
IMPACTS OF ROAD CONSTRUCTION SITE ACTIVITIES ON THE OCCURRENCE OF ACCIDENTS: A CASE STUDY OF THE ZARIA– KADUNA ROAD

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ABSTRACT

Road transportation remains the dominant mode of movement for passengers and freight in Nigeria. Although road construction and rehabilitation projects are undertaken to improve transport efficiency, they often introduce temporary hazards within construction work zones. This study examined the impact of road construction site activities on the occurrence of road traffic accidents along the Zaria–Kaduna Road. The rehabilitation contract commenced in May 2018 and the Zaria–Kaduna section was completed in December 2022; the FRSC crash records analyzed cover the years 2017–2020, being the data available at the time of the study. A descriptive survey design was adopted, combining structured questionnaires, field observations and interviews with road users, contractor staff and FRSC officers. Poor road condition, illiteracy of both road users and workers, faulty vehicle condition, and driver behaviour emerged as the most common causes of accidents, each with a mean rating of at least 3.50. It is deduced, that from year 2018, 2020, an average of 2,612 persons were injured and 399 killed annually. The highest monthly figures rose from 147 injured and 18 killed in October 2017 (before commencement) to 213 injured and 43 killed in October 2018 (after commencement) increase of 45% and 139% respectively. The study recommends regular safety training for workers and road users, greater attention to health and safety by contractors and other stakeholders, consistent implementation of traffic-management plans on construction sites, and stricter enforcement of regulations.

Keywords: Road construction; work-zone safety; road traffic accidents; highway construction; Zaria–Kaduna Road

1 INTRODUCTION

1.1 Background of the Study

Transportation infrastructure is widely recognized as one of the fundamental drivers of economic growth, national integration, and sustainable development. An efficient road transportation system facilitates the movement of people, goods, and services, thereby supporting industrial production, agricultural development, trade, and regional connectivity. In Nigeria, road transport accounts for the overwhelming majority of passenger and freight movements because of its accessibility, flexibility, and extensive geographical coverage (World Bank, 2020). Governments continue to channel substantial resources into building, upgrading, and expanding road networks in response to growing transportation needs. Such investments aim to deliver smoother pavement surfaces, shorter journey times, more efficient vehicle operation, and safer roads overall. Yet the very process of carrying out these improvements typically requires establishing temporary work zones, which can heighten the risk of accidents for both motorists and the personnel working on site (Alsultan et al., 2022).

Road construction work zones are characterized by lane closures, temporary diversions, narrowed carriageways, excavations, movement of construction equipment, stockpiles of construction materials, temporary traffic control devices, and altered driving conditions. These changes frequently disrupt normal traffic operations and increase the cognitive demands placed on drivers, particularly where traffic management measures are inadequate (Theofilatos, Ziakopoulos, Papadimitriou, Yannis, & Diamandouros, 2017), typical road construction work zone is shown in **Plate 1**, showing advance

warning signs, channelizing devices, barriers, and the work area. According to the World Health Organization (2023), approximately 1.19 million people die each year as a result of road traffic crashes worldwide, while millions more sustain serious injuries. The report further indicates that road traffic injuries remain the leading cause of death among young people aged 5–29 years, with low- and middle-income countries bearing a disproportionate share of the global burden.

According to Awodele and Ayoola (2005) several hundreds of construction workers are killed each year on Nigeria construction site, with many rendered temporary or permanently disabled. The national institute of occupational safety and health (NIOSH) reports that roughly 20,000 construction workers are injured each year in highway and street construction accidents, United State of America (Gohil, Parekh, & Patel, 2018). Census of fatal occupational injuries (CFOI) data indicates that 55% of fatalities occurs within the work zone itself “(Gohil, Parekh, & Patel, 2018). According to International Labour Organization statistics, approximately 120 million occupational accidents occur annually in workplaces worldwide, of which about 210,000 are fatal (Rantanen, 2008). A review of accidents reported to Nigeria's Federal Ministry of Labour and Productivity Inspectorate Division over an 11-year period (2002–2012) found a total case fatality rate of 49.5%, a significant increase compared to the earlier study period (Umeokafor et al., 2014).



Plate 1: Typical Highway Construction Work

According to the World Health Organization (2015), 90% of road traffic death occur in low and middle income countries. The crash situation in Nigeria is more serious because of the rapid growth in the number of motor vehicles in the past few years. In Nigeria, studies on road safety have largely focused on driver behavior, roadway conditions, and traffic law enforcement. Comparatively fewer studies have examined highway work-zone safety. According to the International Labour Organization (ILO), an estimated 2.93 million workers die annually worldwide as a result of work-related factors, while approximately 395 million workers sustain non-fatal work injuries each year. Of the total work-related deaths, about 330,000 are attributed to occupational accidents, while approximately 2.6 million are associated with work-related diseases (International Labour Organization, 2023).

Shittu, Popoola, Tsado, Shehu, and Abdulazeez (2022) investigated safety management practices on construction sites in Abuja and found that inadequate hazard recognition, weak safety supervision, and inconsistent implementation of safety measures significantly contributed to accidents. The study recommended stronger safety training, improved hazard identification procedures, and stricter compliance with occupational safety standards. Despite substantial funding directed toward upgrading its highway network, Nigeria still records a high incidence of road crashes (Labinjo et al., 2009). This persistent problem stems from a mix of factors working together rising traffic volumes, poorly maintained roads, risky driving habits, and lax enforcement of traffic rules, compounded further by active construction work along many routes (Labinjo et al., 2009). Construction zones pose a particular danger because motorists are forced to navigate constantly shifting road layouts while sharing limited space with heavy equipment and construction crews (Alsultan et al., 2022).

The Zaria–Kaduna Road is one of Nigeria's most strategic federal highways, connecting the northern region with the Federal Capital Territory. The location map is shown in **Figure 1**, its corridor carries substantial volumes of passenger vehicles, heavy-duty trucks, petroleum tankers, commercial buses, and agricultural transport vehicles. Federal Government awarded the contract in December 2017 for the reconstruction and rehabilitation of Abuja -Zaria-Kano with a total length of 375.9km, out of which Zaria to Kaduna has about 83km, to improve capacity and pavement condition. The project commenced in May 2018 to date, but the Zaria to Kaduna portion was completed in 2022. During these projects, motorists have experienced lane closures, traffic diversions, temporary pavement conditions, and construction activities that influenced road safety.



FIGURE 1: LOCATION MAP OF THE STUDY AREA (ZARIA–KADUNA ROAD)

Although contractors are generally required to implement comprehensive traffic management plans including advance warning signs, temporary speed restrictions, barriers, flag personnel, pavement markings, and adequate illumination the effectiveness of these measures varies considerably across construction sites. Inadequate implementation may increase confusion among drivers and elevate crash risk, particularly during periods of high traffic demand and reduced visibility.

In Nigeria, highway reconstruction projects are commonly executed while traffic continues to use portions of the existing roadway. Consequently, motorists are often required to navigate narrowed carriageways, uneven pavement surfaces, temporary diversions, reduced visibility, and changing traffic patterns. These conditions are further aggravated by excessive speeding, dangerous overtaking, driver impatience, poor compliance with temporary traffic signs, and inadequate enforcement of speed limits within construction zones. Such factors collectively increase the likelihood of crashes involving motorists, pedestrians, construction workers, and construction equipment. Due to the economic importance of Zaria – Kaduna road, federal government awarded the contract for rehabilitation and expansion in 2017. It was observed that during the construction, road traffic crashes continue to occur along the sections under construction, raising concerns regarding the adequacy of existing work-zone traffic management practices and contractor compliance with established safety standards.

Although studies have examined road traffic accidents in Nigeria generally, relatively few have specifically investigated the relationship between construction site activities and accident occurrence along the Zaria–Kaduna Road. This lack of location-specific empirical evidence limits the ability of highway agencies, contractors, and road safety authorities to develop targeted interventions for reducing work-zone crashes. Therefore, this study seeks to evaluate the impacts of road construction site activities on accident occurrence rate along the Zaria–Kaduna Road and to recommend practical measures for improving safety within highway construction zones. The findings of this study will provide evidence-based recommendations for improving work-zone safety and reducing accidents on major highway construction projects in Nigeria.

2 THEORETICAL BACKGROUND

2.1 Road Construction Activities

The typical road construction activities include site clearing and grubbing, earthworks and excavation, embankment construction, drainage installation, culvert and bridge construction, pavement stabilization, asphalt laying, pavement marking, installation of road furniture, and traffic diversion and temporary traffic control.

TABLE 1: MAJOR ROAD CONSTRUCTION ACTIVITIES AND ASSOCIATED HAZARDS

S/N	Construction Activity	Potential Hazard	Possible Accident
1	Site clearing	Dust generation	Reduced visibility
2	Excavation	Open trench	Vehicle fall-over
3	Earthworks	Uneven surface	Loss of vehicle control
4	Drainage construction	Narrow carriageway	Side collision
5	Asphalt paving	Traffic congestion	Rear-end collision
6	Bridge construction	Diversion	Head-on collision
7	Road marking	Temporary lane closure	Sideswipe collision
8	Movement of equipment	Construction vehicles entering traffic	Vehicle collision

Unlike permanent highway facilities, work zones change continuously as construction progresses. Consequently, motorists encounter unfamiliar road alignments, narrowed lanes, temporary barriers, construction equipment, and workers operating close to moving traffic. These conditions increase the complexity of the driving task and require greater driver attention than under normal roadway conditions (Hintersteiner, 2008).

Road construction requires continuous operation of heavy equipment such as bulldozers, excavators, graders, pavers, rollers, cranes, and dump trucks. These machines frequently enter and exit traffic streams, creating additional conflict points with moving vehicles. Where access points are not properly controlled or traffic marshals are absent, the interaction between slow-moving construction machinery and high-speed traffic substantially increases collision risk (Shittu, Popoola, Tsado, Shehu, & Abdulazeed, 2022).

2.2 Causes of Accidents in Road Construction Zones

Research indicates that work-zone crashes are rarely attributable to a single factor rather they result from the interaction of human behavior; speeding, dangerous overtaking, driver fatigue, distracted driving, alcohol or drug impairment, failure to obey temporary traffic signs, and impatience during traffic congestion which is the leading contributors of road traffic crashes within construction zones. Engineering deficiencies includes; inadequate warning signs, poor pavement markings, insufficient illumination, abrupt lane transitions, uneven pavement surfaces, inadequate drainage, and poor traffic diversion design were identified as causes of road accident. Road design and traffic management, vehicle characteristics, and environmental conditions includes; Rainfall, Dust generated during earthworks, fog, poor night time visibility, and glare from oncoming vehicles are also part of the causes of road accident. These conditions reduce visibility and increase stopping distances, thereby elevating crash risk. Expected impact of the causes of accident in construction zone is presented in **Table 2**.

TABLE 2: COMMON CAUSES OF ACCIDENTS IN ROAD CONSTRUCTION ZONES

Cause	Description	Expected Impact
Over speeding	Failure to obey temporary speed limits	Very High
Poor signage	Insufficient warning signs	High
Traffic diversion	Driver confusion	Very High
Poor lighting	Reduced night visibility	High
Heavy equipment	Conflict with traffic	High
Driver fatigue	Reduced concentration	Moderate
Dangerous overtaking	Risky maneuvers	Very High
Loose materials	Vehicle skidding	Moderate

2.3 Traffic Management Measures in Road Construction Work Zones.

Traffic management is a fundamental component of highway construction projects because it enables construction activities to proceed while maintaining the safe and efficient movement of road users. A well-designed traffic management plan minimizes conflicts between construction operations and public traffic by providing clear guidance, adequate warning, and effective control measures throughout the construction period. The primary objective is to protect motorists, pedestrians, and construction workers while minimizing traffic delays and congestion (Federal Highway Administration, 2023).

The effectiveness of traffic management depends on the proper design, installation, maintenance, and monitoring of temporary traffic control devices. International best practice recommends that every road construction project should include a comprehensive Traffic Management Plan (TMP) prepared before construction commences. The plan should identify potential hazards, specify traffic control devices, define temporary speed limits, provide diversion layouts, and establish emergency response procedures (Alsultan et al. 2022; Federal Highway Administration, 2023).

2.3.1 Traffic Signs and Warning Devices

Traffic signs constitute the first line of communication between highway authorities and road users within construction work zones. Warning signs provide advance information about upcoming hazards such as lane closures, road narrowing, uneven pavement, construction equipment, and temporary speed restrictions. Typical highway construction work zone showing advance warning signs, channelizing devices, barriers, and the work area is reflected in **Plate 2**. Proper placement of warning signs enables motorists to anticipate changing road conditions and adjust their driving behavior accordingly. Conversely, missing, damaged, poorly positioned, or non-reflective signs may confuse motorists and increase the probability of crashes, particularly during night-time driving or adverse weather conditions (Federal Highway Administration, 2023).

2.3.2 Speed Management

Excessive speed is widely recognized as one of the most significant contributors to road traffic crashes. Consequently, temporary speed limits are an essential component of work-zone safety.

2.3.3 Temporary Traffic Diversions

Traffic diversion involves redirecting vehicles away from active construction areas through temporary routes. An effective diversion should provide sufficient lane width, smooth horizontal and vertical alignment, adequate drainage, and appropriate signage to ensure safe vehicle movement. Poorly designed diversions may introduce sharp curves, reduced sight distances, uneven pavement, or unexpected intersections, thereby increasing the risk of collisions. Regular inspection and maintenance of diversion routes are therefore essential throughout the construction period (AASHTO, 2018).

2.3.4 Traffic Control Personnel

Traffic control personnel, including flaggers and traffic marshals, play an important role where temporary traffic signals are impractical or where construction activities require intermittent traffic

stoppages. Their responsibilities include directing traffic through construction zones, controlling alternating one-way traffic, coordinating construction vehicle movements, assisting pedestrians, and responding promptly to emergencies. The effectiveness of traffic control personnel depends on adequate training, proper positioning, use of high-visibility clothing, and effective communication with construction supervisors (Federal Highway Administration, 2023).



Plate 2: Typical Highway Construction Work Zone for Advance Warning Signs, Channelizing Devices, Barriers, and the Work Area.

2.3.5 *Night-time Safety Measures*

Night-time construction presents additional safety challenges because reduced visibility limits drivers' ability to detect hazards and interpret temporary traffic control devices. Appropriate night-time safety measures include; reflective warning signs, retroreflective pavement markings, flashing warning beacons, temporary lighting towers, illuminated arrow boards, reflective barriers, and high-visibility personal protective equipment for workers. Typical highway construction work zone Working in the night showing advance warning signs, flashing warning beacons and illuminated arrow boards is reflected in **Plate 3**, while highway construction work zone with reflective barrier and warning sign is shown in **Plate 4**. Adequate illumination improves hazard recognition and reduces the likelihood of crashes involving both motorists and construction personnel.

Table 3: Traffic Management Measures



Measure		Purpose	Expected Effectiveness
Advance signs	warning	Warn motorists	High
Traffic cones		Guide vehicles	High
Temporary barriers		Separate traffic from work area	Very High
Speed signs	restriction	Reduce speed	Very High
Flagmen		Control traffic flow	High
Reflective devices		Improve night visibility	High
Temporary lighting		Enhance visibility	High

2.4 Research Gap

The review of existing literature reveals that substantial research has been conducted on road traffic accidents, construction safety, and work-zone traffic management globally (Alsultan et al., 2022). Nevertheless, several gaps remain. Firstly, relatively few studies have specifically investigated the relationship between road construction site activities and accident occurrence along the Zaria–Kaduna Road, despite its strategic importance as a major federal highway linking northern Nigeria with the Federal Capital Territory. Secondly, limited empirical evidence exists regarding the effectiveness of current traffic management measures implemented during road construction projects on Nigerian highways. Consequently, policymakers and contractors have insufficient location-specific information to guide improvements in work-zone safety. Improving work-zone safety contributes directly to SDG 3 (Good Health and Well-being, Target 3.6 on halving road-traffic deaths) and SDG 9 (Industry, Innovation and Infrastructure) (United Nations, 2015). Beyond conventional signage and enforcement, the deficiencies identified here could be mitigated through low-cost smart work-zone technologies, solar-powered variable-message signs, automated speed-feedback displays, GPS-tracked flag-vehicle systems and drone-based site-compliance monitoring offering scalable, technology-based pathways to safer highway construction in Nigeria (Demeke et al., 2025).

3 RESEARCH MATERIALS AND METHODS

3.1 Method

3.1.1 Data Collection

Primary data was obtained through structured questionnaires, field observations, and interviews with relevant stakeholders, while secondary data which includes accident records was extracted from Federal Road Safety Corps (FRSC). The analysis concentrated on identifying construction-related factors influencing accident occurrence. The survey research design method was adopted for this study to effectively assess professional opinion and road users as regards to the suitability of the subject matter.

3.1.2 Population of the Study

The population of the study comprises professionals such as Contractor's staff, and engineers. It also comprises the road users, the pedestrian and the drivers, then government agency (FRSC). The 6,080 is the average daily traffic (ADT) volume from a manual count used as the finite population N for the road-user stratum only; Yamane's formula gives $n = 375$ for that stratum. Contractor staff, engineers and FRSC officers were added through a separate purposive / complete-enumeration component.

3.1.3 Sample

3.1.3.1 Sampling Strategy

A stratified mixed design sampling method that comprises probability (systematic/random) sampling governed by Yamane's formula was used for the road-user stratum ($n = 375$ from $N = 6,080$), while purposive sampling was used only for the professional stakeholders (contractor staff, engineers and FRSC officers) who possess specific work-zone knowledge. **Equation 1** shows Yamane's formula.

$$n = \frac{N}{1 + N(e)^2} \quad (1)$$

Where, n is the sample size, N is the population size, and $e=0.05$ is the precision level.

3.1.4 Distribution Method

The questionnaire was distributed electronically via email, using an online survey platform. This method was allowed for a broad reach and easy collection of responses. Reminders were sent out to increase response rates. A sample size is a part of the population chosen for a survey or experiment (Rahman 2023).

3.1.5 Techniques of Data Analysis

Analysis means the categorizing, manipulating and summarizing of data in order to obtain information. The analysis carried out are frequently statistics, and cross tabulation. The statistical package used for running the analysis is SPSS 13.0 package. The result of the table was interpreted descriptively. The descriptive interpretation provided explanation of results, which is anchored on scientific assumption and conditions of literature high points (Kothari & Garg, 2019).

3.2 Methodology

In order to obtain crash data on Kaduna- Zaria Express way, Federal Road Safety Corps FRSC 1.1 Kaduna sector command was visited, of which data from 2015 to 2020 was obtained. Questionnaire was also distributed to contractor's staff in charge for the construction of the rehabilitated road (Kaduna – Zaria) and some road users using an established sample size of 375, however, one – on – one interview of the commuters was also observed. Crash data analysis and questionnaire was done by using statistical analysis software (SPSS).

4 RESULTS AND DISCUSSION

4.1 Data Presentation and Analysis

This section deals with presentation and analysis of data collected from questionnaire administered, Crash data gotten from FRSC on Kaduna – Zaria Express way, and finally the physical site survey along the road. It was observed from **Figure 2** that only 2.4% of questionnaires was not returned, all other 97.6% was answered and returned. This reflects the level of responsibilities, high interest and determination associated with the people the questionnaires was administered. **Figure 3** shows that most respondent gender are male with highest percentage of 52.64%.

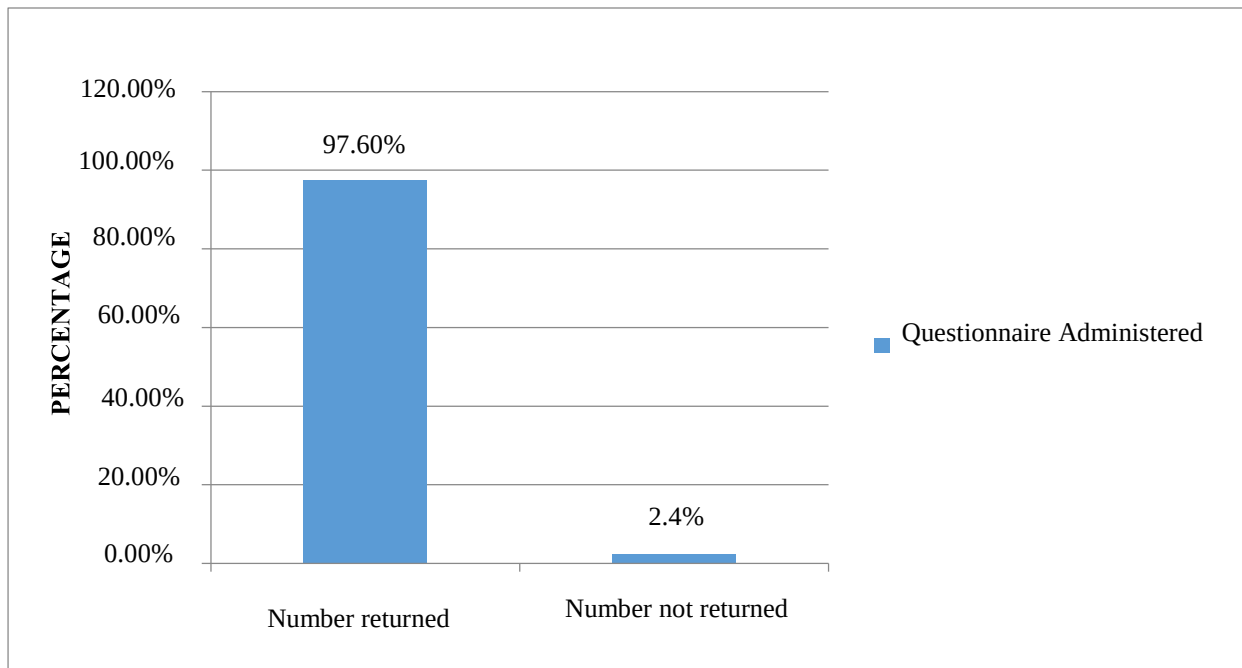


Figure 2: Questionnaire Administered

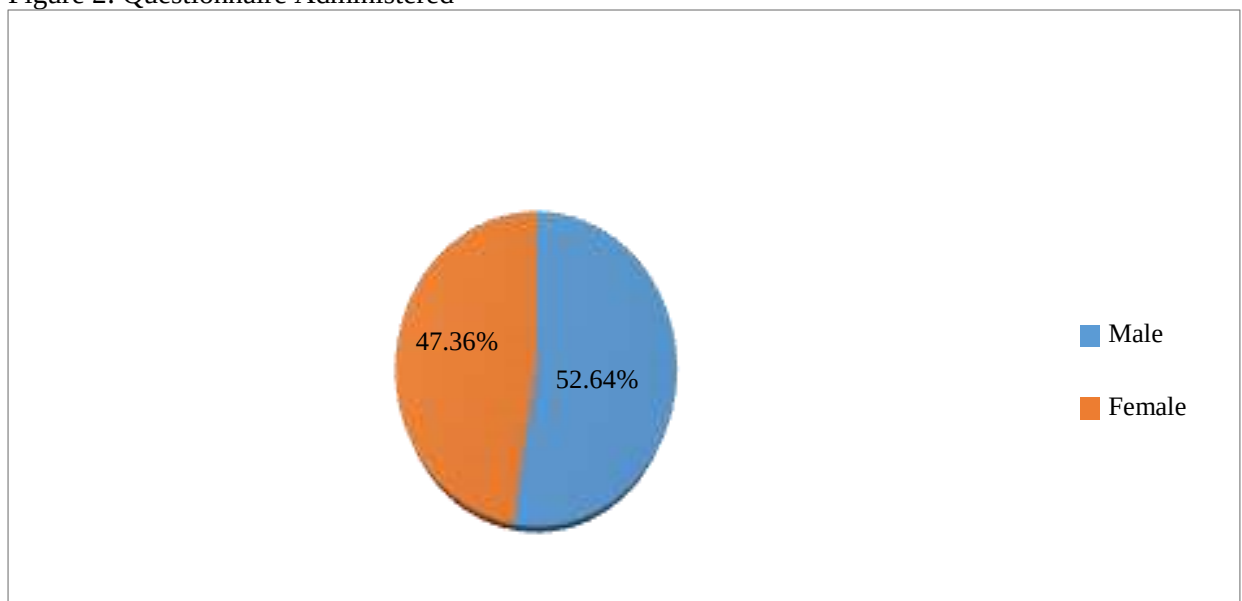


Figure 3: Gender of Respondents

The most of the respondent are road user with the highest percentage of 24.93% as shown in **Figure 4**.

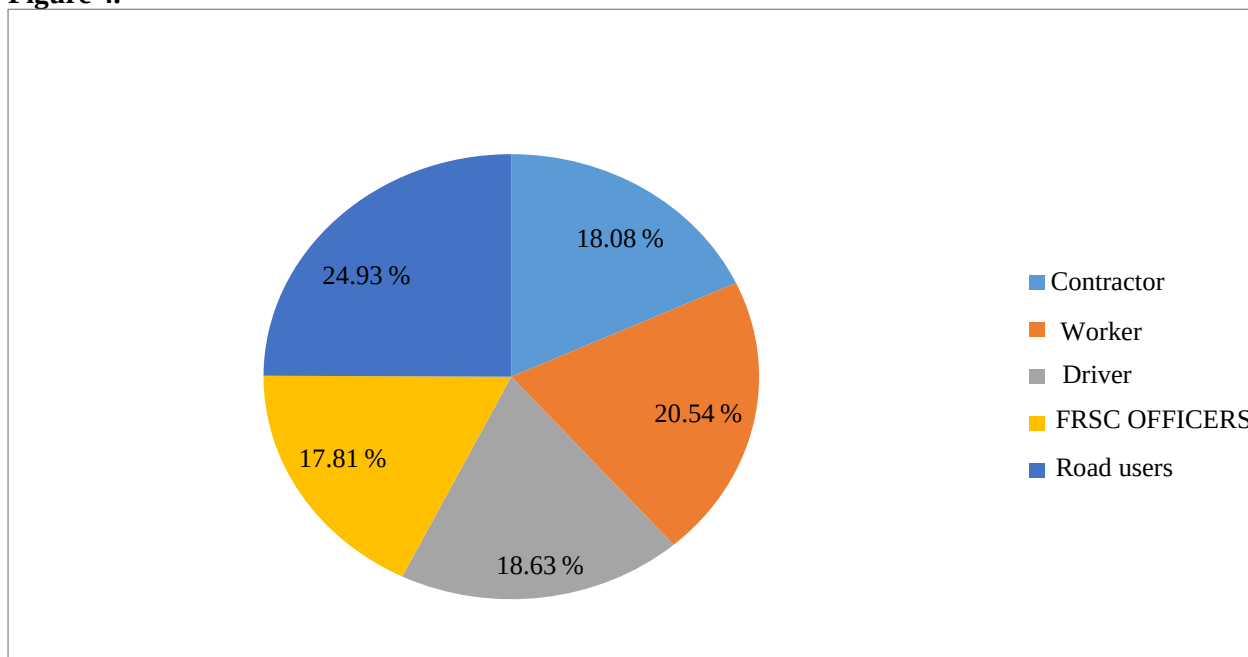


Figure 4: Designation of respondents

Figure 5 shows that respondent with driving experience between 0 -5 years have the highest percentage of 22.68%. While **Figure 6** shows respondents that passes Kaduna-Zaria road once in a month, the highest number of people that passes the road were recorded as 16.39%.

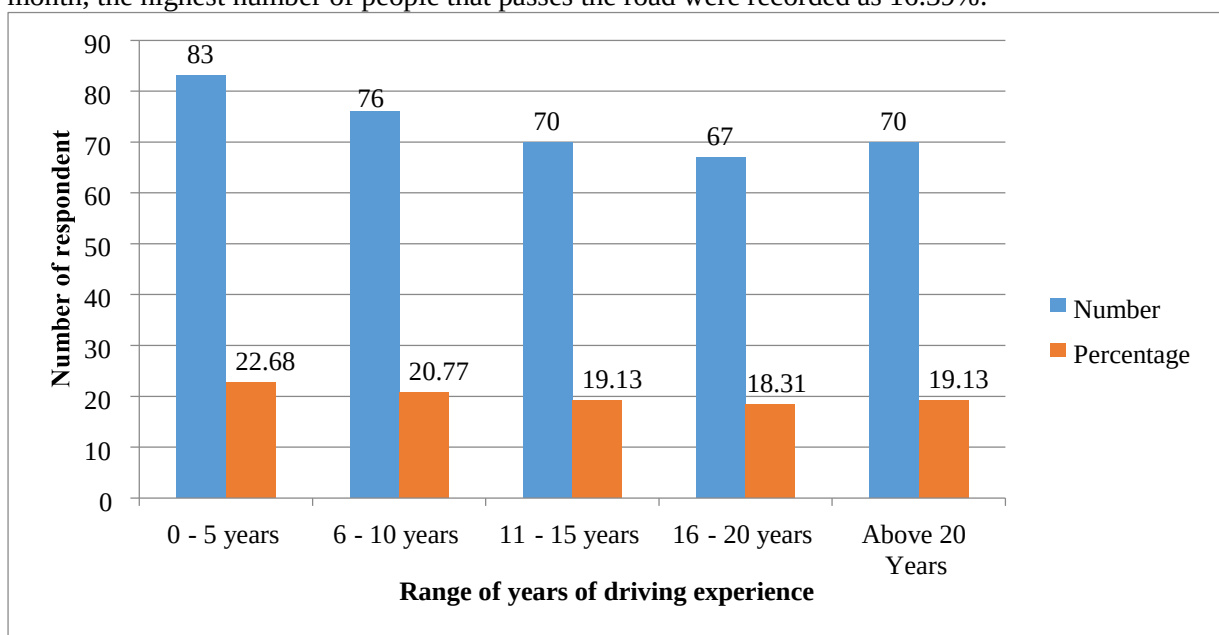


Figure 5: Driving Experience of Respondents.

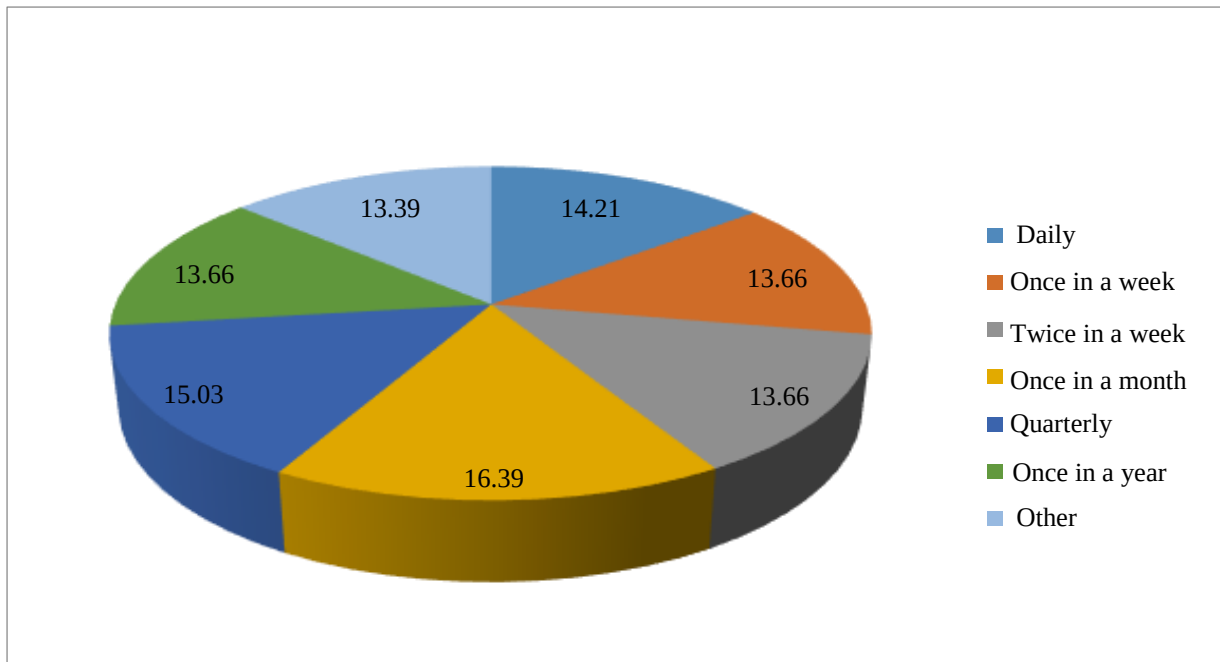


Figure 6: How often do you Pass Kaduna – Zaria road

4.2 Data Analysis of Questionnaire

Total number of questionnaires administered is 375 from **Equation 1**. The mean of the responses was calculated using **Equation 2**

$$Mean = \frac{\sum FX}{\sum F} \quad 2$$

Where F is the frequency of responses in each option and X is the weighting point of option.

In analyzing the data, decision was used for answering the research questions for the purpose of decision making, an interval of 0-2.50 mean value was used as rejected, 2.51-3.49 mean value as undecided and mean value ranging from 3.50 – 5.00 were regarded as accepted. To examine the causes of accident along road construction site, questionnaire in **Table 4A** was administered. **Table 4A** shows that most respondents agreed that “poor road condition “is the most common causes of accident on Kaduna – Zaria with the highest mean of 3.67 which is followed by accident due to illiteracy of both road users and workers with the mean of 3.66.

Table 4: A: Causes of accident

S/N	Response	S (5)	A (4)	UD (3)	D (2)	SD (1)	ΣFX	ΣF	Mean	Remarks
A	Taking intoxicant before or during driving	106	88	81	81	10	1297	366	3.54	Accepted
B	Over speeding and overtaking by drivers	106	90	80	80	12	1302	366	3.56	Accepted
C	Close following distance to vehicle in front.	77	91	65	67	66	1144	366	3.13	Undecided
D	Disobeying speed limit by the drivers	92	96	78	78	27	1257	366	3.43	Undecided
E	Fatigue of the flagman and drivers along the road	81	101	80	80	24	1233	366	3.37	Undecided
F	Illiteracy of the driver	91	105	93	71	6	1302	366	3.56	Accepted
G	Absence of road traffic signs control	20	98	83	84	-	909	366	2.48	Rejected
H	Lack of condoning of construction zone	72	76	76	76	66	1110	366	3.03	Undecided
I	Lack of coordination by contractors along road construction zone	73	82	70	72	69	1116	366	3.05	Undecided
J	Poor visibility on the road near construction site	92	94	89	90	1	1284	366	3.51	Accepted
K	Improper retro- reflective illumination of road signs	71	85	75	69	66	1124	366	3.07	Undecided
L	Illiteracy of both road users and workers	110	98	95	60	3	1350	366	3.66	Accepted
M	Poor road condition	112	94	89	68	3	1342	366	3.67	Accepted
N	Improper diversion on the road by the contractor	-	37	89	150	90	805	366	2.19	Rejected

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S/N	Response	S (5)	A (4)	UD (3)	D (2)	SD (1)	$\sum FX$	$\sum F$	Mean	Remarks
O	Fault from vehicle condition lead to accident	100	99	83	84	-	1313	366	3.59	Accepted
P	Heavy traffic volume on the road	71	85	75	69	66	1124	366	3.07	Undecided
Q	Improper management skills by the contractor in construction approach	69	82	76	72	67	1112	366	3.04	Undecided
R	Barriers, barricade and positioning of flagman is done properly	96	92	92	86	-	1296	366	3.54	Accepted
S	Mounting necessary road sign	92	103	94	76	1	1307	366	3.57	Accepted
T	Lane marking and using suitable colours	95	103	94	74	-	1317	366	3.59	Accepted

Note: SA= Strongly Agree d, A = Agreed, UD = Undecided, D = Disagreed, SD = Strongly Disagreed

How frequent does your company provide the following measures to minimize the reoccurrence of accident on site, answerable only by contractor / site staff, so it is based on the 66 professional respondents not the full 375 road-user sample. **Table 4B** shows that, provision of first aid material is found to be lacking with mean of 2.02 while provision of safety kits is found to be common with the highest mean value of 4.24, followed by enforcement for its usage in site with mean value of 3.87, are the major precautionary measures that reduces the occurrence of accidents.

Table 4: B: Factors Reducing the Accidents rate.

SN	Respo nse	A (5)	F (4)	LF (3)	R (2)	N (1)	$\sum FX$	$\sum F$	Mean	Remark
A	Sensitization of workers on safety knowledge	9	19	13	17	8	202	66	3.06	Undecided
B	Provision of first aid materials	2	3	10	30	21	133	66	2.02	Rejected
C	Provision of safety kits	31	20	15	-	-	280	66	4.24	Accepted
D	Enforcement on site to use safety kits	24	19	14	9	-	256	66	3.87	Accepted

Note: A = Always, F = Frequently, LF = Less Frequently, R = Rarely, N = never

4.3 Crash Data from Federal Road safety Corps on Kaduna-Zaria Express Way

Table 5: A: Number of people Killed and Injured Monthly in Year 2017 - 2020

MONTH	2017		2018		2019		2020	
	Injured	Killed	Injured	Killed	Injured	Killed	Injured	Killed
JAN	403	80	313	68	339	42	200	34
FEB	343	84	181	25	211	30	154	31
MARCH	227	44	260	42	207	29	306	59
APRIL	270	37	394	64	380	43	125	15
MAY	262	55	337	41	357	45	115	18
JUNE	195	34	169	23	216	33	137	9
JULY	142	19	173	27	189	15	113	19
AUG	261	31	234	28	195	15	138	25
SEPT	150	24	177	16	161	30	138	18
OCT	147	18	213	43	141	23	155	39
NOV	179	23	218	30	247	40	157	23
DEC	152	26	310	72	311	49	164	35
TOTAL	2731	475	2979	479	2954	394	1902	325

It is observed that the highest number of people injured (2,979) and those killed (479) were in 2018, the year the contract commenced, signifying the impact of site activities causing the rate of accident. The lowest number of people injured (1902) and those killed (325) were reflected in 2020, which coincide with the COVID-19 movement restrictions of late March–mid 2020, during which inter-state travel fell markedly (Erim et al., 2020); this reduced exposure is a likely contributor, though partly offset by higher speeds on emptier roads and barricade contribute to high rate of accidents in some locations. Similarly, it were observed that in October 2017, before the commencement of the project 147 and 18 were the highest figures recorded for number of injured persons and number of person killed respectively. While in October 2018 after the commencement of the project, 213 and 43 were the highest figures recorded for number of injured persons and number of person killed respectively. This translated to rate of the injured victims increase to 45%, while rate of fatality victims increase to 139% which are quite worrisome. **Table 5B** shows that from the year of commencement of the project (2018), to the year of available data end (2020), an average of 2612 peoples were injured annually and 399 peoples were killed annually which is quite alarming.

Table 5: B: Persons Injured and Killed Annually (2018 – 2020)

Year	Injured	Killed
2018	2979	479
2019	2954	394
2020	1902	325
Total	7835	1198
Average/Anum	2612	399

4.4 Report on Physical Survey of Zaria – Kaduna Express-Way

4.4.1 Compliance of the contractor to diversion Sign

Physical survey of Kaduna – Zaria expressway based on the specification of British Columbian construction standard.

a) Diversion sign

Table 6 shows implemented site diversion signs. However, diversion sign shown in **Plate 5A** and **5B** respectively are not in accordance with highway traffic sign standard cited in FMW highway manual (2013). This is believed to be part of the factors causing accident on the road project sites.

	
Plate 5A: 1KM Distance Diversion Sign	Plate 5B: 500m Distance Diversion Sign

Table 6: Contractor's Compliance with Diversion Sign specification

		Standard Specification FMW Manual (2013) (m)	Implemented Specification (m)	Remark
Size	Width	1.5	2.4	Not compliant with standard
	Height	0.9	1.2	
	Background	Blue	White	
Colour	Legend	White	Red and Black	
	Border	None	None	

b) SPEED LIMIT SIGNS

Table 7 shows implemented site Speed limit signs. However the implemented speed limit sign presented in **Plate 6A** and **6B** show that the size, colour, and mounting height of the implemented speed limit is in accordance with highway standard cited in FMW highway manual (2013).

 Plate 6A: showing 40km speed limit before approaching diversion.	 Plate 6B: showing 30km/hr speed limit before approaching diversion.
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Table 7: Contractor's Compliance with Speed Limit specification

		Standard Specification FMW Manual (2013) (m)	Implemented Specification (m)	Remark
Size	Diameter	0.7	0.74	Compliant with standard
	Background	yellow reflective	Yellow retro-reflective	
	Legend	Black semi- matt	Black	
	Border	Red retro-reflective	Red retro-reflective	
Mounting Height		Height	0.9	2.4

c) BARRIER

Plate 7 shows implemented site installed barriers and **Table 8** summaries notable observation of the installed barriers on site. The installed barriers are slightly different from the standard specification cited in FMW highway manual (2013). This is believed to be part of the factor causing accident on the road project sites.



Plate 7: Jersey barrier

Table 8: Contractor's Compliance with Barrier specification

		Standard Specification FMW Manual (2013) (m)	Implemented Specification (m)	Remark
Size	Width	2.5	2.4	
	Height	0.83	1.2	Not compliant with standard
Colour		Red and white retro - reflective	Red and yellow retro-reflective	

5 CONCLUSION AND RECOMMENDATION

5.1 Conclusions

The following conclusions were drawn from the project:

1. Poor road condition, illiteracy of both road users and workers, fault from vehicle condition, and over-speeding/overtaking by drivers were recorded as the most common causes of accidents on the Kaduna–Zaria expressway, with mean values of 3.67, 3.66, 3.59 and 3.56 respectively.
2. The provision of Safety kits recorded the highest mean value of 4.24, followed by enforcement for its usage in site with mean value of 3.87, are the major precautionary measures that reduce the occurrence of accidents.
3. Before the commencement of the project in October 2017, 147 and 18 were the highest figures recorded for number of injured persons and number of persons killed respectively, while in October 2018 after the commencement of the project 213 and 43 were the highest figures recorded for number of injured persons and number of persons killed respectively. This translated to rate of the injured victims increase to 45%, while rate of fatality victims increased to 139%, which are quite worrisome.

4. It was deduced that from the year of commencement of the project (2018), to the year of available data of Kaduna-Zaria road section, an average of 2,612 peoples injured and 399 people were killed annually, which is quite alarming.
5. The Contractor 's level of compliance with traffic control standard specification in some area was good like speed limit traffic sign, while in other areas it was poor, like barrier and diversion traffic signs, which are believed to be part of the factors causing accident on the road project sites.

5.2 Recommendations

In order to promote and improve safety on road construction sites, there must be a positive action or response by the responsible bodies. In view of this, the following recommendation were made:

1. Employees training on workplace safety should be encourage by employer or contractor of a project in order to minimize accident on site.
2. First aid equipment and safety officers should be provided on sites.
3. FRSC, Police should continue enlightening road users and drivers on the dangers of over-speeding, overtaking and enforcement of regulations should be observed.
4. Contractor and other stakeholders should not only be inclined to maximizing profit from projects but rather committing themselves to maintaining Health and Safety standards.

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