Risk Factors, Pattern and Outcome of Motorcycle-associated Head Injury in Sokoto: An Analysis of 184 Cases

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Abstract

Background Road traffic accident (RTA) is the eighth leading cause of death worldwide. Motorcycle-associated head injury is the leading cause of road traffic associated morbidity and mortality in developing countries. Even though the incidence and mortality of head injury from motor cycle crash is on the increase in developing countries, especially in the African continent, most of the studies published in the literature on this subject matter took place in the developed Western countries.

Materials and Methods This was a retrospective cross-sectional study of data from patients managed in our institution between December 2014 and November 2016.

Results One hundred and eighty-four patients were analyzed. None of the patients used safety helmet for protection. The mean age was 27.6 ± 17.2 years with male female ratio of 6.7:1. Lone crash by cyclists and collisions accounted for 66.8% and 33.1% of the cases, respectively. Passengers and riders comprised 75% of the patients, while 25% were vulnerable pedestrians. The most frequently abused substance by the patients was tramadol (65.52%). Severe head injury and pupillary abnormality were found in 23.9% and 45.5% of the patients, respectively. Cranial CT scan showed abnormalities in 40.2% of the patients. Surgery was done in 28.3% of the patients with mortality rate of 20.7%.

Conclusions The use of motorcycle as a mean of transportation has caused significant negative impact on the society. Young people, who constitute the workforce, are majorly affected, and this invariably leads to a serious economic burden on the concerned families and communities.

Keywords
- motorcycle
- head injury
- Sokoto
- epidemiology

Introduction

Road traffic accident (RTA) is the eighth leading cause of death worldwide; however, it is the third leading cause of death and the most common cause of disability in Nigeria.[1-5] Motorcycle-associated injuries are responsible for the majority of RTA and death in low-income countries.[3] Most of the fatalities and disabilities that occur from RTA are due to traumatic head injuries.[3,6]Overall, motorcycle-associated

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head injury is the leading cause of road traffic associated head injuries in the developing countries (81%).[7] Research has shown that per mile travel, motorcycle riders have a 34-fold higher risk of death in a crash than people driving other type of motor vehicles.[8] Even though the incidence and mortality of head injury from motor cycle crash is on the increase in the developing countries, especially in the African continent, most of the studies published in the literature on this subject matter took pertained to the developed Western countries.

Head injury from motorcycle crash is most common among young men, due to the current economic uses of motorcycle in Nigeria. According to Solagberu et al, there are four reasons sustaining the use of motorcycles: cheaper cost (US $500) compared with second hand cars (US $3000); only means of transport to many streets, connecting roads, or villages; fast and can beat traffic jams in urban roads; and commercial operators make quick money.[3]

In Sokoto, motorcycle is the only means of intracity commercial transport system, making people of all age groups vulnerable. However, younger people are more predisposed to motorcycle-associated head injury because of their higher rate of mobility for socioeconomic and religious reasons. In Sokoto, primary school pupils, secondary and tertiary school students, government workers, and businessmen and women without private cars move around with commercial or private motorcycle. A finding in Ilorin, north-central Nigeria, showed that the majority of the motorcycle injury patients were students (people attending school as well as those in higher education 20.5%) who were either passengers or pedestrians on journeys to and from school, while others were traders (17.9%), artisans (17.0%), and commercial cyclists (11.6%).[9]

Aim

To study the clinical epidemiology and management outcomes of motorcycle-associated head injury in Sokoto.

Materials and Methods

This is a retrospective cross-sectional study using data of patients managed for motorcycle-associated head injuries between December 2014 and November 2016. Patients who discharged against medical advice; and patients who died before neurosurgical review were excluded. The following information was extracted from patients records and analyzed using Statistical Packages for the Social Sciences, version 20: sociodemographic characteristics of the patients, biomechanics of injuries, clinical features, and management outcomes.

Results

Biographic Data

A total of 205 patients were seen and managed in our institution during the study period, of which only 184 met the inclusion criteria for this study. Clinical history showed none of the patients used safety helmet. The mean age of occurrence of motorcycle-associated head injury was 27.6 ± 17.2 years (range 1–71 years). Most of the patients (81% [149/184]) were age 40 years and below, while the remaining 19% (35/184) were above 40 years of age. There were 87% (160/184) males and 13% (24/184) females. Between the ages of 31 to 40 and ≥ 60 years, no female was involved in the motorcycle RTA, whereas between the ages of 41 and 60, more females than men were involved in motorcycle RTA (►**Table 1** and ►**Fig. 1**).

Biomechanics of Injury and Substance Abuse Risks

Loss of control of the motorcycle leading to a lone crash against stationary objects accounted for 66.8% (37/184) of the cases. Motorcycle versus motorcycle collision and motorcycle versus motor vehicle collision accounted for 20.1% (37/184) and 13% (24/184) of the cases, respectively. Motorcycle riders made up of 37.5% (69/184) of the patients, while passengers and pedestrians were 37.5% (69/184) and 25% (46/184) of the patients, respectively. There was history of substance abuse in 15.7% (29/184) patients, mostly by the riders. Tramadol accounted for 65.52% (19/29) of the substances abused, while cannabis and alcohol accounted for 20.69% (6/29) and 3.45% (1/29) of the substances abused, respectively. Other substances which were mostly not identified accounted for 10.34% (3/29) of substance abuse (►**Table 2** and ►**Fig. 2**).

Table 1 Sociodemographic characteristics of the patients

Variable	Frequency (*n* = 184)	Percent
Age (years)		
≤10	31	16.8
11–20	43	23.4
21–30	46	25.0
31–40	29	15.8
41–50	13	7.1
51–60	13	7.1
≥ 60	9	4.9
Sex		
Male	160	87.0
Female	24	13.0

Mean age = 27.6 ± 17.2 years.

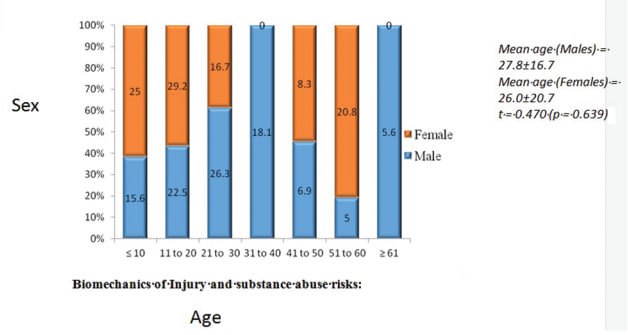

Fig. 1 Age–sex comparison of the patients.

Table 2 Characteristics of the accidents as reported of patients

Variable	Frequency (*n* = 184)	Percent
Mechanism of injury		
Lost handle and fell	123	66.8
Collided with another bike	37	20.1
Collided with a car	24	13.0
Type of injury		
Rider	69	37.5
Passenger	46	25.0
Pedestrian	69	37.5

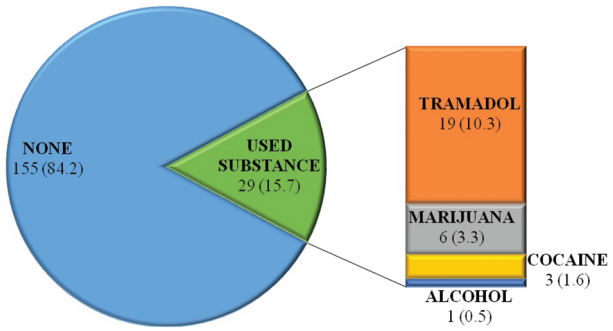

Fig. 2 Substance abuse among patients.

Clinical Assessments, Management and Follow-up Information

Majority of the patients (41.8% [77/184]) had moderate head injury, followed by mild head injury (34.2% [63/184]). Severe head injury occurred in 23.9% (44/184) of the patients. Pupillary abnormalities were seen in 45.5% of the patients. While unequal pupils were seen in 26.1% (48/184) cases, bilateral pupillary dilatation was seen in 17.4% (32/184) patients. Injuries in non-neurological organ systems occurred in only 6.5% of the patients. In 4.9% (9/184) patients, only one organ system, mostly the chest, was involved, whereas in 1.6% (3/184), two or more organ systems were involved. Radiological assessment of intracranial injuries was impossible in 20.7% (38/184) patients either as a result of lack of funds conduct brain CT scan or the scanner was not functional at the time of presentation. Above 39 percent (39.1% [72/184]) of the patients had normal findings on CT scan, while 40.2% (30/184) of the patients had various forms of pathologies seen, with 16.3% (30/184) having extra-axial blood clots. Above 71 percent of the patients (71.7% [132/184]) underwent nonoperative treatment, while 28.3% (52/184) patients underwent operative treatment. Above 11 percent of the patients (20.7% [52/184]) died, while 79.3% (146/184) survived. Thirty-seven percent (54/184) patients stopped follow-up visits in the outpatient clinic after 1 to 3 visits, while 56.2% (82/184) patients attended outpatient clinic for follow-up between 4 to 6 appointments. Only 6.8% (10/184) continued follow-up clinic attendance up to weeks (►**Tables 3** and **4**).

Table 3 Clinical assessment of patients

Variable	Frequency (*n* = 184)	Percent
Glasgow coma scale		
Mild (> 12)	63	34.2
Moderate (9–12)	77	41.8
Severe (8)	44	23.9
Pupils		
Normal	104	56.5
Unequal	48	26.1
Dilated bilaterally	32	17.4
Comorbidity		
None	172	93.5
One organ system	9	4.9
Two or more organ systems	3	1.6
Hematomas		
No CT	38	20.7
No abnormality	72	39.1
Extradural	20	10.9
Subdural	10	5.4
Intracerebral	9	4.9
Intraventricular	3	1.6
Subarachnoid	2	1.1
Hemorrhagic contusions	30	16.3

Table 4 Management and follow-up of patients

Variable	Frequency (*n* = 184)	Percent
Type of management		
Nonoperative	132	71.7
Operative	52	28.3
Outcome		
Alive	146	79.3
Dead	52	20.7
No. of follow-up visits (n = 146)		
1–3	54	37.0
4–6	82	56.2
7–10	10	6.8

Note: Mean no. of follow-up visits = 3.9 ± 1.6.

Discussion

This is a retrospective cross-sectional study on patients seen and managed in our institution between December 2014 and November 2016. Two hundred and five patients were managed: six patients died at the Accident and Emergency Department during resuscitation and fifteen patients

discharged against medical advice. Both were excluded from this study. The remaining 184 patients met the inclusion criteria for this study. The mean age of the patients was 27.6 years (standard deviation [SD] = 17.2) with an age range between 1 to 71 years. This is slightly lower than the mean age in a similar study in Ibadan, Nigeria (33.1 years with SD = 18.3).[3] Previous studies showed male preponderance. A study in Cambodia showed male-to-female ratio of 5:1 for patients between the ages of 11 to 20 years and 6:1 for patients between the ages of 21 to 30 years, respectively.[7] A study in Ibadan showed male-to-female ratio of approximately 5:1.[10] These ratios are consistent with our finding of 87% males and 13% females (ratio 6.7:1). However, studies from high income countries showed smaller male-to-female ratios.[7,9,11,12] This high frequency of motorcycle-associated head injury among men is perhaps due to the fact that men are more frequently engaged in commercial activities in many cultures in the developing countries, especially countries in Africa where the bulk of this problem resides.

Motorcycle-associated head injury is mostly seen common among young and energetic people, as observed in this study, with 81% of the patients between the ages of 1 to 40 years. Similarly, Peeters et al reported a frequency of 84.5% among people between 11 and 30 years of age.[7] However, recent studies in high-income countries showed a notable shift in the motorcycle-associated head trauma population toward older age groups.[7,9,11,12] A very notable finding in this study is that patients' sex was a major determinant of age distribution of motorcycle-associated head injuries: between the ages of 31 to 40 and 60 years and above, no female patient was involved in the motorcycle RTA, whereas between the ages of 41 and 60, more females than males were involved in motorcycle RTA (►**Table 1** and ►**Fig. 1**).

Gabella et al found that after adjusting for age and crash characteristics, nonhelmeted riders were 2.4-times more likely than those wearing a helmet to sustain brain injuries or skull fractures, while Rowland et al in the following year found that after adjusting for collision type, speed limits, and environmental factors, nonhelmeted riders had a 3.1-fold increased risk of head injuries or death compared with helmeted riders.[13,14]These two studies highlighted the pivotal role of safety helmet in preventing head injuries by riders and passengers of motorcycles. Despite these research findings and various campaigns against nonuse of helmet by motorcycle riders and passengers in many countries, compliance by to helmet use by cyclists remain a huge challenge, especially in developing countries. In Nigeria, according to the sector Commander of the Federal Road Safety Corps, Hyginus Omeje, the national road traffic standard is that motorcycle riders must wear a crash helmet and must ride with a retroreflective jacket, especially at night; hence, there have been traffic checks and campaigns have been organized by the officers of the Federal Road Safety Corps of Nigeria on use of helmet.[13] Despite these efforts, noncompliance with regard to the use of safety helmet remain very prevalent in Nigeria. None of the patients in this study used safety helmet and the same was found in a study in Ilorin, Nigeria.[3] This lack of compliance with respect to the use of safety helmet is reflective of how there are currently no national laws enacted in the Nigeria parliament on the use of safety helmet. However, due to a stringent law on compulsory use of helmets in Vietnam, there has been a decrease in the trend of traumatic brain injuries (TBI) from less than 40% to nearly 100%.[13]

The mechanisms of injury in motorcycle accident were by lone crash or collision. A relatively large number of patients in this study were involved in a motorcycle accident by way of lone crash by the riders (66.8%). Collision occurred either by motorcycle versus motorcycle (20.1%) or by motorcycle versus motor vehicle (13%). Both lone crashes and collisions had the following identical underlying factors: inexperience, machismo behaviors in young people, and/or substances abuse. There exists a competition to showcase riding skills and ability to carry passengers by commercial riders, mainly coming about as a result of machismo behaviors common among young riders. These are corroborated by various research findings: Soderstrom et al found that the overrepresentation of young riders in motorcycle injuries was due to inexperience in riding a motorcycle or a higher exposure to riding, while others found that the risk-taking characteristics of young riders, including speeding, running yellow light and drinking while riding contributed to the high risk of motorcycle injuries.[15-17]

Drinking and driving is one of the leading causes of motorcycle-associated head injuries, resulting in significant death and disability.[18] According to the United States' National Highway and Safety Administration (NHSTA), there were approximately 30 deaths per day in 2017 due to drunk riding and an intoxicated motorcyclist involved in a crash was 28 times more likely to die than passenger car occupants per miles driven.[15,19] Besides alcohol, 32% of motorcycle riders treated in Maryland trauma centers during 1990–1991 had used marijuana (cannabis) prior to the crash, which was significantly higher than the 2.7% of car drivers.[20,21] Among the 15.7% with history of substances abuse in this study, 3.45% and 20.7% abused alcohol and marijuana (cannabis), respectively, and had consumed these drugs before riding. However, the most frequently abused substance in this study was tramadol (65.5%), which is an emerging drug of abuse in Nigeria in recent years. In a study in a neuropsychiatric hospital in Maiduguri, Nigeria, the prevalence of tramadol abuse was 54.4% and the most common reason for abuse was to relieve tiredness.[22] In Ilorin, Nigeria, the finding was that most of the patients were riders (53.6%), while passengers and pedestrians comprised 32.1% and 14.3%, respectively.[13] In this study, riders and pedestrians were equally affected (37.5% each), while passengers comprised 25% of the patients. Children and elderly women were the most vulnerable pedestrians.

The most common type of head injury in this study (based on classification by Glasgow coma scale [GCS]) was moderate head injury (41.8%). While mild head injury is second most common, accounting for 34.2% of the cases, severe head injury is the least common (23.9%). This is incongruous with a previous study, which found that 80% of patients with head injuries sustained minor head injury.[23] We found associated injuries in other non-neurological systems in 6.5% of patients,

which is also at variance to what was found in previous studies, especially in Ibadan, with as high as 20.8% in pelvis and long bones alone.[24]

Cranial CT scan was done on 79.3% of our patients, while the remaining 20.7% patients could not do cranial CT scan due to a lack of finances, leading to an inability to make radiological diagnoses in this set of patients (20.7%). This finding was congruous with the study in Ibadan, Nigeria, where cranial CT scan was obtained in 72.2% of patients with head injuries.[10]Among those who had brain CT scan in this study, only 40.2% had abnormal radiological findings. Extradural haematoma was seen in 10.9%, hemorrhagic contusions was seen in 16.3%, subdural haematoma was seen in 5.4%, traumatic subarachnoid hemorrhages was seen in 1.1%, intracerebral hemorrhages was seen in 4.9%, and intraventricular bleed seen in 1.6% of the cases. However, in a study by Adeleye et al, brain CT scan revealed possible surgical lesions like extensive brain contusions in 18.8%, acute extradural hematoma in 4.1%, acute subdural hematoma in 3.8%, traumatic intracerebral hemorrhage in 3.2%, and pneumocephalus in 1.0%.[24] While extra-axial bleed was the most common radiological findings in our study (16.3%), brain contusions were the most frequent radiological finding in Ibadan (18.8%).[24] In other similar studies traumatic subarachnoid hemorrhage was the most common CT finding in TBI, occurring in approximately 30 to 40% of patients with moderate-to-severe TBI, and 5% of patients with minor TBI.[25-28]

Operative treatment was performed in 28.3% patients, with procedures ranging from wound debridement, duroplasty, cranioplasty, trauma flap craniotomy, and decompressive hemicraniectomy In a similar study, only 13.1% received operative care, while another 6.8% with surgical lesions either died before surgery was performed or refused consent.[10] Our mortality rate of 20.7% was congruous with another finding from a similar study in this environment, with mortality rate of 23.9%.[10] Follow-up was significantly erratic, with mean follow-up visits of 3.9 ± 1.6 times. This was inadequate to measure longtime changes.

Conclusions

The use of motorcycle as a mean of transport has caused more negative than positive impact on the Sokoto community. Motorcycle-associated head injury is mainly predominant among young male residents who constitute the major workforce within the catchment areas of the study population. The high morbidity and mortality rate seen in this study showed that there was a significant loss of manpower within the community, thereby increasing the population of dependents and future beggars in the streets. Noncompliance with regard to the use of safety helmet seen in this study and similar studies in this environment have led to an increased incidence compared with places where the use of helmet is enforced by the government; therefore, there is the need for national laws to be enacted and enforced to reduce the incidence and severity of injuries.

Conflict of Interest
None declared.

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