

Effects of Roadway Condition and Traffic Features on Road Safety

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Abstract

Nigeria is a developing country and road safety is in a transforming stage. The order of accident severity is increasing because of the daily growth of the vehicle population. Crashes cause disablement, damage to property and health, social suffering, death, and overall environmental degradation. It is alarming when you look at the road accident situation in Nigeria. The high road accident rates are primarily because the main roads and highways are not effective in meeting traffic demands, vehicle defects, road user behavior, poor road geometrics, and visibility are some of the factors that contribute to the high accident rate. Road traffic crashes have resulted in heavy economic costs to the country. It is, therefore, necessary to make roads user-friendly and safe, which can be achieved through promoting road safety to minimize accidents involving both human beings and vehicles. With the population of vehicles becoming more and more, the number of accidents is growing every year. A black spot is a place on a National Highway/ State Highway and other roads where traffic crashes often occur. The deficiencies in safety were identified to reduce crashes and be of help to the road users towards their security. The deficiencies, as well as the ways of their enhancement, have been shown in this thesis. The study aims to find out the safety problems for the project stretch and provide remedial and mitigating measures to reduce the road crashes on the project road.

Key Words

Accident, federal road safety corps, blackspots, mitigating measures, minimize.

5. Introduction

In 2020, National and State Highways comprise a total road network of 1.94 % and 2.97% and 95.1% comprises, with other roads. Total road crashes comprise in NH is 40.2%, State highway is 3.6.2% and balance comprise with other road to 45%, in which fatal crashes results to 35.7 % in NH, 26.8 % in SH and 38% in other roads.

The number of road accidents pertaining to pedestrians, cyclists and two wheelers is resulted as 15%, 2.4% and 36.5%. All together this implies 53.9% of road accidents which is quite a higher percentage in global trend.

Youth of an age group from 18-45yrs accounted for approximately 69.6% of road mishaps, the employed persons who aged from 18 to 60 comprise a portion of 84.7% in fatal cases.

In 2020, the death accident percentage for females was 14% and for male is 86%.

.1 Statistics of Road Traffic Crashes in Nigeria

- Under the classification of Traffic Rule Violations, over speeding is a foremost executioner, accounting to 64.4% of the individuals killed followed by driving the vehicle in the wrong direction, which results in 5.8% of fatal injuries. Drunken driving cases resulted in 2.8% fatal crashes and use of cell phones accounted for 2.4% of fatal crashes.
- 13% of crashes are caused by the people without the license as well as who are not proficient drivers.
- In case of two-wheeler 29% of fatal accidents recorded of not using helmets and in case of four-wheeler 16 % of fatal accidents are recorded for not wearing seat belts.
- 41% of road crashes are held and resulted in death, whose fitness of the vehicle are not appropriate.

- Overloaded vehicles accounted for about 12% of deaths. As per the road accident in Nigeria manual published in 2023 by Federal Road safety Corps, accidents occurred or took place from year 2016 to 2023 on National highways, State Highways and Other roads.

Table 1a: Nigeria Summary of Accidents and Deaths from 2016-2023

Road Traffic Crash Trend in Nigeria								
Years	2016	2017	2018	2019	2020	2021	2022	2023
Killed	1015	5081	6205	5483	5181	5121	5053	5574
Injured	38930	31874	38078	35981	32220	31094	30105	33311

Table 2b: Nigeria % Summary of Accidents and Deaths from 2013-2023

Road Traffic Crash Trend in Nigeria				
Years	Total Casualty	RTC	TBT	%
2013	17170	13583	1271	7.4024
2014	12058	10380	873	7.2400
2015	12077	9734	749	6.2019
2016	11363	9694	689	6.0635
2017	10972	9383	691	6.2978
2018	9858	9741	775	7.8616
2019	11151	11072	772	6.9231
2020	15349	11875	676	4.4042
2021	16337	13028	737	4.5112
2022	18319	13656	915	4.9948
2023	14205	10617	782	5.5051
Total	148859	122763	8930	67.406

5. Literature Review

Constantinou et al, (2011) shows that drivers aging less than 25 years, where majorly identified with traffic offenses.

Bassat and Shinar (2011), they concluded that roadway design features are one the most important factors that influence safety for road users. And they concluded that shoulder width affects the speed and position of the vehicle, which leads to a decrease in accident rates.

Jinsun and Doohee (2003) set up a connection between mishap seriousness and side of the road features. From the outcome, run-off-roadway mishaps can be diminished by maintaining a

strategic distance from cut side angles, diminishing the good ways from outside of the shoulder edge to monitor rail, diminishing the number of segregated trees along roadway segment and expanding the good ways from the outside of shoulder edge to luminaire posts. Run-off terrain way mishap is unpredictable cooperation of street side factors, for example, sign backings, incidental fixed items, nearness of guardrails, utility poles and tree gatherings along the streetway.

5. Objective

- To study the hourly and daily differences in accidents on selected roads.
- To identify the Black-spots as per Ministry of Road Transport & Highways protocol and suggest its rectifications or measures to make the project stretch accident-free.
- To identify deficiencies in Geometric Designs.
- To identify the safety issues in highway design to meet the needs of all types of traffic and to diminish the conflict zones.

4.3 Research Methodology and Analysis

4.1 Need for Crash Analysis

The primary source of crash data is the local enforcement agencies. Accident data are used to assist in explaining why mishaps occurred, to identify locations which are accident prone, to support in countermeasures or safety programs and in evaluating the effectiveness of countermeasures. The primary objective in analyzing traffic accidents is to improve safety

through the identification of crash patterns, crash severity mitigation and reducing the number of accidents through appropriate methods.



Figure 1: Accident Analysis flow chart.

The first step is to determine the problem due to which accidents are occurring.

The second step is used to answer the question “why” the accident occurred. This is used to define the most risk populations for accidental injuries while helping in identifying some mediations.

The third step is to decide what measures can be taken to prevent the problem, using information on the causes and risk factors to develop, pilot test and evaluate interventions.

The next step is to identify the necessary actions to avoid the issue by referring to the classifications of cause as the assessment indicators for developing, piloting and evaluating interventions.

The last step is the suggestion of the treatments that most probably could be introduced on a large scale.

4.2 Methodology

The key steps of the methodology are:

- Accident data collection for 3 years.
- Accident/ Crash Analysis.
- Identification of accidental black spots.
- Causes of accidents and proposal of recommendations.

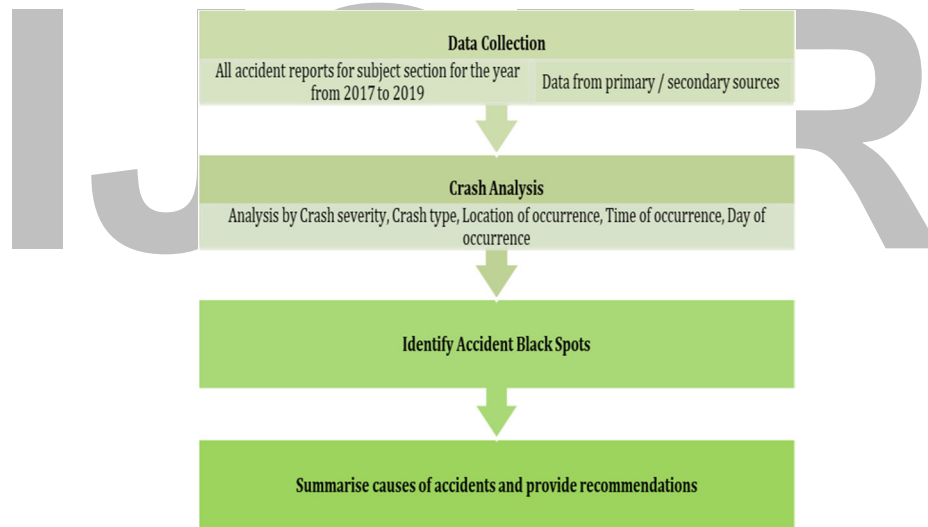


Figure 2: Flow Chart for Approach Methodology.

4.3 Crash Analysis

The key function of crash analysis is to create safety for road users by discovering the crash patterns, decreasing the crash severity as well as to analyzing the causes of the crashes and proposing some safety measures. The main purpose is to eliminate the crashes and to provide a comfortable, safe journey, while having a reasonable travel time.

The procedure of the crash analysis study is as follows:

- a) Review of crash data considering entire sections.
- b) Identify locations with high crash occurrences.
- c) Quantify for given location(s) the main accidents trend(s).
- d) Find out the causes of problems.

There are two methods for determining of black spot/ Accident Prone Locations:

4.3.1 Based on crashes Severity Index

$$ASI = (N_f \times W_f) + (N_g \times W_g) + (N_m \times W_m)$$

The Threshold value can be evaluated by the formula described below.

$$= \bar{V} + 1.5 \sqrt{\left(\frac{\sum [V - \bar{V}]^2}{(N-1)}\right)}$$

Where V = V₁, V₂,..... V_n are the ASI values of locations 1, 2,.....n.

$$\bar{V} = \text{Average ASI value} = \frac{V_1 + V_2 + \dots + V_n}{N}$$

Where N is the total number of ASI values.

5. Results and Findings

5.1 Nature of Accidents

The accident data have been collected and analyzed below to identify the type of accidents, location, time, vehicle type, other contributing factors, and environmental factors associated with injury severity. It was observed that 89,066 accidents were recorded from the year of 2016-2023 in Nigeria.

Table 3: Recorded Number of Accidents from the year of 2016-2023 in Nigeria

	Recorded Number of Accidents in Nigeria							
Years	2016	2017	2018	2019	2020	2021	2022	2023
Killed	1015	5081	6205	5483	5181	5121	5053	5574
Injured	38930	31874	38078	35981	32220	31094	30105	33311

Source: FRSC Annual Report, 2023

5.2 Accidents by severity

Based on accident data, the types of accidents were classified into four categories and presented below.

Table 4: Classification of Accidents Based on the Severity of Accident.

Accident Classification Based on Severity		
Types of Crashes	Number of Crashes	% of Crashes
Fatal	38745	51.7
Grievous Injury	27456	45.5
Major Injury	0	34.4
Nion Injury	0	0.0
Total	368	100

Table 5: Summary by Road Conditions

Accident Classification Based on Road Condition		
Road Condition	Accidents	
	Number	%
Straight Road	148	40.7
Slight Curve	90	24.5
Sharp Curve	140	38.9

6. Discussions on Research Findings

Loc-1: The black spot location is marked as the most congested location with religious structures beside the road edge. There are significant commercial activities surrounding this location. There are lots of parked vehicles along the roadside due to religious structure, which causes congestion at this location. There are significant movements of straight and U- turning vehicles with pedestrian movement at this location.

Loc-2: Black spot location is marked as ‘Tee Junction’, which diverts the traffic to Abuja City. It seems there is no installation of safety measures/roadside furniture like signboards on this highly

congested Junction. The geometric and junction design for the section is not as per the codal provision.

Loc-3: Black spot location is marked at a highly urban road in Abuja municipal which is a highly congested road, due to the Abuja international market on both sides of the road, which makes the 2-lane road jam. The geometric deficiencies and improper intersections near residential areas are observed at this point of location.

Loc-4 & 5: Black spot location is marked at Abuja –Lokoja Road. It's a hilly and rolling terrain. Sharp curves were observed with no sight distance, inadequate shoulder width, inadequate lighting at night, and non-existence of crash barriers for off-track vehicles. No safety features or roadside furniture like signage, chevron, and hazard markers were not observed on this consecutive black spot location.

Loc-6: Black spot location is marked at urban road in Bwari town which is highly congestion road, due to Zuba market and residency on both side of the road, which makes the two-lane road jam and crash prone area. The geometric deficiencies and improper intersection near residential areas is observed on this point of location. No safety measures like rumble strip were observed to reduce the speed of vehicle.

6.1 Description Road Safety Measures

Various considerations made for the safe design and the safety features included are summarized under the following:

- Alignment
- Grade Separated Interchange
- Intersection Arrangements, Underpasses

- Road Signs, Pavement Marking & Lighting
- Roadside Hazard
- Roadside Communities & Facilities
- Traffic calming measures during road construction.

7. Conclusions

The majority of Road traffic crashes were caused due to over speed and vehicles out of control, and most of the crashes were taking place on straight roads and sharp curves. These crashes happened due to the fault of the drivers because of drowsiness and the sleep of the drivers. It was found that a maximum number of crashes were taking place at five locations, However, the majority of the literature shows that 77.5 % of road casualties were recorded due to driver negligence. Out of 368 accidents, 100 fatal, 149 Grievous injuries and 119 minor injuries recorded during the analysis and accidents recorded due to weather conditions, 157 were happened in fine weather conditions, and 59 were happened in very hot weather conditions, and 43 were happened in cold weather condition, and other accident happened in light rain, mist, fog, etc.

Various safety elements considered in the geometric design of the NH and the road safety features incorporated in the report will address the safety engineering aspect of the national highway. During construction, the layouts proposed for various construction scenarios shall be strictly adhered to as per IRC: SP-55 and the road signage and road marking shall be adhered to as per IRC-67 and IRC-35. The road safety features will be installed to make it a “forgiving highway.”

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