



## Identification of Black Spots Within Minna Metropolitan City, Niger State, Nigeria

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### ABSTRACT

Road traffic accident is one of the major causes of death in Nigeria. This paper discussed road traffic accidents and identified black-spots along the routes in the study area. To achieve the aim data were collected from the Federal Road Safety Corps, and General Hospital Minna. Incident features like location, date, type of vehicle involved, and casualties or fatalities were analyzed and presented in descriptive and inferential form using frequencies, percentages, tables, while the black-spots data were imported into the GIS database in ArcGIS version 10.1 environments. The result indicated that the year 2015 had the highest number of crashes while 2016 had the highest death rate of 183 killed out of 809. On type of road crash, the result indicates that vehicle to vehicle crash gets the highest proportion of about 1181 (53.43%), while vehicle to objects, and vehicle to motor-bicycle has the least of 7.96% and 7.73% road crashes. The causality rate indicates that serious injuries accident has the highest 69.20%, with minor injuries recorded the least of 9.37% between 2012 to 2017. On the type of injuries sustained, tibia has the highest reported cases of 210 people involved, 121 treated, 89 were referred, while Ulla has the lowest reported cases of 10 people, 4 treated, while 6 referred. On the type of vehicles involved, commercial vehicles had the highest crashes with 66.5%, while the government vehicles had the least of 7.0%. Finally, black spots analysis, indicates that road with U-turn/intersection (29.01%), has the highest blackspots, while Cross-Junction has the lowest of 47(18.66%). The findings from the study revealed among many others; the need for constant training of drivers to ensure adherence to road traffic regulations. Adequate funding of traffic personnel/ operations to aid contemporary/ practical approach in the management of road traffic system, and the adoption of preventive measures through the use of road design among others.

**Keywords:** Road Traffic Crash, Crash Black, Spots, and Casualties

### INTRODUCTION

Road traffic accident is one of the major causes of death in Nigeria. Road accidents have taken away so many lives in Nigeria today that hardly does any single disease match its mortality. People have died prematurely and properties worth several millions of Naira have been lost as a result of road traffic accident Every day over 3400 people die on the world's roads and tens of millions of people are injured or disabled every year (Paploanru *et al.*, 2001). Road traffic crashes claim more than 1.2 million lives each year and have a huge effect on health and development. In addition to deaths on the roads, up to 50 million people suffer nonfatal injuries each year as a result of road trauma, while there are additional indirect health consequences that are associated with this epidemic (Oyewole 1995), Crash black-spots analysis has traditionally focused on road segments or

specific junctions Traditional methods of accident-prone zone determination by road experts have included comparing occurrence count information at different locations and rating these areas by crash severity. Crash black-spots are often determined by a range of approaches; however there is no general method, that is why continued comparison of techniques is necessary if road crash black-spots are to be detected in the most successful way (Anderson, 2007). (Bhalla *et al.*, 2014) proved that GIS is a proper tool for analyzing multifaceted nature of incidents and determined the application of GIS for developing an efficient database on road crashes. If such type of database is developed,

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an appropriate analysis of crashes can be undertaken and proper management strategies can be proposed to reduce the crash rate. (Rodrigues *et al.*, 2015) introduced a model for road network classification based on traffic crashes integrated in a geographical information system. Also, an equation was introduced to acquire a road safety index through the combination of the following indicators: severity of crashes and crash costs. In addition to the road network classification, the use of the model allows to evaluate the spatial coverage of incidents in order to indicate the centrality and distribution of the areas with the highest occurrence of road crashes. (Prasannakumar *et al.*, 2011) with the evaluation of spatial characteristics of the crash data by Moran's I method demonstrated that crash datasets, as a whole, are classified as clustered in nature. The major benefit for this specific technique is indicating the extent of risk of an incident, defined earlier. Generally in defining a cluster, the surrounding buffer is ignored which will basically impose an amount of exposure to incident for those who enter it. This amount of exposure would not be considered employing the clustering methods (Anderson, 2007). Also (Çela *et al.*, 2013) used the Network Kernel function to determine whether or not there was a tendency towards clustering in the whole crash dispersion. In addition to approving the patterns of the number of crashes, the Network Kernel function was used to find where the concentrations were actually created. Spatial clusters can be additionally used for pattern discovery in Geographical Information System

(Turton and Openshaw, 2001). (Pino-Díaz *et al.*, 2012) developed a flexible procedure to evaluate proximity in terms of both time and space of the happening of crashes. On dense networks with dispersed traffic, 2D clustering methods based only on proximity function better than linear techniques. Edge effects are restricted to the boundary of the study area (Steenberghen *et al.*, 2004). However, only lately has GIS made a huge impact in road crash black-spots research and it brings with it a wide range of practical spatial-statistical techniques to increase the accuracy and information of black-spots detection. Therefore, the specific objective of the study is the identification black spots within minna metropolitan city between 2012 to 2017.

## METHODOLOGY

### Study Area

Minna city serves as the administrative headquarter of Niger state and Chanchaga LGAs, but the township has grown to engulf the suburb like Kpakungu, Barki Saleh and Tunga, Bosso etc. The city has about 6,789 kilometres square of land area and according to the 2006 census the population is estimated to be 209,341 and a projected population of 286,838 to 2016 using growth rate of 3.2%. The city of Minna is located between the latitude 9°28' N and latitude 9°42' N and longitude of 6°30' E to longitude 6°35' E. The north eastern part of the city is characterized by more or less continuous rock outcrop which hinder urban development in that direction. Figure 3 shows Map of Minna metropolis.

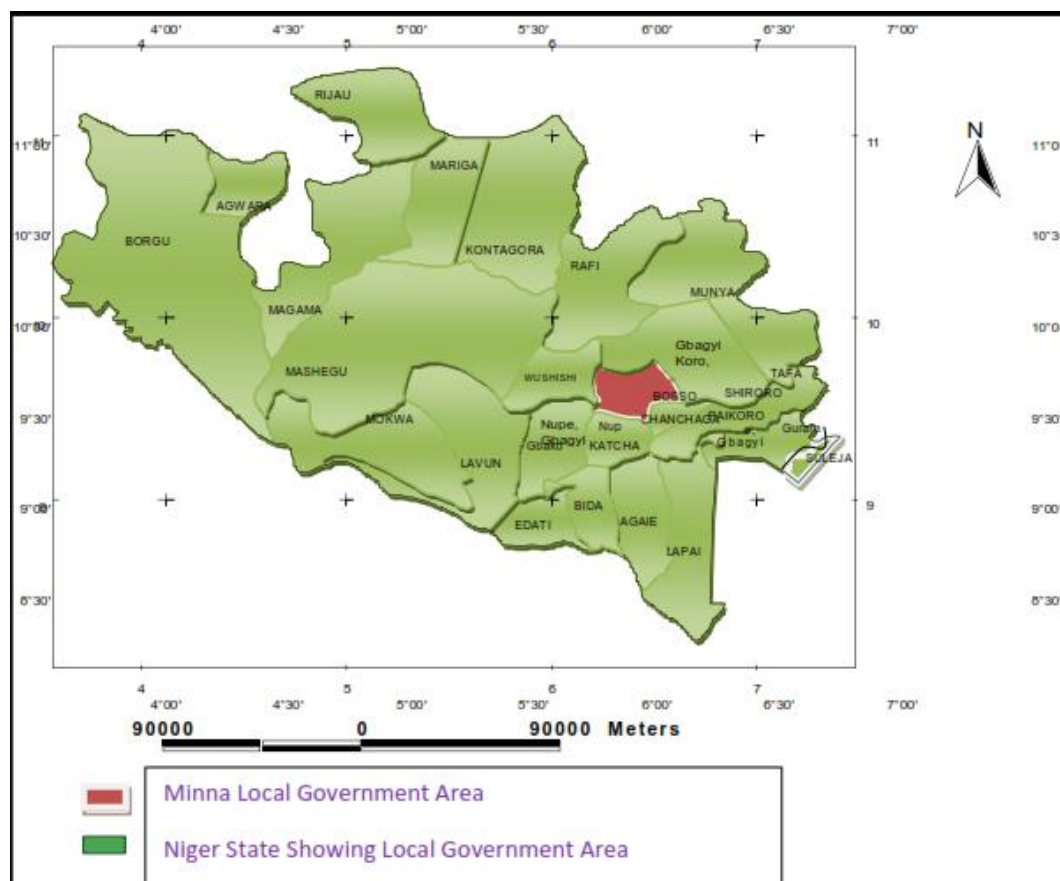


Figure 1: Location of Minna in Niger state

Source: Ministry of Land and Housing, Minna (2013)

**Data Collection and Analysis**

This study relies on the documented accident records from FRSC (Federal road safety corps) Minna Office, General Hospital Minna, NIGIS Minna, and data collection using the Global positioning system (GPS). An extensive fieldwork was undertaken with a view to making detailed inventory of conditions on ground. Field work was aimed to achieve objectives of the study. Interpolation Method was used to estimate cell values by averaging the values of sample data point in the neighborhood of each processing cell. The road accident map of Minna was produced using GIS environment for the identification of crash ‘black-spots’. This was carried out by the implementation of crash locations on a map and determination of statistically significant spatial concentrations of crashes. There are numerous spatial tools developed to enhance the perception of the changing geographies of point patterns to determine accident-prone zones or black-spots.

**RESULTS AND DISCUSSION**

The summary of reported road traffic accidents trend in Minna metropolis from 2012 to 2017 was obtained from the Federal Road Safety Commission Minna, Niger State command. The records shows the yearly number of reported crashes, number of persons involved, number of persons injured and killed respectively ( see Table 1), the types of vehicles involved( see Table 2), severity crash of the vehicles involved(see Table 3), and of the numbers of reported crashes annually in the study area. The record shows between 2016 and 2017 decreased in number of persons involved and decrease from 2015 to 2017, while the injured decrease from 2012 to 2014, while the number of persons killed increase between 2012 and 2013, with decreased in 2014, and increased between 2015 and 2016, and decreased in 2017. However, it has been observed that from 2012 to 2017 record shows monthly rise and fall simultaneously in the rate of road traffic occurrence in the area. This could be attributed to improved conditions of roads as well as advances in the Federal Road

Safety Commission’s performance. The report also shows that the year 2015 has the highest number of crashes while 2016 has the highest death rate of 183 killed out of the total (see Table 4).

Figure 2 shows that vehicle to vehicle crash was the most prevalent type of road crash i.e. 1181 (53.43%) of the crashes in Minna as compared to vehicle and pedestrian crashes which covers 430(19.45%) and 252 (11.40%) respectively of RTC occurrences between 2012 to 2017 (Table 1). While, Vehicle to material, and vehicle to motor-bicycle has 7.96% and 7.73% of the road crashes in Minna.

Figure 2 shows the casualties in Minna, with the highest frequency of serious injuries and slight injuries in the city have been exhibited in the years of 2014 and 2012, while the most shocking fatal accidents of road crashes have been unveiled in 2015 and 2014 . In general, 368 road users in the town became victims of RTCs between 2012 to 2017. The result reveals the casualties as 21.44%, 69.20% , and 9.37% people suffer fatal accidents, serious injury, and minor injury every year in the town between 2012 to 2017.

Table 1: Summary of Reported Traffic Crashes in Minna between (2012-2017)

Year	Total No. of Reported Crash	No of Person Involved	No. of Person Injured	Total No Killed
2012	142	292	195	97
2013	381	501	375	126
2014	416	620	508	112
2015	432	630	489	141
2016	424	612	428	183
2017	415	513	423	150
TOTAL	2,210	3,168	2,418	809

Source: Compiled from Federal Road Safety Corp (FRSC), Minna Office (2018)

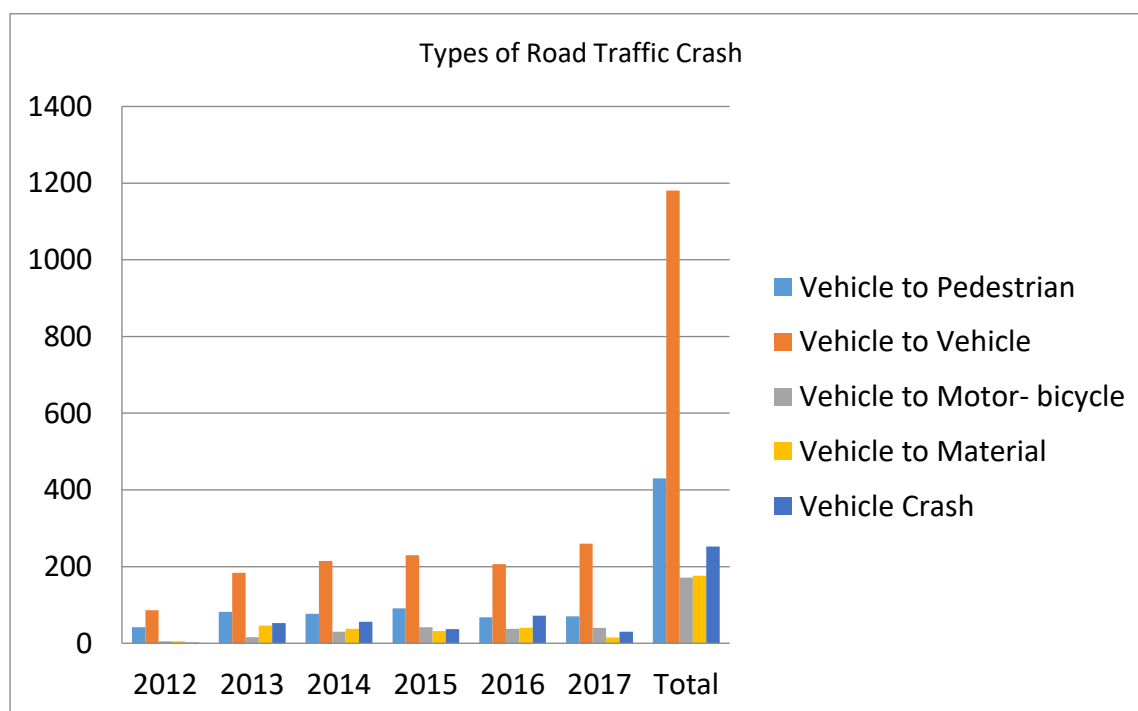


Figure 2: Types of Road Traffic Crash

Source: Compiled from Federal Road Safety Corp (FRSC), Minna Office (2018)

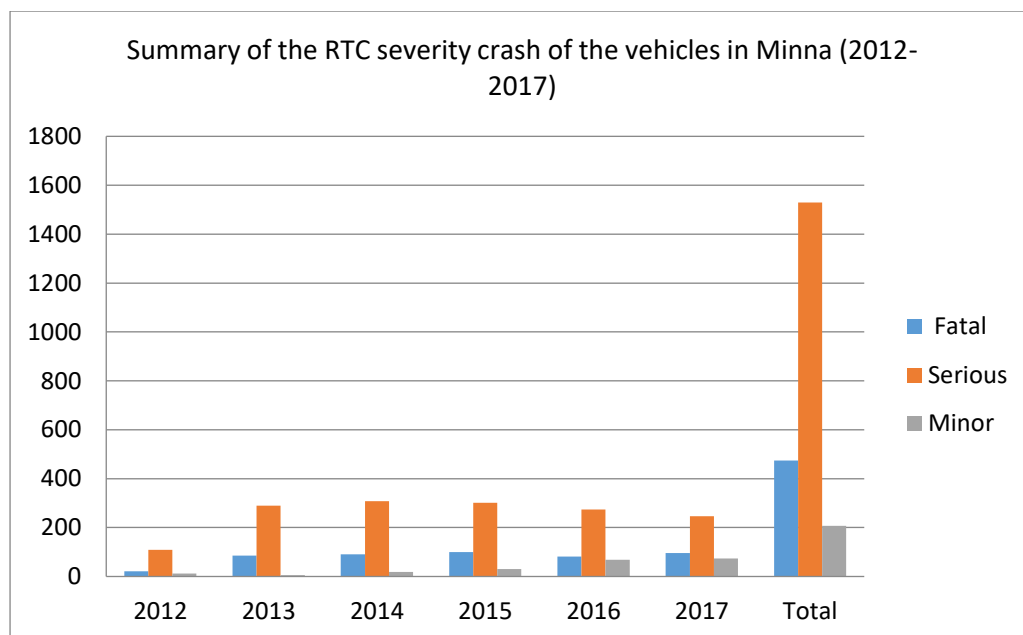


Figure 3: Severity crash of the vehicles in Minna between (2012-2017)  
 Source: Compiled from Federal Road Safety Corp (FRSC), Minna Office (2018)

Motorcycle accidents are often severe and can result in spinal cord injuries, brain damage, loss of limbs, other severe effects or death. These injuries frequently require the victim to spend their lives undergoing medical treatment that cost a lot of money. Table 4, revealed the Road Traffic Crash fracture injuries cases reported, with treated, and referred cases. About 492 casualties experiences on Tibia, Femur, Fibula, Skull, Radius, and Ulna injuries between 2012-2017. Out of the total recorded cases, Tibia fracture has the highest and ulna has the lowest cases. The distributions shows that Tibia have

210(42.6%) cases, with 121 treated, and 89 were referred; Femur 66(13.4%), 23 treated, while 43 referred; Fibula has 126(25.6%), 52 cases were treated ,and 74 referred; Skull has 36(7.3%) reported, 18 were treated, while 18 others were referred; Radius injuries has 44(8.9%) ,only 6 treated , while 38 were referred; Ulna injuries 10(2.3%) crash reported, 4 were treated, while 6 other cases were referred. The reasons for the referred injuries cases could have been linked to either lack of adequate facilities or lack specialists to handle such injuries case.

Table 2. Summary of Reported Fractures Types of Road Traffic Crash Injuries

Type of injury sustained	Total crash reported	(%)	Total reported crash treated	%	Total crash Referred	%
Tibia	210	42.6	121	54.01	89	33.24
Femur	66	13.4	23	10.23	43	16.04
Fibula	126	25.6	52	23.21	74	27.61
Skull	36	7.3	18	8.03	18	6.72
Radius	44	8.9	6	2.67	38	14.17
Ula	10	2.03	4	1.78	6	2.23
Total	492	100.00	224	100.0	268	100.0

Source: Minna General Hospital Accident Records, (2018)

Figure 4 reveals that commercial vehicles has the highest road traffic crash with a total numbers 1494 (66.5%), of while Private vehicles and Government vehicles has 619(26.5%) and 97(7.0%) respectively. However, between 2012 and 2016 there was a progressive increased in the rate of roads traffic crash, and decreased in 2017, while the privates vehicles also witnessed an increased between 2012 to 2015, with decreased in 2016 and increased in 2017. Similarly, private vehicles, its increased in road crashes from 2012 to 2015, and fall in 2016 , with increased in 2017. The increase and decreased in road traffic crashes was observed as a result of detolerating roads condition due to seasonal changes.

Black spot mapping is important in traffic related safety. Location that experience accidents crash at relatively high frequency rate were considered as accident black spot, since accidents spot were observed to be at random , this made possible to identify black spots along the routes in Minna metropolis.

This research paper discovered ( 95) various black spots across the study area, but only 23 major Black Spots were presented in the table and represented on the line graph map of Minna. This is to reduce the large data collected.

Table 3 show that, 234 Road Traffic Crashes were reported . Based on the number of road traffic records between 2012-2014. However, the summary of the road traffic crashes black spots analysis indicates that R/ About has 59(25.21%), U-Turn 68(29.01), T-Junction 65(27.78%) , and Cross-Junction has 47(18.66%). However, it is observed that all the route with Black Spots were designated to be a risk crash Locations, because of the landslide margin of the crashes reported in various Black spots locations. However, U-Turn Black Spots have the highest risk cases, while Cross-Junction has the lowest risk. This is shown on the Line crash risks graph plotted (See Fig 5 )

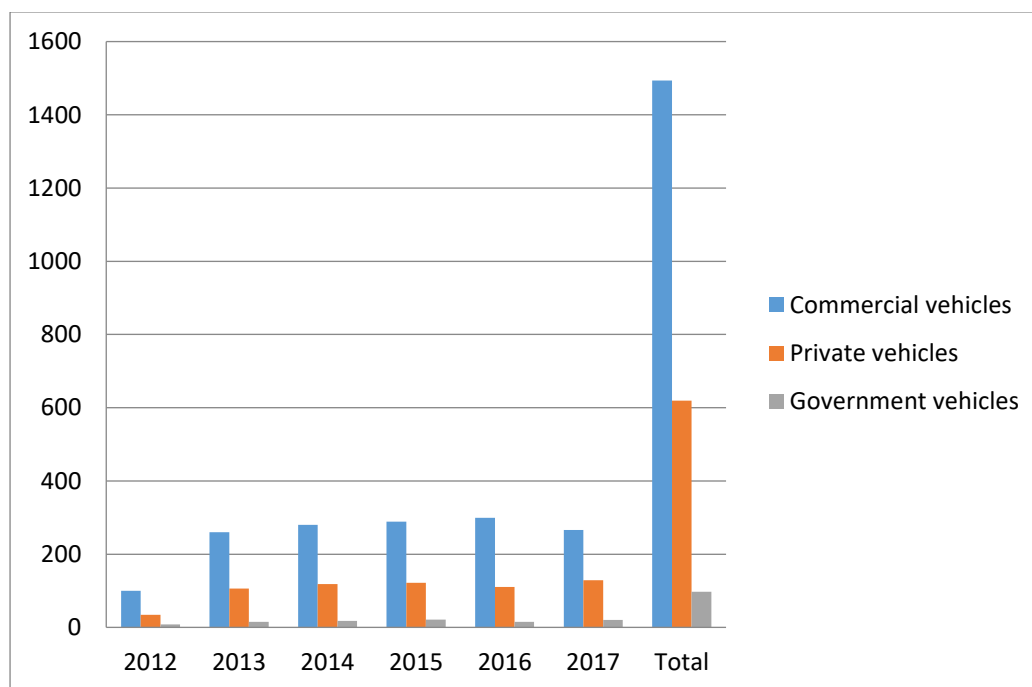


Figure 4: Type of Vehicles Involved in Road Traffic Crashes

Source : Compiled from Federal Road Safety Corp(FRSC) , Minna office(2018)

Table 3: Black Spots on route sign intersections, locations, coordinates and Crash Frequency between 2012-2017

Location	GPS		Route Type	Crash Frequency
	X (Nothing)	Y (Easting)		
Abdulsalam Garage	232859.321	1060718.989	U-Turn	7
Army Barrack	233672.183	1058777.418	U-Turn	7
Bay- Clinic	231656.87	1062127.219	T-Junction	9
Bosso-FUT	228893.897	1068252.906	U-Turn	7
Chanchaga	234347.458	105497.649	T-Junction	11
City Gate	233129.014	1059903.493	Round About	12
Coca cola	231523.442	1062138.49	U-Turn	16
COE Gate	233507.665	1059141.591	T-Junction	11
David Mark Road	231907.157	1062560.195	Round About	10
El-Amin	233056.763	1064224.668	U-Turn	7
FRSC Office	231724.933	1062708.209	U-Turn	17
Kpakunku	229265.445	1061849.202	Round About	10
Maikunkele	227162.082	1069712.334	R. About	12
MI Estate	233844.456	1062003.426	U-Turn	7
Mobile	230905.521	1063612.498	R. About	7
New Market	229167.045	1063785.694	R. About	8
NNDC Shiroro	232426.416	1059800.992	Cross Junction	15
OPP UBA	231407.041	1063087.764	Cross Junction	8
Shango	233541.173	1059077.381	Cross Junction	15
Shiroro Junction	230252.908	1060743.273	T-Junction	16
State Secretariat	232996.872	1060244.723	T-Junction	9
Top Medical	232391.813	1061744.418	T-Junction	9
Trade Fair	233203.884	1059690.172	Cross Junction	9

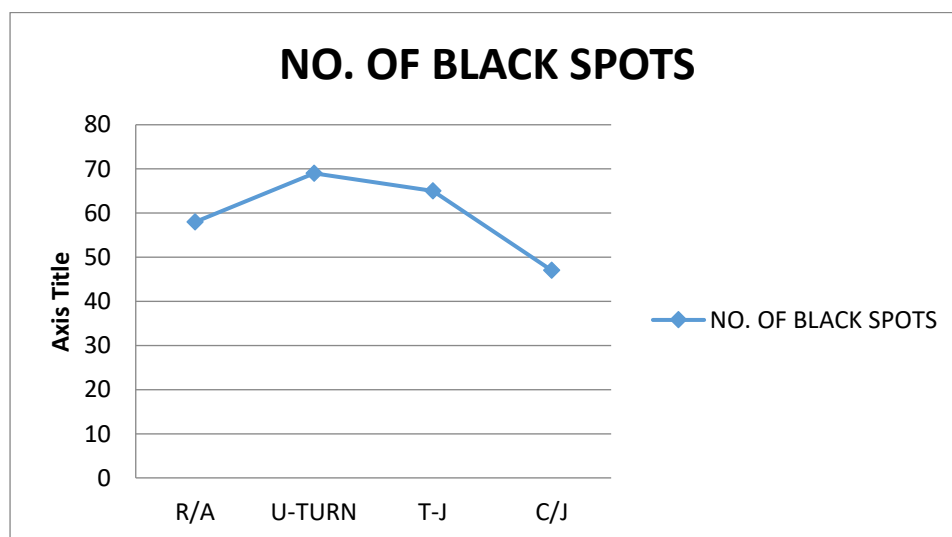


Figure.5: Road Traffic High Crash Risk Black Spots graph for T-Junction, U-Junction, Round About and Cross Junction

Source: Compiled From FRSC-Minna Office and fieldwork

Figure 6-8 shows the streets guide Map of Minna Metropolis overlay, with Global Positioning System( GPS) used to accurately locate the Black Spots along the routes. The Black Spots were represented by continuous surfaces colours shaded to indicate the lower traffic accident

density, the Medium traffic accident density, and the highest traffic accident density, with colours assigned to indicate various characters .The pink colour (High Black Spots locations), blue colour for (Medium Black Spots location), while the Yellow colour for (Low Black Spots



location) .It was observed that area with high frequency of road traffic accident were places with high population density areas . These include where school pupils and other road users frequently used. Accidents occurred when pedestrians cross the road carelessly, alongside cases of reckless driving, excessive speeding, driving under the influence of alcohol and road condition. While these factors are capable of causing road accident with varying degree of fertility, mapping the location of accident black spots is important as well for development and town planning purpose. The locations of black spots were shown in(Fig 7) .

road crashes were concentrated on the major dual carriage way (i. e Minna- Mobile- Bosso road.) for the period under study. The accident tends to be much closer to one another between city gates and eastern by- pass, city gate and western by- pass and city gate to Mobile- Bosso road. Critical analysis of the distribution of accidents black spots show that the responsible factors have a strong positive correlation between number of traffic road condition and nature of the going vessels. Obuekwe et.al (2003) identified contributing factors to traffic accidents to include reckless driving, excessive speeding, driving under the influence of alcohol and road condition. While these factors are capable of causing road accident with varying degree of fatality, mapping the location of accident black spots is important as well for development and town planning purpose

Figure 8. From the point to point overlay on the RTC distribution map, the pink colour (High weighted Black Spots), blue colour for (Medium weighted Black Spots), while the Yellow colour for (Low weighted Black Spots) indicates that

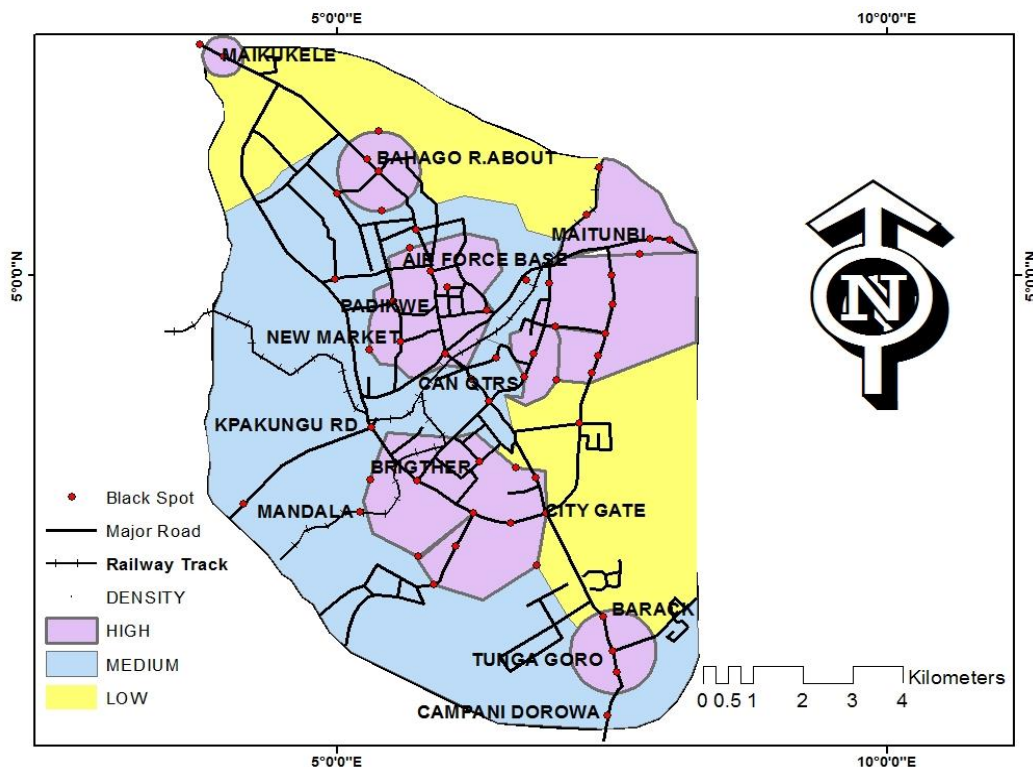


Figure 6: Distribution of Road Traffic Crash Black Spots in Minna Metropolis (2012 -2017).  
 Source: Field Survey and FRSC data, Minna Office (2018)



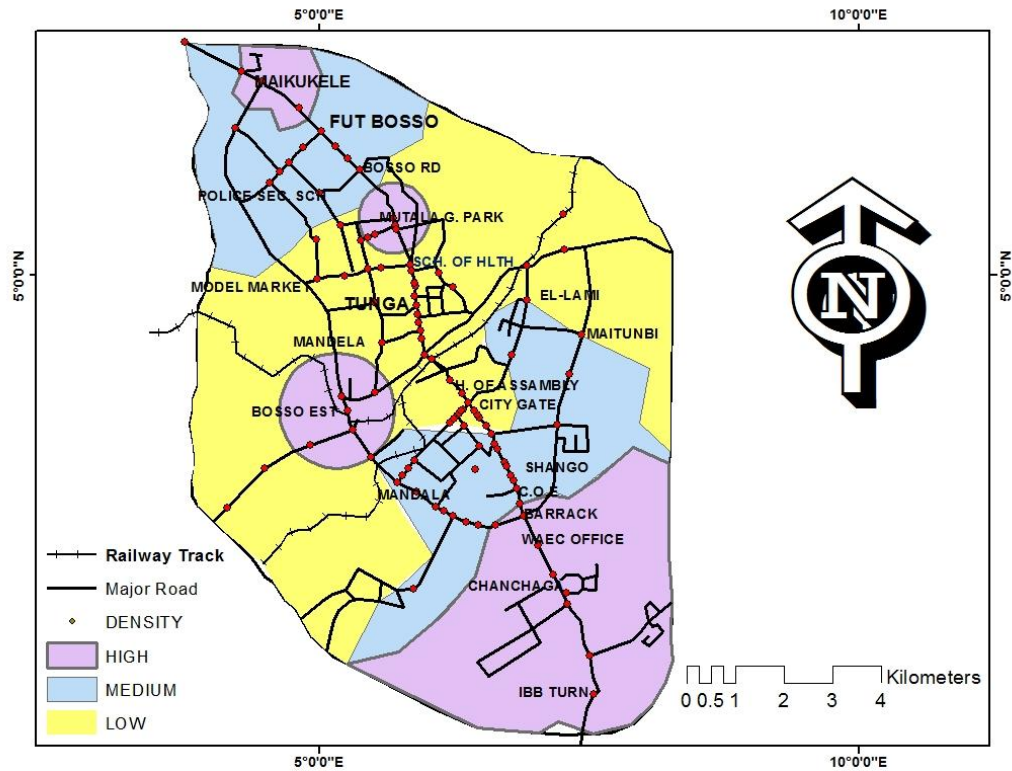


Figure 7: Distribution of Road Traffic Crash Black Spots in Minna Metropolis (2012 -2017).  
 Source: Field Survey and FRSC data, Minna Office (2018)

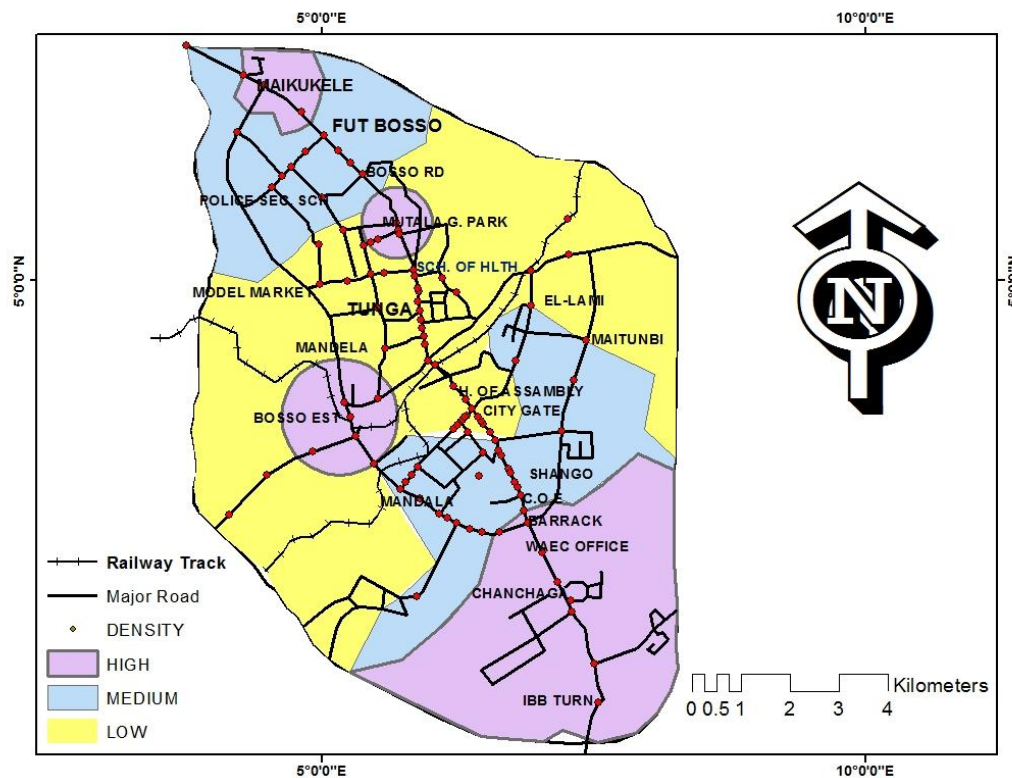


Figure 9: Distribution of Road Traffic Crash Black Spots in Minna Metropolis (2012 -2017).  
 Source: Field Survey and FRSC data, Minna Office (2018)

## Conclusion

Road Traffic Crash are as a result of combination of several factors and it is usually difficult to single out one main cause. It may be better and more appropriate to analyse the areas of high concentrations of accidents (blackspots) when determining why and how the accident took place. The integration of Geographic Information System (GIS) and remotely sensed has provided an effective technique for visualizing and analysing of road traffic accident black spots in the study area. From the results of the study, it can be concluded that over speeding might the major cause of accidents along the route. The study also discovered that FRSC Office U-turn, has the highest blackspots along the study routes. This shows that the FRSC in-efficiency in the control of traffic crash accident along the metropolis routes. Finally, the design of the road, the roadway characteristics and roadside such as Bridge, U-urn/intersection, market, stationary vehicles, slope, built-up areas, potholes and sharp bend contributes significantly to accidents on the route.

## Recommendations

In order to reduce traffic accidents in Minna metropolis routes, the following measures to rectify the problem were recommended

- i Installation of speed reduction devices as a traffic calming measure should be developed across the study area.
- ii Road infrastructure such as road signs, bridges, street light etc. should be adequately maintained, and if possible, improved upon along the entire route. Above all, infrastructure such as road sign, pedestrian bridge etc. that are lacking along the study route should be provided, all aiming at free accident drive.
- iii There is a need to establish a Vehicle examination unit for regular inspection of all vehicles at least once a year and certificate of approval should be provided to the qualified vehicles. All vehicles to be used in the country,

should meet safety standards such as proper brakes, lights, seat belts, and good tyres.

- iv Road safety education should be organized within a framework of lifetime, that is, by using aggressive public information campaigns.

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