed methods approach, commencing with quantitative data collection (comparative cross-sectional design). Subsequently, qualitative data were obtained through focus group discussions (FGDs).

Study population

Bricklayers and carpenters working in the informal sector of the construction industry comprised the study population. Bricklayers typically lay stones, blocks, and bricks in the construction of building walls and civil works while carpenters are workers who build or repair wooden structures or their components.

Inclusion criteria

Study participants must have worked for at least one year in the vocation and be at least 18 years old. They must be registered members of an artisan group.

Exclusion criteria

Bricklayers and carpenters with acute severe illnesses who were unable to respond to interviews.

Quantitative method

Sample size

The formula for estimating sample size for the comparison of proportions across two groups was used in determining the sample size for this study.

$$N/per\,group = \frac{(Z_\alpha + Z_\beta)^2 x[(P_1 + P_1) + (P_0 + P_0)]}{(P_1 + P_0)^2}$$

N/per group= minimum sample size per group.

Zα =standard normal deviate for α at 95% confidence limit, (i.e., probability of making a type 1 error) =1.96.

Zβ= standard normal deviate for β at 80% confidence limit (i.e., probability of making a type 2 error) =0.84.

P_1 = Proportion of carpenters who had an injury at work from a past study = 38.5%[13].

Q_1= 100% minus P_1 = 61.5%.

P_1 = Proportion of bricklayers who had an injury at work from a past study = 28.3%[11.]

Q_2= 100% minus P_1 = 71.7%.

$$N/per\,group = \frac{(1.96 + 0.84)^2 x[(0.385x0.615) + (0.283\ x0.717)]}{(0.102)^2}$$

$$N = \frac{7\,84x[(0.237) + (0.203)]}{(0.102)^2} = \frac{3.4496}{0.0104} = 331.7$$

Sample size adjustment for 10% refusal (non-response) and another 10% for potential confounder (age).

$n = 331.7 \times (100/100 - 20)$, $n = 331.7 \times 1.25 = 414.6 \approx 420$ (approximated to the nearest ten).

The total sample size comprised 420 participants each in both carpenter and bricklayer groups (420 per artisan group).

Sampling technique

Eligible Master artisans were recruited over three months via a multi-stage sampling technique. The sampling process is illustrated in Fig. 1.

Stage 1: Ife East senatorial district was selected in Osun State using balloting (a form of simple random sampling).

Stage 2: Two (Ife East and Ife Central) local government areas LGAs were selected out of 10 LGAs in the selected

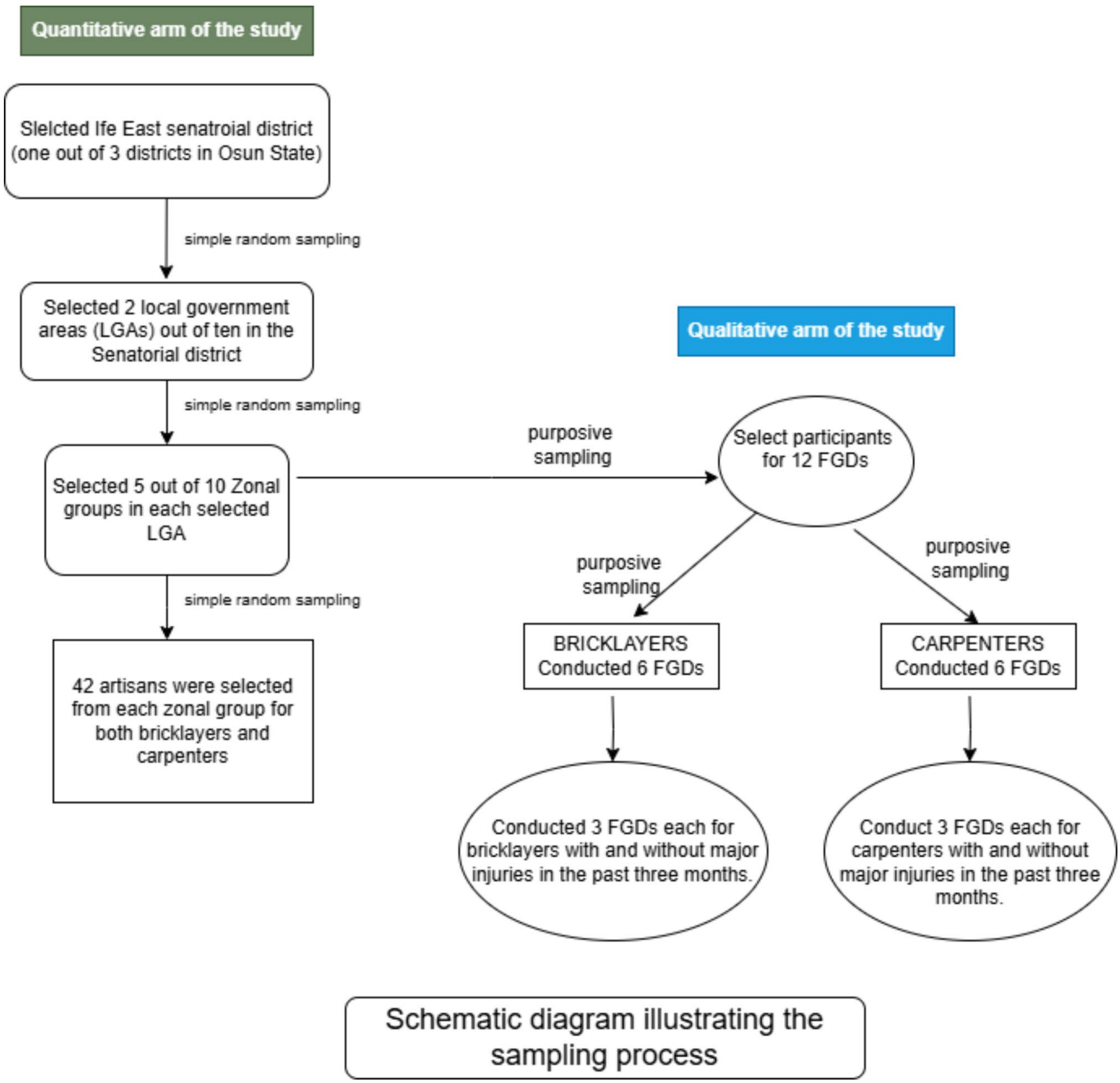

Fig. 1 Chart showing the sampling process of the study

senatorial district using simple random sampling (balloting). (Each senatorial district has 10 LGAs)

Stage 3: Five artisan zonal groups were selected per LGA using a simple random sampling technique (balloting). Each LGA had 10 zones.

Stage 4: The list of registered members was obtained from the artisans group executive and 42 members in each selected artisan zonal group were recruited through simple random sampling. This sampling procedure was conducted for both artisan groups (bricklayers and carpenters) in the study. Repeated visits were made to each zonal association to allow selected members to participate in the study. However, those who were unavailable at the time of the study were replaced via simple balloting.

Study instrument

Data collection was conducted using a semi-structured interviewer-administered questionnaire which was developed solely for this study and made available on Android tablets after scripting on REDCap [33]. The English version of the questionnaire is included as a supplementary file (supplementary file 1). The questionnaire was translated into Yoruba, the native language, and back-translated to English by linguistic experts. It gathered information on artisans' socio-demographics, work patterns, experience, knowledge, and use of personal protective equipment. Additionally, details about occupational injuries, their types, patterns, severity, location, and care costs were obtained. The questionnaire covered safety knowledge, practices, PPE use, attitudes, enabling factors, subjective norms, and factors influencing occupational injuries (personal, psychosocial, and working conditions).

Sleep status was assessed using the 4-item Jenkins sleep scale and persons with any sleep complaint for 15 days or more in the past month were categorised as having sleep problems [34]. Job stress was evaluated using the 10-item workplace stress survey scale, each item was scored 10 with a maximum obtainable score of 100 [35]. Persons with a score less than 30 have low stress, moderate stress; 40–60 and severe stress is 70 or more [35]. Both Jenkins sleep and workplace stress survey scales have been validated and used in Nigeria and similar countries [36–39].

Clinical examinations

Clinical examination such as visual acuity was conducted by trained research assistants who were nurses/health care workers. These tests were conducted as screening tests for study participants at no cost. Other examinations were height, weight and blood pressure checks to serve as motivation for study participants to participate in the study. As these participants do not access healthcare facilities regularly for health assessments, this study presented a unique opportunity to avail them of some basic health checks [40, 41]. The basic health checks were conducted at a private corner in their association meeting venue. Persons with abnormalities on clinical examination were referred as appropriate with the aid of printed referral forms.

Pre-testing of the quantitative study tool

Pre-test The study instrument was pre-tested among 30 artisans each across both artisan groups (60 in all) in a local government area outside of the selected study location. The pre-test adjudged respondents' acceptability of the questions and ease of responding to them. Also, the appropriateness of the questionnaire to elicit correct information that are relevant to the study objectives were assessed. Following the pre-test, ambiguous questions and those that elicited inappropriate responses were restructured and re-assessed.

Data management and analysis

Daily upload of completed questionnaires to the REDCap web-based server was ensured for real-time monitoring. Data were downloaded from the REDCap server in CSV/Excel format for data cleaning and converted to an SPSS file for data analysis.

Data analysis was conducted using SPSS 25 (IBM SPSS) The demographic characteristics of artisans (e.g., age and marital status etc.) were summarised using frequencies and proportions. Pearson's chi-square test was used to determine the association between categorical variables (e.g., presence or absence of occupational injury and artisan's group). In addition, the chi square test for trends was used to determine the linear association between categorical variables where the independent variable is an ordinal variable (e.g., presence or absence of occupational injuries and highest level of education). The independent samples t-test was used to assess differences in means of quantitative variables across artisan groups.

Multivariate logistics regression analysis was conducted to identify factors associated with occupational injuries. The explanatory variables for the regression model include the sociodemographic variables (age, years of work, educational status, income, migrant status, etc.) and the different workplace factors (workplace conditions, personal and psychosocial factors) while the outcome variable is the occurrence of occupational injury. Variables were included in the model if they were significant at p-values of 0.1 or less. However, years of experience; a variable that exhibited multicollinearity was excluded from the model. For all statistical analyses, $p < 0.05$ was taken as statistically significant.

Qualitative methods

Sampling technique

The discussants for the qualitative arm of the study were artisans who were selected purposively in three wards of each LGA where the quantitative survey was initially conducted. Twelve Focus Group Discussion (FGD) sessions were held, consisting of six sessions each for bricklayers and carpenters who did not participate in the initial quantitative survey. The FGD participants were further divided into those who sustained major injuries at work in the 3 months preceding data collection and those who did not. Major injuries were defined as incidents which required taking time off work or needed hospital admission.

Study instrument

The study instrument is a focus group discussion guide which was developed for this study based on the review of literature. The English version of the FGD guide is included in the supplementary file (supplementary file 1). The sessions were facilitated with the support of a note-taker, who has expertise in qualitative data collection and holds a Master of Public Health degree. All the FGDs were conducted in the native language (Yoruba) and each session lasted about 40–65 min. For qualitative data, all FGDs were moderated by the first author, who maintained reflexivity by being aware of personal factors that might influence the discussions. The moderator ensured personal beliefs and professional bias did not shape the discussions, using open-ended questions, active listening, and non-verbal cues to create a free environment conducive for discussions. Reflective notes were documented after each session to evaluate the moderator's influence and improve techniques for future FGDs.

Pretesting of the qualitative study instrument

Two FGDs were conducted to pretest the qualitative study instrument in one local government area outside the study location. Insights from the pretest were incorporated into the study tool, with a specific focus on refining probe questions related to the study objectives.

Data analysis

For qualitative data analysis, the recorded FGD sessions were transcribed verbatim in Yoruba language and then translated into English language by a linguistic expert. Transcripts were cross-checked for accuracy against the initial recordings. Codes were then created, utilizing both deductive and inductive methods, to encapsulate overarching themes. Subsequently, subcodes were established under each broad code to capture relevant sub-themes. Definitions for each code and subcode were described in a comprehensive codebook.

Direct quotes from FGD discussants, illustrating themes and sub-themes, were incorporated in italics within the manuscript. Qualitative data analysis employed Atlas.ti qualitative analysis software version 8. Moreover, a single individual moderated and analysed all the Focus Group Discussions (FGDs), thereby allowing for a seamless reference to nuances within the transcripts. The results were triangulated with quantitative findings to fulfil the study objectives. The findings are presented using the contiguous approach to integration where quantitative and qualitative findings are presented separately [42].

Results

Socio-demographic characteristics and prevalence of occupational injuries

The association between sociodemographic factors and injury prevalence in the preceding 3 months is presented in Table 1. Occupational injuries in the three months prior to data collection were reported by 39.9%

Table 1 Association between sociodemographic factors and injury prevalence in the last 3 months

Variables	BRICKLAYERS ($n=421$)			CARPENTERS ($n=425$)		
	Injured $n=168$ (%)	Not injured $n=253$ (%)	Statistical comparison	Injured $n=220$ (%)	Not injured $n=205$ (%)	Statistical comparison
Age (years)						
20–39	73 (67.0)	36 (33.0)	$*\chi^2=65.548$	47 (67.1)	23 (32.9)	$*\chi^2=13.938$
40–59	66 (43.4)	86 (56.6)	$p<0.001$	141 (52.4)	128 (47.6)	$P<0.001$
≥60	29 (18.1)	131 (81.0)		32 (37.2)	54 (62.8)	
Level of Education						
No formal education	21 (21.9)	75 (78.1)	$*\chi^2=26.377$	20 (50.0)	20 (50.0)	$*\chi^2=0.377$
Primary education	72 (38.1)	117 (61.9)	$p<0.001$	104 (50.5)	102 (49.5)	$p=0.539$
Secondary education or more	75 (55.1)	61 (44.9)		96 (53.6)	83 (46.4)	
Marital Status						
Not in a marital union	22 (66.7)	11 (33.3)	$\chi^2=10.694$	11 (57.9)	8 (42.1)	$\chi^2=0.299$
Married	146 (37.6)	242 (62.4)	$p=0.001$	209 (51.5)	197 (48.5)	$p=0.584$
Average monthly income in naira						
10,000-49999 (<$67)	86 (40.4)	127 (59.6)	$*\chi^2=4.845$	117 (54.9)	96 (45.1)	$*\chi^2=1.250$
50,000–99,999 ($67-$133)	65 (44.2)	82 (55.8)	$P=0.089$	72 (48.3)	77 (51.7)	$p=0.264$
≥ 100,000 (≥ $134)	17 (27.9)	44 (72.1)		31 (49.2)	32 (50.8)	
Years of work experience						
1–10	23 (29.9)	54 (70.1)	$*\chi^2=61.411$	19 (36.5)	33 (63.5)	$*\chi^2=8.867$
11–20	45 (50.6)	44 (49.4)		33 (41.3)	47 (58.8)	
21–30	46 (56.8)	35 (43.2)		78 (50.0)	78 (50.0)	
31-40-	75 (75.8)	24(24.2)	$p<0.001$	54 (50.0)	54 (50.0)	$p=0.003$
≥40	64 (85.3)	11 (14.7)		21(72.4)	8 (27.6)	
Mean ± SD						
Native of the current town						
No	47 (47.0)	53 (53.0)	$\chi^2=2.753$	74 (56.1)	58 (43.9)	$\chi^2=1.415$
Yes	121 (37.7)	200 (62.3)	$p=0.097$	146 (49.8)	147 (50.2)	$p=0.234$

$*\chi^2$ = chi square test for trends

of bricklayers and 51.8% of carpenters. The prevalence of occupational injury was highest among persons in the 20–39 years' age bracket and this was statistically significant among both bricklayers ($p < 0.001$) and carpenters ($p < 0.001$). A higher proportion of bricklayers with secondary education or more had an occupational injury in the last 3 months and this was statistically significant ($p < 0.001$), however, there was no statistically significant association between level of education and injury occurrence among carpenters. In addition, a higher proportion of bricklayers who were not in marital union had occupational injury in the preceding 3 months ($p = 0.0010$) but there was no association between marital status and injury prevalence among carpenters. Among both bricklayers and carpenters, a higher proportion of persons with less than 20 years of work experience had occupational injury in the last 3 months prior to data collection and this was statistically significant (bricklayers; $p < 0.001$, carpenters; $p = 0.005$).

Factors associated with occupational injuries.

The prevalence and pattern of occupational injury among bricklayers and carpenters are presented in Table 2. The prevalence of occupational injuries in the 3 months preceding data collection was higher among carpenters (51.8%) than bricklayers (39.9%) and this difference was statistically significant ($p = 0.001$). Although more carpenters (165; 75%) as compared with bricklayers (115; 68.5%) had an occupational injury in the last one month, this was not statistically significant ($p = 0.154$). More carpenters (289; 68.0%) had their most recent injury within the last 12 months as compared with their counterparts who were bricklayers (247; 58.7%) and this was statistically significant ($p = 0.005$). The most frequent injury among bricklayers was bruises (137; 32.5%) while cuts/lacerations (189; 44.5%) had the highest frequency among carpenters. Trips/falls (162; 38.5%) was the most common mechanism for injuries among bricklayers while being crushed between two objects (139; 32.7%) was the most reported mechanism of injury among carpenters. (Table 2)

The association between selected work characteristics and injury prevalence in the last 3 months among artisans is presented in Table 3. A higher proportion of bricklayers who engaged in manual handling (pulling, pushing, carrying, and lifting) had occupational injury in the last 3 months ($p = 0.002$) while there was no statistically significant association between engagement in manual handling activity at work and injury prevalence in carpenters. For both bricklayers and carpenters, persons who handled less than 100 kg daily at work had the lowest prevalence of injuries and this was statistically significant (bricklayers; $p = 0.005$, carpenters; $p = 0.041$). Bricklayers who used vibrating tools at work had higher injury prevalence ($p = 0.004$), but this was not true for carpenters ($p = 0.660$). No statistically significant association was observed between 3-month injury prevalence and variables such as type of pre-vocation training, duration of training, number of days and average hours worked per week, common work situation, ever had on-the-job training and supervisory visits in the last 6 months.

Table 4 shows the association between comorbidity status, clinical findings and 3-month injury prevalence among respondents. A higher proportion of bricklayers who currently take alcohol had an injury in the last 3 months and this was statistically significant($p = 0.024$), however, this was not true for carpenters ($p = 0.824$). A lower proportion of bricklayers with impaired vision had occupational injury in the last 3 months and this was statistically significant ($p < 0.001$), but this association was not evident among carpenters ($p = 0.171$).

The binary logistic regression analysis of the association between 3-month injury occurrence and selected respondents' characteristics is presented in Table 5. Age was a significant determinant of injury occurrence among artisans. For bricklayers, persons aged between 20 and 39 years (OR 6.9; 95% CI 3.1–15.3; $p < 0.001$) and those aged 40–59 (OR 2.9; 95% CI 1.5–5.6; $p = 0.001$) years had higher odds of experiencing occupational injury in the last 3 months before the survey when compared with those aged 60 years or more. A similar pattern was observed among carpenters as persons aged 20–39 years (OR 4.1; 95% CI 2.0-8.5 $p < 0.001$) and those aged 40–59 years (OR 2.1; 95% CI 1.2–3.6 $p = 0.007$) had higher odds of having occupational injuries in the last 3 months when compared with those aged 60 years or more. Monthly income was a determinant of occupational injuries among bricklayers only as those who earn less than 50,000 naira (OR 2.3; 95% CI 1.2–4.7 $p = 0.019$) and those who earn 50,000–99,999 naira (OR 2.5; 95% CI 1.2–5.2 $p = 0.014$) had higher odds of having occupational injuries in the last 3 months as compared with those who earn 100,000 naira or more.

For both bricklayers and carpenters, the average weight handled at work influenced injury occurrence. Bricklayers who handled an estimated weight of 200 kg had twice higher odds of having an occupational injury in the last 3 months (OR 2.1; 95% CI 1.3–3.5 $p = 0.004$) compared with those who handled less than 100 kg. For carpenters, those who handled between 100 and 199 kg daily had almost 2 times higher odds of having occupational injuries in the last 3 months (OR 1.9; 95% CI 1.02–3.4 $p = 0.045$) when compared with their colleagues who handled less than 100 kg daily.

Findings from focus group discussions

The qualitative segment of the study involved 70 participants in focus group discussions. The findings from the FGDs align with and offer additional insights into

Table 2 Prevalence and pattern of occupational injury among bricklayers and carpenters

Variables	BRICKLAYERS Frequency (%) $n=421$	CARPENTERS Frequency (%) $n=425$	Statistical comparison
Had occupational injury in the last 3 months			
No	253 (60.1)	205 (48.2)	$\chi^2 = 11.981$
Yes	168 (39.9)	220 (51.8)	$p=0.001$
Had occupational injury in the last one month			
No	53 (31.5)	55 (25.0)	$\chi^2 = 2.033$
Yes	115 (68.5)	165 (75.0)	$p=0.154$
Number of times injured in the last one month			
1	61 (53.0)	85 (51.5)	
2	26 (22.6)	47 (28.5)	$\chi^2 = 1.516$
≥ 3	28 (24.3)	33 (20.0)	$p=0.469$
Period of most recent injury (months)			
≤ 12	247 (58.7)	289 (68.0)	$\chi^2 = 7.930$
> 12 months	174 (41.3)	136 (32.0)	$p=0.005$
Hospitalized due to injury			
No	171 (91.0)	196 (90.7)	$\chi^2 = 0.006$
Yes	17 (9.0)	20 (9.3)	$p=0.940$
Missed work due to injury			
Yes	77 (18.3)	85 (20.0)	$\chi^2 = 3.449$
No	323 (76.7)	307 (72.2)	$p=0.178$
No but injury limited work activity	21 (5.0)	33 (7.8)	
Number of workdays missed			
1–9	37 (48.1)	23 (27.1)	
10–19	14 (18.2)	17 (20.0)	$\chi^2 = 9.041$
20–29	5 (7.8)	15 (17.6)	$p=0.029$
≥ 30	20 (26.0)	30 (35.3)	
Mechanism of the injury			
Trip/fall	162 (38.5)	113 (26.6)	
Flying/falling object	83 (19.7)	77 (18.1)	$\chi^2 = 28.991$
Crushed between two objects	78 (18.5)	139 (32.7)	
Stepped on sharp object	41 (9.7)	39 (9.2)	$p<0.001$
Others +	31 (7.4)	22 (5.2)	
Cut from sharp object	26 (6.2)	35 (8.2)	
Type of injury sustained **			
Bruise	137 (32.5)	89 (20.9)	
Cuts/laceration	133 (31.6)	189 (44.5)	
Blunt injury	119 (28.3)	127 (29.9)	
Sprain/Strain	57 (13.5)	56 (13.2)	
Fracture	20 (4.8)	15 (3.5)	
Dislocation	26 (6.2)	18 (4.2)	
Puncture wound	31 (7.4)	44 (10.4)	
Others	14 (3.3)	15 (3.5)	

** Multiple responses allowed, + others included workplace violence, building collapse

the results obtained from the quantitative analysis. The themes, subthemes and formulated meanings from the focus group discussions are summarised in Table 6.

Pattern and prevalence

There was a unanimous agreement among participants that occupational injuries are widespread among both bricklayers and carpenters. Discussants highlighted common types of injuries, with carpenters emphasizing cuts and lacerations from roofing sheets and saws, puncture wounds from nails, and blunt trauma from hammers hitting their hands. Additionally, some carpenters mentioned blunt trauma resulting from falling planks or other objects.

Table 3 Association between work characteristics and 3-month injury prevalence

Variables	BRICKLAYERS ($n=421$)			CARPENTERS ($n=425$)		
	Yes, Injury *n* (%)	No injury *n* (%)	Statistical comparison	Yes, Injury *n* (%)	No injury *n* (%)	Statistical comparison
Type of pre-vocation training						
Apprenticeship	164 (40.1)	245 (59.9)	$\chi^2=0.222$	216 (51.8)	201 (48.2)	$\chi^2=0.010$
Technical College	4 (33.3)	8 (66.7)	$p=0.637$	4 (50.0)	4 (50.0)	$p=0.920$
Duration of training (months)						
<48	86 (44.8)	106 (55.2)	$\chi^2=3.515$	80 (48.2)	86 (51.8)	$\chi^2=1.392$
≥48	82 (35.8)	147 (64.2)	$p=0.061$	140 (54.1)	119 (45.9)	$p=0.238$
Number of days worked per week						
<5	17 (33.3)	34 (66.7)	$\chi^2=1.046$	34 (49.3	35 (50.7)	$\chi^2=2.688$
5	46 (40.7)	67 (59.3)	$p=0.593$	48 (60.0)	32 (40.0)	$p=0.261$
>5	105 (40.9)	152 (59.1)		138 (50.0)	138 (50.0)	
Average hours worked per day						
≤8	127 (37.7)	210 (62.3)	$\chi^2=3.470$	172 (53.1)	152 (46.9)	$\chi^2=0.954$
≥8	41 (48.8)	43 (51.2)	$p=0.063$	48 (47.5)	53 (52.5)	$p=0.329$
Common work situation						
Ground level						
No	9 (56.3)	7 (43.8)	$\chi^2=1.853$	47 (51.6)	44 (48.4)	$\chi^2=0.001$
Yes	159 (39.3)	246 (60.7)	$P=0.173$	173 (51.8)	161 (48.2)	$p=0.980$
At height						
No	82 (42.9)	109 (57.1)	$\chi^2=1.336$	81 (55.1)	66 (44.9)	$\chi^2=1.002$
Yes	86 (37.4)	144 (62.6)	$p=0.248$	139 (50.0)	139 (50.0)	$p=0.317$
Underground						
No	154 (39.1)	240 (60.9)	$\chi^2=1.717$	203 (50.9)	196 (49.1)	$\chi^2=2.057$
Yes	14 (51.9)	13 (48.1)	$p=0.190$	17 (65.4)	9 (34.6)	$p=0.151$
Average weight handled per day (kilogram)						
≤100	57 (32.0)	121 (68.0)	$^*\chi^2=7.856$	101 (46.10	118 (53.9)	$^*\chi^2=4.194$
100–199	32 (43.2)	42 (56.8)	$p=0.005$	36 (61.0)	23 (39.0)	$p=0.041$
≥200	79 (46.7)	90 (53.3)		83 (56.5)	64 (43.50	
Use vibrating tools at work						
No	132 (37.0)	225 (63.0)	$\chi^2=8.408$	93 (50.5)	91 (49.5)	$\chi^2=0.194$
Yes	36 (56.3)	28 (43.8)	$p=0.004$	127 (52.7)	114 (47.3)	$p=0.660$
Ever had on-the job training in occupational safety						
No	156 (41.2)	223 (58.8)	$\chi^2=2.499$	180 (54.1)	153 (45.9)	$\chi^2=3.229$
Yes	12 (28.6)	30 (71.4)	$p=0.114$	40 (43.5)	52 (56.5)	$p=0.072$
Had supervisory visit in the last 6 months						
No	164 (40.6)	240 (59.4)	$\chi^2=1.981$	208 (51.7)	194 (48.3)	$\chi^2=0.002$
Yes	4 (23.5)	13 (76.5)	$p=0.159$	12 (52.2)	11 (47.8)	$p=0.968$

$^*\chi^2$ = chi square test for trends

> *": ... I don't think there is a carpenter who will go to work in a day and will not get injured, there is none yet. It is either your hand getting injured by wood or being hit by a hammer, or your leg getting injured, block can suddenly fall on one's leg and injure the person and there is nothing you can do. Injury is something that is very common to ... carpenters" (**P3**,* **Injured Carpenter**, ***FGD 7***).

Bricklayers primarily raised concerns about bruises caused by crumbling blocks and blunt trauma from falls and objects. The following excerpts support their observations

> *"...the most common type of injury occurs when you have laid blocks and you are almost at lintel level because the (wall) bracket can suddenly break and you can fall...When you are climbing a ladder to the scaffolding, the ladder might collapse, this is very common. This has happened to me several times, the bamboo used for scaffolding can detach or break and you can fall, this is the most dangerous. (***P3**, **Injured Bricklayer**, **FGD 3)**

Factors associated with occupational injuries

Artisans shared their understanding of the factors they believe contribute to workplace injuries. Their insights

Table 4 Association between comorbidity status, clinical findings and 3months injury prevalence among respondents

Variables	BRICKLAYERS ($n=421$)			CARPENTERS ($n=425$)		
	Injured *n* (%)	Not injured *n* (%)	Statistical comparison	Injured *n* (%)	Not injured *n* (%)	Statistical comparison
Treated for any chronic illness in the last one year						
No	115 (42.9)	153 (57.1)	$\chi^2=2.778$	142 (54.6)	118 (45.4)	$\chi^2=2.180$
Yes	53 (34.6)	100 (65.4)	$p=0.096$	78 (47.3)	87 (52.7)	$p=0.140$
Workplace stress						
Low Stress	105 (36.8)	180 (63.2)	$\chi^2=4.243$	122 (50.6)	119 (49.4)	$\chi^2=4.332$
Moderate stress	56 (45.2)	68 (54.8)	$p=0.120$	85 (50.9)	82 (49.1)	$p=0.115$
Severe stress	7 (58.3)	5 (41.7)		13 (76.5)	4 (23.5)	
Sleep Problems (Jenkins scale)						
No Sleep problem	128 (41.7)	179 (58.3)	$\chi^2=1.513$	157 (52.0)	145 (48.0)	$\chi^2=0.21$
Sleep problems (> 15 days)	40 (35.1)	74 (64.9)	$p=0.219$	63 (51.2)	60 (48.8)	$p=0.886$
Smoking status						
Never smoked	139 (38.1)	226 (61.9)	$\chi^2=5.486$	201 (52.9)	179 (47.1)	$\chi^2=2.585$
Current smoker	7 (70.0)	3 (30.0)	$p=0.064$	4 (57.1)	3 (42.9)	$p=0.275$
Former smoker	22 (47.8)	24 (52.2)		15 (39.5)	23 (60.5)	
Alcohol use status						
Never took alcohol	60 (36.8)	103 (63.2)	$\chi^2=7.430$	83 (53.5)	72 (46.5)	$\chi^2=0.388$
Stopped drinking	22 (29.7)	52 (70.3)	$p=0.024$	31 (49.2)	32 (50.8)	$p=0.824$
Currently take alcohol	86 (46.7)	98 (53.3)		106 (51.2)	101 (48.8)	
Clinical examination findings						
Body mass index (Kg/m^2)						
< 18.5	9 (31.0)	20 (69.0)	$\chi^2=2.057$	14 (42.4)	19 (57.6)	$\chi^2=1.831$
18.5-24.99	123 (39.3)	190 (60.7)	$p<0.358$	162 (51.6)	152 (48.4)	$p=0.400$
≥ 25	36 (45.6)	43 (54.4)		44 (56.4)	34 (43.6)	
Impaired visual acuity						
No	150 (47.6)	165 (52.4)	$\chi^2=31.045$	189 (53.2)	166 (46.8)	$\chi^2=1.877$
Yes	18 (17.0)	88 (83.0)	$p<0.001$	31 (44.3)	39 (55.7)	$p=0.171$

have been categorized into three main themes: personal, workplace, psychosocial, and miscellaneous factors.

Personal factors influencing occupational injuries

In general, artisans acknowledged that certain personal characteristics specific to each construction artisan may contribute to workplace injuries. Such attributes include age, level of training, failure to use personal protective equipment, greed/rush to make more income and substance use.

As regards age; most artisans believed that younger persons tend to have more injury because they are more agile and engage in risk-taking behaviours. In addition, some discussants agreed that although older artisans may be frail, they are more experienced and careful while working thereby limiting occupational injury burdens among them. However, minority opinions suggested that age is not a definitive factor, and injuries can affect individuals of all ages depending on the level of risk exposure for the artisan.

> *…the younger artisans are over-confident, and they lack experience, so they have more injuries.* ***(P6 Injured Carpenter FGD 8)***

> *A lot of the elderly artisans are very well experienced in the job but they can't do it because of their age, so they just give instructions, you can't compare someone who has 50 years of experience with a person who has 10 years of experience. When you get to work you will see young people climbing to do the job and the elderly people will be on the ground/floor giving instructions…. In fact, … elderly artisans do avoid risky jobs.* ***(P4 Carpenter non-injured FGD 10)***

Pre-vocation training gaps Among bricklayers, a concern was raised about the perceived deficiencies in apprenticeship training for younger artisans, potentially predisposing them to workplace injuries due to a lack of foundational knowledge in workplace safety, such as installing scaffolds using improvised materials etc.

> *…we children of this generation don't exercise enough patience during our training. My boss gave me quality training (during my apprenticeship); it is not every bricklayer that knows how to couple scaffolding**(P5 Bricklayer_ Injured FGD 1)**.*

Table 5 Binary logistic regression analysis of the association between 3-month injury occurrence and selected respondents' characteristics

Variables	BRICKLAYERS ($n = 421$)				CARPENTERS ($n = 425$)			
	COR (95% CI)	*P* value	AOR (95% CI)	*P* value	COR (95% CI)	*P* value	AOR (95% CI)	*P* value
Age (years)								
20–39	**9.2 (5.2–16.1)**	$p < 0.001$	**6.9 (3.1–15.3)**	$p < 0.001$	**3.4 (1.8–6.7)**	$p < 0.001$	**4.1 (2.0-8.5)**	**< 0.001**
40–59	**3.5 (2.1–5.8)**	$p < 0.001$	**2.9 (1.5–5.6)**	**0.001**	**1.9 (1.1–3.1)**	0.015	**2.1 (1.2–3.6)**	**0.007**
≥ 60	REF		REF				REF	
Level of Education								
No formal education	REF		REF				REF	
Primary education	2.2 (1.2–3.9)	0.006	0.9 (0.4–1.8)	0.707	1.0 (0.5-2.0)	0.955	0.8 (0.4–1.7)	0.607
At least Secondary education	4.4 (2.4–7.9)	$p < 0.001$	0.8 (0.3–1.8)	0.512	1.2 (0.6–2.3)	0.678	0.8 (0.4–1.7)	0.515
Marital Status								
Not in marital union	3.3 (1.6-7.0)	0.002	1.7 (0.7–4.1)	0.260	1.3 (0.5–3.3)	0.585	-	
Married	REF		REF				-	
Average monthly income in naira								
10,000–49,999 (<$67)	1.8(0.9–3.3)	0.078	**2.3 (1.2–4.7)**	**0.019**	1.3 (0.7–2.2)	0.424	1.3 (0.7–2.3)	0.384
50,000–99,999 ($67-$133)	2.1 (1.1–3.9)	0.030	**2.5 (1.2–5.2)**	**0.014**	1.0 (0.5–1.7)	0.906	0.9 (0.5–1.7)	0.855
≥ 100,000 (≥ $134)	REF		REF				REF	
Average hours worked per day								
≤ 8	REF		REF				REF	
≥ 8	1.6 (1.0-2.6)	0.06	1.3 (0.7–2.3)	0.369	0.8 (0.5–1.3)	0.329	0.8 (0.5–1.3)	0.354
Pre-vocation training duration (months)								
< 48	1.5 (1.0-2.2)	0.061	0.8 (0.5–1.4)	0.466	0.8 (0.5–1.2)	0.238	-	
≥ 48	REF		REF				-	
Native of current town							-	
Yes	REF		REF				-	
No	1.5 (0.9–2.3)	0.098	1.3 (0.8–2.2)	0.358	1.3(0.9–1.9)	0.235	-	
Use vibrating tools at work								
No	REF		REF				-	
Yes	2.2 (1.3–3.8)	0.004	1.6 (0.9–3.1)	0.132	1.1(0.7–1.6)		-	
Average weight handled per day (kilogram)								
≤ 100	REF		REF		REF		REF	
100–199	1.6 (0.9–2.8)	0.091	1.7 (0.9–3.3)	0.095	**1.8 (1.0-3.3)**	**0.044**	**1.9(1.02–3.4)**	**0.045**
≥ 200	**1.9 (1.2–2.9)**	**0.005**	**2.1 (1.3–3.5)**	**0.004**	1.5 (1.0-2.3)	0.053	1.4 (0.9–2.2)	0.128
Impaired visual acuity								
No	REF		REF				-	
Yes	0.2 (0.1–0.4)	$p < 0.001$	0.5 (0.3–1.1)	0.063	0.7 (0.4–1.2)	0.172	-	
Comorbidity								
No	REF		REF				-	
Yes	0.7 (0.5–1.1)	0.096	1.0 (0.6–1.7)	0.902	0.7 (0.5–1.1)	0.140	-	
Alcohol use status								
Never tool alcohol	REF		REF					
Stopped drinking	0.7 (0.4–1.3)	0.289	1.0 (0.5–1.9)	0.912	0.8 (0.5–1.5)	0.561		
Currently take alcohol	1.5 (1.0-2.3)	0.062	1.4 (0.8–2.2)	0.229	0.9(0.6–1.4)	0.659		
Ever had on-the job training in occupational safety								
No	1.7 (0.9–3.5)	0.118	-		1.5 (1.0-2.4)	0.073	1.2 (0.7-2.0)	0.436
Yes	REF		-				REF	

REF = reference category * COR = Crude odds ratio, *AOR = Adjusted odds ratio

Table 6 Themes, subthemes meanings from the focus group discussions on factors associated with occupational injuries among construction artisans

Theme	Subtheme	Subtheme meanings
Personal factors	-Age/ageing	Discussants noted that younger artisans were more prone to injury while older persons are more experienced, cautious and tend to avoid risky tasks.
	-Pre-vocation training gap	Perceived deficiencies in apprenticeship training limits artisans' safety knowledge and practice
	-Low Income status	Earning low income compels artisans to take on riskier jobs or rush through tasks to save time for additional work, often neglecting safety measures.
	-Non-use of PPE	Failure to use PPE increases the risk of injuries when exposed to hazards.
	-Substance use	Substance use increases the risk of workplace injuries by impairing concentration and encouraging risk-taking behaviour.
Psychosocial factors	-Job stress	Job stress impairs concentration and increases injury risk for artisans.
	-Emotional problems	Emotional problems unsettle the mind, increasing the risk of mistakes and injuries at work.
Work related factors	Working at heights/in the rain	Working at heights and in adverse weather increases risk of falls and injuries
	Type of work material	Working with certain building materials e.g., stones, may predispose artisans more to injuries
	Use of substandard building material	Substandard materials jeopardize safety and increases risk of injury.
Miscellaneous	Poor housekeeping	Unsafe handling or placement of items on-site may cause injuries to workers.
	Physical violence	Fights at construction site may lead to injuries

Non-use of personal protective equipment (PPE): Artisans also identified this as a likely factor associated with workplace injuries, as these artisans were unable to benefit from the injury prevention purpose of such devices.

> *.there are some protective equipment such as gloves that we ought to use to protect ourselves from injury while working but oftentimes we don't use them because they are not convenient for us to use. If we were to be working for a company there would be sanction for anyone that doesn't use it,* **(P2_*Carpenter Uninjured FGD 10*)**

Income status Artisans believe that income status is an important factor in injury risk. Many think that with higher income levels, they can limit their exposure to injury-prone tasks, such as climbing roofs and scaffolding. Some would prefer to employ others to work for them while they coordinate or supervise the work, minimizing their exposure to injuries as much as possible. Low-income status also contributes to injury susceptibility by driving the need to expedite job tasks, undertake additional work for increased earnings and subsequently heightening the risk of injuries.

> *climbing heights is mostly common among young artisans. May the Lord answer our prayers. As young as I am, if I become wealthy, hummmn. I will be sending... people to climb heights (work) for me. I have a colleague who is also very young, he has never held a hammer in recent times but he gets jobs, in this case, wealth is the factor****(P3 _Carpenter Uninjured FGD 11)****.*
> *The reason why injury is common ... is because of greed, we are always in a hurry to finish a particular job so that we can secure another, so we will not patiently do the job and this could result in injury.****(P1 _Carpenter Uninjured FGD 12)****.*

Substance use This emerged as an important subtheme in injury susceptibility. Artisans commonly acknowledged that the consumption of substances like alcohol or marijuana could impact concentration, balance, and risk-taking behaviour during work.

> *"...work injury is common among those artisans that use substances because if you drink dry gin to work, when the effect ... begins to play out, you become intoxicated and lose balance, so you will not be able to work well and it is possible to get injured in the process.***(P2*FGD_Bricklayer_ Uninjured FGD 5)*)**.*

Psychosocial factors

Various psychosocial issues emerged as a major theme associated with the occurrence of injuries at work among construction artisans. These issues include poor job satisfaction, stress and anxiety especially with the recent economic downturn in the country.

Job stress/dissatisfaction Artisans reported that a mismatch between workload and income expectations causes stress, impacting concentration and increasing injury risk. Moreover, they reported that recently introduced economic policy changes such as the fuel subsidy removal and cashless policy, may have negatively affected artisans' income, leading to stress and heightened injury risk.

> *Lack of job satisfaction also causes injury because many clients don't make us happy. For instance, a*

*job is worth #10,000 and the client is insisting on paying #5000, if you have no other option, you will force yourself to do the job, you will now be sad while doing the job, you will also want to rush the job and this can cause injury.**(P5 FGD_Bricklayer_Injured FGD 3)**.*
*.... Presently, one of the causes of troubled mind is the removal of this fuel subsidy. When you leave home early in the morning and return with nothing (no money) and your children are expecting you to bring something (money) home, this will affect you psychologically and having this stress can cause workplace injury.**(P4Bricklayer_ Injured FGD 2)**.*

Emotional problems Participants highlighted the significant impact of emotional issues on workplace injuries. They emphasized the need for complete mental focus at work to prevent mistakes that could harm both the quality of work and the artisan's well-being. They also stressed the importance of addressing emotional concerns before arriving at work and avoiding dwelling on past events, as flashbacks could lead to adverse outcomes.

*Your mind must not be troubled when going for a bricklaying job such that if you are bothered about something you must put that thought aside when working and later go back to your thoughts after you have completed your work. Even if you don't fall, the equipment/tools which we are using to work are harmful, is a shovel easy to handle? (asks a rhetorical question) not to talk of digger, even the trowel which we use for plastering can cause injury when it is too sharp and it suddenly cuts one's hand. So you must be able to concentrate when working, if you do this, the injury you are likely to sustain at work will be minimal.**(P2_Bricklayers_Uninjured FGD 6)**.*
*I was up tapping (nailing)the fascia-board when my mind flashed back to the last injury incident that happened, before I knew it, I felt dizzy and my leg just slipped and I had another cut instantly. You can see the first wounded part and this is the second part which was the last (attempts to show the moderator the wounds), the cut was deep to the muscle... So, if your mind is troubled or you lack concentration don't climb up to work.**(P5_Carpenter_Injured FGD 7)**.*

Work-related factors

The different issues due to intrinsic work factors were also highlighted as important in the pathway of injury causation among informal construction artisans. Discussants highlighted the role of working at heights, nature of work material and the use of substandard building items.

Working at heights/in the rain,

It was established that working at heights significantly increases the risk of workplace injuries compared to other work environments. Furthermore, working in wet or rainy conditions was identified as a precarious situation capable of elevating the likelihood of sustaining injuries.

*The majority of the houses that we complained that we fell from are the very high roofing styles that our people adopted from overseas. But when comparing here with overseas ... they have machines that can lift them to any height any person wants to work but the opposite is the case here. .... But for the very high roofing styles, injuries will be sustained during repair because we don't have machines that will lift us, we use our legs to climb.**(P2 Carpenter_Injured FGD 7)**.*
*Working in the rain is very risky. Normally when you are roofing a building in the rain, the roofing sheet will become slippery and you can get injured in the process, you can even fall from the roof. Also, some woods are oily such that they become slippery when it rains, if in the process of roofing a building in the rain and you step on such wood, you can fall from the building. So, working in the rain is very risky in all aspects.**(P7 Carpenter_uninjured FGD 11)**.*

Work material: From the discussions, it was apparent that the type of work material may increase the likelihood of injuries among artisans. For instance, working with stones was reported to be commonly associated with splinter injuries

the most dangerous (risky) aspect of the bricklaying job is laying a (building's) foundation with stones, there is no bricklayer who will lay a foundation using stones that will not get injured because while breaking the stones with hammer, the stone fragments (splinter) can hit you and there is no way you won't get injured on the spot (body part) where the stone fragment hits you, you will definitely bleed. (P4: _Bricklayer Uninjured FGD5.

Substandard building materials.

A recurring concern raised in the discussions was the widespread use of counterfeit and substandard materials, coupled with inferior construction techniques. These practices were associated with problems such as building collapses, falls from heights, and direct injuries like lacerations at the worksite.

I went for a job and I wanted to nail a roofing sheet, I sustained laceration injuries on my three fin-

gers because the present-day roofing sheets are way much lighter than how they used to be. We now use our hands to tear (cut) roofing sheets whereas in the olden days, you can only use a heavy pair of scissors to cut roofing sheets. Now, substandard materials have ruined the carpentry profession P2 _Carpenter_ _Injured FGD 8.

if a person gets a job and he uses substandard materials, the building might even collapse when he didn't use enough cement, so when the building collapses on such a person, he can sustain injury P7 Bricklayers uninjured Ife FGD_4.

Miscellaneous factors

Other issues that were reportedly associated with workplace injuries were grouped as miscellaneous factors. These include poor housekeeping practices, which can create hazardous conditions and increase the risk of falls, slips, and trips. Additionally, physical violence, often linked to land disputes at construction sites, can pose a significant threat to the safety of artisans working on-site.

Findings from the FGDs indicate that poor housekeeping practices at construction sites can increase the risk of injuries for artisans. These hazardous situations can arise from improper storage or arrangement of building items or equipment and the accumulation of clutter.

*when roofing, our practice is to stand wall plate known as 3inches by 4inches wood on the wall… I was the one assigned to distribute wood to other colleagues. So, I was doing the distribution, unknown to me a goat came into the premises to eat up leftover food and the leaves used to wrap the food, during that process that goat had touched those standing 3inches by 4inches wood and when I moved close to those woods part of them fell on my shoulder which resulted to this wound.(**P4_Carpenter_ Injured FGD 9**).*

It was also emphasized that artisans are at risk of injuries during land disputes especially involving physical assaults on construction sites. Some believe charms may be buried on-site during disputes and may cause injuries through enchantment, thus adding a supernatural dimension to injury risks.

*If there are issues/disagreements on the land where you are working, this also poses injury to the artisan (so that means thugs can come and injure you while working, is that what you are saying?) Yes (**P3: Bricklayer uninjured_ FGD4**)*

*. apart from thugs physically attacking the bricklayer with cutlasses and the like, does he know what might have been buried inside the land, the opposition might have buried charm on the land.(**P1 Bricklayer Uninjured FGD 6**).*

Discussion

This study assessed factors influencing occupational injuries among informal sector artisans in Nigeria's construction industry. It stands out perhaps as one of the few studies to adopt a mixed methods approach, offering contextual insights into the possible causes of workplace injuries among these artisans.

The study found that about two-fifth of bricklayers and slightly more than half of carpenters had occupational injuries in the prior 3 months. These rates were higher than the rates found in a previous study by Ngwu et al., which reported injury prevalence rates of 28.7% for bricklayers and 38.5% for carpenters in Port Harcourt, Nigeria [13]. This may be explained by the fact that our study focused on artisans working in the informal sector, while Ngwu et al.'s study focused on artisans employed in the formal construction sector. Other studies from Africa have reported prevalence rates of occupational injuries among construction workers ranging from 32.4 to 84.7% [17, 26, 43–48]. Our findings underscore the substantial burden of occupational injuries among Nigerian artisans, a factor often overlooked in occupational epidemiology studies. A consistent pattern of occupational injuries emerged from the study, with bruises, cuts, and blunt trauma constituting the most prevalent injury types. These injuries were primarily caused by slips, trips, falls, falling objects, and crushing incidents. This finding aligns with previous studies conducted in Nigeria and other African countries [43, 48–50], further highlighting the alarming burden of injuries among construction artisans. The uniformity of injury patterns across multiple study sites and contexts underscores the urgent need for comprehensive safety measures and targeted interventions to mitigate the occupational risks faced by these artisans in these precarious work environments, particularly in low-resource settings.

In our study, age was a significant predictor of occupational injuries for both carpenters and bricklayers with individuals below the age of 60 more at risk of injuries. This finding aligns with previous research highlighting the increased vulnerability of younger artisans to workplace injuries [43, 51]. Qualitative findings supported the observed age-related pattern, indicating that older carpenters and bricklayers often prioritize personal safety and seek supervisory roles. This shift is attributed to their accumulated years of work experience and a heightened awareness of safety risks. Younger individuals, on the other hand, may be more inclined to engage in more risky tasks, such as climbing heights or working on scaffolds, due to their perceived invincibility and urge to expedite work tasks [47, 52].

Monthly income emerged as a significant factor influencing the risk of injuries among bricklayers, with those earning below 100,000 naira (approximately US$133 at the time of the study) being more susceptible to injuries. Qualitative data further supported this trend, as carpenters acknowledged the tendency of higher-income individuals to delegate high-risk tasks and assume supervisory roles. This observation highlights a clear inverse relationship between income and direct exposure to hazardous tasks within the construction industry, suggesting that economic factors can influence artisans' occupational safety practices.

Bricklayers engaged in manual handling activities such as pulling, pushing, carrying, and lifting, had a higher susceptibility to injuries. This was not unexpected as these kinds of activities predispose workers to different mechanisms of injuries such as falls, falling objects and crush incidents [53]. However, for carpenters, the prevalence of manual handling activity was nearly universal, thus making it a less distinctive factor in injury risk. Furthermore, the handling of weights surpassing 100 kg per day was a significant predictor of occupational injuries for both bricklayers and carpenters, probably due to the increased likelihood of balance loss, slips, falls, or crush incidents. Working with substantial weights is linked to musculoskeletal disorders and injuries, as indicated in the literature [54]. These findings highlight the varied injury risks linked to different tasks in the construction industry, thus underscoring the necessity for tailored safety measures.

Failure to use PPE was highlighted as a factor that may predispose to injuries or amplify their severity. This is widely acknowledged in the literature, particularly among informal construction workers in low and middle-income countries who often do not use PPEs or use them incorrectly, thereby missing out on their injury-prevention benefits [49, 55, 56]. The reasons for this inadequate PPE use are multifaceted and include factors such as limited availability, high costs, discomfort, a lack of knowledge about the importance of PPE, and a perception that it is unnecessary [57, 58]. Addressing these issues requires targeted interventions, including comprehensive training programs for artisans and ensuring the provision of adequate PPE.

Lack of adequate safety training was a prominent factor identified in this study as a predisposing cause of injuries among artisans. This gap in training leaves many artisans without the knowledge and skills necessary to carry out their work in a safe manner [59, 60]. This is of particular concern for artisans who rely on makeshift wooden or bamboo scaffolding, which are inherently unstable with increased risk of falls from heights. Enhancing the safety competencies of artisans through comprehensive training programs is essential to minimize the risk of injuries associated with high-risk tasks such as working at heights or on scaffolding.

Physical violence arising from land disputes on construction sites is a frequently overlooked factor contributing to the risk of injuries among artisans. This issue is gaining recognition as workplace violence becomes more prevalent, even within the informal construction sector of Nigeria and other low-income countries [61]. Similar findings have been reported in prior research, highlighting incidents of violence stemming from land disputes, bullying, and worker-worker conflicts [61, 62]. Addressing conflicts at construction sites is crucial to protecting the well-being of artisans, thus necessitating interventions aimed at preventing or mitigating such occurrences.

This study was not without limitations as the study was conducted in Osun State, which may not be representative of the entire country. Additionally, the study participants were bricklayers and carpenters, hence, study findings may not be generalizable to the other types of informal sector artisans in the construction industry. To deepen the understanding of occupational injuries among artisans, future research should use prospective methods to monitor injury occurrences over time. Comparative studies between formal and informal sector artisans could provide valuable insights into the factors influencing injury risk and the efficacy of safety interventions across varied work settings. Additionally, more research is required to quantify the economic impact of injuries among artisans, encompassing direct costs like medical care, lost wages and productivity losses among others.

Conclusion

This study established that informal sector artisans, especially those in construction, bear a high burden of occupational injuries. Key determinants of such injuries include younger age (below 60 years), lower income, engagement in manual handling activities, and handling weights over 100 kg daily. Other important factors include non-use of personal protective equipment, insufficient safety training, and physical violence incidents. It is important to improve the occupational safety and health of these artisans through the implementation of some key interventions.

These interventions include the design and implementation of the safety training programs, promoting and ensuring proper use of personal protective equipment, workplace hazard control, promote the development of conflict resolution skills among artisans and engendering safe housekeeping practices. These interventions require close collaboration among government agencies, artisans and other stakeholders. These interventions will significantly enhance safety and well-being, thereby reducing occupational injuries among these vulnerable artisans.

Abbreviations

AOR	Adjusted Odds Ratio
CI	Confidence Interval
FGD	Focus Group Discussion
PPE	Personal Protective Equipment
SPSS	Statistical Package for Service Solution

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12889-025-21473-5.

Additional files 1: The PDF version of the study instrument is attached as supplementary file 1.

Acknowledgements
The authors wish to acknowledge CARTA for funding and the artisan associations for their participation in this study.

Author contributions
All authors (TOO, AAO and NN) co-designed the study. TOO coordinated data collection with inputs from AAO and NN. TOO conducted the analysis and drafted the results. All authors contributed to the final draft of the manuscript and approved the submitted version of the paper.

Funding
This study is supported a grant for PhD research provided by Consortium for Advanced Research Training in Africa (CARTA) which is funded by the Carnegie Corporation of New York. (Grant No–B 8606.R02), SIDA (Grant No:54100029) and the Developing Excellence in Leadership, Training and Science in Africa (DELTAS Africa) Initiative (Grant No: 107768/Z/15/Z). The views expressed in this publication are those of the authors and not necessarily those of the partners in the consortium.

Data availability
Datasets supporting the findings of this study are available on request to the corresponding author.

Declarations

Ethics and consent to participate
Informed consent was obtained from all participants. Ethical approval to conduct the study was obtained from the Human Research Ethics Committee (Medical) of the University of Witwatersrand, South Africa (M221066) and from the Health Research and Ethics Committee of the Institute of Public Health, Obafemi Awolowo University, Nigeria. (IPHOAU/12/1766). In addition, the study was conducted in line with the ethical standards as laid down in the Declaration of Helsinki and its later amendments or comparable ethical standards [63]. Permission to carry out the survey was obtained from the head of the artisans' association in the selected LGAs. Written informed consent was obtained from all adult persons before participating in the survey after adequate explanation of the purpose of the study and the study risks and benefits. Participation was voluntary and confidentiality as well as data security was ensured. Respondents were informed of their rights decline or withdraw at any time without penalties. Data were stored on a computer that is password-protected and only accessible to the investigator. The clinical impression obtained from available information after survey assessements was communicated to individual repondents. All participants with clinical conditions detected on screening or those with other health complaints were subsequently referred after due counselling, to an appropriate formal healthcare provider of their choice with the aid of a printed study referral form.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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Received: 4 April 2024 / Accepted: 15 January 2025
Published online: 22 January 2025

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