

## Characteristics of Fatal Road Crashes in Plateau State, Nigeria (2016 – 2019)

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### Abstract

*Africa has the worst crash fatality rates in the world. The World Health Organization (WHO) estimated that the continent has a crash fatality rate of 26.6 deaths per 100,000 people. Some analysts believe that this is grossly underrepresented and the true figure would be around 65 deaths per 100,000 people. Nigeria has one of the largest fleets of vehicles and number of crashes in Africa and contributes to a large measure in this scandalously high crash fatality rates. The need to address this problem cannot be overemphasized. It is imperative that the characteristics of fatal crashes be examined as a way to determine what the issues at stake are. However, not many studies have been conducted to deconstruct fatal crashes especially at the local level in Nigeria. This paper examines the characteristics of fatal crashes in Plateau State, Nigeria. Data was collected from the State Sector Command Headquarters of the Federal Road Safety Commission (FRSC) for Plateau State. Data crash records were then extracted and deconstructed. The results showed that most of the fatal crashes and fatalities occurred between 9am and 12 noon and 3pm and 6pm. There were larger number of crashes and fatalities caused by multiple-vehicle crashes than single-vehicle crashes; and only five routes were responsible for 57% of fatal crashes and 66% of fatalities. Brake failure and speed violations were the most common causes of fatal crashes and fatalities, respectively. The paper recommends that stiffer penalties be imposed for violations of traffic rules and regulations and officers of the Vehicle Inspection Office (VIO) and Federal Road Safety Commission (FRSC) should work together in collaboration to ensure better safety records on the roads.*

**Keywords:** Crash Rates, Fatal Crashes, Fatalities, Road Safety

### INTRODUCTION

The low- and middle income countries of the world bear the greatest burdens of road traffic fatalities. It is estimated that more than 90% of the more than one million people killed, annually, in road traffic crashes worldwide reside in developing countries (WHO, 2018). This is a serious cause for worry.

In recent years and decades, there has been a rise in economic and social living conditions of residents in developing countries. An improvement in real income and living standards has translated into ownership of vehicles, whose numbers have swelled on the roads. Unfortunately, infrastructural development has not kept pace with the number of vehicles. The roads are still abysmally poor and a disregard for road rules and regulations by motorists has resulted into many crashes that have claimed lives (Ghaffar, Hyder, Govender & Bishai, 2004).

In African countries, fatalities rates are expectedly abysmal. WHO (2018) estimated the fatality rate to be 26.6 deaths per 100,000 people, which is three times the rate for Europe. This is unacceptably high. Unfortunately, some African

researchers insist this rate is too conservative, pegging it at a higher level of about 65 deaths per 100,000 people (Adeloye, Thompson, Akanbi, Azuh, Samuel, Omoregbe & Ayo, 2016). Boateng (2021) indicated that road cashes trauma is among the top 10 causes of death in Ghana. In Tanzania and Kenya, the increasing death tolls from road traffic crashes has necessitated the enactment of road traffic laws and enforcement measures. These have become almost inevitable because most of the crashes have resulted from reckless driving behavior of motorists. It is safe to argue that this situation cuts across most African countries.

In Nigeria, WHO (2018) suggested that the 5,000 deaths reported for road traffic crashes in 2016 was grossly below the number it estimated at 39,000. The fatality rate estimated at 21.4 deaths per 100,000 people, is still unacceptably high despite being below the 26.6 deaths per 100,000 people at the continental level. Data from the Federal Road Safety Commission (FRSC) and the National Bureau of Statistics (NBS/FRSC, 2020) show that the combined death toll from the 4<sup>th</sup> quarter of 2020,

1<sup>st</sup> and 2<sup>nd</sup> quarters of 2021 totaled 4,939, which is nearly the total number reported in 2016. This suggests an increase in fatal crashes in the country.

The importance of understanding the nature of crash fatalities cannot be overemphasized. Crash fatalities come with enormous economic, social and human costs. Crash fatalities account for some 3% of the GDP of many countries. Osayomi and Areola (2015) pointed out that as at 2008, the economic costs of death in Nigeria was approximately US\$65 billion (more than N2 trillion @ US\$1 = N400). This is a colossal loss by any standard. The situation has grown worse since then. However, few studies in Nigeria have comprehensively examined the nature of fatal crashes at local levels to specifically determine areas that require intervention. This study analyses fatal crashes in Plateau state, Nigeria, to provide insight into their local characteristics that may illuminate areas that need attention.

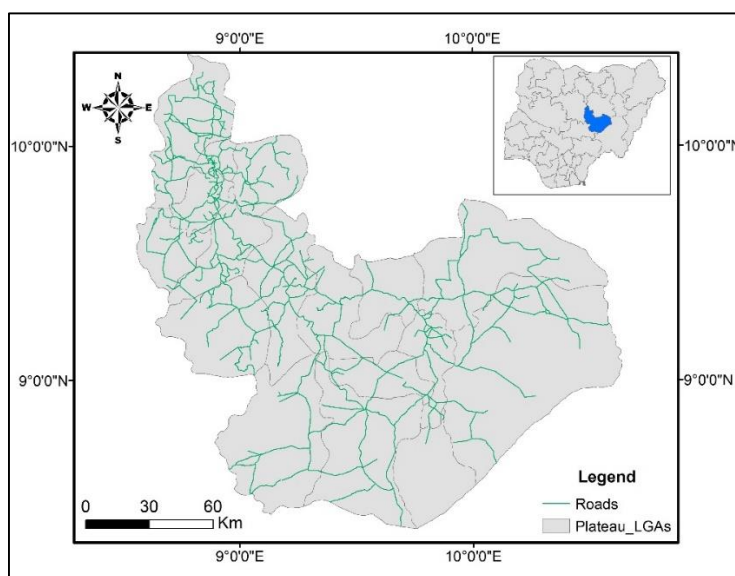
## MATERIALS AND METHODS

### Study Area

Plateau State is one of 36 states in Nigeria and the Federal Capital Territory, FCT. It lies between

latitudes 8° 30' and 10° 30' N and longitudes 7° 30' and 8° 38' E. It consist of 17 local government areas (LGAs), with a land mass of 26,899 sq. km, making it the 12<sup>th</sup> largest state in Nigeria. Its population is estimated at about 3.5 million people (Plateau State Government, 2022).

Plateau state is made up of two geographical relief regions: the highland region, the Jos Plateau, which gave the state its name, and the lowland region. The highland region is famous for its clement weather conditions, with mean annual temperature regime of about 25° C. It is also well known as the tin mining region that once dominated the world tin market in the 1940s and 1950s. The more than a century of tin mining activities in the region also helped to open up the area through a network of roadways that linked economic and commercial centres to tin mining and labour camps and the tin mines. The lowland region in expectedly hotter in regards to temperature. It is the food basket of the state, famous for rice, and especially yam production, alongside other crops.



**Figure 1** Road Network of Plateau State

The road network of the state is generally good. However, in the Plateau region it is constricted by hills, which makes little room for easy expansion to accommodate the increasing volume of traffic in the urban areas. With a large population, the city areas of Jos and Bukuru are

coming under intense traffic volumes. These are, arguably, the commercial centres of the north central region in Nigeria and attract large volumes of traffic from neighbouring states. Being the gateway to the FCT, Abuja from the northeast states of Bauchi, Borno, Yobe, Gombe, Taraba and

Adamawa, the state witnesses a large number of through traffic. The steep hills of the Plateau, as one descends to the lowland areas of the state and its neighbouring states, are a cause for worry because of their winding nature as the roads snake their ways between the hills. Some of these routes are known to be hotspots of some serious road crashes in Nigeria. The Hawan Kibo route which links Plateau State to Nasarawa state and the FCT is particularly notorious and often labelled among the crash hotspots in the country. The Kwanan Maciji (translated as “Snaky road”) that descends through the Pankshin escarpment towards Langtang LGA and the one that is also similarly called but descends from Pankshin to Shendam/QuanPan area are also considered dangerous. With the reckless driving behaviour of motorists both within the city centres and on the rural roads, Plateau state provides several opportunities for fatal crashes to occur.

### Data Collection and Analysis

Data was collected from the Plateau State Sector Command Headquarters of the Federal Road Safety Commission in Jos. The data covered the periods between January 2016 and August 2019. It also contains the records of all crashes reported to and documented by the commission during this period of time.

From this data set, fatal crashes were identified and extracted. These records were then further decomposed into characteristics deemed important for analysis. These characteristics include routes of fatal crashes, number of fatalities, time of the day, number of vehicles involved in the fatal crashes and recorded causes of crashes. These are considered important attributes of the crashes that may throw more light on the nature of fatal crashes in the state. Data are presented as tables and graphs and a regression analysis was conducted to determine the relationship between causes of crashes and the recorded number of fatalities.

## RESULTS AND DISCUSSION

### General Characteristics of Fatal Crashes

Between 2016 and 2019, 150 fatal crashes were recorded, involving 276 vehicles. This is an average of 38 fatal crashes annually. The total number of fatalities was 277, which is 69 deaths annually. These statistics also translate to approximately 2 deaths for every one fatal crash.

### Temporal Characteristics

#### Monthly and Yearly Distribution

Table 1 presents data on fatal crashes by month and year.

Table 1 Monthly distribution of fatal crashes and fatalities

Month	2016		2017		2018		2019		Total	
	Crash	Fatality	Crash	Fatality	Crash	Fatality	Crash	Fatality	Crash	Fatality
January	3	3	2	5	3	8	0	0	8	16
February	5	5	1	1	4	8	2	2	12	16
March	3	11	2	9	4	8	5	5	14	33
April	6	9	6	10	0	0	6	17	18	36
May	4	8	2	2	2	3	3	10	11	23
June	6	6	5	12	4	4	0	0	15	22
July	3	3	2	2	8	15	3	3	16	23
August	2	5	6	13	2	9	3	3	13	30
September	2	2	3	7	3	10	NA	NA	8	19
October	2	6	1	1	2	2	NA	NA	5	9
November	4	15	1	3	3	4	NA	NA	8	22
December	7	9	10	10	5	9	NA	NA	22	28
Total	47	82	41	75	40	80	22	40	150	277

There was a marginal downward trend in number of fatal crashes between 2016 and 2019. The fatalities, however, undulated with a drop in 2017 and a rise in 2018. It may be safe to assume that both the number of fatal crashes and fatalities went down in

2019, projecting from the data available up to August of the year.

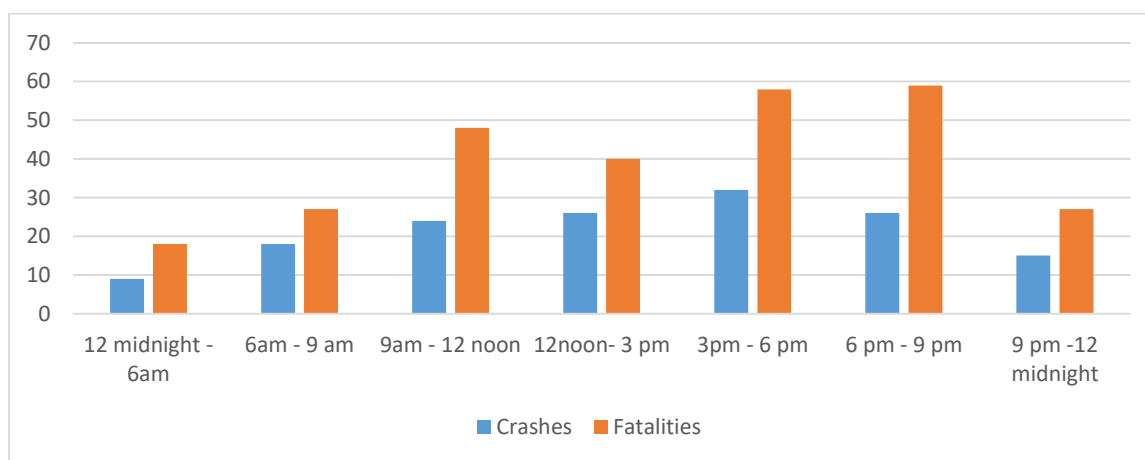
The months of March, April and December appear to record relatively larger numbers of crashes and fatalities. Starting from February and

going through the rainy season months to August, crash numbers are relatively high. Ishaku, Binbol, Ishaya, Danjuma and Wuyep (2021) showed that Plateau state experiences the onset of the rainy season in early April. The wet road surfaces may contribute to the crash numbers even though the more common causes of crashes on record are non-weather reported. Nevertheless, wet surfaces makes it easier for brakes to fail, especially when the vehicle is at high speed. The data showed that brake failure is an important cause of fatal crashes and fatalities in the state.

The month of December is also important. Being a festive month of Christmas, with large volumes of traffic in any given direction. It is therefore possible to explain the relatively high numbers of crashes and fatalities on increased risks of large traffic volume and overspeeding, which are commonly associated with the season.

#### *Time of the Day*

Figure 2 presents the numbers of fatal crashes and fatalities recorded by time of the day.



**Figure 2** Number of Fatal Crashes and Fatalities

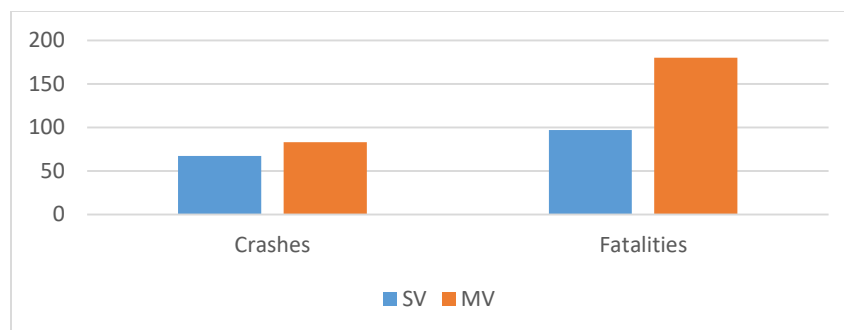
The graph exhibits double-maxima characteristics. The time period between 3p and 9pm is particularly important as it accounted for 39% of fatal crashes and 42% of crash fatalities in the state during the study period. The pseudo-peak period of 9am to 12 noon also appears to require attention in two respects: it has a comparatively high numbers of fatal crashes and crash fatalities, and also shows a large disparity between the number of fatal crashes and crash fatalities, which is also characteristic of the 3pm-6pm and 6pm to 9pm time periods.

Generally, the high volume of traffic in the day time compared to night time is responsible for the high numbers of fatal crashes and fatalities. The periods between 9 am and 12 noon are particularly hectic as they coincide with high volumes of traffic specially those generated from within the state towards other places for business and other activities, It is also the period when through traffic in either direction, towards and from FCT Abuja

would be passing through the state. The 3pm to 9pm time period also coincide with “return” trips. The late afternoon (3pm to 6pm) and the evening periods (6pm to 9pm) may also come with fatigue, sense of urgency and night time vision and anxieties over the need to reach the destination especially since night time insecurity is on the high in the study area. Expectedly, high speeds are posted and more reckless decisions are taken by drivers to overtake other slower moving vehicles ahead of them. On the steep, winding and treacherous escarpments, this would be a recipe for fatal crashes. This insecurity may also explain the low numbers posted for fatal crashes and fatalities between 9pm and 6am. This time period generally produces the lowest traffic volume.

#### **Single Vs Multiple Crashes**

Figure 3 presents the data on single and multiple vehicle fatal crashes.

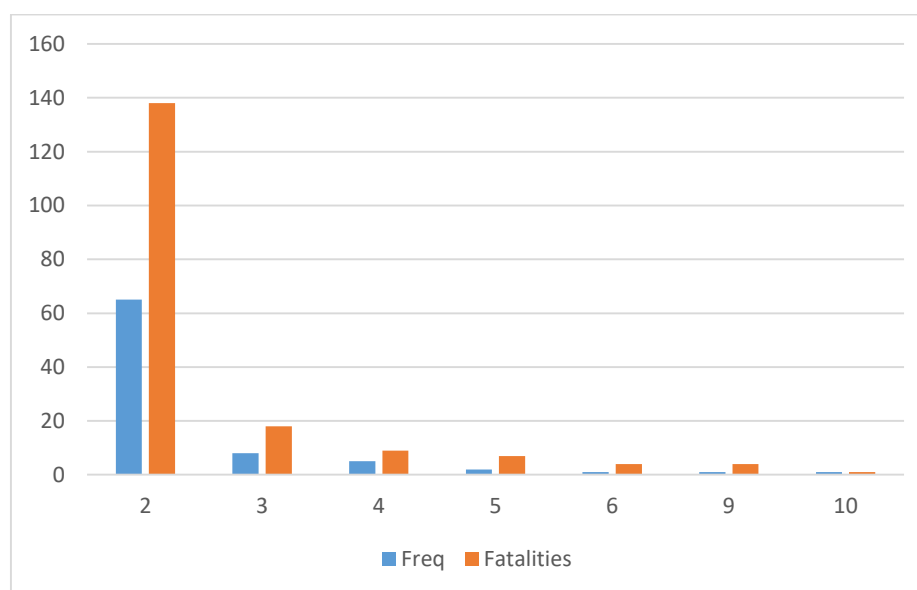


**Figure 3** Single Vehicle and Multiple-Vehicle Fatal Crashes and Fatalities

There were more multiple-vehicle than single-vehicle crashes and fatalities. A single-vehicle crash are those crashes that involve only one vehicle, e.g., a run-off-the-road crash. Multiple-vehicle crashes are those where more than one vehicle are involved, e.g., head-on collision. It is generally understood that single vehicle crashes are a product of driver misbehavior, e.g., distraction during driving, while multiple-vehicle crashes result from inadequacy in the interaction between two drivers on the road (Knippling, 2013). Single-vehicle crashes accounted for 45% (67) of fatal crashes but only 35% (97) of the fatalities. Multiple vehicle crashes were slightly more in number of fatal crashes (83 for 55%) and had much more fatalities (180 for 65%). In essence, multiple-vehicle crashes had more fatality impacts despite only a slightly larger number in fatal crashes. The chances of death occurring is therefore higher in the multiple-vehicle crashes.

Generally, single-vehicle crashes are greater in number than multiple-vehicle crashes, even though MV crashes involve a larger number of vehicles and higher number of fatalities. This is borne out only partially in the study area, where the MV crashes are greater both in fatal crashes and fatalities. The higher probability of fatality occurring in a MV crash may not be unconnected with the fact that the causative factors are different from SV crashes (Hong, Tamakloe & Park, 2019). The MV crashes are usually a result of inadequate interaction between two or more drivers on the road and generally involves a larger number of people than SV crashes. This increases the risks of fatalities.

The MV fatal crashes were further scrutinized. Figure 4 presents the data.



**Figure 4** Multiple Vehicle fatal Crashes and Fatalities

There were 83 MV fatal crashes (55%) recorded, involving 209 vehicles (76%) and resulting in 180 (65%) fatalities. Of immediate interest however are the MV crashes that involved several vehicles at the

same time. Five of these crashes involved five or more vehicles each. Table 3 presents the data on these pile-up crashes.

**Table 1** Multiple-vehicle fatal crashes involving 5 or more vehicles

No of Veh. Involved	Freq	Fatalities	Types of Veh. Involved	Time (Hours)	Initial Cause	Route	Date
5	2	7	4 Cars, 1 Truck	1516	BFL	Babale Road	26/05/2016
6	1	4	3 Cars, 2 Buses, 1 Truck	1815	BFL	Bukuru- Barkin Ladi	14/02/2018
9	1	4	5 Cars, 3 Tricycles, 1 Truck	1640	BFL	Zaria Road	23/03/2017
10	1	1	5 Tricycles, 4 Cars, 1 Truck	1720	BFL	Zaria Road	21/03/2016

All MV crashes in this category had a truck involved and brake failure as the initial cause. Severally, MV crashes involving trucks have the trucks as the initiator and cause. Generally, a brake failure may result into a head to back crash, where the truck hits the vehicle in its front at the back and a domino effect is generated that results in several vehicles involved at the same time. As the momentum of the initial crash (truck on car) wanes with more vehicles being hit, the impact decreases. This probably explains the low number of fatalities recorded. The data shows that the larger the number of vehicles involved, the less the fatalities. Figures 3 and 4 show that two-vehicle crashes are by far the most dangerous and fatal crash type.

As already noted, poor vehicle maintenance is rife among Nigeria vehicle owners. Brake failure and tyre bursts are therefore common especially among trucks. They are among the top three causes of fatal crashes in the state between the study period.

### Spatial Characteristics

#### Routes

Figures 4 - 7 present the data on fatal crashes and fatalities by routes. The most important routes are the Hawan Kibo-Jos, Hawan Kibo-Forest, Jos-Babale, Pankshin – Langtang, and Bukuru – Farin Lamba routes in that order. Each of the routes recorded more than 20 fatalities. Collectively, they account for 66% (184) of all fatalities. They all recorded more than 11 fatal crashes each for a combined 57% (85) of all fatal crashes.

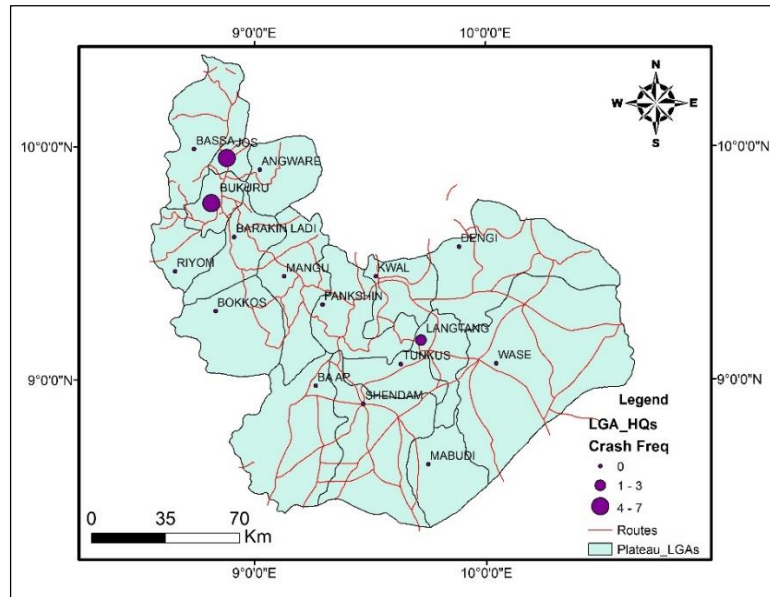
The Hawan Kibo – Jos, Hawan Kibo – Forest and Bukuru – Farin Lamba routes are one continuous roadway demarcated into three sections for convenience of localizing the crashes. The roadway on its own is a Federal Road safety Commission Unit Command, RS4.13. It is a 76 km roadway that is one of the busiest in Plateau state because it is the gateway route from Jos, the state capital and most of its southern parts to Abuja, the capital city of Nigeria. Through traffic from the northeast states of Nigeria and from Jos therefore flow through this route to the FCT, Abuja and Nasawara state, and from there, onwards to Lagos and other parts of Southern Nigeria.

The roadway, especially the Hwan Kibo – Jos section, is one of the most treacherous in the country. It is the section that runs down the steep western escarpment of the Jos Plateau and snakes its way through several hills to the lower plains of the Forest area in Kaduna state and onwards.

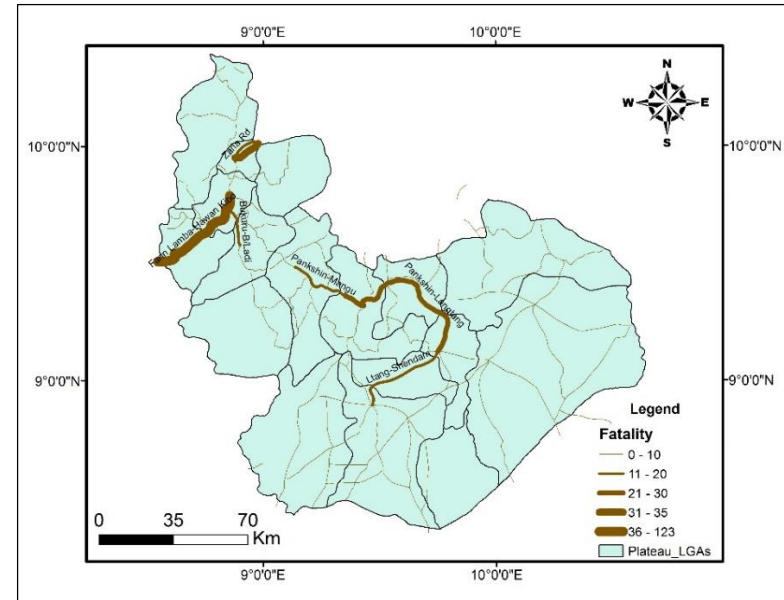
All the aforementioned routes have one characteristic in common: they are all on the steep escarpments on the Jos Plateau, descending towards the lower lying areas. Jos – Babale is the route that leads to Bauchi state and the Pankshin – Langtang route leads from the Jos Plateau highland to the lower lying southern part of Plateau State. They all, therefore, have several degrees of bends as the roads negotiate the hills. Consequently, they are challenging road landscapes, especially to new drivers and vehicles that are not well-maintained or in good conditions.



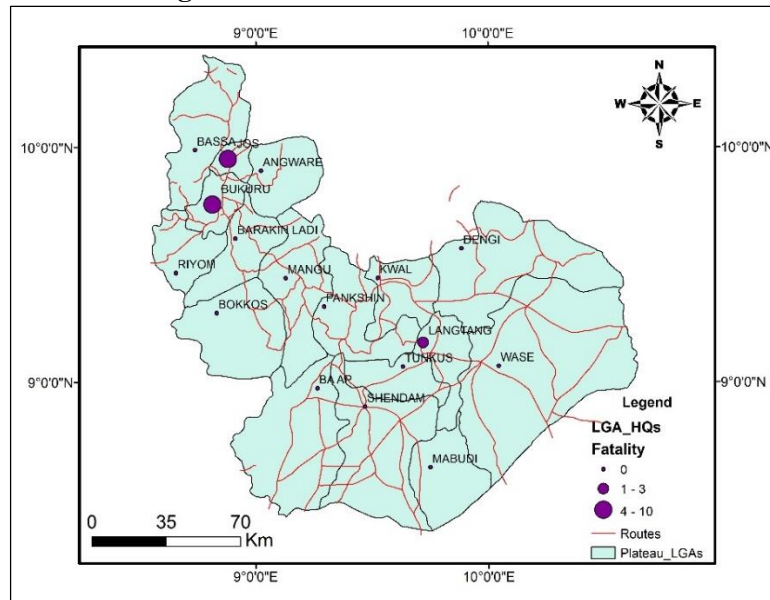
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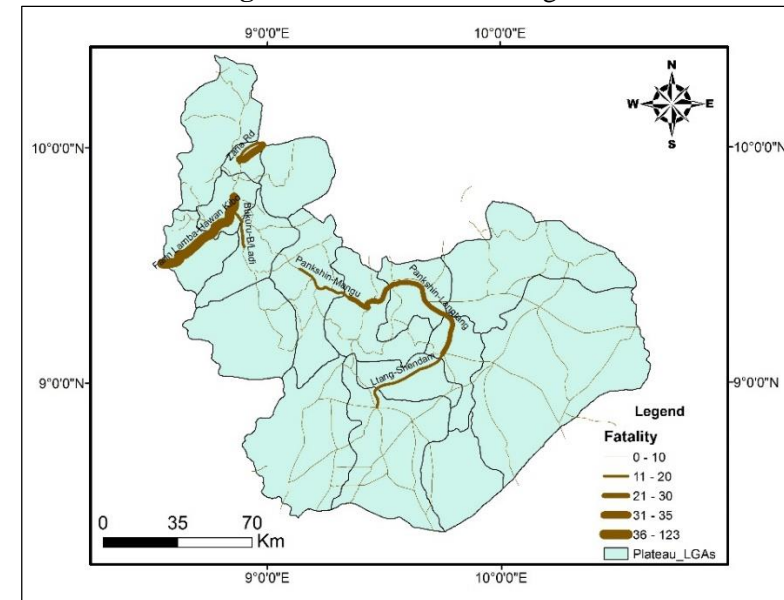
**Figure 4** Fatal Crashes within Towns



**Figure 5** Fatal Crashes along Routes



**Figure 6** Fatalities within Towns



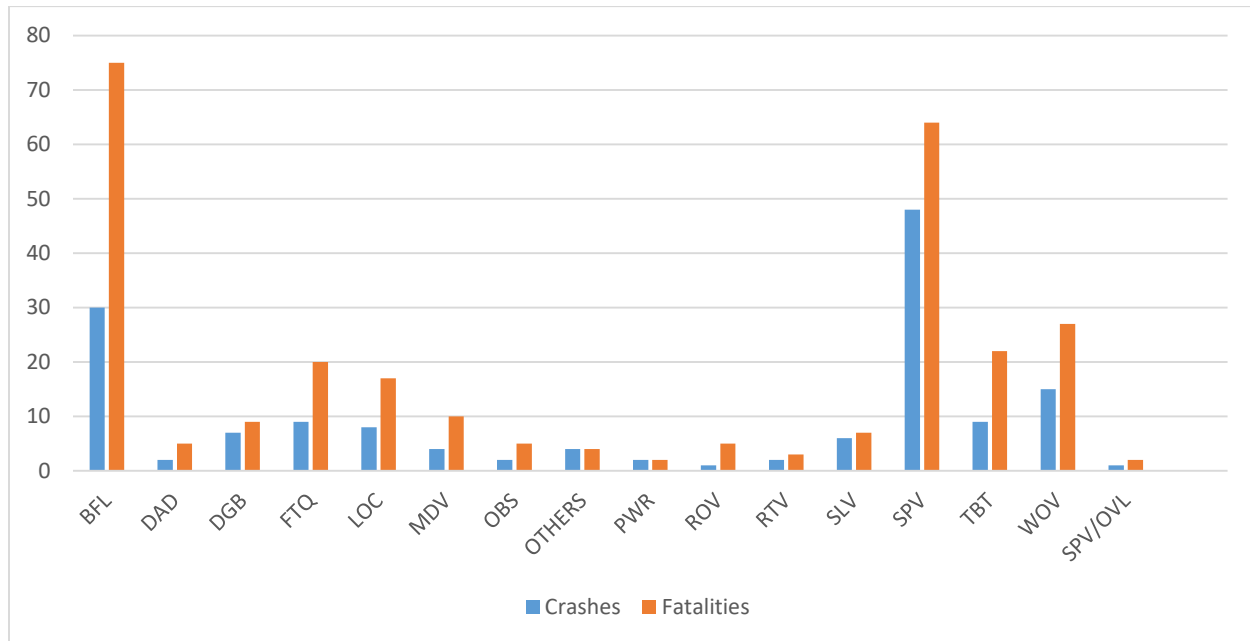
**Figure 7** Fatalities along Routes

It may be important to note that some of these routes are not in excellent conditions. There are large numbers of potholes and stretches of roadways that are very bad. Many of the vehicles are also in very poor conditions and should not be plying the roads.

These are some of the important causes of fatal crashes on the routes.

### Causes of Fatal Crashes

The data contains 14 different causes of road fatal crashes and “others.” Figure 5 presents the data.



BFL: Brake failure; DAD: Driving under Influence of Alcohol/Drugs; DGD: Dangerous Driving; FTQ: Fatigue; LOC: Loss of Control; MDV: Mechanically Deficient Vehicle; PWR: Poor Weather; ROV: Road Obstruction Violation; RTV: Route Violation; SLV: Signal Light Violation; SPV: Speed Violation; TBT: Tyre Burst; WOV: Wrongful Overtaking; OTHERS: e.g., Hit and Run; non-determined cause because of removal, etc

**Figure 5** Causes of Fatal Crashes and Fatalities

The most prominent causes of fatal crashes and fatalities are brake failure, speed violations, wrongful overtaking, tyre burst, fatigue and loss of control. These represent two general broad classification of crashes; human and vehicle factors. The human factors are those causes that are associated with poor human decision making and judgment. These include overspeeding, wrongful overtaking, fatigue and loss of control. The vehicle or mechanical factors are those usually linked to poor vehicle maintenance culture or defects. These include tyre burst and brake failure. Usually, human factors are responsible for more than 65% of crashes, while vehicular or mechanical causes are attributed about 10% and the road or environmental factor account for about 25% (Rumar, 1985).

Of the 14 causes of crashes recorded, three (brake failure, tyre burst and mechanically deficient

vehicle) are vehicle or mechanical factors. Collectively, they accounted for 43 (29%) fatal crashes and 107 (39%) of the fatalities. It may be argued that this factor contributed a little above the expected numbers of fatal crashes and fatalities. Brake failure is the largest single contributor to fatalities (27%) and the second largest contributor to fatal crashes (20%). Tyre burst is also the third largest contributor to fatalities (8%). These statistics are not exactly surprising because Nigerian vehicles are generally poorly maintained and in bad conditions (Adi, 2011). The commercial vehicles used for long distance travels are also known to be defective in many respects especially the brake systems, lighting and tyre conditions (Okafor, Azuike & Omuemu, 2018).

Only one case of poor weather conditions recorded represented environmental or road factors,



and accounted for 2 crashes (1.33%) and 2 fatalities (0.72%). The remaining crashes and fatalities were attributed to human factors. These are the remaining balance of 105 (70%) and 168 (61%) of fatal crashes and fatalities, respectively. Speed violation is the most prominent human cause of fatal crashes (48 for 32%) and fatalities (64 for 23%). Several studies have established overspending as the prime cause of road crashes in Nigeria (Yahaya et al., 2021; Yunus

& Abdulkarim, 2021). Other prominent human causes included wrongful overtaking, fatigue and loss of control.

Table 2 shows that the number of fatal crashes and fatalities based on causes of crashes correlated highly (92%). The regression model indicates that 85% of the fatalities are accounted for by the number of fatal crashes based on causes of crashes. The relationship is therefore significant.

**Table 2** Relationship between fatalities and fatal crashes based on causes of crashes

<i>Regression Statistics</i>				
Multiple R		0.928451623		
R Square		0.862022415		
Adjusted R Square		0.85282391		
ANOVA F		93.7133		
Significance F		7.64642E-08		

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	0.108991577	1.443729454	0.07549	0.94082
fatalities	0.534827232	0.055247531	9.68056	7.6E-08

The causes of crashes are usually an important factor to consider in understanding the nature of the crash problem. Crashes do not occur in a vacuum, there is usually an underlying reason for their occurrence. Determining these reasons and how their contribution to the problem is a good strategy for devising solutions. Analysis of the causes of fatal crashes and their respective contributions to fatal crashes and fatalities reveal that they should become the pivot around which solutions to address the problem should be anchored.

## CONCLUSION

The day time period expectedly, recorded the highest number of fatal crashes and fatalities. Examined alongside the major contributory routes, it may be understood that a large number of the crashes and fatalities may be connected to the large volume of through traffic witnessed by the state. Being a gateway state to Abuja and through it to Lagos and the southern part of Nigeria from especially al the northeastern states, the Hawan Kibo and Jos-Babale routes play prominent roles in the fatal crash problem in Plateau State. These are

gateway routes from Jos to Abuja and Jos to Bauchi, respectively. Interestingly, all the five routes that had the largest number of fatal crashes (57%) and fatalities (66%) descend for the Jos Plateau highland region through steep, winding roadways to the lower lying regions. The steep gradient, poor vehicle maintenance culture and overspending probably conspired to cause the large numbers of crashes and fatalities along these routes. Human and vehicular factors are the overwhelming causes of fatal crashes and fatalities. Brake failure, overspeeding, tyre burst, fatigue and loss of control are the most important causes. These are obvious pointers to reckless driving decisions and poor vehicular conditions and maintenance.

There is hardly any of these causative problems that cannot be successfully addressed within the extant laws governing driving and traffic flow. Unfortunately, enforcing the law is not one of the strongest points in traffic control in Nigeria and Plateau State. The vehicle inspection office and the Federal Road Safety Commission (FRSC) need to collaborate with one another to ensure compliance with traffic rules and regulations especially in

regards of vehicle maintenance, speed limits violations and dangerous driving. Probably imposition of stiffer penalties would resolve a large portion of the fatal crash and fatalities in the state.

## REFERENCES

Adeloye D, Thompson JY, Akanbi MA, Azuh D, Samuel V, Omoregbe N, Ayo CK (2016) The burden of road traffic crashes, injuries and deaths in Africa: a systematic review and meta-analysis. *Bull World Health Organ* 94(7):510

Boateng, F. G. (2021) Why Africa Cannot Prosecute (Or Even Educate) its Way Out of Road Accidents: Insights from Ghana, *Humanities and Social Sciences Communications*, 8(13), 1 - 11

Ghaffar, A., Hyder, A. A., Govender, V. & Bishai, D. (2004) Road Crashes: A Modern Plague on South Asia's Poor, *J Coll Physicians Surg Pak*. Dec;14(12), 739-41. PMID: 15610634.

Hong, J., Tamakloe, R. & Park, D. (2019) A Comprehensive Analysis of Multi-Vehicle Crashes on Expressways: A Double Hurdle Approach, *Sustainability*, 11, 2782

Ishaku, P. A., Binbol, N. L., Ishaya, S. K., Danjuma, M. N. and Wuyep, S. Z. (2021) Analysis of Rainfall Onset, Cessation and Length of Rainy Season in the Guinea Savanna Region of Nigeria, *African Journal of Geographical Sciences*, 2(1), 105-116

Knipling, R. R. (2013) "Car-Truck Crashes in the National Motor Vehicle Crash Causation Study," Proceedings of the Transportation Research Board (TRB), 92<sup>nd</sup> Annual Meeting, 13

NBS/FRSC (2020) Road Transport Data September Report, Federal Road Safety Corps, Abuja, Nigeria

Osayomi, T. and Areola, A. A. (2015). Geospatial Analysis of Road Traffic Accidents, Injuries and Deaths in Nigeria, *Indonesian Journal of Geography*, 47(1), June, 88 – 9.

Plateau State Government (2022) Official Website of the Plateau State Government, [plateaustate.gov.ng/plateau/at-a-glance#:~:text=Plateau%20State%20is%20located%20in,of%20about%20three%20million%20people](https://plateaustate.gov.ng/plateau/at-a-glance#:~:text=Plateau%20State%20is%20located%20in,of%20about%20three%20million%20people)

Rumar, K. (1985). The Role of Perceptual and Cognitive Filters in Observed Behavior. In L. Evans and R. C. Schwing (Eds.), *Human Behavior and Traffic Safety*. New York: Plenum Press. World Health Organization (WHO) (2018). Global Status Report on Road Safety 2018. World Health Organization, Geneva.

Yahaya, A. M., Yusuf, A. S., Musa, I., Maaji, F. I., Bambale, S. U., Oscar, R., Bawa, A. M. and Uwanuakwa, A. (2021) A Spatiotemporal Appraisal of Road Traffic Accident in Kaduna Metropolis, Nigeria, *Journal of Social, Humanity, and Education (JSHE)*, 1 (3), 209 - 226

Yunus, S. and Abdulkarim, I. A. (2021) Geospatial Analysis of Road Traffic Accidents and Emergency Response Optimization in Kano Metropolis, Nigeria, Research Square, DOI: <https://doi.org/10.21203/rs.3.rs-1138619/v1>