Spatial Pattern of Road Traffic Accident Casualties in Nigeria

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Abstract:The paper examined the spatial variation of road traffic accident casualties in Nigeria with a view to suggesting measures to reduce the scourge. The data used for the study included the total number of deaths and number of injuries from road traffic accident in Nigeria for the period 2004 to 2007. These were collected from the Nigerian Police Force Headquarters and the Federal Road Safety Commission. Data were also collected from relevant federal and state ministries. The results of the analysed data were then shown in map form to depict the spatial variation of road traffic accident casualties across the 36 states and the Federal Capital Territory. Multiple regression method was then used to model the spatial pattern of road accident casualties in Nigeria for the study period. The result showed that spatial variation exists in the incident of road traffic accident in Nigeria. The paper finally made recommendations to reduce the carnage on Nigerian roads.

Keywords: Injuries, Deaths, Safety, Law enforcement, Risks

1. Introduction

Road accident fatalities continue to attract the attention of policy makers and the populace all over the world. The incessant carnage on the roads, especially in developing countries, constitutes a major challenge to safety professionals. This is evident from available statistics on road accident crashes and injuries all over the world.

However, as a result of safety measures adopted in developed countries, variation exists in the magnitude of this scourge between developed and developing countries. While for example developed countries have experienced a decreasing trend since the 1960s, the fatality rate in African countries ranges from 10-fold to more than 100-fold of those in the United States (Chen, 2010; Jacobs & Aeron-Thomas, 2000; Peltzer and Renner, 2004). Lagarde (2007) also reported that while South-East Asia has the highest proportion of global road fatalities (one-third of the 1.4million occurring each year in the world), the road traffic injury mortality rate is highest in Africa (28.3 per 100,000 population) compared with 11.0 in Europe. Indeed, if major challenges are not made to reverse the trend, it is feared that road traffic crash fatality rate in Africa as a whole is anticipated to increase by 80 per cent between 2000 and 2020 (Peden et al., 2004).

In terms of vulnerability, road traffic injuries and fatalities are mostly concentrated on males of their most productive age. According to OECD (2006) and Williams (2003); young drivers have been found to have higher rates of accidents than older drivers (see also Lafont et al., 2008). Statistics has also shown that mortality in road traffic accidents is very high among young adults in their prime and who also constitute the workforce (Balogun et al., 1992).

Besides, pedestrians account for between 45 per cent and 75 per cent of all road traffic deaths in developing countries (Odero et al. 1997). In Africa, pedestrians and passengers of public transportation are the most affected (Lagarde, 2007). These are usually the breadwinners in many cultures. Over 75 per cent of road traffic casualties in Africa are in the economic productive age bracket between 16 and 25 years.

The causes of traffic crashes and fatalities are also varied. Three major categories have traditionally been identified. These are human, vehicle and highway infrastructure (Haddon, 1980). Amongst the three factors, the human factors including road user behaviour and incapacitation have been found to account for more than 85 per cent (see Odero et al., 2003). Among them, the two-best-known contributing factors are speeding, drinking and driving (Chen, 2010; Afukaar, 2003). Human incapacitation, such as visual acuteness and driver fatigue has also been identified among the human factors (Onabolu, Otulana and Awodein, 2008).

The vehicle factor relates to the road-worthiness of vehicles. Vehicle failure resulting from vehicle defects, lack of maintenance and using low quality spare parts also contribute to road crashes and fatalities (Odero, 2003). Highway infrastructure defects such as potholes, sharp bends and generally poor road conditions also have significant effect and contribute to road crashes.

A significant precaution to save lives in the event of road crashes is provision of emergency services. Limitations that explain the poor outcome for people involved in road traffic crashes in Africa have been identified as lack of trained surgeons, intensive care staff, and field para medics, underserved medical facilities; inappropriate dedicated transportation and disorganized or non-existent emergency and trauma services (Lagarde, 2007).

However, most studies in road traffic crashes and fatalities have concentrated on the trends of such events and not emphasizing the spatial patterns. Yet, road traffic crashes and fatalities should be examined also from spatial dimension. In the same way that variations exist in climate, vegetation and economic resources, so also do variations exist in the incidence of road traffic fatalities at global, regional and local levels (World bank, 1999).

The objective of this study is to assess the spatial variation in the incidence of Road Traffic Accident Casualties across the 36 states in Nigeria including the Federal Capital Abuja with a view to making recommendations to curb the carnage on Nigeria roads.

2. Review of Related Literature

A handful of theories have been put forward to explain Road Traffic Accidents causations. Some of the best known theories use System theory and Risk theory in an attempt to explain the causation of Road Traffic Accidents.

2.1 System Theory

The systems perspective views human performance as a function of many interacting system-wide factors. In the context of human error and accident causation, for example, it is now accepted that errors are a consequence of 'systems' failure rather than merely aberrant psychological factors within individuals. Human error is thus no longer always seen as the primary cause of accidents, rather, it is treated as a consequence of latent failures residing within the wider system (Reason, 2000). In a road safety context, elements of the system beyond road users, such as vehicle design and condition, road design and condition, road policies, and so on, all shape drivers behaviour on the road.

Although there are other models of accident causation (e.g. Levenson, 2004; O'Hare, 2000), the systems-based models is the most prominent and it is now widely accepted that the accidents which occur in complex socio-technical systems are caused by a range of interacting human and systemic failures (Salmon and Lenne, 2009). Systems-based accident analysis and investigation, described also in the 'Swiss model', (Reason, 2000) has been applied with significant success in a range of safety critical domains such as in road transport, aviation, process control, rail transport and in a range of other domains which they have been applied successfully (Salmon et al., 2009; Smith et al., 2001; Wiegmann et al., 2003).

2.2 Risk Theory

Risk theory has also been used in the description of accident causation. Risk can be defined as the effect of uncertainty on objectives whether positive or negative. Its management is followed by coordinated economical application of resources to minimize, monitor, and control the probability and impact of unfortunate events (Hubbard, 2009; Rundmo, 2004; Moen, 2005) or to maximize the realization of opportunities. Risks can come from uncertainty in financial markets, project failure, legal liabilities, credit risk, accidents, natural causes and disas ters as well as deliberate attacks from an adversary. Road traffic accidents risk, according to Dejoy (1989) is a function of four elements. The first is the exposure or amount of movement or travel within the system by different users or a given population density. The second is the underlying probability of crash, given a particular exposure. The third is the probability of injury given a crash. The fourth element is the outcome of injury. Risk can also be explained by human error (Reason, 2000; Rasmussen, 1999); kinetic energy, tolerance of human body and post-crash care (Bustide et al, 1989).

Lupton (1999) also asserts that Risks can be seen from four perspectives. These are the rationalist, realist, constructionist and middle positions. The rationalist sees risks as real world phenomena to be measured and estimated by statistics, prioritized by normative decision theory and controlled by scientific management. The realist sees risks as objective hazards or threats that exist and can be estimated independently of social and cultural processes but that may be distorted or biased through social and cultural frameworks of interpretation. The constructionist sees nothing as a risk in itself. Rather, what we understand to be a risk, the constructionist sees as the product of historically, socially and politically contingent ways of seeing. Proponents of the middle positions between realist and constructionist theory see risk as an objective hazard or threats that is inevitably mediated through social and cultural processes and can never be known in isolating from these processes (see Jaeger *et al*., 2001; Horden, 2004).

2.3 Geographical Approach to Traffic Accidents

The geographical approach to the study of traffic accidents relates the concept of place, time and environment to accident occurrence. It is believed that land use, road element, width of the road, bending of road, hilly area, topography and regional distribution in occurrence of road traffic accident are factors to be considered. According to Cutter (1993), geographical scale is important for impacts and their reduction. Land use pattern, types of road network, local business and activity pattern will influence the system risk in an area (Komba, 2006). There is also rural-urban differences. In urban areas, there are more accidents, lower degree of injury while in rural areas, there are lower accident levels but more serious fatalities.

3. Materials and Methods

The data needed for this study are the number of deaths and the number of injured persons resulting from Road Traffic Accidents in the different states of Nigeria for the period 2004 – 2007. The 36 states in Nigeria and Federal Capital, Abuja are shown on figure 1. The data were collected from records of the Nigerian Police Force Headquarters and the Federal Road Safety Commission office in Abuja.

Data were also collected on the total number of registered vehicles in the different states of the country for the period 2004 – 2007 through the States' Statistical Agencies. The distribution of the population of the country by states were collected from records of National Population Commission (NPC). These were obtained through the National Population Census conducted for the country in 2006.

Length of Federal Government of Nigerian Roads in the states were obtained from records of Federal Ministry of Works and Annual Abstract of Statistics 2008 compiled by the National Bureau of Statistics. The collected data were then collated, analysed and presented in form of maps to show the spatial distribution of Road Traffic Accidents casualties by states in the country. These are shown in figures 2., 3. and 4. In addition, regression method was used to build statistical models for the explanation of the spatial pattern of Road Traffic Accident casualties in the country. The analyses were carried out using the Statistical Package for the Social Sciences (SPSS) and Excel.

4. Results and Discussions

4.1 Pattern of Total Road Traffic Accident Casualties

The distribution of total Road Traffic Accident Casualties by states in Nigeria is as shown in table 1.0. The distribution of the accident casualties has been divided into 3 groups based on the percentage of total casualties recorded by each state.

The groupings are as shown on table 2.0. Group A comprise of states with percentage score of Road Traffic Accident Casualties ranging from 0.00 – 2.99 per cent. Group B comprises of states with percentage score of between 3.00 – 5.99 per cent while group C comprises of states with percentage score of between 6.00 – 8.99 per cent. The states that fall within group A are Abia, Adamawa, Akwa Ibom, Anambra, Bayelsa, Borno, Delta, Ebonyi, Edo, Ekiti, Enugu, Gombe, Imo, Jigawa, Kebbi, Kogi, Kwara, Federal Capital – Abuja. These states can be ranked as comparatively recording low level of total Road Traffic Accident casualties in the country. Group B comprises of Bauchi, Cross River, Kano, Katsina, Lagos, Ondo, Osun, Oyo and Plateau States. These states could be ranked as recording a relatively medium level of Road Traffic Accident casualties. Group C comprises of Benue, Kaduna and Ogun States. These states standout as recording high level of Road Traffic Accident casualties in the country.

Figure 2. shows the distribution of Road Traffic Accident casualties by states.

TABLE 1.0: Statistics on Road Accident casualties in Nigeria (2004 - 2007)

State	Total Population in Millions	Total No. of Accidents	Casualties						Length of Roads in Kms	Total No. of Registered Vehicles
			Total No. of Casualties	%	No. of Deaths	%	No. Injured	%		
Abia	2.83	689	1056	0.96	394	1.10	662	0.89	607	156,779
Adamawa	3.17	2,215	2875	2.61	782	2.19	2,093	2.81	1,316	
Akwa Ibom	3.92	2,323	3077	2.79	1145	3.21	1,932	2.60	601.9	62,317
Anambra	4.38	947	905	0.90	361	1.01	634	0.85	554.4	74,770
Bauchi	4.68	1,687	3691	3.35	1235	3.36	2,456	3.30	1,280	
Bayelsa	1.70	755	794	0.72	199	0.56	595	0.80	167.8	10,783
Benue	4.22	4,119	6765	6.14	1864	5.23	4,901	6.53	1,611	
Borno	4.85	1,267	1980	1.80	518	1.45	1,462	1.92	2,207	
Cross River	2.89	2,487	3886	3.62	1140	3.20	2,746	3.33	1,075.19	19,505
Delta	4.10	2,225	2819	2.56	855	2.40	1,964	2.64	732.5	
Ebonyi	2.17	1,196	2060	1.87	480	1.35	1,580	2.12	502.8	23,516
Edo	3.22	2,892	2674	2.43	687	1.93	1,987	2.67	916.5	34,729
Ekiti	2.38	977	1355	1.23	304	0.85	1,051	1.41	367	12,963
Enugu	3.26	2,673	2179	1.98	821	2.30	1,358	1.82	858	
Gombe	2.35	1,057	2201	2.00	965	2.71	1,236	1.66	499	2,500
Imo	3.98	1,197	1589	1.44	634	1.79	955	1.28	599.5	28,043
Jigawa	4.35	764	1114	1.06	355	1.01	759	1.02	751	
Kaduna	6.09	3,210	9643	8.75	3,763	10.55	5,880	7.65	1,688	31,585
Kano	9.38	4,031	4008	3.64	1,237	3.47	2,771	3.72	908.5	52,515
Katsina	5.79	1,668	3819	3.46	1,204	3.84	2,615	3.51	842	27,415
Kebbi	3.24	847	1081	0.98	280	0.79	801	1.08	862.4	119,607
Kogi	3.28	1,137	1670	1.51	693	1.74	977	1.31	1,133	
Kwara	2.37	876	1761	1.60	507	1.42	1,254	1.68	1,044	47,212
Lagos	9.01	4,540	5120	4.64	1,807	5.07	3,313	4.45	675.9	527,484
Nassarawa	1.86	733	1823	1.65	602	1.59	1,221	1.64	887	
Niger	3.95	1,023	1954	1.77	739	2.07	1,215	1.63	2,177.2	27,689
Ogun	3.73	5,964	9622	8.73	2,975	8.35	6,647	8.93	1,071.8	7,906
Ondo	3.44	2,047	3377	3.06	999	2.80	2,378	3.20	724.4	14,364
Osun	3.42	3,414	5558	5.04	1,431	4.01	4,127	5.55	628.5	30,071
Oyo	5.59	4,740	5046	4.58	1,532	4.30	3,514	4.72	1,060.5	14,232
Plateau	3.18	2,905	4059	3.68	1,420	3.98	2,639	3.55	979.3	43,799
Rivers	5.16	2,666	2438	2.21	674	1.55	1,764	2.37	657	
Sokoto	3.70	668	844	0.77	549	1.34	295	0.40	582	40,440
Taraba	3.02	908	1264	1.15	322	0.90	942	1.27	1,624	7,201
Yobe	2.32	1,011	2410	2.19	797	2.20	1,613	2.17	877.4	57,334
Zamfara	3.26	451	723	0.66	151	0.42	572	0.77	1,035	26,702
FCT	1.47	2,506	2930	2.66	1,041	2.92	1,889	3.54	236.6	
Total	141.71	74,815	110170		35,462		74,798		34,341.05	1,501,461

Sources: Nigerian Police Force Headquarters; Federal Road Safety Commission; National Population Commission; National Bureau of Statistics; Federal Ministry

Table 2: Summary Grouping of States on Severity of Road Traffic Accident Casualties

Group	Rank	States
A	Low (0.00 – 2.99%)	Abia, Adamawa, Akwa Ibom, Anambra, Bayelsa, Borno, Delta, Ebonyi, Edo, Ekiti, Enugu, Gombe, Imo, Jigawa, Kebbi, Kogi, Kwara, Nassarawa, Niger, Rivers, Sokoto, Taraba, Yobe, Zamfara, Federal Capital Territory
B	Medium (3.00 – 5.99%)	Bauchi, Cross River, Kano, Katsina, Lagos, Ondo, Osun, Oyo, Plateau
C	High (6.00 – 8.99%)	Benue, Kaduna, Ogun

Source: Author's Analysis of Table 1.0

4.2 Pattern of Motor Vehicle Deaths

The distribution of motor vehicle deaths by states in Nigeria is also shown on table 1.

The distribution has been divided into 4 groups based also on the severity of total deaths recorded by the states. The groupings are as shown on table 3.0. Group A comprises of Abia, Adamawa, Anambra, Bayelsa, Borno, Delta, Ebonyi, Edo, Ekiti, Enugu, Gombe, Imo, Jigawa, Kebbi, Kogi, Kwara, Nassarawa, Niger, Ondo, Rivers, Sokoto, Taraba, Yobe, Zamfara States and Federal Capital Territory. These states can be ranked as recording relatively low level of motor vehicle deaths in the country.

Group B comprises of Akwa Ibom, Bauchi, Benue, Cross River, Kano, Katsina, Lagos, Osun, Oyo and Plateau States. The states can be ranked as recording relatively medium level of motor vehicle deaths in the country.

Group C comprises of Benue and Ogun State and these states can be ranked as recording relatively high level of motor vehicle deaths in the country. The fourth group is Group D comprising only of Kaduna State which can singularly be ranked as the only state with relatively very high level of motor vehicle deaths in the country. Figure 3.0 shows the spatial distribution of motor vehicle deaths by states in the country.

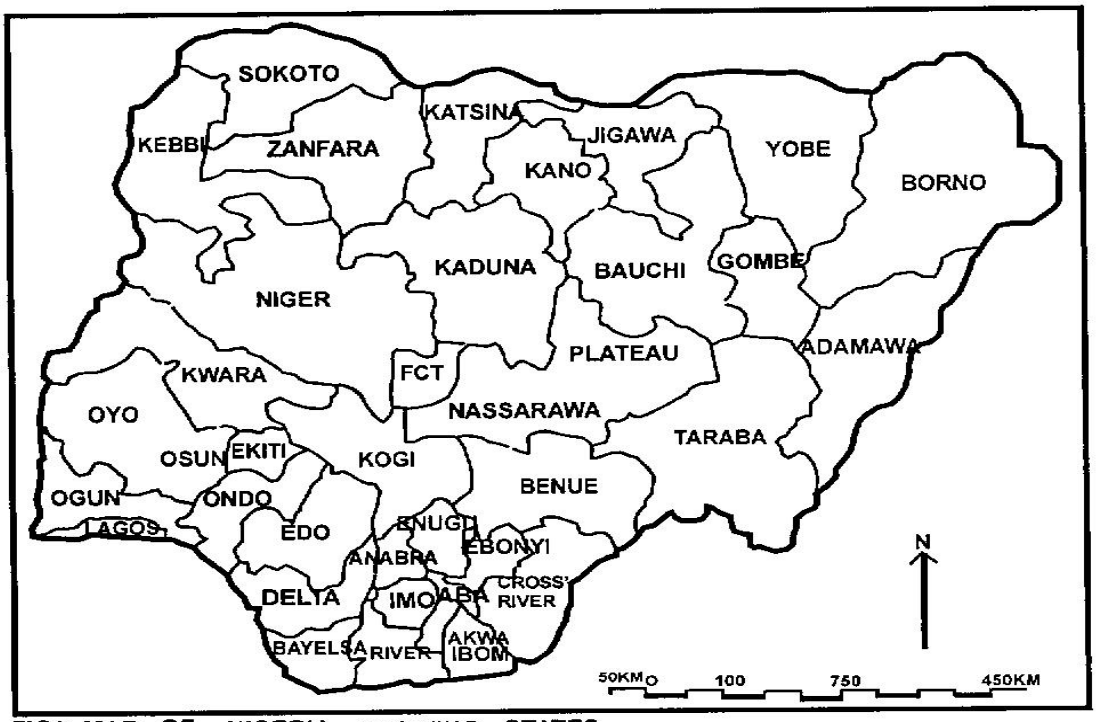

FIG1: MAP OF NIGERIA SHOWING STATES

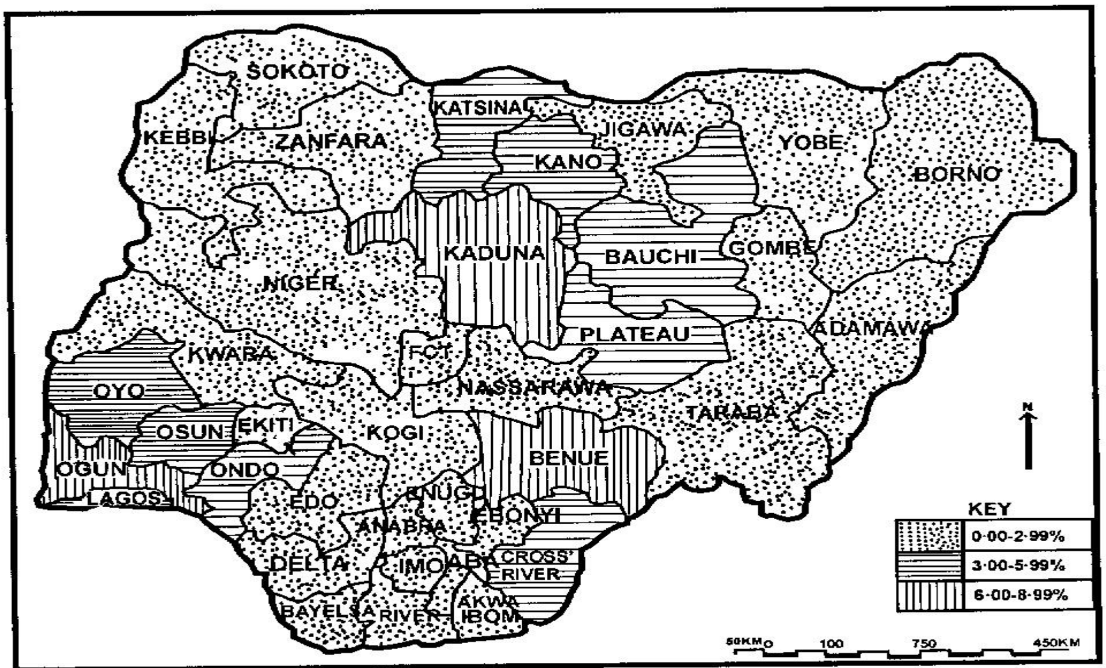

FIG2: MAP OF NIGERIA SHOWING DISTRIBUTION OF TOTAL ACCIDENT CASUALTIES BY STATES (2004-2007)

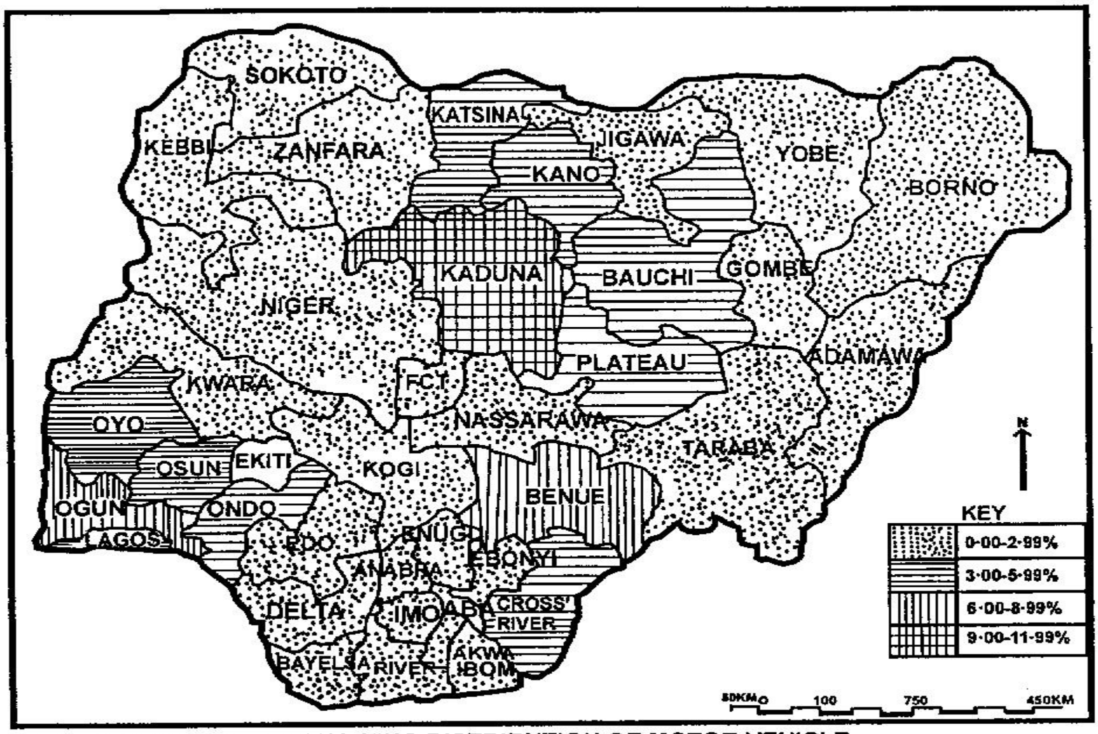

FIG3: MAP OF NIGERIA SHOWING DISTRIBUTION OF MOTOR VEHICLE DEATHS BY STATES (2004-2007)

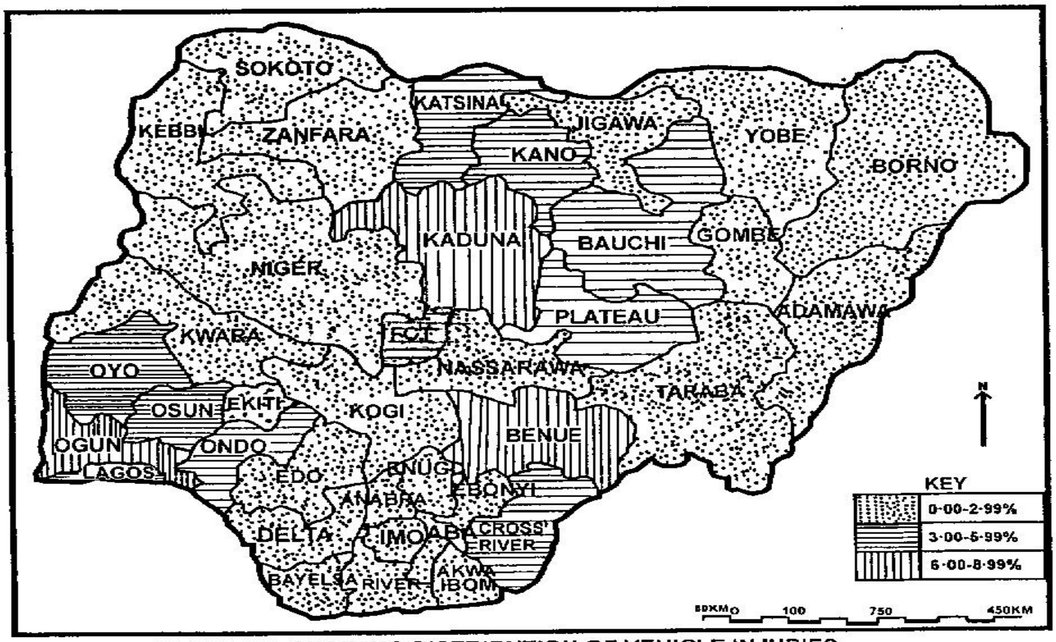

FIG4: MAP OF NIGERIA SHOWING DISTRIBUTION OF VEHICLE INJURIES BY STATES (2004-2007)

Table 3: Summary Grouping of States on Severity of Motor Vehicle Deaths

Group	Rank	States
A	Low (0.00 – 2.99%)	Abia, Adamawa, Anambra, Bayelsa, Borno, Delta, Ebonyi, Edo, Ekiti, Enugu, Gombe, Imo, Jigawa, Kebbi, Kogi, Kwara, Nassarawa, Niger, Ondo, Rivers, Sokoto, Taraba, Yobe, Zamfara, Federal Capital Territory.
B	Medium (3.00 – 5.99%)	Akwa Ibom, Bauchi, Cross River, Kano, Katsina, Lagos, Osun, Oyo, Plataeu.
C	High (6.00 – 8.99%)	Benue, Ogun
D	Very High (9.00 – 11.99%)	Kaduna

Source: Author's Analysis of Table 1.0

4.3 Pattern of Motor Vehicle Injuries

The pattern of distribution of motor vehicle injuries by states in the country is also as shown on table 1.0. The distribution can be grouped into 3 categories based on the severity of motor vehicle injuries recorded by the states.

Group A comprises of Abia, Adamawa, Akwa Ibom, Anambra, Bayelsa, Borno, Delta, Ebonyi, Edo, Ekiti, Enugu, Gombe, Imo, Jigawa, Kebbi, Kogi, Kwara, Nassarawa, Niger, Rivers, Sokoto, Taraba, Yobe and Zamfara States. These states can be ranked as recording relatively low level of motor vehicle injuries in the country.

Group B comprises of Bauchi, Cross River, Kano, Katsina, Lagos, Ondo, Osun, Oyo, Plateau States and the Federal Capital Territory. They can be ranked as recording relatively medium level of Motor Vehicle Injuries in the country.

Group C comprises or Benue, Kaduna and Ogun States and can be ranked as recording relatively high level of Motor Vehicle Injuries in the country. Table 4.0 shows the summary groupings of the severity of Motor Vehicle Injuries by states while figure 4.0 shows the spatial pattern of the distribution.

Table 4.Summary Grouping of States on Severity of Motor Vehicle Injuries

Group	Rank	States
A	Low (0.00 – 2.99%)	Abia, Adamawa, Akwa Ibom, Anambra, Bayelsa, Borno, Delta, Ebonyi, Edo, Ekiti, Enugu, Gombe, Imo, Jigawa, Kebbi, Kogi, Kwara, Nassarawa, Niger, Rivers, Sokoto, Taraba, Yobe, Zamfara
B	Medium (3.00 – 5.99%)	Bauchi, Cross River, Kano, Katsina, Lagos, Ondo, Osun, Oyo, Plateau, Federal Capital Territory.
C	High (6.00 – 8.99%)	Benue, Kaduna, Ogun

Source: Author's Analysis of Table 1.0

5. Modelling the Spatial Pattern of road Traffic Accident casualties

The model developed here relates total accident casualties with total number of road accidents; population estimates, length of roads and number of registered vehicles for a country. The model is a modification of that used by Nasir in 2009 in his study of Road Accident Deaths in India and that used by Flanders in Belgiun in 2001.

The original model takes the form:

$$RF = RA + PE + LR + PT + \varepsilon$$

Where RF represents Road fatalities, RA – Road Accidents; PE – Population Estimates; LR – Length of Roads; PT – Traffic Population; ε is the Error term.

The model for this study takes the form:

$$RAC = TRA + PE + LR + NRV + \varepsilon$$

Where RAC = Road Accident Casualties
TRA = Total Road Accidents
PE = Population Estimate
LR = Length of Federal Government roads
NRV = Total Number of Registered Vehicles
ε = An Error term

Two multiple regression models were developed for the study. One for Motor Vehicle Deaths and the second for Motor Vehicle Injuries for the study period in the country.

In order to take the interactive nature of the variables into consideration, the model was transformed into its logarithm form (See Zlatopher, 1984; Pocock *et al*., 1982). Using the Least Square Regression Method the collected data were analysed with the Statistical Package for the Social Science (SPSS) and Excel.

5.1 Pattern of Motor Vehicle Deaths

The model for motor vehicle deaths takes the form.

$$\text{Log (MVD)} = \log(TRA) + \log(PE) + \log(LR) + \log(NRV) + \varepsilon$$

Where MVD represents Motor Vehicle Deaths, TRA represent Total Road Accidents, PE represents Population Estimates; LR represents Length of Roads; NRV represents Number of Registered Vehicles

Table 5.0 shows the Regression Summary of Motor Vehicle Deaths with the independent variables. The independent variables explain 73.2 percent of the total variation in motor vehicle deaths. The remaining 26.8 percent are variables which cannot be included in the model due to their exogenous features. These could include lack of emergency services and first aid in the event of motor vehicle accidents.

Table 5: Regression Summary for Motor Vehicle Deaths and the Independent Variables

Dependent Variables	Independent Variables	Regression Coefficient	Standard Error	t-values	Levels of significance
Motor Vehicle Deaths (MVD)	Constant	-0.303	1.088	-0.279	0.782
	Total Road Accidents (TRA)	-0.013	0.220	-0.101	0.920
	Population Estimate (PE)	0.819	0.111	7.766	0.000*
	Length of Roads (LR)	0.166	0.138	1.596	0.120*
	No. of Registered Vehicles (NRV)	-0.025	0.080	-0.245	0.808

$R^2 = 0.732$ DF = $^4/_{32}$ F = 21.828 > 2.69

* Significant at 0.05 level of significance

The regression summary shows that motor vehicle deaths has negative association with total road accidents and number of registered vehicles. This is not surprising since the establishment of the Federal Road Safety Commission in Nigeria in 1988 has had positive impact in reducing motor vehicle accidents in the country and consequently motor vehicle deaths.

The regression summary also shows that motor vehicle deaths has a positive association with population estimate and length of roads. These outcomes are not surprising also because increase in the level of motorization in a country is associated with increasing population. Increasing population is also associated with higher probability of accident occurrence. Also, improvement in road networks encourages speeding by drivers and also accidents.

Further the F-test shows that the regression is significant since the F-statistic of 21.828 is greater than the critical value of 2.69 at 0.05 level of significance. The t-values also show that population estimate and length of roads are significant at 0.05 level. The value of the coefficient of determination, R^2 which is 73.2 per cent shows that the model is a good fit for the data. The predictive ability of the model is thus confirmed. The regression model obtained is:

$$\text{Log (MVD)} = -0.303 - 0.013\log(\text{TRA}) + 0.819\log(\text{PE}) + 0.166\log(\text{LR}) - 0.025\log(\text{NRV})$$

5.2 Pattern of Motor Vehicle Injuries

The model for motor vehicle injuries takes the form:

$$\text{Log (MVI)} = \log(\text{TRA}) + \log(\text{PE}) + \log(\text{LR}) + \log(\text{NRV}) + \varepsilon$$

where MVI represents motor vehicle injuries; TRA, total road accidents, PE, population estimate; LR, length of roads; NRV, number of registered vehicles.

Table 6. shows the regression summary of motor vehicle injuries and the independent variables. The independent variables explain 83.8 per cent of the total variation in motor vehicle injuries.

Table 6.:Regression Summary for Motor Vehicle Injuries and the Independent Variables

Dependent variable	Independent Variables	Regression Coefficients	Standard Error	t-value	Levels of Significance
Motor Vehicle Injuries (MVI)	Constant	1.037	0.833	1.245	0.222
	Total Road Accidents (TRA)	-0.143	0.168	-1.474	0.150
	Population Estimate (PE)	0.916	0.085	11.185	0.000*
	Length of Roads (LR)	0.237	0.105	2.945	0.006*
	No. of Registered Vehicles (NRV)	-0.049	0.061	-0.636	0.530

$R^2 = 0.838$ DF = $^4/_{32}$ F = 41.46 > 2.69

* significant at 0.05 level of significance

The remaining 16.2 per cent are variables which cannot be included in the model as a result of their exogenous features. These could include behaviour and driving capacities of drivers, and vehicle conditions.

The regression summary shows that motor vehicle injuries has positive association with population estimate and length of roads. This is to be expected since population growth leads to increased level of motorization and higher probability of accidence occurrence and also injuries. Also, improved road provision promotes motorization and motorability.

In this study, total road accidents is found to have negative association with motor vehicle injuries. This could be due to the efforts of the Federal Road Safety Commission established in the country in 1988 to reduce road traffic accidents and injuries on the Nigerian roads. The results show that number of registered vehicles has negative association with motor vehicle injuries. This is hard to interpret but one should not dismiss the possibility that security checks by law enforcement agencies also help to reduce the number of unregistered and un-roadworthy vehicles on the roads.

The study also shows that two independent variables, population estimate and length of roads are significant at 0.05 level, considering their t-values. The value of the coefficient of determination R^2 which is 83.8 per cent shows that the model is a good fit for the data. The F-test also shows that the regression is significant since the F-statistic of 41.46 is greater than the critical value of 2.69 at 0.05 level of significance. The predictive ability of the model is thus confirmed. The multiple regression model obtained is

$$\text{Log(MVI)} = 1.037 - 0.143\log(\text{TRA}) + 0.916\log(\text{PE}) + 0.237\log(\text{LR}) - 0.049\log(\text{NRV})$$

6. Conclusion and Recommendations

This study has examined the spatial distribution of road traffic accident casualties among the 36 states and the Federal Capital Territory of Nigeria. The study shows that regional variations exist in the incidence of road traffic accident casualties in the country within the study period of 2004 – 2007.

The study has tried to model motor vehicle deaths and motor vehicle injuries on Nigerian roads. The results show that total road traffic accidents, population estimate, road lengths and number of registered vehicles are important variables to take into consideration in examining road traffic accident casualties in the country.

In order to curtail road traffic accidents on Nigerian roads, the following recommendations are pertinent:

1. Drivers should be trained and retrained as a means of effectively dealing with road traffic accident reduction.
2. Motorists should drive within speed limits and with a speed consistent with road conditions.
3. Motorists should not drink and drive and should comply with the legislation on speed limits.
4. Seat belts should be worn by motorists for both short and long trips.

5. First aid kit should be provided in every vehicle and emergency first aid facilities should be made available for accident casualties.
6. Road safety education should be part of the curriculum in our educational institutions.
7. Traffic laws must be judiciously enforced by the various law enforcement agencies in the country.

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