

## Original Article

# Impact of transportation policy on injury characteristics in a teaching hospital, Calabar, Nigeria

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**Abstract:** Introduction: The global burden of road traffic injury (RTI)-related trauma is enormous and has the highest impact in low income economies. Loss of lives in the most productive age groups and the socio-economic costs to these weak economies, coupled with poor infrastructure for management of the severely injured dictate that well executed preventive measures be instituted in these countries. Low and middle income economies account for 90% RTI-related deaths in the world, yet in these regions, public health regulations on road safety hardly exist and where they do, are hardly enforced. Aim: To document variations in injury frequency, severity and outcomes following the ban on the use of motorcycles as a means of public transportation in Calabar. Patients and Methods: A prospective study of RTI patients who presented in our Emergency center over a 12 month period. Information recorded included biodata, anatomic location of injury, injury-arrival time, mode of transportation to hospital and final disposition at discharge. Chest injuries were excluded as there were no data for comparison. Results were analyzed by SPSS version 20 and compared with the 2005 Trauma Study Group results. Results: There were 366 road traffic injuries out of 5612 emergency room presentations during the period. There were 237 males and 99 females (M: F= 2.4: 1), mean age of patients was 30.13±12.62 years. Businessmen were the most commonly involved occupational group (n= 138; 38.7%) and the mean injury-arrival interval was 16.57±56.14 hours. Only 12 (3.6%) patients arrived by ambulance and 108 (32.1%) left against medical advice. Conclusion: RTIs constitute a major socioeconomic burden in the developing world. Lack of research, high risk behaviors and lack of enforceable road use regulations contribute to high rates of RTI-related mortality and morbidity. Preventive interventions and appropriate research to identify risk factors will reduce the burden of RTIs in low and middle income economies.

**Keywords:** Road traffic injuries (RTI), public health policy, prevention, low income economy

## Introduction

The global burden of road traffic injury (RTI)-related trauma is enormous and injury constitutes a major public health challenge [1, 2]. Less developed countries constitute the habitation of most of the world's population where injury rates are higher, and few control activities have been undertaken in these regions [1]. Understanding the risk factors for injury, translating this knowledge into well designed preventive measures adapted to the local injury epidemiology are important in trauma management [2]. This is more critical in less developed economies with immature trauma systems, poorly developed infrastructure and social support systems and entrenched cycles of disease, poverty and ignorance [3, 4]. In both developed

and developing regions, injury rates are higher in the most vulnerable sections of the community, and in those of low socioeconomic status [1].

Literature estimates that road traffic injuries account for 3400 deaths daily and an estimated 5million lives could be saved on the world's roads during the Decade of Action for Road Safety 2011-2020 [5]. Besides being the leading cause of death in people aged 15-44 years, road traffic injuries are projected to rise from being the ninth leading cause of death worldwide in 2004 to the fifth in 2030 [5]. Road traffic injuries also present a significant economic burden. With an estimated 90% of global road fatalities occurring in low and middle income countries, the economic impact of these inju-

ries is an added severe strain to these weak economies. It is projected that every USD 1 spent on preventive interventions can save up to USD 20 in lost earnings, reduced productivity and health costs [4]. This can potentially free huge resources for other developmental needs.

The developed world has recorded most of the progress made in road safety and trauma intervention systems. Reports from Africa and other developing regions show that the economically productive age groups are most commonly involved in road traffic accidents, and make the case for urgent public policy response from these regions [6-8]. The role of motorcycle related injuries, high risk activities such as recklessness, the influence of alcohol and non-use of protective gears like helmets and seatbelts has been highlighted in previous African studies [6, 9-11]. These are areas where judicious public policy interventions can make a huge difference in these developing economies. In developing countries, the choice of the mode of transport is influenced by socio-economic factors and most injuries occur in urban areas, affecting mainly pedestrians, passengers and cyclists more than drivers [12]. Four groups of preventive intervention programmes have been documented to be effective in the developed world. These are health education/awareness campaigns, legislation, product design and environmental modifications [13, 14]. Legislation has been documented to play a significant role in reducing the frequency and severity of injuries [13]. A large number of developing countries are however unable to derive optimum benefit from interventions aimed at preventing road traffic injuries due to a lack of investments in safety interventions and appropriate research [13, 15].

Low and middle income economies account for 90% of worldwide deaths related to road traffic injuries [14, 16]. A successful multidisciplinary model of road traffic injury surveillance in a developing country has been documented, and improvements in data collection is considered key for the successful implementation and monitoring of preventive safety programmes [17]. Rapid urbanization, increased motorization, unsafe public transportation, risky road behaviors and a diverse vehicular mix coupled with differential access to medical services in developing economies contribute a major role

in death and disability resulting from road traffic injuries [14]. Preventive measures are cheaper than the 1-2% of annual gross domestic product lost to road traffic injuries in these economies [7, 8, 14], yet these measures are either not appropriately implemented or are scarcely developed in low and middle level income countries.

Prior to 2010, motorcycles were the commonest mode of transportation in Calabar metropolis, an area of 604 km<sup>2</sup> with an estimated population of 1.2 million. In 2005, the University of Calabar Teaching Hospital (UCTH) Trauma Study Group documented the injury characteristics in different anatomic regions except chest injuries presenting in the hospital [2, 9-11, 17]. A chest injury study covering the period 2002-2004 had previously been undertaken [18]. In 2010, Government policy imposed a ban on the use of motorcycles as a means of public transportation within Calabar metropolis. One year later, the ban was fully enforced and motorcycles eliminated as a means of urban transportation. Our study seeks to document the impact of an appropriately enforced road transportation policy on injury characteristics and outcomes in a Teaching Hospital in Calabar, Southern Nigeria. This will contribute to the database of literature on injuries and potentially stimulate the development and implementation of appropriate preventive measures in our environment.

### **Aims & objectives**

To document the variations, if any, in injury frequency, severity and other characteristics following the implementation of a major policy change in urban transportation involving the use of motorcycles in Calabar, Southern Nigeria.

### **Patients and methods**

A prospective study of all patients who presented in the Accident and Emergency Unit of the University of Calabar Teaching Hospital following injury. Patients data were obtained including biodata, anatomic locations of injury, etiology, injury-arrival time, pre-hospital care, mode of transportation to hospital and treatment outcomes. Traumatic brain injury severity was assessed using the revised trauma score. The vehicle involved, mechanism of injury and role of risky behaviors like alcohol use and non-use of safety measures were also documented.

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**Table 1.** Clinical and Outcome parameters

Variable	Frequency n (%)		
Gender	Male	237 (70.5)	
	Female	99 (29.5)	
	Total	366 (100)	
Occupation	Self-employed	130 (38.7)	
	Public employee	68 (20.2)	
	Students/pupils	94 (28)	
	Driver	24 (7.1)	
	Pensioners	3 (0.9)	
	Unemployed	17 (5.1)	
	Total	366 (100)	
	Mode of Arrival	Ambulance	12 (3.6)
Bus		73 (21.7)	
Private car		64 (19)	
Taxi		187 (55.7)	
Total		366 (100)	
Age (years)	Mean±SD	Minimum	Maximum
	30.13±13.62	1	75
Injury to arrival time (Hrs)	16.57±56.14	0.16	672
Behavior	Alcohol abuse	69 (20.6)	
	Seat belt use	40 (13)	
	Helmet use	14 (24.6)	
Outcomes	Treated & Discharged	163 (48.5)	
	Referred	60 (17.9)	
	Left against medical advice	108 (32.1)	
	Dead	5 (1.5)	
		366 (100)	

Only patients with complete data as requested in the ProForma for the study were entered in the analysis of results. Chest injuries were excluded in our results because there were no studies for these injuries during the 2005 Trauma Study for comparison. Results were analyzed using SPSS Version 20 and compared with published results of the 2005 UCTH Trauma Study Group. Tests of significance were performed using Ufton's Chi-square and Student T-test as indicated.

### Results

There were a total of 5612 Accident and Emergency (A & E) presentations during the 12 months under review. Out of these, there were 366 RTI-related presentations comprising 237 males and 99 females (M: F= 2.4: 1). There were 57 (15.6%) motorcycle related accidents. The mean age of the patients was 30.13±13.62 years. One Hundred and Thirty (38.7%) patients

were businessmen, 68 (20.2%) were civil servants while 94 (28%) were students or pupils and 24 (7.1%) were drivers. The mean injury to arrival interval was 16.57±56.14 hours while alcohol abuse was present in 69 (20.6%) cases. One hundred and eighty-seven patients (55.7%) arrived the hospital by taxi, 73 (21.7%) by bus, 64 (19%) by private care and only 12 (3.6%) by ambulance. In terms of outcomes, 163 (48.5%) patients were discharged after treatment, 60 (17.9%) were referred, 108 (32.1%) left against medical advice (LAMA) and 5 (1.5%) died from their injuries (**Table 1**).

**Tables 2 and 3** show the major injury presentations during the period. There were 54 (16.1%) traumatic brain injuries, 22 (6.6%) spinal injuries, 4 (1.2%) open humeral fractures, 15 (4.5%) close humeral fractures, 6 (1.8%) open femoral fractures and 26 (7.7%) close femoral fractures. Open tibial fractures accounted for 30 (8.9%) cases, close tibial fractures were 14 (4.2%), penetrating abdominal injuries occurred in 3 (0.9%) patients and blunt abdominal injuries in 9 (2.7%) patients. The mean revised trauma score for patients with traumatic brain injury was 11.01±0.74 and the proportion of injuries per 100 A & E presentations was 15.3 compared to 19.9 in 2005.

### Discussion

Africa's roads have been described as "the deadliest in the world" and young breadwinners constitute the majority of those who are killed on African roads [19]. In a 2010 World Health Organization (WHO) survey released in 2013, Nigeria had the highest road traffic injury death rates in Africa (33.7%/100,000), followed by South Africa (31.9/100,000) [20]. In addition to killing and/or maiming young breadwinners, the economic implications of road traffic crashes in Africa is enormous with African governments

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**Table 2.** Comparison of major types of injury for 2005 and 2011

Variable	2011 Freq (%)	2005 Freq (%)	Test of significance
Traumatic brain injury	54 (16.1)	118 (27.83)	Upton's $\mu^2= 14.78$ $p= 0.000^*$
Spinal fracture	22 (6.6)	14 (3.30)	Upton's $\mu^2= 4.371$ $p= 0.037^*$
Open humeral fracture	4 (1.2)	14 (3.30)	Upton's $\mu^2= 3.609$ $p= 0.057$
Close humeral fracture	15 (4.5)	13 (3.07)	Upton's $\mu^2= 1.031$ $p= 0.310$
Open femoral fracture	6 (1.8)	22 (5.19)	Upton's $\mu^2= 6.109$ $p= 0.013^*$
Close femoral fracture	26 (7.7)	19 (4.48)	Upton's $\mu^2= 3.565$ $p= 0.059$
Open tibial fracture	30 (8.9)	42 (9.91)	Upton's $\mu^2= 0.0208$ $p= 0.648$
Close tibial fracture	14 (4.2)	38 (8.96)	Upton's $\mu^2= 6.755$ $p= 0.009^*$
Penetrating abdominal injury	3 (0.9)	13 (3.07)	Upton's $\mu^2= 4.244$ $p= 0.039$
Blunt abdominal injury	9 (2.7)	13 (3.07)	Upton's $\mu^2= 0.100$ $p= 0.752$

\*Statistically significant.

**Table 3.** Comparison of Annual A & E presentations & injury severity for traumatic brain injury for 2005 and 2011

Variable	2011	2005	Test of significance
Total annual number of injuries	366	424	Upton's $\mu^2= 388.14$
Total annual number of A & E presentations	5612	2129	$P= 0.000^*$
Proportion of injuries per 100 A & E presentations	15.3	19.9	
Revised trauma score for traumatic brain injuries	11.01±0.74	10±0.99	$t= 6.69$
Total	54	118	$df= 170$ $p= 0.000^*$

\*Statistically significant.

losing 0.8-0.9% of their gross domestic products (GDP) to road traffic crashes and the ensuing consequences [19]. Failure of instituting appropriate legislation, and enforcement of legislation with respect to the major risk/protective factors, where they exist, is a major determinant of injury events and outcomes on African roads [19]. Previously documented factors including safety audits on new and existing roads, harmonization of vehicle standards, urban speed limits, laws on risky behaviors like blood alcohol regulations, child restraint laws and policies to protect vulnerable road users are options which have reduced the volume and consequences of road traffic injuries in high income countries but hardly exist, or are enforced in African countries who combined, have only 2% of the world's registered vehicles but contribute the highest risk of dying as a result of a road traffic collision [19]. This risk is estimated to be 24.1/100,000 population in the WHO Africa region against the global rate of 18/100,000 [19, 20].

Our results show that enforcing a ban on the use of motorcycles as a mode of commercial

transportation in Calabar metropolis alone resulted in a statistically significant reduction in the overall rate of RTI-related trauma presentations in our A & E from 19.9 per 100 in 2005 to 15.3 per hundred in 2011. Since our A & E also receives trauma victims from outside Calabar metropolis, the overall effect of a State-wide ban of this mode of public transportation can be inferred. The study also shows that businessmen were the most frequently involved occupational group and the mean age of the patients was 30.13±13.62 years. The male gender was also more commonly involved in road traffic injuries with 237 (70.5%) cases. These findings in our study agree with other studies that road traffic injuries affect more men and occur more often in the productive age group within the first four decades of life [9-11, 18, 19]. Beyond the injury, the interval to intervention is an important determinant of outcomes in trauma situations. The mean injury-arrival time in this study was 16.57±56.14 hours, well beyond the "golden hour" for salvage of the severely injured in major trauma situations. The absence of an organized ambu-

lance system is again highlighted in this study. One hundred and eight-seven patients (55.7%) arrived in a taxi, 73 (21.7%) arrived in a bus, 64 (19%) were brought in private cars while only 12 patients (3.6%) arrived in an ambulance. This, combined with poor road infrastructure and absence of trained Emergency Medical Technician (EMT) personnel may result in loss of critical life-saving opportunities in severe trauma situations. This study also shows that 108 (22.1%) patients left hospital against medical advice. Many patients of this category, especially those with fractures, often end up in traditional bonesetting practices. The role of cultural beliefs and other factors that influence the continuing patronage of traditional bone-setters in our environment is well documented [21-23].

Our results also show a statistically significant reduction in traumatic brain injuries, open femoral fractures and closed tibial fractures during the period after the ban was effected. Though statistically insignificant, there was also an overall reduction in the frequency of open humeral fractures, open tibial fractures as well as blunt and penetrating abdominal injuries during the period. Motorcyclists, cyclists and pedestrians are devoid of the protection offered by vehicular cabins against extra vehicular forces and constitute the "vulnerable road users" [19]. The impact of injury is therefore likely to be more severe without any shock absorption from external forces offered by the vehicular cabin. Motorcycle riders and passengers are also more likely to be thrown off the motorcycle and receive direct impact with resulting severe injury [9]. There was however a statistically significant increase in spinal fractures over the period compared to 2005. This may be accounted for by the large number of patients who did not use any seatbelt with the potential for whiplash injuries. Out of 306 patients involved in motor vehicle related accidents in this series, only 40 (13%) used seat belts. Alcohol abuse was also recorded in 60 (20.6%) cases.

This study shows that whereas there was a 163% increase in the total annual Emergency room presentations in 2011 over 2005, the total annual number of road traffic accident-related injuries fell from 424 in 2005 to 366 in 2011 (13.7%), proportion of injuries per 100 Emergency room presentations fell from 19.9% to 15.3%, and in evaluating the severity of inju-

ry in traumatic brain injured patients, the revised trauma score in this group of patients showed a statistically significant improvement from a mean of  $10 \pm 0.99$  in 2005 to  $11.01 \pm 0.74$  in 2011. Overall therefore, there was a reduction in the total number of road traffic injuries, decrease in the number of most major injuries and reduced severity of traumatic brain injuries associated with a fall in the number of motorcycle related injuries which accounted for 57 (15.6%) injuries during the period. All the motorcycle-related accidents took place outside Calabar metropolis.

The role of institutionalizing and enforcing preventive behaviors in reducing road accident related injuries and the perils inherent in exempted groups in Western societies is well documented [15, 24, 25]. The lack of road regulations and lack of enforcement where they may be present in the developing world and the impact of this on road traffic injuries is also documented [1, 14, 19]. Lack of research on injury from the developing world remains a challenge [15, 16], and the socioeconomic impact of these injuries on these weak economies is also documented [4, 14]. Well executed preventive measures will therefore remain important in the prevention of these injuries and the associated losses in lives and economic costs in the weak economies of the developing world. The results of this study show the positive effects on total number of injuries and injury severities brought about by a public health decision to ban motorcycles as a means of commercial transportation in Calabar metropolis. Governments in the developing world need to invest more in injury research and preventive measures to reduce the negative economic impact of road traffic injuries in the long term.

### Conclusion

Road traffic injuries (RTIs) constitute a major socioeconomic burden in the developing world. Lack of research, lack of enforceable road use regulations and high risk behaviors are some of the contributors to high rates of RTI-related mortality and morbidity in these societies. The role of preventive measures in reducing the number and severity of RTI is well documented. Public health interventions aimed at prevention, combined with appropriate research to identify local risk factors will help reduce the

burden of RTIs in the developing world and free resources for other socioeconomic needs. This is important considering the lack of appropriate infrastructure to support the management of severely injured patients in these weak economies.

### Disclosure of conflict of interest

None.

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