



SPATIAL AND TEMPORAL ANALYSIS OF ROAD TRAFFIC CRASHES ALONG KANO-MAIDUGURI ROAD

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ABSTRACT

One of the major challenges in the today's world is the increased rate of Road Traffic Crashes (RTC) and its casualties on our roads which are becoming worse and more devastating, claiming lives and properties by the day. This paper is aims to explore the spatial and temporal patterns of RTC between Kano-Wudil on Kano-Maiduguri Road. The study uses RTC monthly data for 2010, 2011, 2012, 2013 and 2014 obtained from Policy, Research and Statistics Department of FRSC and uses multiple linear regressions, descriptive tool and GIS to demonstrate the result of the findings. The results reveal that, Gano is a major hotspot with 57 RTC accounted for 15.6% and majority of the RTC (80%) took place during the day time. The conclusion was that, increase rate of RTC has a positive correlation with explanatory variables human and mechanical causes. It is recommended that, there is need for effective placement of road furniture between Gano to Nigeria Police Academy (POLAC) as the more accident prone corridor for helpful sensitisation.

Keywords: Road traffic crashes, operation corridors, patterns, hotspots, Federal Road Safety Commission

INTRODUCTION

There is no doubt about it that, one of the major problems in today's World is the high rate of road traffic crashes (RTC) and deaths on our roads. More than 30 million people have died and over 15 million have been injured in car accidents worldwide since the debut of automobile some hundred years ago (Balogun, 2006). According to the World Health Organisation (2014), deaths through RTC have become a global epidemic sweeping people gradually, which if not properly addressed will be the second most cause of disability and adjusted life year loss in developing countries by the year 2030 (WHO, 2004). The International Federation of Red Cross and Red Crescent Societies (IFRCS) predict that by 2020 road accidents will become the third leading sources of death. It is estimated that, 1.26 million RTC deaths occur and about 50 million people are injured in the world every year (WHO, 2004 in Akpoghomeh 2012). The social, economic and political impacts of RTC are widespread all over the world. The global economic cost as at 2003 alone was estimated at 518 billion dollars of which 100 billion dollars took place in poor developing countries such as Nigeria (Make Road Safe, 2006). The loss of lives, damage to property and the sorrow it leaves in human mind are profound through the degree varies from nation to nation with developing

countries being the hardest hit (Peden *et al*, 2004). For example, in 1998, the Pakistan police in Karachi reported 544 deaths and 793 injuries due to road traffic accidents, while ambulance records noted 343 deaths and 2,048 injuries. In Korea RTC amplified nearly eight-fold from 37,000 in 1970 to 290,481 in 2000, which was the leading cause of death for people under 29 (Bong-Min and Jinhyun, 2003). Similarly, in South Africa between the period of 2001-2006, about 28, 890 road traffic death occurred (Lehohla, 2009). In Ghana, available data revealed that, about 1,900 persons are killed and 15,000 injured annually in road traffic crashes (Oduro, 2012). The FRSC of Nigeria revealed that, 7, 269 people died, 20, 752 persons sustained various degrees of injuries and 7, 517 people are permanently disabled in the year 2012, as a result of RTC across highways in Nigeria (FRSC Digest, 2012), whereas, in 2014, 10, 380 RTC were reported with 5, 991 fatality (FRSC, Corps Performance and Analysis, 2015).

According to Akpoghomeh (2012), the continued dangerous trends of road traffic accidents in Nigeria place the country second after Ethiopia, as it recorded at least one death in every two hours and one injured in every 30 minutes. These made RTC became a national problem which requires concerted effort and synergy between those saddle with the responsibility of

maintaining road safety and members of public (Ekele, 2012). The Federal Road Safety Commission (FRSC) in its attempt to reduce the carnage designed 18 operations corridor in addition to the six corridors designed by the World Bank for RTC analysis from 2010-2013. Katsina-Kano-Wudil-Dutse-Azare-Potiskum is among the 18 operations corridors established by FRSC with traffic point at Wudil, which is among the most accident prone routes in Northern Nigeria. This route is the highest flying route connecting the northeastern states of Nigeria and the neighbouring countries into Kano City for socioeconomic activities. For example, in 2010 alone, this corridor has an average traffic volume/per hour of 1681 and has recorded 135 cases of RTC involving 934 people (FRSC, 2014). With above mentioned development and the increased number of patrol vehicle and manpower from 18, 098 as at 2012 to 20, 899 as at 2015, the country witnessed a slight reduction in RTC from 13, 583 with fatality of 6, 523 as at 2013 to 9, 734 case with only 5, 044 fatality in 2015 (FRSC, Corps Performance and Analysis, 2015).

All the same, unexpected death due to RTC has continued to be a source of grief in a number of homes in Nigeria. There is

scarcely a week that passes without an account of a ghastly Road Traffic Crashes with many deaths being recorded. Despite the annual road safety campaigns and mobilization by FRSC, it is unfortunate that the number of road traffic crashes is always on the increase leading to higher loss in both human and material resources (FRSC, 2012). It is against this background, this study investigates the spatial and temporal patterns of road traffic crashes along Kano-Maiduguri Road with emphasis between Kano-Wudil Road.

MATERIAL AND METHODS

Study Area

The Kano-Wudil Road is situated at the eastern part of Kano State and the study covered only 50km from Kano-Wudil between latitude 11°08' N and 11° 95' N of the equator, and longitude 8° 58'E and 8°81'E of the prime meridian, stretches from Ado Bayero overhead bridge along Zaria Road, passing through Tarauni, Nassarawa, Kumbotso, Dawakin-Kudu, Warawa, and Wudil Local Government Areas as shown in Figure1.

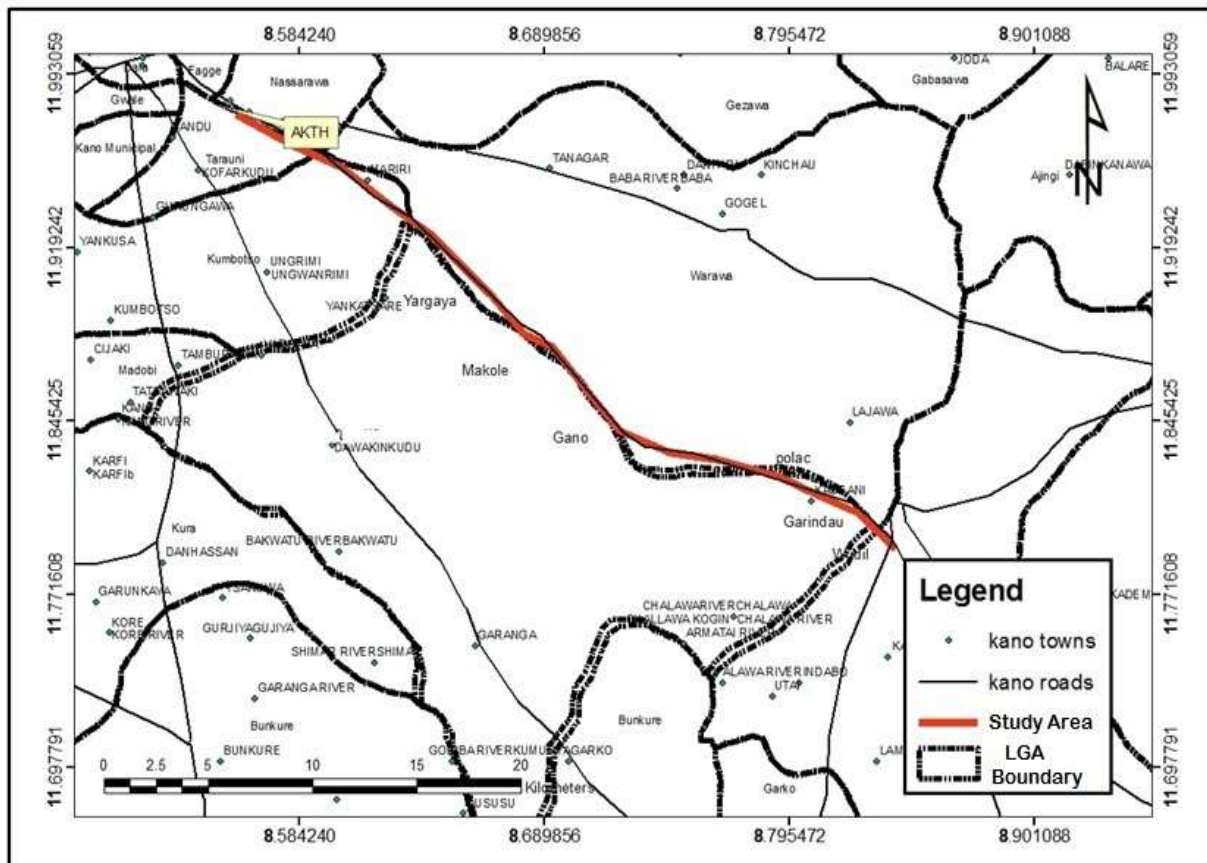


Fig. 1: Kano-Wudil Road

The conventional Kano-Maiduguri Road is among oldest, the busiest and highest plying route, and is among the most accident prone route in Northern Nigeria, constructed around 1920 under the colonial rule, connecting the North Eastern states of Nigeria and neighbouring countries into Kano City for socioeconomic activities. It is part of Katsina-Kano-Wudil-Dutse-Azare-Patiskum operations corridor as designed by FRSC, Nigeria (FRSC, 2014). In 2010 alone, the route had an average traffic volume/per hour of 1681 which has recorded total cases of 135 RTC where 934 persons involved (FRSC, 2014). Nevertheless, as the dualisation exercises reaches the said route, with establishment of diversions and other obstruction, the total RTC decrease from 135 in 2010 to 120 in 2012 representing 11%

decrease. However, a slight increase of 10% recorded in 2013 over 2012 figure. The traffic volume increased from 1681 per hour to 2170 per hour in 2013 i.e. 29% increase. Fatality increased from 77 in 2010 to 146 in 2011 (90%). Thereafter, it assumed a decreasing trend of 13% 2011 to 2013 (Table 1). It is nevertheless, note worthy that the better the quality of road, the greater the number of RTC. This result confirms finding of other studies that better quality of road in Nigeria is sometimes responsible higher RTC because drivers most likely over speed and drive dangerously on good roads leading to more frequent and serious traffic crashes (Onakomaiya, 1988, Filani and Gbadamosi, 2007).

Table 1: RTC and Traffic Volume Record from 2010 – 2013 along Kano-Wudil Road

Year	Total Cases			Total Casualty		Not injured	Person involved	Traffic volume/hour
	fatal	serious	Minor	killed	Injured			
2010	40	89	6	77	143	406	934	1681
2011	44	77	3	146	600	332	1078	1019
2012	41	71	9	115	646	280	1041	920
2013	36	84	27	67	541	425	1033	2170

Source: FRSC, 2014

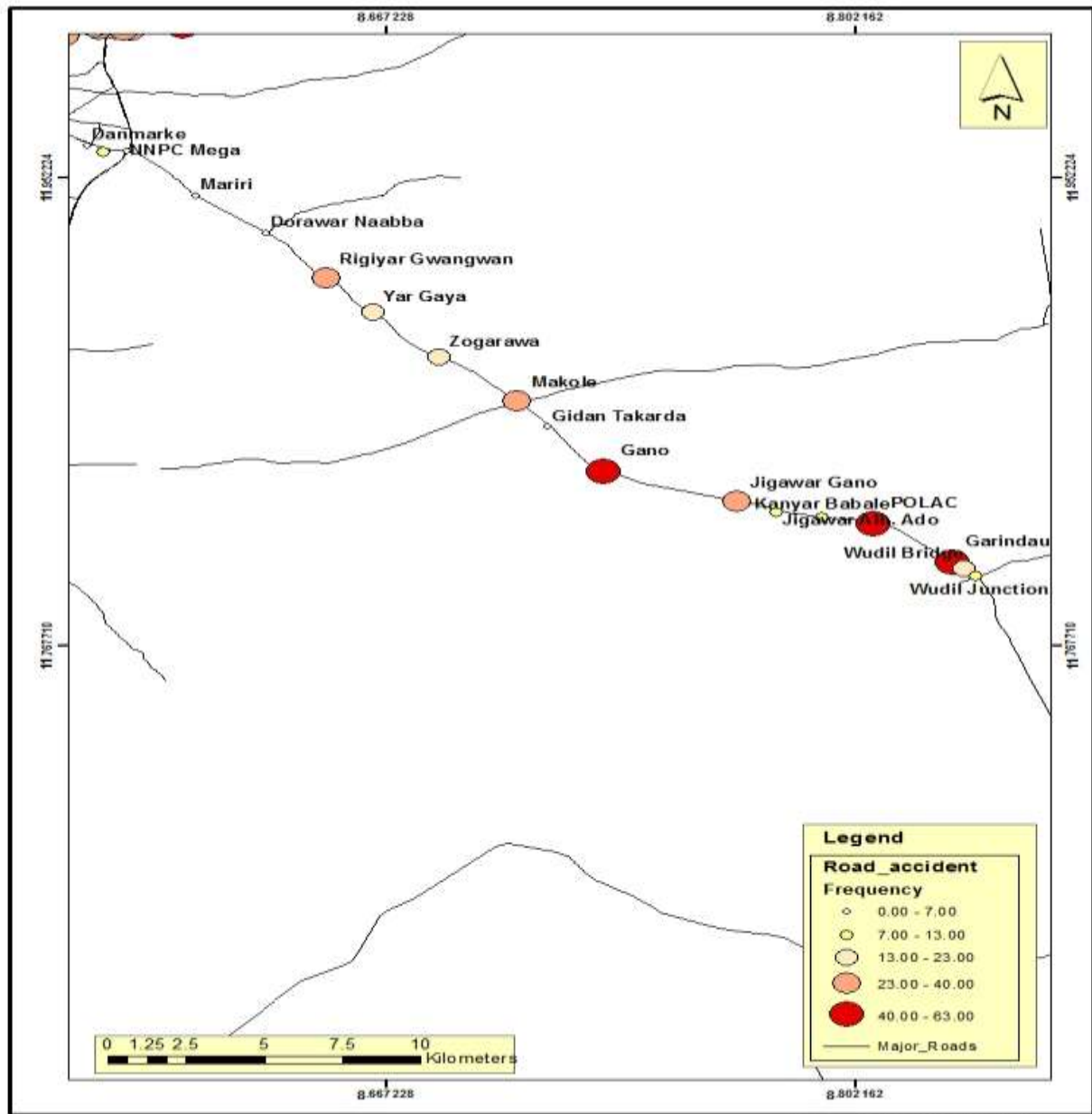
RESEARCH METHODS

For the conduct of this study, the use of a secondary data was employed. It is restricted to use the RTC monthly data for five years period from January 2010 to December 2014, obtained from the Kano State Sector Command of the Federal Road Safety Commission of Nigeria and the Policy, Research and Statistics Department, FRSC, RSHQ, Abuja. The data were collected when RTC occurred and contained information on the date and time; the locations, number of people involved (death and injured) and causes of RTC. The result is demonstrated using descriptive statistics and multiple linear regressions. GIS were used to spatially demonstrate the hotspots locations of RTC; Global Positioning System (GPS) was used to obtain the geographical coordinates to give an absolute location for the identified hotspots 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 for identification, locating and mapping out the hotspots and safety deficient areas. To demonstrate the temporal patterns of the RTC, the study divided the time of the day 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 took place and its percentage along the road. SPSS Package was also used for the analysis.

RESULTS AND DISCUSSION

Hotspots for Road Traffic Crashes on Kano-Wudil road

In this section, the study analysed the findings made on the other objective of the study on hotspots locations for RTC on Kano-Wudil road as presented below, based on the FRSC requirement to describe a location as hotspot by at least 3 RTC in a month and 12 RTC in a year (FRSC, 2014). Figure 3 revealed that the Federal Road Safety Commission of Nigeria identified different accident spots along Kano-Wudil Road. A total number of 18 spots have been identified and categorized for ease of reference (Figure 2). For the five years under study, the result shows that Gano with a frequency of 57 accidents representing 15.6% is the highest hotspot location for road traffic crashes, POLAC with 56 accidents frequency representing 15.3% is the second hotspot and Garindau with 47 crashes (12.8) is 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 road friction. 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 study disclosed that FRSC Unit Command Wudil and Nigeria Police Force Wudil do provide immediate intervention when RTC occurred. Apart from taking the RTC information, the victims are convey to a nearby Wudil General Hospital and POLAC Clinic for immediate medical attention.



Source: Data analysis (2016)

Fig. 2: Hotspots locations for RTC on Kano-Wudil road

Temporal Patterns of the Road Traffic Crashes on Kano-Wudil Road

Table 2 indicates the temporal pattern of road traffic crashes on Kano-Wudil road. It was revealed that majority (over 80%) of the RTC on this road took place during daytime and the peak time was between 12noon-06pm constituted 54% of RTC within the years under study. These time coincide with period when

people are more active and mobile especially on this road been the busiest and highest flying roads connecting even the neighbouring countries into Kano City for trade and socioeconomics activities. Between 06am-12:00noon also a high number of RTC were observed as roads are opened for massive vehicular movement to schools, places of businesses and interstate travelling.

Table 2: Distributions of RTC on Kano-Wudil Road through Time

Road	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

Source: Data Analysis (2016)

On this road however, this hours (06am-12noon) is characterised as early hours for people movement 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 causes crashes in discriminatively.

Causes of road traffic crashes on Kano-Wudil Road

The study observed the causes of RTC on Kano-Wudil Road. Table 3 illustrates the causes of RTC on Kano-Wudil Road for the period of five years. The study categorized the causes in to human related; such as dangerous driving (DGD), speed violation (SPV), lost of control (LOC), wrong overtaking (WOT), mechanical related; like tyre burst (TBT), mechanically deficient vehicle (MDV), brake failure (BFL) and road related such as bad road conditioning, poor weather, among others.

Table 3: Causes of RTC on Kano-Wudil Road

Road	DGD	SPV	LOC	WOT	TBT	RTV	MDV	OTHERS	TOTAL
Kano-Wudil	100 (27%)	152 (42%)	8 (2%)	76 (21%)	20 (5.4%)	4 (1%)	5 (1.4%)	1 (0.2%)	366 100%

Source: FRSC, 2016

However, it revealed that nearly everyone of the RTC on the roads under study, within the period covered, are as a result of dangerous driving, speed violation and wrong overtaking constituting 90% of the total crashes. It is indicated that other causes such as obstruction, sign light violation, brake failure, etc, does not have much impacts. It is clear from the finding that human causes are the most predominant contributor to the rate of RTC.

Tables 4 and 5 are used to test the following hypothesis; (i) there is no significant relationship between the major causes and the rate of RTC on Kano-Wudil road (H₀). This is intended to demonstrate whether causes of road traffic crashes do affect the rate of the crashes on Kano-Wudil road. The rate is the dependent variable while, the cause and hours of the crashes are the explanatory variable. The tables however, are sub-divided into two to control multicollinearity between time hours of

darkness and daylight. The relationship between the dependent (response) and independent (explanatory) variables for this research can be articulated by means of the regression model adopted from Agbeboh, *et. al.* (2013) and Aderamo, (2012) and is expressed as below

$$RCO = f (HUM, MEC, DKN, \text{ and } DYL)$$

This is operationalised in the form;

$$RCO = a + \beta_1HUM + \beta_2MEC + \beta_3DKN + \beta_4DYL + \epsilon$$

Where;

RCO = Rate of crashes occurrences

HUM = Human factors that are causing the road traffic crashes

MEC = Mechanical factors that are causing the road traffic crashes

DKN = 12 hours of darkness out of the 24 hours of the day

DYL = 12 hours of daylight out of the 24 hours of the day

Table 4: Regression result with Darkness

Variable	Coefficient	t-Statistic	P-Value
Mechanical	1.000000	1.83E+15	0.0000
Human	1.000000	8.03E+15	0.0000
Darkness	1.54E-15	3.651383	0.0006
C	3.26E-15	5.174328	0.0000
R-squared	1.000000		
P-Value (F-statistic)	0.000000	Durbin-Watson statistics	1.665210

Table 4 shows that all the dependent variables; mechanical, human and darkness as appeared in the table are independently statistically significant at 1% level. Hence, based on the data under examinations, mechanical and human factors as well as darkness certainly affect the rate of the crashes. In addition, the coefficient of mechanical and human factors implies that any additional fault of either a driver (such as dangerous driving, wrong over taking, over speeding etc) or mechanical (such as brake failure and tyre burst) will lead on the average to an increase in the rate of RTC, holding other factors constant.

However, a unit change of darkness i.e. an hour increase in the night will lead to increase in the rate of RTC by each 0.000000000000000154 (very close to zero) crashes. The explanatory variable in the model explain their influence in the RTC completely (100%) and the R^2 1.00 indicates that the model is well fitted and connected as it fully explain the relationship between the dependent and independent variables. The Durbin-Watson statistics of approximate 1.67 pointed out that there is no serial correlation in the data used for this analysis.

Table 5: Regression result with Daylight

Variable	Coefficient	t-Statistic	P-Value
Mechanical	1.000000	1.51E+15	0.0000
Human	1.000000	3.01E+15	0.0000
Daylight	-7.84E-17	-0.206918	0.8368
C	3.26E-15	5.767152	0.0000
R-squared	1.000000		
P-Value (F-statistic)	0.000000	Durbin-Watson statistics	1.634689

The Table 5 regression result indicates that the increase rate of road traffic crashes has a positive correlation with explanatory variable human and mechanical causes, while on the other hand has a negative relationship with daylight. The coefficient of determination, R^2 explain it similarly as before. This shows that any additional human error from the drivers or mechanical fault in the vehicle leads to an increase in the rate of RTC holding other factors constant.

daylight and darkness). One can infer from the result that extra cautions are expected to be maintained among the road users.

However, this result confirms finding of other studies that better quality of road in Nigeria is sometimes responsible for higher RTC because drivers most likely over speed and drive dangerously on good roads leading to more frequent and serious traffic crashes (Filani and Gbadamosi, 2007).

Furthermore, the regression results show that the model is good enough for the explanation of the effect of the explanatory variables on the rate of RTC. It implies that, causes of RTC are not equally responsible among. They differ significantly because; they are multi-factorial and involve the interaction of a number of pre-crash factors that include people, vehicles and the road environment and these factors especially driver's attitude and road conditions that led to the RTC differ spatially in relation to locations and between time of the day (hours of the

CONCLUSION

From result and what is revealed in the various literature reviewed for this study, no community can be more developed if its transportation sector is neglected and receiving less concern from the government, due to the fact that development of every sector of human survival is bind on the narrow part of transportation.

The study analysed the findings on hotspots locations for RTC on Kano-Wudil road, based on the FRSC requirement for describing a location as hotspots by at least 12 RTC in a year. It

was concluded that, that Gano is the major hotspots with 57 RTC accounted for 16%, followed by POLAC 56 accounting 15%. These concluded that, over 50% of the RTC took place in four locations situated between Gano to Wudil.

The basic findings of this study reveal hours of the daylight (06:00am-12noon) are the time of major crashes along the road under study within the period covered. This coincide with period when people move to schools and 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. 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. These concluded that, the time pattern of RTC on Kano-Wudil road differ in time and locations. Indeed, human causes such as dangerous driving, wrong overtaking and speed violation of the road users are strongly revealed as the major causes of RTC and do partake in the daylight hours than the darkness due to variation in the vehicular traffic movement.

The situation of RTC in the state and roads under study is becoming unbecoming, which if care is not given will remain the source of death to many individuals. It is in this regard that, this study offers the following recommendations:

1. The NURTW, NARTO and RTEAN of various motor parks should assist in inspecting all vehicles loading at their respective stations to ensure that they are free from any mechanical default.
2. The FRSC in conjunction with road transport unions should keep organizing a sensitization campaign in selected motor parks at least quarterly to continue creating awareness to the drivers on the number of people demised and properties loss every year as a result of road traffic
3. There is need for effective placement of road furniture (bill board inclusive) between Gano to Polac (Nigerian Police Academy) as the more accident prone corridor for helpful sensitization especially at this time when dualisation is in progress.
4. 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.

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