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ANALYSIS OF HOTSPOTS AND TIME PATTERNS OF ROAD TRAFFIC CRASHES ON MAJOR ROADS LINKING KANO METROPOLIS

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ABSTRACT

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It would not be exaggerative to say, people from different part of sub-Saharan Africa came to Kano Metropolis for transaction of one business or the other on daily basis. The Kano-Maiduguri, Kano-Kaduna, Kano-Hadejia and Kano-Daura Roads are the highest-flying corridors connecting the North Eastern States, North Western States, the Southern parts of the country, as well as some neighbouring countries such as Niger, Chad, and Cameroun into Kano Metropolis for socioeconomic activities. The major challenges are the increased rate of Road Traffic Crashes (RTC) and its casualties on these roads which are becoming worse and more devastating, claiming lives and properties by the day. The aim of this paper is to explore the hotspots and temporal patterns of RTC on major roads linking Kano Metropolis. The study used RTC monthly data for 2010 to 2014 obtained from Planning Research and Statistics Department, Federal Road Safety Commission (FRSC), Abuja. The data obtained were subjected to chi-square test of homogeneity to assess the proportion of RTC. The result reveals that Dakatsalle along Kano-Kaduna Expressway is a major hotspot with 63 RTC account for 4.7%, followed by Gano on Kano-Wudil road accounted for 57 (4.2%). Result further showed a calculated X^2 - value of 69.447 for 9 df at 0.05 alpha level indicating RTC occurrences differ significantly through the hours of the day. The study concludes that, the patterns of RTC along all roads differ significantly through time of the day. It is recommended that, FRSC and Police should ensure an effective traffic control inspection of some selected hotspots between 12pm-06pm being the peak period for RTC.

INTRODUCTION

It would not be exaggerative to say, Road Traffic Crashes is unarguably one of 'titanic' tragedies confronting man. The magnitude and trend world-wide is heartbreaking. Unfortunately, the rising tide of this global

problem has continued to outstrip all efforts curtail it. Such major efforts in most parts of the world especially in developing nations, Nigeria inclusive are either half hearted or half baked.

Incidentally such infertile decisions involve money, time, and resources and so on which are more often than not limited. RTC remain a sad and unfortunate event. It is sad because of the huge human and material losses suffered and unfortunate because it is preventable (Balogun, 2006). The worry here is that while the pains of accident are known, nobody has accurately estimated its cost or fashioned a means of arresting and reversing the ugly trend. The global cost of RTC and resulting injuries amounted to some \$518 billion. Developing countries accounted for some \$65 billion of that amounts, which was more than what they receive in official development assistance (Balogun, 2006). The majority of motor vehicles were operated in the developed world, and it might be expected that most fatalities would occur, there. However, statistics from World Health Organisation (WHO) showed that, low and middle-income countries accounted for about 85% of deaths and disproportionate high percentage of disability globally. The social cost is incalculable. The loss of breadwinners and the long-term care for people disabled in road traffic accident has driven many families into poverty, particularly in the developing countries. Specifically 260,000 children die from road traffic

collisions each year while 10 million are injured. This makes motor vehicle a leading cause of injury death among children worldwide. Heidi (2006) in his study reported that, 1.2 million people in the world lose their lives through road accidents every year. The number has rising to 1.3 million people and between 20 and 50 million people sustain various forms of injuries annually as a result of road accident. The most affected of these consequences of road accidents is more on the people in the age bracket of 15 and 29.

The ever-increasing pressure on the road transport is a mind-bugging source of sudden death, which throws a number of families into grief in our country (Balogun, 2006). Statistics from WHO shows, at present, road traffic crashes are ninth 9th leading cause of mortality and morbidity and WHO, 2009 forecasts that by 2020 road traffic injuries could place at 3rd position among the causes of death and disability, ahead of such other health problems as malaria, tuberculosis and HIV/AIDS (Table 1). Furthermore, it is estimated that if nothing is done globally to curtail the rampant nature of road accidents and most especially on the causes of deaths of casualties before by the year 2020, 1.9 million people will be killed by road accidents in the world, (WHO, 2011).

Table 1: Global Burden of Disease measured in disability Adjusted life years

1990	2020
1. Lower respiratory infections	1. Ischaemic heart disease
2. Diarrhoeal diseases	2. Unipolar major depression
3. Condition arising during the Perinatal period	3. Road traffic accidents
4. Unipolar major depression	4. Cerebrovascular disease
5. Ischaemic heart disease	5. Chronic obstructive pulmonary disease
6. Cerebrovascular disease	6. Lower respiratory infections
7. Tuberculosis	7. Tuberculosis
8. measles	8. War
9. Road traffic crashes	9. Diarrhoeal diseases
10. Congestial anomalies	10. HIV/AIDS
11. Chronic obstructive pulmonary Disease	11. Condition arising during the Perinatal period
12. HIV	12. Measles
13. War	13. Congestial anomalies

Source: The Global Burden of Disease: A comprehensive assessment of mortality and disability from disease, injuries and risk factors in 1990 and projections for 2020 in Balogun, (2006).

No doubt about it, motorised road transport plays a central role in European societies. Obviously most of the goods needed for everyday life are transported by road and the current generation has far greater opportunities for motorised travel in the course of work and leisure than their forefathers. But their advantages have been achieved at a large cost – the human and economic costs, in terms of the numbers of road accidents and of people killed and injured as a result of them. In a research conducted in Britain and Wales to assess the death pattern of various age groups and their sexes within the period of 2000 to 2002, it was found out that 40% of males and 30% of females' drivers who died in road accidents were in the age bracket of 16 and 19 years. This number had risen to 44% for males and 38% for females by the end of 2005, (Department of Transport, 2006). Similarly, in the United State, about 45, 800 people were killed and another 2.4 million injured as a result of motor vehicle collision in 2005, thus making road traffic crash the 6th leading preventable cause of death in the United State (UN, 2003). Moreover, in Canada, Motor vehicle collisions are the cause of 48% of severe injuries (Africa Report, 2011).

However, the Southeastern Asia recorded the highest proportion of global fatalities and morbidity in the world with over 33% (435,000) of the 1.26 million annual road crash deaths in the year 2000 (UN, 2003 cited in Akpoghomeh, 2012). According to the country report on Road Safety in Cambodia, road accident is caused by human factors (road users), road defects and vehicle defects. It was found in the report that, road accident in Cambodia was increased by 50% in five years while the fatality rate was doubled. To help reduce the rate of road accident it was suggested that, Road accidents Safety Committee was set up, accident data system was established, accident evaluation policy and driver training measures were to be put in place, (Ung Chun, 2007). India recorded 105, 000 traffic deaths in a year, over 96, 000 deaths in China (UN, 2003 in Akpoghomeh, 2012). In Thailand, it was reported that motorcycle-related crashes accounted for the majority of injuries and death from road traffic accidents, contributing factors includes alcoholic consumption, invalid driver's license,

inexperience and age of the drivers, as they were found to be a common characteristics in motorcycle accidents than in accidents by other vehicles (Swaddiwudhipong, *et al.* 1994; Ichikawa, Chadbunchachai & Marui, 2003; cited in Akpoghomeh, 2012).

The situation of RTCs is most severe in Sub-Saharan Africa where the lives of millions are lost and significant amount of property is damaged. For example, more than 85% of these casualties occur in low and middle income countries (UNECA, 2009). This has imposed a huge economic burden on developing economies that may amount to 1% - 2% of GNP in most countries (*ibid*). In Ethiopia for example, the situation has been worsened as the number of vehicles has increased and consequently due to increased traffic flow and conflicts between vehicles and pedestrians. Despite government efforts in the road development, road crashes remain to be one of the critical problems of the road transport sector in Ethiopia (UNECA, 2009). Every year many lives are lost and much property is destroyed due to road traffic accidents in the country. The country has experienced average annual road accidents of 8115 over the past 11 years (Central Statistical Agency, 2000/01-2010/11) compared to over 8000 deaths annually in Turkey (Murat, 2009).

Road traffic accidents in Africa as a whole have led to the death rate of 28 per 100,000 populations and are the highest in world with some countries recorded more than 100 deaths per 10,000 vehicles (Akpoghomeh, 2012). In South Africa, there is enough evidence that, the government uses over R500 million annually from the Road Safety Fund to fight fraud, bribery and corruption. However, it was revealed in a study at South Africa that, most people died through road accidents which occurred on Saturday (20.8%) followed by Sunday with 17.1%, (Injury Mortality Surveillance System, 2005). In Ghana however, there is substantial evidence to prove that, the higher the number of road accidents which occur in given period of time, the higher the number of casualties who die in the accident. According to Afukaar, *et al.* (2008) in their report presented to the National Road Safety Commission, in Ghana, there was a total of 11,320 road accident which killed 1779 people in 2005.

The number of road accidents increased to 12,038 in 2007 and killed 2024 people. At the end of 2009, there were 12,299 road accidents in the country and 2237 lives were lost. Nigeria as a nation, according to WHO has total population 135.3 million, and a GNP per capital of \$1,085, has a life expectancy of 45 and 46 years for male and female respectively. Out of these few years, the citizen can at best hope to live healthy live for 41.3 and 41.8 for male and female respectively. It was revealed that 197 out of every 1000 children born will die in childhood. The adult mortality rate per 1000 averages 496. The income per capital is a forlorn \$51 and the total health expenditure as percentage of GDP is 5.0 percent. These clearly indicates that's Nigeria is not so healthy. The contribution of road crash to this statistics in Nigeria is startling. Between year 2000 and 2005, a total of 65,248 vehicles were involved in road traffic accidents, with buses and other mini transport means accounting for 51.6% and articulated vehicles accounting for 16.8% while the remaining 31.6% are attributed to Cars. The number of vehicle that got involved in accident each day can easily be calculated. But suffice to say that at least, three buses got involved in road crash daily in Nigeria during the reporting period (Balogun, 2006).

Cases of road traffic crashes are reported almost daily on the major roads linking Kano Metropolis. It occurs regularly at some flash points such as where there are sharp bends, potholes and at bad sections of the highways. At such points over speeding drivers usually

find it difficult to control their vehicles, which then result to fatal traffic crashes, especially at night (Atubi, 2012). It is against this background that, this study aimed at exploring the hotspots and temporal patterns of road traffic crashes on major roads linking Kano Metropolis, as it is difficult to use what prevail for RTC in one road to explain for another road since conditions associated with RTC varied from road to road especially if the spatial coverage differs.

MATERIALS AND METHODS

Study Area

The Kano-Maiduguri, Kano-Kaduna, Kano-Hadejia and Kano-Daura roads are the highest-flying linking routes that connect the North Eastern states, North Western States, the Southern parts of the country, as well as some neighbouring countries such as Niger, Chad, and Cameroun into Kano Metropolis for socioeconomic activities. For the purpose of this study only a total of 160 kilometres sections of Kano-Maiduguri, Kano-Kaduna, Kano-Hadejia and Kano-Daura roads were considered because most of the traffic volume is concentrated there, limited to Kano-Wudil (45km) route on Kano-Maiduguri road, Kano-Gezawa (23km) on Kano-Hadejia road, Kano-Dambatta (42km) on Kano and Kano-Chiromawa (50km) on Kano-Kaduna Expressway (Figure 1.1). However, the study is restricted to analysed the hotspots and time patterns of road traffic crashes along major roads linking Kano Metropolis, using RTC data from 2010 – 2014.

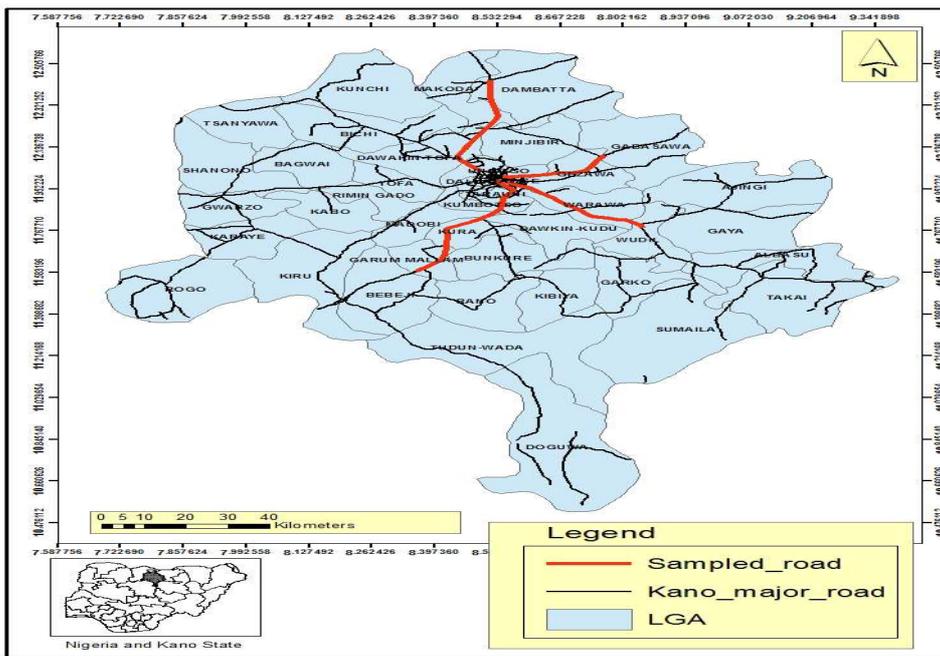


Figure 1: Major Roads Linking Kano Metropolis

Kano Metropolis is the seat of Kano State government administration situated at about 840 km from the edge of the Sahara. The area is made up of eight LGAs of Dala, Fagge, Gwale, Kano Municipal, Kumbotso, Nassarawa, Tarauni and Ungogo, located between Latitudes 11°53'20"N to 12°6'40"N

and Longitudes 8°23'20"E to 8°36'41"E. It is bounded to the Northeast by Minjibir, to the East by Gezawa, to the Southeast by Dawakin Kudu, to the Southwest Madobi and Tofa, and to the Northwest by Dawakin Tofa Local Government area (Figure 2).

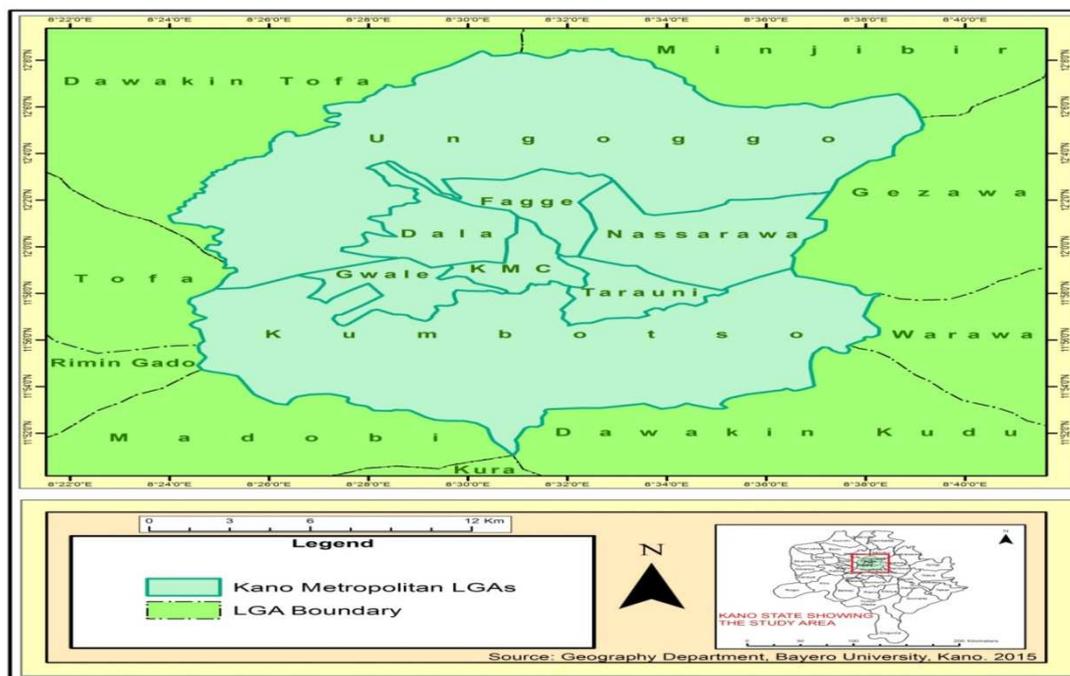


Figure 2: Kano Metropolis

Its socio- economic transformation attracted migrants from other parts of the state as well neighbouring countries and beyond, this paved way to the rapid population growth in Kano metropolis having 96, 805 person in 1931. This figure rose to 130, 170 persons in 1950 and recorded 295, 432 people in 1963 (Maiwada, 2000). With reference to the 2006 Population and Housing Census, Kano metropolis rose to 2, 165, 223, and based on this figure, the population projection 2014 ranked it at 3, 751, 188, with a population density of nearly 7, 000 per sq km, made up of Hausa and Fulani, and made it well-known to be the commercial and industrial nerve centre of Northern Nigeria. It plays a dominant role in controlling the socio-economic activities as well as the industrial production in the region, and virtually the economy of other Northern states depends largely on the economy of Kano Metropolis. These influences are fingered not only within the country, but also in some neighbouring countries such as Niger Republic, Chad and Benin. Prior to the imposition of British rule in Nigeria, Kano already had a long history dated back as far as seventh century; it had emerged as a leading centre of cottage industries, commerce and agriculture in the region. Kano Region is the richest and most important constituent in the West- African sub-region (Mustapha, Yakudima and Alhaji et al., 2014). Nigeria's economy since the colonial times has been largely driven by export of raw materials and Kano was a major producer of groundnuts. In fact, it produced about half a million tons which was about half of Nigeria's groundnut production during peak periods. It provides a stable and continuous market for both manufactured and semi-processed goods. The volume of trading activities conducted on daily basis in the markets, notably Muhammadu Abubakar Rimi Market (Sabon-Gari), Kwanar Singer, Kanti- Kwari, Kurmi and Dawanau signify the great potentials as a market for various products. In addition to the large and unique markets, Kano metropolis is also blessed with plentiful and various kinds of agricultural products which provide huge raw materials for Agro-Allied industries. Agricultural products like Maize, Guinea Corn, Rice, Cotton and Groundnut are readily available to serve as raw materials for oil

milling, flour and textile industries. Other agro based raw materials are Gum Arabic, Livestock, Hides and Skin, Cowpeas, and Citrus fruits.

The impressive infrastructural facilities such as the Mallam Aminu Kano International Airport (MAKIA), road links to other parts of the country and as well as the excellent road network within the state provide unique opportunities for the steady growth of commercial activities. There are over 100 branches of major banks in Kano, such as the Union Bank, First Bank, United Bank for Africa, Afribank and Unity Bank. Similarly, there are several branches of insurance companies and brokerage firms making Kano the leading financial center of Northern Nigeria (Kano State Government, 2007).

However, Kano City been the economic capital of the north received the highest influx of other people who daily come to work in the newly established factories and commercial activities. The major roads linking Kano Metropolis remain the passageways at which people on socio-economic tricks from the northeastern state would have access to the inner city through a road transport. It become busiest thousands of vehicles were recorded flowing into Kano for such a commercial activities at daily bases. For example, the traffic volume on Kano-Wudil road was 1681 per hour in 2010 increased to 2170 per hour in 2013 i.e. 29% increased possibly especially from Kano-Wudil axis (FRSC Digest, 2014). These made the cases of RTC higher and very difficult to address as it is happening almost daily because, it is very rare to see a day without accident on the major roads linking the Metropolitan Kano though, is varied spatially.

Research Methods

Secondary data was used in this study, mainly the RTC monthly documented data for five years period (from January 2010 to December 2014) obtained from State Sector Command and the Policy, Research and Statistics Department of FRSC Kano and Abuja. Simple descriptive tools and GIS were used to spatially to effectively identify the hotspots locations of RTC on major roads linking Kano Metropolis.

Moreover, Global Positioning System (GPS) was also used to obtain the geographical coordinates to give an absolute location for the identified hotspots from each of the roads and their position in relation to the other hotspots. The crashes particulars such as date, locations and number of RTC were included in GIS database as a sophisticated statistical technique used for identification, locating and mapping out the hotspots and safety deficient areas as applied in the work of Apparao, *et al.* (2010) and Deepthi *et al.* (2010). In addition, Chi-square was used to present the temporal variations of RTC according to hours of the day and a Chi-square test were also used to test the hypothesis that, RTC uniformly occurred through the hours of the day as applied in the work of Gosmawi and Sonowal, (2010). For the study to achieved a desired intend, the time of the day were divided into four periods; 12midnight-06am (darkness to sunrise), 06am-12noon (morning to daylight), 12noon-06pm (Daylight to sunset) and 06pm-12midnight (night with sufficient light to darkness) respectively. And each time is presented with number of RTC that took place and its percentage along the major links.

RESULTS

Hotspots for Road Traffic Crashes on the Major Roads Linking Kano Metropolis

In this section, the study analysed the findings made on the hotspot locations for RTC along major roads linking Kano Metropolis. This was based on the FRSC requirement for describing a location as black spot by at least 3 cases of RTC reported in a month and 12 RTC in a year. This was carried out road by road as presented below.

Kano-Wudil Road: Figure 3 revealed the accident spots along Kano-Wudil Road. A total of 18 spots have been identified and categorized for ease of reference. It shows that Gano ranked highest hotspot location for road traffic crashes along Kano-Wudil road while Nigerian Police Academy Wudil (POLAC) stand as the second hotspot and Garindau the third in accident frequency. However, it appeared from the result that more than half of the RTC (about 52%) that took place on this road were in only four locations all situated between Gano to Wudil. This zone is the most

dangerous on Kano-Wudil road characterised by regular flash points, sharp bends, potholes and bad shoulder. Drivers on over speeding, wrong overtaking and dangerous driving habits find it difficult to control their vehicles, resulting to serious and ghastly RTC around this area. The locations with least RTC frequency were Mariri, Gidan Takarda and NNPC Mega, each identified with few accidents frequency in the same order. These locations are characterised by very open and straight surfaces with no flash points as sharp bend, potholes and related problems that can lead to frequent RTC.

Kano-Chiomawa Road: Figure 3 revealed the different hotspots locations for road traffic crashes on Kano-Chiomawa coverings up to Dakatsalle along Kano-Kaduna Expressway. A total number of 23 spots were identified between Kano-Dakatsalle and categorized for ease of reference. It can be deduced that, Dakatsalle with highest frequency represent approximately 1 in 10 of all the RTC observed in the four roads followed by Kura and Kwanar Dawaki. This is related to the parking of heavy vehicles on both sides of the roads all day and night, people and motorcycles cross the roads without caution while drivers on high speed hardly control. It is clear from the table that majority (62%) of the crashes on this road, were located in five locations. The study carried out a point estimation of the difference between the first three locations with highest rate of RTC as mentioned earlier and least three locations as Garun Babba, Imawa and Yadakwari, to establish how the difference between the two major groupings appears. The result reveals a high range value (56.00) signifying that, accidents rate really predominate over certain ranges of the identified locations.

Kano-Gezawa Road: A total number of 18 spots were identified between Kano-Gezawa and categorized for ease of reference. On the percentage distribution of hotspots locations for road traffic crashes along Kano-Gezawa on Kano-Hadejia Road, Figure 3 revealed that Tokarawa is the dominant location for RTC on this road. It accounts for about 16.3% of the total crashes that took place within the 60 months under study.

Yankaba Motorpark is the second hotspots followed by Gunduwawa. It is also clear that majority of the crashes took place within a distance of not more than five kilometres from Yankaba market junction to Gunduwawa (Figure 3). These places recorded most of the crashes because of large number of human activities taking place along this road such as the market, schools, hospitals and Motor Park. **Kano-Dambatta Road:** A total number of 17 spots were identified along Kano-Dambatta

(Figure 3). It is revealed that Dambatta is the foremost hotspot location for the RTC as large number of human activities is taking place there, especially the positioning of Dambatta market, schools, hospitals and Motor Park along the roads; followed by Dandalama which is characterised by a sharp bend and Shantake each contributing almost the same cases respectively. Wailare and Danmarke are two other locations with considerable number of the cases.

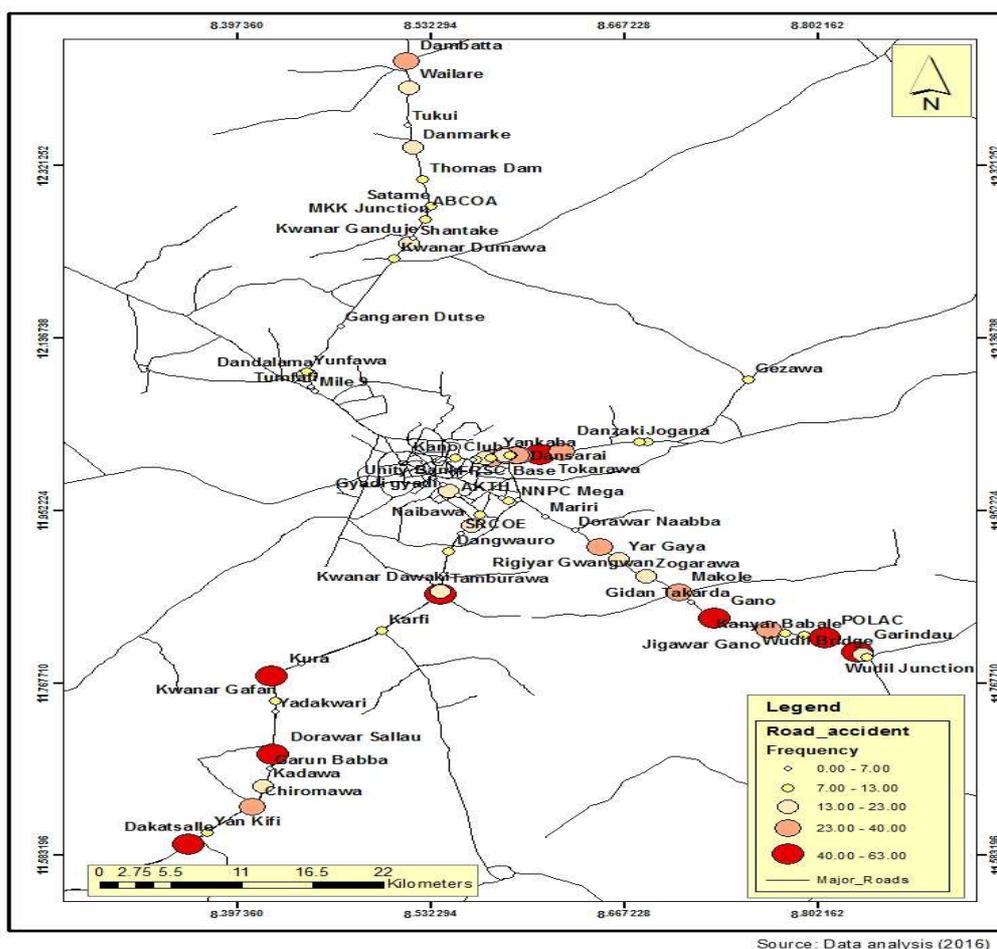


Figure 3: Hotspots for RTC on Major Roads Linking Kano Metropolis

Time Patterns of the Road Traffic Crashes on Major Roads Linking Kano

The temporal patterns of RTC on major roads linking Kano Metropolis were also addressed in this study. The temporal pattern revealed that most (over 50%) of the RTC on these roads occurred during daytime (06am-12noon) with a peak between 12noon-06pm. Between 06am-12noon also a high number of RTC were observed as roads are opened for massive

vehicular movement to schools, places of businesses and interstate travelling. These hours are the busiest as there is heavy rush of commuters from within and outside the state and the roads remain the main gateway into Kano Metropolis and highest in terms of traffic flow of vehicles and higher density movement of people especially on Kano-Kaduna Expressway.

Table 2: Distributions for RTC on major roads linking Kano Metropolis through Time

Major Roads	Time								Total
	12midnight-06am		06am-12noon		12noon-06pm		06pm-12midnight		
	No. of RTC	%	No. of RTC	%	No. of RTC	%	No. of RTC	%	
Kano-Wudil	2	0.50	120	33	199	54	45	12.50	366
KanoChiromawa	4	1	164	40	217	53	24	6	409
Kano-Gezawa	2	1	133	39	174	50	34	10	343
Kano-Dambatta	3	2	59	31	72	39	53	28	187
Total	11	1	476	37	662	50	156	12	1305

Source: FRSC, 2016

However, the pattern demonstrated on individual roads among the major roads as presented in Figure 4 established the fact that, RTC occurrences differs through the time of the day due to the variation in the traffic flow and density on the major roads linking Kano Metropolis. On Kano-Wudil road the period 06am-12noon is when people move to schools e.g. Kano University of Sciences and Technology, Wudil, Nigeria Police Academy, Federal University Dutse; offices, markets as there is no free day in which people do not use the road to go to one market or the other throughout the week. For example; Wudil market on Friday, Jama'are on Saturday, Makole, Garko and Kachako on Sunday, Shuwari on Monday, Takai and Sumaila on Tuesday, Laraba Zango on Wednesday and Darki on Thursday, to mention but a few. Despite the fact that the road is under construction throughout the period of the

study, this did not stop drivers from over speeding, wrong over taking and other thought of dangerous driving which caused crashes.

Figure 4 however, shows that Kano-Gezawa road between 06am-12noon are the busiest hours of heavy scuttle of commuters to schools, health facilities like Sir Muhammadu Sunusi Hospital, factories especially around Bompai, Tokarawa and Jogana industrial areas, business places and market within and outside the state. Not different from the two other roads mentioned earlier, Kano-Gezawa has minute cases of RTC in the midnight hours especially between 12 midnight and 06 am indicating decreases in the vehicular movement and rate of RTC. This implies that, the patterns of RTC on major roads linking Kano Metropolis differ in time and space, and the finding supports the earlier works of Goswami and Sonowal, (2010).

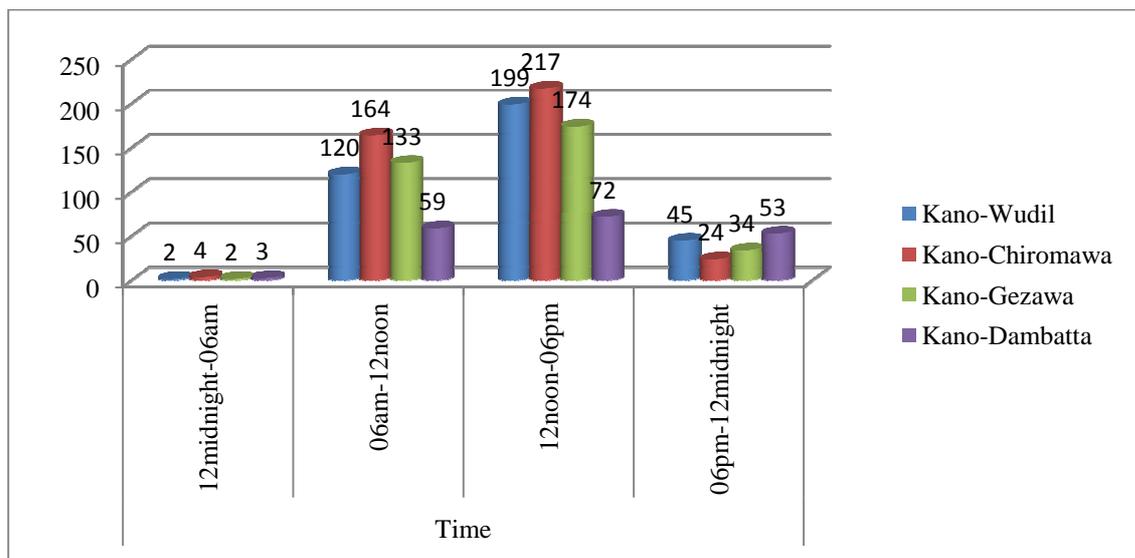


Figure 4: Time of RTC on Major Roads Linking Kano Metropolis

Source: FRSC, 2016

Also, Kano-Dambatta Road recorded the least cases of RTC compared to the other roads under study. However, the road had the highest number of RTC in the night 06pm-12 midnight characterised as the hours of night with insufficient light to full darkness, due to higher concentration of vehicular movement from the neighbouring country of Niger Republic.

The null hypothesis (H_0) that, RTC occurrences do not significantly differ through the hours of

the day on major roads linking Kano Metropolis was tested using Chi-square. The result shows that the χ^2 – value of 69.447 at 9 degree of freedom was significant at 0.01 level (Table 3) indicating that, RTC occurrences differ significantly through the hours of the day. The conclusion was that, the temporal patterns of RTC on major roads linking Kano Metropolis differ significantly.

Table 3: Chi-square Result of RTC on major roads linking Kano Metropolis through Time of the day

Hours	Kano-Wudil	Kano-Chiromawa	Kano-Gezawa	Kano-Dambatta	d f	Calculated Value
	f	f	f	f		
12am-06am	2	4	2	3		
06am-12pm	12	164	133	59	9	69.447**
12pm-06pm	19	217	174	72		
06pm-12am	9					
	45	24	34	53		

Source: FRSC, 2016

**Significant at 0.01 level.

CONCLUSION AND RECOMMENDATIONS

From the result of the study, it was reveals that one of the major problems in the today’s transportation is the increasing rate of RTC and deaths on our roads, where injuries and fatalities resulted from traffic crashes are a serious problem all over the roads under study. The hotspots and Time pattern of RTC on major roads linking Kano Metropolis was studied and analysed. In addition, the hotspots were located, the temporal patterns were described and hypothesis was tested accordingly. A conclusion was drawn based on the study and recommendations were offered in the same order. The study concluded that Dakatsalle along Kano-Kaduna Expressway is major hotspots for RTC because the location is turned to be a heavy vehicles park station, where at both sides of the roads vehicles are parked 24 hours in discriminatively, people and motorcycles cross the roads anyhow and drivers on high speed hardly control their vehicles from RTC and followed by Gano on

Kano-Wudil road which have been found lacking in terms of safety measures, associated with a lot of RTC risk such sharp bend, potholes and bad shoulder around Gano, Polac and Jigawar Gano. These concluded that, locations were varied in the rate of RTC and the roads are not the same in the traffic flow of vehicular movement as well as the conditions that might led to RTC. The result of the study supported the earlier work of Atubi, (2012).

The times of crashes when the accident took place were also addressed and revealed that the peak period of RTC on major roads linking Kano-Metropolis was between 12noon- 06pm (recorded over 50%) in all the roads because, these hours are the busiest as there is heavy rush of commuters from within and outside the state. It was only on Kano-Dambatta road the study disclosed the higher cases in the night (06pm-12midnight) due to higher concentration of vehicular movement from the neighbouring country of Niger Republic.

These concluded that, the pattern of RTC on major roads linking Kano Metropolis differ in time and space, and the finding supports the earlier works of Goswami and Sonowal, (2010). The following were the recommendations drawn based on the findings of the study:

1. The FRSC in conjunction with other stakeholders should keep organizing a sensitization campaign in selected motor parks at least quarterly to continue creating awareness to the drivers on the increasing rate of RTC and number of people demised and properties loss of properties on major roads linking Kano Metropolis. These could be done by using posters and if possible audio-visual presentation on the victims of RTC for drivers to see how RTC kill people and damages properties.
2. There is need for effective placement of road furniture (bill board inclusive) at Dakatsalle on Kano-Chiromawa road, between Gano to Polac (Nigerian Police Academy) on Kano-Wudil road, as the more accident prone corridors for helpful sensitization especially at this time when dualisation is in progress. These could be done by using images with slogan like "Drive to stay alive, Drive carefully, Accident kill more passengers, Only living celebrate, Safety first" among others.
3. The FRSC Wudil unit command should establish a permanent work station either Gano or Police academy to reduce dangerous driving and other related human factors increasing the rate of RTC. However, the FRSC Chiromawa Unit should timely be at Dakatsalle and regulate people's behaviour of crossing roads and illegal parking which seriously obstruct drivers and lead to RTC. These could be done by FRSC.
4. It was also recommended that, FRSC and Police should be using GPS to have the geographical coordinate of Latitude and Longitude of RTC spots while taking accident information. This will help in giving the precise and absolute location of the crashes for effective measure where necessary. These could be done if FRSC and Police can give their staff training on GIS, such would help in mapping the hotspots and black spot locations.
5. The FRSC and Police should organize an effective traffic control inspection at some selected hotspots between 12am-06pm as the busiest time of more commuting and the staff should be more concentrative in regulating driver's attitude and ensure the exercises to be of less corruption.
6. FRSC and other stakeholders should improve on regular, consistent and comprehensive enforcement of road rules to improve road user behaviors' especially on drivers' related causes of RTC particularly dangerous driving, Speed violation, wrong overtaking. And if possible, place speed limiting devices (Cameras) on busy hotspots to enforce speed limit, this will change the young commercial cars drivers from "I must get there within an hour" which really enhance RTC on the major roads linking Kano Metropolis.
7. The community should however, be participative in reporting any road traffic regulation violation observed to the nearest FRSC and Police patrol team, formation or any other Law enforcement personnel or formation for appropriate redress.

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