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Prevalence of Falls and Associated Factors among Construction Workers in Port Harcourt, Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author FAN designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Author IDA managed the analyses of the study. Authors FAN and KED managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Background: Falls at construction sites are common occurrences with some resulting in fatalities. This study was to determine the prevalence and pattern of falls at construction sites in Port Harcourt Metropolis, Nigeria.

Materials and Methods: This descriptive cross-sectional study sampled 340 construction workers from the two Local Government Areas of Port Harcourt Metropolis. A structured, close-ended, interviewer-administered questionnaire and Walk through Survey were the research instruments. Ethical approval was gotten from the Research and Ethics Committee of University of Port Harcourt and informed consent was gotten from each of the respondents prior to commencement of the study. Data obtained were analysed using descriptive and analytical statistics.

Results: Of the 340 respondents in the study, 124 had experienced falls giving a prevalence of 36.5%. On the pattern of falls, trips/slips from short distance accounted for 23.4% while falls from ladder was 17.7%, scaffolds 15.3% and roof tops accounted for 12.9%. The commonest cause of the falls was failure to use Personal Protective Equipment PPE (17.7%). Furthermore, 63.2% of the respondents had good knowledge of safety precautions while 57.4% had good safety practice. Knowledge of safety precautions was significantly associated with age, education, experience and safety training (p = 0.000).

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Conclusion: There was a high prevalence of falls at construction sites in Port Harcourt mainly from trips/slips, ladders and scaffolds. Majority of the workers had good knowledge and practice of safety precautions. It is recommended that health education, periodic safety training and enforcement of safety practices among construction workers be instituted, intensified and sustained.

Keywords: Falls; injuries; safety; construction; workers.

1. INTRODUCTION

The construction industry essentially a hazardous work environment and potentially contributing significantly to work place injuries. Falls are a leading cause of job-related injuries and even death of workers in construction sites [1]. Construction industries, despite their accelerated growth occasioned by industrialization, are major contributors to workplace hazards throughout the globe. The construction sector has continuously experienced expansion and has boomed with activities including building of Industries, Health Care facilities, schools, markets, residential apartments and official buildings amongst other activities. Workers are however key players in any given construction sector because they critically involve in operations sector. Occupational falls have been linked to the demanding, temporary and complex nature of the tasks, safety issues, manpower and duties related to the construction environment. Occupational fall is movement from a higher to a lower level which usually occurs rapidly and without control in a working environment [1,2]. Types of fall includes; roofing falls, ladder falls, falls from scaffolds etc. Consequences of occupational falls would include: physical (which include injuries to the body) Economic (i.e. monetary injuries!), social, psychological and even rehabilitative [2].

A qualified safety personnel is one who has undergone series of lectures, practical and training in ensuring the safety of workers and has obtained a recognized certificate of completion from an accredited organization. Certain international organizations responsible for ensuring proper training of personnel include; International Organization for Standardization, British International Safety Organisation. Different legal requirements are needed for safety training depending on the country's government and policy [3,4]. Fall hazards can also take place due to instability of erecting strong and formidable structures and the use of make-shift, especially in Scaffolds. It also arises from dismantling structures and in situations where there is restricted and limited working areas. To best tackle this problem, the factors bringing about falls at any construction site must be identified and curbed [4].

Internationally, the Bureau of Labor Statistics, as contain in a United States publication disclosed that 'fall' prevalence among workers rated about 34% [5]. Other prevalence of falls at the construction site was reported to be 14.0% and 36.9% in Hong Kong and Malaysia respectively. According to Nadhim in 2016, a fall prevalence of 36.9% was recorded in USA, 31% in UK and 12% in Australia. In Africa, fall injuries that occurred due to fall was recorded to be 6.5% in Addis Ababa in Ethiopia. In Nigeria, a prevalence of 29.15% and 32.0% was reported in Rivers State and Enugu Metropolis respectively [6-11].

For adequate prevention of falls at construction sites, Risk assessment of construction sites by qualified persons before work should be conducted, Provision of a full protection program that would ensure the safety of workers, Ensuring that well qualified workers are employed for specified tasks and Workers should be trained prior to commencement of any task, proper supervision of these workers while working and making safety a part of daily dialogue [12,13]. This study was to determine the prevalence and associated factors of falls among workers at construction sites in Port Harcourt metropolis, Nigeria.

2. MATERIALS AND METHODS

2.1 Study Area

The study was conducted at the construction sites in Port Harcourt metropolis. Port Harcourt is the capital of Rivers State in Nigeria. It is a port town lying along the Bonny River. It is located in Southern Nigeria and the traditional inhabitants are the Ikwerre and to some extent Okirika people. Port Harcourt is a metropolis covering 2 local government areas (Obio-Akpor comprising 17 wards and Port Harcourt City comprising 20

wards), with the main city being Port Harcourt City. The Port Harcourt metropolis spans over an area of 369 km^2. Its economy is primarily based on the oil and petroleum industry which has contributed immensely to the current state of urbanisation and modernisation. There are good number of new projects of schools, offices, shopping malls, banks, churches, health care facilities, roads, residential and official buildings which are the sole responsibilities of the construction sector. It is also a major industrial centre with many multinational firms such as Total Oil Company, Shell Petroleum, Agip, General electric as well as other businesses from the petroleum industry to the construction industry.

2.2 Study Design and Population

This descriptive cross-sectional study recruited male and female construction workers between 18 and 56 years.

2.3 Sample Size

Using the formula: n =$\frac{Za^2Pq}{d^2}$ a sample size (with allowance for non-response) of 349 was arrived at.

Where:

n = minimum sample size required
za = value corresponding to the confidence level of 95% which is 1.96^2
p = proportion or prevalence of the attribute of interest. Here, the prevalence of falls at the construction site will be 29.15% (Douglas & Adeloye, 2016)

d = margin of precision (5%)

q= $100 - p$
q=$100 - 29.15 \quad = \quad 70.85$

n=$\frac{1.96^2 \times 29.15 \times 70.8\ 5}{5^2}$
n=$\frac{3.8\ 4\ 16 20\ 65 28}{25}$
n= $\frac{7933.97}{25}$
n =317

Providing for 10% non-response rate = 0.1×317=31.7

317+31.7= 348.7

n=349

2.4 Sampling Method

Multi-stage sampling was employed

Stage 1: This stage involved breaking Port Harcourt metropolis into 2 clusters in line with the existing administrative units (i.e. two local governments: Port Harcourt City Local Government Area (PHALGA) with 20 wards and Obio/Akpor Local Government Area (OBIO-AKPOR) with 17 wards).

Stage 2: Involved the selection of 5 wards from each of the strata i.e. the 2 LGAs by balloting. The wards selected in PHALGA were Ward 1, Ward 18, Ward 3, Ward 8 and Ward 13. For Obio-Akpor, the selected wards were Ward 9, Ward 6, Ward 1, Ward14 and Ward 7

Stage 3: Involved the identification of active construction sites in each of the selected wards in the two LGAs. The active construction sites identified in each wards selected is contained below.

Stage 4: This involved the selection of 5 active construction sites in each of the 10 selected wards again by balloting from a list of the 50 active construction sites selected (i.e. 5 sites from each of the 10 wards).

Stage 5: This stage involved the identification of construction workers in each of the 50 selected active construction sites. From the survey, each site had an average number of 15 workers, giving a total of 750 workers in the 10 wards selected i.e. 50 multiplied by 15 which gives us 750.

Stage 6: This stage involved the equal allocation of the sample size to the 50 active sites in the 10 wards i.e. 7 workers per site.

Stage 7: This involved the selection of 7 workers from each of the sites by simple random sampling method of balloting to satisfy the sample size of 349.

2.5 Study Instruments

A semi-structured, self and interviewer-administered questionnaires adapted from pre-existing templates and having 5 sections (Wong et al, 2005; Liy et al, 2016) was used. Section A explored the socio-demographic data of the respondents consisting of 8 questions. Section B explored data on the occupational background,

Section C explored prevalence and pattern of falls among the respondents with 5 questions. Section D explored their knowledge on safety precautions towards the prevention of the occurrence of falls at construction sites comprising of 15 questions on a 15 point scale (≤ 5 = poor knowledge; 6-10 = fair knowledge; 11-15 =. Good knowledge). Section E explored the level of safety practices consisting of 15 questions where (≤ 5 = poor practice, 6-10 = fair practice and 11-15 =. Good practice). A walk-through survey with a well arranged checklist was also employed. Distribution and retrieval was done immediately after completion on the same day.

2.6 Data Collection / Analysis

Collected data were entered into Excel spread sheet and SPSS version 20. Descriptive and analytical statistics were used to treat data (i.e. frequencies, percentages, means and standard deviations) which were then presented in tables.

2.7 Ethical Considerations

Ethical clearance was obtained from the Research and Ethics Committee of the University of Port Harcourt just as permission to undertake this study was acquired from the project managers at the different construction site in Port Harcourt where the participants were recruited for the study. Also, informed consent was obtained from each respondent.

2.8 Limitation

Respondents were apprehensive of the presence of the researchers thinking they were Government official coming to close down the site for safety breaches. They were reassured that it was an academic exercise that will help in improving workplace safety.

3. RESULTS

A total of 349 questionnaires were administered over a period of sixteen (16) days. However, nine (9) questionnaires were not appropriately filled. Hence, the result presented is for the 340 accurately filled questionnaires representing 97.4% of the total sample.

3.1 Report of the Walk-through Survey

A Walk Through survey was carried out at 8 randomly selected construction sites in parts of Port Harcourt. This was done between the hours of 10 a.m. to 1 p.m. for 5 days at the various study sites.

Table 1. Socio-demographics of respondents

Variable	Frequency (n=340)	Percent (%)
Age(years)		
18-25	106	31.2
26-35	141	41.5
36-45	84	24.7
≥ 46	9	2.6
Sex		
Female	24	7.0
Male	316	93.0
Marital status		
Single	218	64.1
Married	103	30.3
Separated	8	2.4
Divorced	6	1.8
Widowed	5	1.5
Religion		
Christianity	247	72.6
Islam	41	17.4
Others	34	10
Level of education		
None	29	8.5
Primary	117	34.4
Secondary	150	44.1
Tertiary	44	12.9

Table 2. Occupational history of respondents

Variables	Frequency (n=340)	Percentage (%)
Years of experience		
< 2 years	14	4.1
2 to 5years	165	48.5
6 to 10years	63	18.5
11 to 15years	77	22.6
>15years	21	6.2
Specialization		
Plumbers	43	12.65
Carpenters	39	11.5
Bricklayers	53	15.6
Electricians	24	7.1
Iron benders	28	8.2
Painters	18	5.3
General Labour	55	16.2
Supervisors	12	3.5
Project Managers	10	2.9
Equipment Operators	33	9.7
Others	25	7.4
Trained in safety		
Trained	195	57.35
Untrained	145	42.65

Table 3. History and pattern of falls among respondents

Variable	Frequency	Percent (%)
Ever fallen(n=340)		
Yes	124	36.5
No	216	63.5
No of time fallen (n = 124)		
Once	79	63.7
≥ 2	45	36.3
Time of day fallen (n = 124)		
Morning	19	15.3
Afternoon	15	12.1
Evening	64	51.6
Night	26	21.0
Pattern of fall (n=124)		
Trip/slip from short distance	29	23.4
From ladder	22	17.7
From scaffold	19	15.3
Roof/top of building	16	12.9
From stairs	14	11.3
Fall into the excavation	11	8.9
Fall from lift-shaft	9	7.3
Others	4	3.2

Table 4. Injury, type of injury sustained and cause of fall

Variables	Frequency (n=124)	Percent (%)
Fall associated injury		
Yes	100	80.6
No	24	19.4
Injury sustained (multiple response)		
Bruising of skin	40	40.0
Hand fracture	12	12.0
Leg fracture	8	8,0
Laceration/skin tear	15	15.0
Head injury	9	9.0
Chest injury	6	6.0
Others	10	10.0
Cause of fall	**Rank order**	
Failure to use PPE	22	17.7
Unsafe act of another person	19	15.3
Slippery surface	17	13.7
Tiredness/fatigue	15	12.1
Lack of skill	13	10.5
Misuse of working equipment	12	9.7
Carelessness	10	8.1
Insufficient light/	9	7.3
Inadequate working space/others	7	5.6

Table 5. Distribution of knowledge of safety precautions against fall

Variable	Frequency (n=340)	Percent (%)
Good knowledge	215	63.2
Fair knowledge	100	29.4
Poor knowledge	25	7.4

Table 6. Distribution of safety practices

Variable	Frequency (n=340)	Percent (%)
Good practice	195	57.4
Fair practice	67	19.7
Poor practice	78	22.9

Table 7. Relationship between socio-demographic characteristics of workers and knowledge of safety precautions at construction sites

Demographic characteristic	Knowledge of safety precaution			Total (%)	X^2 (df)	p-value
	Good knowledge	Fair knowledge	Poor knowledge			
Sex						
Male	198 (62.86)	92(29.21)	25(7.94)	**315 (100)**	2.142 (2)	0.343
Female	17(68.00)	8(32.00)	0(0.00)	**25 (100)**		
Total	**215(63.24)**	**100(29.41)**	**25(7.35)**	**340 (100)**		
Age(years)						
≤ 25	45 (42.06)	58(54.21)	4(3.74)	**107 (100)**	60.576(4)	0.000*
26- 35	97 (68.79)	24(17.02)	20(14.18)	**141(100)**		
≥ 36	73(79.35)	18(19.57)	1(1.09)	**92(100)**		
Total	**215 (63.24)**	**100 (29.41)**	**25(7.35)**	**340 (100)**		
Educational qualification						
None	4(13.79)	16(55.17)	9(31.03)	**29(100)**	64.753(6)	0.000*
Primary	63(53.85)	44(37.61)	10(8.54)	**117(100)**		
Secondary	108(72.00))	36(24.00)	6(4.00)	**150(100)**		
Tertiary	40(90.91)	4(9.09)	0(0.00)	**44(100)**		
Total	**215 (63.24)**	**100 (29.41)**	**25(7.35)**	**340 (100)**		

Table 8. Relationship between occupational history and knowledge of safety precaution

Occupational history	Knowledge of safety precaution			Total (%)	X^2(df)	*p-value*
	Good knowledge	Fair knowledge	Poor knowledge			
Years of experience						
≤ 5years	90(50.27)	69(38.55)	20(11.17)	**179(100)**		
≥ 5years	125(77.64)	31(19.25)	5(3.11)	**161(100)**	28.264(2)	0.000*
Total	**215(63.24)**	**100(29.41)**	**25(7.35)**	**340(100)**		
Safety training						
Trained	166(85.13)	27(13.85)	2(1.02)	**195(100)**	97.219(2)	0.000*
Untrained	49(33.79)	73(50.34)	23(15.86)	**145(100)**		
Total	**215(63.24)**	**100(29.41)**	**25(7.35)**	**340(100)**		
Specialization						
Plumbers	20(46.51)	15(34.88)	8(18.60)	**43(100)**	5.312(20)	0.233
Carpenters	20(51.28)	15(38.46)	4|(10.26)	**39|(100)**		
Bricklayers	37(69.81)	14(26.42)	2(3.77)	**53(100)**		
Electricians	12|(50.00)	10(4.76)	2(8.33)	**24(100)**		
Iron benders	20(71.43)	5(17.86)	3(10.71)	**28(100)**		
Painters	15(83.33)	2(11.11)	1(5.56)	**18(100)**		
General Labour	35(63.64)	18(32.73)	2(3.64)	**55(100)**		
Supervisors	12(100.0)	0(0.00)	0(0.00)	**12(100)**		
Project Managers	10(100.0)	0(0.00)	0(0.00)	**10(100)**		
Equipment Operators	20(60.61)	11(33.33)	2(6.06)	**33(100)**		
Others	14(56.00)	10(40.00)	1(4.00)	**25(100)**		
Total	**215(63.24)**	**100(29.41)**	**25(7.35)**	**340(100)**		

Table 9. Relationship between socio-demographics characteristics of workers and safety practices

Demographics	Safety practices			Total (%)	X^2(df)	*p-value*
	Good practice	Fair practice	Poor practice			
Sex						
Male	180(57.14)	63(20.00)	72(22.86)	**315(100)**	*0.234(2)*	*0.889*
Female	15(60.00)	4(16.00)	6(24.00)	**25(100)**		
Total	**195 (57.35)**	**67 (19.71)**	**78(22.94)**	**340 (100)**		
Age(years)						
≤ 25	153(61.94)	36 (14.57)	58 (23.48)	**247 (100)**	*15.497(2)*	*0.000**
≥ 36	42(45.16)	31(33.33)	20(21.51)	**93(100)**		
Total	**195 (57.35)**	**67 (19.71)**	**78(22.94)**	**340 (100)**		
Educational qualification						
None	7(24.14)	9(31.03)	13(44.83)	**29(100)**	35.267(6)	*0.000**
Primary	63 (53.85)	30(25.64)	24(20.51)	**117(100)**		
Secondary	90 (60.00)	19(12.67)	41(27.33)	**150(100)**		
Tertiary	35(79.55)	9(20.45)	0(0.00)	**44(100)**		
Total	**195 (57.35)**	**67 (19.71)**	**78(22.94)**	**340 (100)**		

Table 10. Relationship between knowledge of safety precaution and practice of safety

	Safety practice			Total %	X^2(df)	*p-value*
	Good practice	Fair practice	Poor practice			
Knowledge of safety precaution						
Good knowledge	151(70.23)	40(18.60)	24(11.16)	**215(100)**	82.278(4)	*0.000**
Fair knowledge	42(40.00)	25(25.00)	33(35.00)	**100(100)**		
Poor knowledge	2(8.00)	2(8.00)	21(84.00)	**25(100)**		
Total	**195(57.35)**	**67(19.71)**	**78(22.94)**	**340(100)**		

Table 11. Relationship occupational history and safety practices

	Safety practices			Total (%)	X^2(df)	*p-value*
	Good practice	Fair practice	Poor practice			
Years of experience						
≤ 5years	87(48.60)	43(24.02)	49(27.37)	**179(100)**	11.858(2)	*0.003**
>5years	108(67.08)	24(14.91))	29(18.01))	**161(100)**		
Total	**195(57.35)**	**67(19.71)**	**78(22.94)**	**340(100)**		
Safety training of workers						
Trained	166(85.13)	25(12.82)	4(2.05)	**195(100)**	159.481(2)	0.000*
Untrained	29(20.00)	42(28.97)	74(51.03)	**145(100)**		
Total	**195(57.35)**	**67(19.71)**	**78(22.94)**	**340(100)**		
Specialization						
Plumber	15(34.88)	8(18.60)	20(46.51)	**43(100)**	2.231(20)	*0.12**
Carpenter	13(33.33)	10(25.64)	16(41.03)	**39|(100)**		
Bricklayer	37(69.81)	12(22.64)	4(7.55)	**53(100)**		
Electrician	12(50.00)	5(20.83)	7(29.17)	**24(100)**		
Iron bender	20(71.43)	5(17.86)	3(10.71)	**28(100)**		
Painter	15(83.33)	2(11.11)	1(5.56)	**18(100)**		
General labour	35(63.64)	12(21.82)	8(14.55)	**55(100)**		
Supervisors	12(100.0)	0(0.00)	0(0.00)	**12(100)**		
Project Manager	10(100.0)	0(0.00)	0(0.00)	**10(100)**		
Equipment operator	20(60.61)	9(27.27)	4(12.12)	**33(100)**		
Others	6(24.00)	4 (16.00)	15(60.00)	**25(100)**		
Total	**195(63.24)**	**67(29.41)**	**78(7.35)**	**340(100)**		

Table 12. Relationship between socio-demographic characteristics of workers and occurrence of fall

Demographics	Fall		Total (%)	X^2(df)	*p-value*
	Yes Freq. (%)	No Freq. (%)			
Sex					
Male	119 (37.78)	196 (62.22)	**315 (100)**	3.159(1)	*0.076**
Female	5 (20.00)	20 (80.00)	**25 (100)**		
Total	**124 (36.47)**	**216 (63.53)**	**340 (100)**		
Age(years)					
≤ 35	110(44.53)	137(55.47)	**247(100)**	25.343(1)	*0.000**
≥36	14(15.05)	79(84.95)	**93(100)**		
Total	**124 (36.47)**	**216 (63.53)**	**340 (100)**		
Educational qualification					
None	18 (62.07)	11 (37.93)	**29(100)**	86.541(3)	
Primary	76 (64.96)	41(35.04)	**117 (100)**		*0.000**
Secondary	25 (16.67)	125(83.33)	**150(100)**		
Tertiary	5(11.36)	39 (88.64)	**44(100)**		
Total	**124 (36.47)**	**216 (63.53)**	**340 (100)**		

Table 13. Relationship between knowledge of safety precaution, practice of safety with occurrence of fall

	Fall		Total (%)	X^2(df)	*p-value*
	Yes Freq. (%)	No Freq. (%)			
Knowledge of safety precaution					
Good knowledge	59(27.44)	156(72.56)	**215(100)**	31.149(2)	*0.000**
Fair knowledge	45(45.00)	55(55.00)	**100(100)**		
Poor knowledge	20(80.00)	5(20.00)	**25(100)**		
Total	**124 (36.47)**	**216 (63.53)**	**340 (100)**		
Safety practices					
Good practice	22(11.28)	173(88.72)	**195(100)**	145.857(2)	*0.000**
Fair practice	34(50.75)	33(49.25)	**67(100)**		
Poor practice	68(87.18)	10(12.82)	**78(100)**		
Total	**124 (36.47)**	**216 (63.53)**	**340 (100)**		

Table 14. Relationship between occupational history and occurrence of fall

Occupational history	Fall		Total (%)	X^2(df)	*p-value*
	Yes Freq. (%)	No Freq. (%)			
Years of experience					
≤ 5years	79(44.13)	100(55.86)	**179(100)**	*9.5817(1)*	*0.002**
>5years	45(27.95)	116(72.05)	**161(100)**		
Training in safety					
Trained	43(22.05)	152(77.95)	**195(100)**	41.031(1)	*0.000**
Untrained	81(55.86)	64(44.14)	**145(100)**		
Total	**124(36.47)**	**216(63.53)**	**340(100)**		
Specialization					
Plumber	16(37.21)	27(62.79)	**43(100)**		
Carpenter	15(38.46)	24(6154)	**39(100)**	**3.548(10)**	*0.673*
Bricklayer	15(28.30)	38(71.70)	**53(100)**		
Electrician	12(50.00)	12(50.00)	**24(100)**		
Iron bender	11(39.29)	17(60.71)	**28(100)**		
Painter	8 (44.45)	10(55.56)	**18(100)**		
General labour	20(36.36)	35(63.64)	**55(100)**		
Supervisors	2(16.67)	10(83.33)	**12(100)**		
Project manager	2(20.00)	8(80.00)	**10(100)**		
Equipment operator	13(39.39)	20(60.61)	**33(100)**		
Others	10(40.00)	15(60.00)	**25(100)**		
Total	**124(36.47)**	**216(63.53)**	**340(100)**		

3.2 Observations

- About half of the workers at various sites visited don't make use of any Personal Protective Equipment PPE.
- There was adequate light supply in many construction site. However, few building sites lacked sufficient illumination.
- One third of the construction sites explored have good working space while others do not.
- It was observed that good number of workers climbed the scaffold without any fall arrest gadget like the safety belt.
- Slippery surfaces where observed to be present at the work sites and no worker was bothered about it.
- Make-shift pattern of construction was observed; this means that most construction workers make use of substandard material for their ladder and scaffold stand because it was available and less expensive.
- All the construction site had no trained safety personnel.
- It was also observed that excavations and slippery surfaces had no signage around them.
- During the survey at road construction site, it was observed that the machine operator engaged in drinking and smoking section while operating the machine.
- It was observed that workers where carrying heavy loads while climbing the ladder, and lots of them climbed the ladder with mud underneath their foot wears.
- One quarter of the stairs used in the sites visited had no guard rail.

4. DISCUSSION

Globally, fall has been identified as a common form of accident encountered in the construction industries which has led to so many injuries and death. It results from risky and hard activities in the construction site which involves climbing, lifting of heavy loads and many others.

This study recorded quite a high fall prevalence of 36.5%. The rate of fall could be due to the workers' lack of adherence to safety rules and safe work procedures observed during the walk-through survey. This finding is similar to the study in Malaysia with a fall prevalence of 36.9%. A similar prevalence of 32.0% was recorded in Enugu Metropolis and also comparable to the work done in United States which showed an incidence of 34% [4,11]. However, this finding was a variance with the study conducted in Obio Akpor 29.15% and Ethiopia 6.5% respectively. The contrast could be due to non-specificity of the study to fall incidence. Rather their study was generalized on the accidents in the construction industry.

From the study, 23.4% of workers encountered trip/slip from short distance which can be caused by slippery surface and improper arrangement of working materials and equipment. Fall from ladder accounted for 17.7%, this can be caused by the use of substandard materials in the production of the ladder used by these workers and also due to improper fixing of the base of the ladder to the ground. Among the sites visited, it was observed that the ladders used by the workers were tied together with ropes and with a lighter wood which is not the ideal or recommended wood for the making of construction ladders. Falls from scaffold 15.3%, fall from the roof/top of building 12.9%, falls from stairs 11.3%, fall into the excavation 8.9%, and fall from lift-shaft 7.3%.This finding is comparable to a Hong Kong study where fall from the ladder accounted for 16%, stair falls 13%, fall from scaffold 14.6% and fall from the rooftop 14%. It is also similar to that of Ismail & Ghani in Malaysia where the results showed similar pattern of fall [14-17]. This fall mishaps can actually have harmful effect on human safety and health, loss of life and injuries, reduction in work speed leading to delay in meeting deadline, economic loss and also adverse implication for insurance.

Findings showed that (63.2%) of the respondents had Good knowledge of safety precautions while 100 (29.4%) had Fair knowledge and 25 (7.4%) had Poor knowledge of safety precautions. It can be deduced that higher percentage of respondents have good knowledge of safety precautions against fall and the workers with insufficient knowledge of safety precaution are few. This finding was similar to the finding in United State with good knowledge accounting for 70% and poor knowledge 21%. This finding is however higher than that in Uganda where good knowledge was 33.2% while poor knowledge accounted for 66.8%. The variance could be due to the nature of the population studied and the rate of compliance to safety among the workers. Despite the encouraging number of workers that have good knowledge of safety precautions, there are still evidence of fall among these workers. Therefore, we can say that having

appropriate knowledge without consistently putting them in practice will not prevent the occurrence of fall. One cannot have a proper knowledge and bottle them up without practising them because once this happens, the purpose of acquiring knowledge has been defeated.

A total of 195(57.4%) of the respondents exhibited good safety practices against fall and 67(19.7%) demonstrated fair safety practice against fall, while 78(22.9%) of the respondents exhibited poor safety practice against falls. Failure to use personal protective equipment, lack of attention while at the construction site, carelessness, and lack of skill, incorrect attitude, and unsafe/careless act of another person are some of the factors leading to falls among construction workers. High percentage of the workers rest when they get tired while few of them continue working without resting. Furthermore, 32% of the respondent said they are provided with protective equipment, 50% indicated that they are not being provided with protective materials while 18% of the workers admitted that they are sometimes being provided for. A whole lot of injuries and death would have been prevented if the workers are provided with the appropriate safety harness before starting any task at the site. Employers of labour should see the need of providing these workers with gadgets that can prevent and protect them from falling while working at the various sites. This result was in accordance with the findings from the study done in Namibia, where good knowledge was recorded as 61.3% and 84.3% respectively [18-20].

From the survey and personal walk through survey at the sites, it was uncovered that most of these workers indulged in many risky behaviours at the site. It was seen that one third of the workers were smoking and drinking of intoxicating substances while working at the site, this can be termed 'unsafe act'. Alcohol affects mental and physical composure in people that consume them, this has actually led to most of the falls among them. The human body is designed to take a rest when tiredness and fatigue starts to set in and failure to this will amount to serious loss of concentration which can in-turn support or lead to the occurrence of fall.

The study revealed a relationship between age and fall. From the result, there is an increase in the prevalence of fall incidents with age (p=0.00). Workers who are 35 years and below fell more (44.53%), while those that are 36 years and above fell less (15.05%). This can be explained that these workers are still in their youthful age and most of them lack sufficient knowledge and experience in the construction industry. Another reason being that younger persons tend to get curious and sometimes act in trial and error without considering the risks involved in their actions. The result is in disagreement with the study outcome where age showed no relationship with prevalence of fall (0.345). Dong et al further stated that older workers had higher rate of fall than the younger one. The reason for this discrepancy is that Dong carried out a retrospective study where he got data from registers of fatal job-related injuries from 1992 to 2008 and he studied falls among older workers in Hong Kong. This study has shown a relationship between years of experience and fall (p = 0.002). Respondents who had more than 5 years of years of experience fell less (27.95%) while those who had experience of 5 years and below fell more with proportion of (44.13%). Increased years of experience have a more positive effect on the reduction of fall. Doing a specific job for a longer period of time would likely make one an expert in that field. Workers would learn several lessons from the hazards they have been exposed to on daily or weekly basis and then adapt to safe guarding their lives in order not to repeat the same mistake that led to mishaps.

Level of education also showed a statistically significant relationship with fall (p=0.000). Increase in level of education showed a positive effect with fall since respondents with secondary and tertiary education had a lower proportion of fall with percentage of (16.67%) and (11.36%) respectively. There was an increase in the number of fall among respondents who have no formal educational background (62.07%) and respondents who had completed just primary education (64.96%). This signifies that lack of education is a contributing factor to the occurrence of falls among construction workers. This work has gone further to indicate a relationship between knowledge of safety precaution and fall. From the result, there is decrease in fall with increasing knowledge (p = 0.000). The workers with good knowledge fell less with a percentage of (27.44%) and the workers with poor knowledge fell more with a higher proportion of (80.00%). This finding is in keeping with that in Obio/Akpor, Nigeria with a p-value of 0.001. Likewise, there is a decrease in fall with good practice of safety (p = 0.000). Those with poor practice fell more (87.18%)

while those with good practice fell less (11.28%). This shows that knowledge of safety precaution and safety practice goes hand in hand in the prevention of fall.

Furthermore, there is a connection between training of workers in safety and fall (p = 0.000). There is an increase in the incidence of fall among those that are not trained in safety (55.86%), and a lower proportion of fall has been attributed to workers who have received safety training (22.05%). Training workers in safety is paramount to workers safety, achieving goals in timely manner and reduction in cost and damage of resources. Training of workers in the areas of safety culture is cost effective.

5. CONCLUSION

Fall is present and high among construction workers in the selected companies of this study. It was largely due to workers' lack of proper knowledge of safety and precaution. Factors such as use PPE, poor lighting, working space, alcohol while working, inadequate sleep etc. were contributory.

6. RECOMMENDATION

It is recommended that a minimum level of Secondary education be instituted for all construction workers. There is also need for continuous health education and enforcement of safety standards at all work site by responsible agencies.

CONSENT

Informed consent was gotten from each of the respondents prior to commencement of the study.

ETHICAL APPROVAL

Ethical approval was gotten from the Research and Ethics Committee of University of Port Harcourt.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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QUESTIONNAIRE AND CHECKLIST

Survey Questionnaire On: The Prevalence of Fall and Associated Factors among Construction Site Workers in Port Harcourt

Section A: Demographics

S/N	Question	Options	Response
1	**Sex**	Male Female	
2	**Age as at last birthday(years)**	a. <18 b. 18-25 c. 26-35 d. 36-45 e. ≥46	
3	**Marital status**	a. Single b. Married c. Separated d. Divorced e. Widowed f. Living with partner	
4	**Religion**	a. Christianity b. Islam c. Traditional worship d. Others	
5	**Tribe**	a. Ikwerre b. Igbo c. Kalabari d. Hausa e. Yoruba f. Ogoni g. Urhobo h. Efik i. Others	
6	**Level of education completed**	a. None b. Primary c. Secondary d. Tertiary	

Section B: Occupational History

1. Years of experience: <1 year [ ] 1-5 years [ ] 6-10 years [ ]
1-15 years [ ] >15years [ ]

2. Have you been trained in safety? Yes [ ] No [ ]

3. Specialization: Plumber [ ] Carpenter [ ] Bricklayer [ ]
Electrician [Iron bender [ ] Painter [ ] General
Labour [ ] Architect [ ] Project [ ] Manager [ ]
Equipment operator [ ] others……..

Section C: Prevalence of Falls at Construction Sites

1. Have you ever fallen while working at the construction site? Yes [ ] No [ ]

2. If yes, how many times? Once [ ] 2-4 [ ] 5times or more [ ]

2. If yes, what kind of fall have you experienced?

Type OF Fall	Tick
a. Fall from ladder?	
b. Fall from scaffolding?	
c. Fall from roof/top of building?	
d. Fall from stairs?	
e. From lift-shaft?	
f. Trip/slip/fall from short distance?	

Others (please specify)…….

3. If yes, which of the following factors do you think was the cause of the fall in question 1 above? (Please tick)

Factors that Caused Fall	Tick
a. Failure to use PPE	
b. Substandard equipment	
c. Carelessness	
d. Lack of skill	
e. Unsafe/careless act of another person	
f. Slippery surface	
g. Misuse of working equipment	
h. Not enough light	
i. Inadequate working space	
j. Working in an unsafe posture	
k. Unsafe loading/placing/mixing	

4. What time of the day did the fall happen? Morning [ ] Afternoon [ ] Evening [ ] Night [ ]

5. Did the fall cause any injury to you? YES [ ] NO [ ]

5. If yes, what kind of injury? (Tick)

Type of Injury	Tick
a. Bruising of skin	
b. Hand fracture	
c. Leg fracture	
d. Laceration/skin tear	
e. Injury	
f. Chest injury	

Section D: Knowledge of Safety Precautions

1. Can tiredness at work lead to the occurrence of falls at a construction site?
Yes [ ] No [ ]

2. Can poor concentration at work lead to falls at a construction site?
Yes [ ] No [ ]

3. Can carelessness lead to the occurrence of falls at a construction site?
Yes [ ] No [ ]

4. Can lack of appropriate skill for a job lead to the occurrence of falls at a construction site?
Yes [ ] No [ ]

5. Do you think that slippery surfaces can lead to the occurrence of falls at a construction site?
Yes [ ] No [ ]

6. Can wearing a proper safety clothes prevent the occurrence of all types of falls at a construction site?
Yes [ ] No [ ]

7. Can poor lighting conditions lead to the occurrence of falls at a construction site?
Yes [ ] No [ ]

8. Not using safety belts when climbing high above the ground can lead to the occurrence of falls at a construction site?
Yes [ ] No [ ]

9. Can little working space lead to the occurrence of falls at a construction site?
Yes [ ] No [ ]

10. Can misuse use of construction equipment cause the occurrence of falls at the construction site?
Yes [ ] No [ ]

11. Can working in uncomfortable posture lead to the occurrence of fall at the construction site? Yes [ ] No [ ]

12. Taking alcohol while working makes you alert and prevents the occurrence of falls at the construction site?
Yes [ ] No [ ]

13. Not having a trained safety personnel at the construction site can lead to the occurrence of fall at the construction site?
Yes [ ] No [ ]

14. Can working without adequate signage around wet surfaces lead to the occurrence of fall at the construction site?
Yes [ ] No [ ]

15. Can working with ladders that are not properly secured to a firm support lead to the occurrence of falls at the construction site?
Yes [ ] No [ ]

Section E: Safety Practices to Prevent the Occurrence of Fall

1. Do you rest when you feel tired?
Yes [ ] No [ ]

2. Do you access to protective equipment at the construction site?
Yes [ ] No [ ]

3. Do you uses safety belt while climbing high above the ground?
Yes [ ] No [ ]

4. Do you make sure that you pay good attention to your work?
Yes [ ] No [ ]

5. Do you take alcohol while working at the construction site?
Yes [ ] No [ ]

6. Do you ensure you sleep well at night?
Yes [ ] No [ ]

7. Do you participate in safety inductions and training?
Yes [ ] No [ ]

8. Do you discontinue your work when there is insufficient working space at the construction site?
Yes [ ] No [ ]

9. Do you wear proper protective clothing and footwear when working in slippery surfaces?
Yes [ ] No [ ]

10. Do you find it hard to concentrate while working because of different problems?
Yes [ ] No [ ]

11. In order to finish your work quickly, you don't go on break during break time?
Yes [ ] No [ ]

12. Do you discontinue your work when there is not enough light to work,
Yes [ ] No [ ]

13. Do you remove slippery material on the floor e.g. banana peels, or leaking oil at the site
Yes [ ] No [ ]

14. Do you make sure that you have the right skill before commencing any job at the construction site?
Yes [ ] No [ ]

15. Do you discontinue your work when there is heavy rainfall?
Yes [ ] No [ ]

Walk Through Survey Checklist to Identify Hazards Related with the Occurrence of Falls at Construction Sites in Port-Harcourt, Nigeria

Hazards Capable of Positively Influencing the Occurrence of Falls

	Yes	No
Is there use of protective clothing		
Are Scaffold components visibly free of any physical damage		
Are all Floor openings properly covered?		
Are there Small work space		
Are the workers Climbing heights without safety belts		
Is scaffolding erected on a firm and level surface?		
Are there Uneven work surfaces		
Is there proper housekeeping regime in the workplace?		
Are stairways fitted with handrails and guardrail systems?		
Availability of trained safety personnel		
Are Adequate signage conspicuously posted around wet surfaces?		
Are there adequate Lighting in the workplace?		
Are floors free from mud, oil, water etc.?		
Are materials properly stacked and segregated		
Are all access/egress means free from slip and trip hazards?		
Are all scaffoldings to be erected designed by competent Engineer?		
Are proper guardrails installed?		
Are workers using Fall Arrest Device while working at height above 1.8m?		
Are workers discouraged to carry loads while climbing a straight ladder?		
Are all damaged ladders clearly marked and removed from the worksite?		
Is the joining of ladders by ropes to reach high positions prohibited at site?		

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