



Upper and Lower Extremity Injury Pattern and Severity of Motorbike Accident – A Retrospective Study

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Authors' contributions

This work was carried out in collaboration between all authors. Authors AA, LQ and YA designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors LQ and YA managed the analysis of the study, software and did the validation. Author AA managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Aim: This study aims at determining the upper and lower extremity injury pattern and severity of motorcycle accidents in the Tamale metropolis, Ghana.

Methods: A retrospective hospital-based study comprising data on 190 motorcycle accident victims at the Accident and Emergency Centres of three major hospitals (Tamale Teaching Hospital, Central and West Hospitals) in Tamale metropolis from February to April 2018. Demographic data, injury type, injury location, use of crash helmet and injury outcomes were retrieved from the medical records registry. Data was analysed using SPSS version 23.0. Categorical variables were compared using Chi-square test and One-way ANOVA test was done to compare groups.

Results: From the 190 victims, 78.9% were treated and discharged, 17.4% were disabled and 3.7% died. Injury mechanism was significantly (F-test = 22.64, p = 0.00) linked with injury outcome.

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Victims who had frontal impact collision and died (71.4%) were significantly ($p < 0.05$) more than those who were treated and discharged (26.7%). Accident victims with upper extremity injury who became disabled (18.2%) were more ($p < 0.05$) than those treated and discharged (16.7%). Out of the 190 victims involved in motorcycle accidents, 64.2% were not wearing crash helmet. There was significant relationship ($p < 0.05$) between use of crash helmet and injury outcome. More (23.0%) of accident victims disabled were not wearing crash helmet and among those who died, none (0.0%) had a crash helmet on.

Conclusion: Upper and lower extremity injuries as well head and neck injuries were high among motorcycle accident victims. The study recommends capacity building for healthcare professionals to manage head, neck, upper and lower extremity injuries at the Accident and Emergency Centres. Regular training programs should be conducted by law enforcement authorities in northern Ghana to train motorcycle riders and educate them on road traffic regulations. Compliance to the use of crash helmet by motorcyclists should strongly be enforced. Further prospective studies are needed to delineate these injury patterns and ascertain reason behind non-usage of crash helmet by motorcyclist in the Metropolis.

Keywords: Motorcycle accident; road traffic accident; retrospective study; extremity injury; Tamale; Ghana.

ABBREVIATION

ANOVA : *Analysis of Variance*
RTA : *Road Traffic Accident*
SPSS : *Statistical Package of Social Sciences*
TTH : *Tamale Teaching Hospital*
USA : *United States of America*
WHO : *World Health Organization*

1. INTRODUCTION

The use of motorcycle as a means of transportation is a common feature in most developing countries [1-4] primarily for its fuel efficiency, attending low cost and ease of manoeuvring within communities with less accessible road network. Motorcycle users are among the most vulnerable road users and are prone to various forms of injuries during road traffic accident (RTA). According to the World Health Organization (WHO) reports, motorcycle accidents account for more than 380,000 annual deaths worldwide, 28% of global deaths in 2016 of which 90% occurs in low- and middle-income countries [5].

Motorcycle accident is correlated with increased morbidities and mortalities [2,3,6] with studies reporting a 34-fold higher risk of death for motorcycle users involved in a crash per vehicle mile travelled and 8-times likelihood of injury compared with accidents involving in cars [7,8]. Studies have associated these higher risk of injuries and deaths with factors such as: rider inexperience, not wearing crash helmet, riding under the influence of alcohol or illicit drugs and

risk-taking behaviours for showmanship [9]. According to a study conducted in Taiwan, 60% of fatalities involving motorcyclists are due to not wearing of crash helmet, unlicensed status and riding under the influence of alcohol [10].

Most motorcycle accident victims are more likely to sustain serious injuries including head and neck, extremities, thorax and abdomen as a result of exposure to direct impact. According to Hui et al., [6], in fatal motorcycle frontal crashes, the head is a frequent injury location leading to traumatic brain injuries causing about 84% of all motorcycle related deaths. A study conducted by Adam et al., [11] found that one of the causes of traumatic brain injuries in the Tamale Teaching Hospital in Ghana was road traffic accident involving motorcycle users.

Motorcycles have been the main means of transportation in northern Ghana. The increased usage is relatively associated with a high number of accidents and fatalities. Additionally, young lives are lost through these accidents which affects the skilled labour capacity, productivity and valuable working time for accident victims and relatives. An understanding of the varied injury types and injury mechanism associated with motorbike-related accidents is vital to formulating prevention programs and also will help hospitals to anticipate the trend of injuries so as to better manage such injuries. This retrospective review was therefore undertaken to determine the upper and lower extremity injury pattern and severity of motorcycle accidents in the Tamale metropolis.

2. MATERIALS AND METHODS

2.1 Study Design

A retrospective hospital-based study to review available records on motorcycle accidents at the Accident and Emergency Centres of three major hospitals within the Tamale metropolis from February to April 2018.

2.2 Study Site

The Accident and Emergency Centres of the Tamale Teaching Hospital, Central Hospital and West Hospital served as the study sites for evaluation of retrospective data.

2.3 Data Collection

The Accident and Emergency Centres of the three major hospitals had recorded a total of 587 accident cases involving vehicles, motorcycles and pedestrians within the studied period. Inclusion criteria comprised injuries sustained from motorcycle-related accidents including motor tricycles. Injuries sustained from cars or vehicular accidents were excluded. Out of the total recorded, 192 were motorcycle-related accidents of which two reports did not meet the inclusion criteria and were excluded after double checking medical records at the registry. One (1) case for inaccurate codification and the other

accident victim died before reaching the hospital. In all, the total number of motorcycle-related accident victims collated was 190.

Data on sociodemographic characteristics of patients, injury mechanism, use of helmet, location of injury and type of injury were retrieved from the medical records at the registry.

2.4 Statistical Analysis

The data was entered and analysed using SPSS version 23.0 (www.ibm.com; Armonk, NY). Chi-square analysis was used to assess the strength of association between categorical variables and groups were compared using one-way ANOVA. P-value <0.05 considered statistically significant.

3. RESULTS

3.1 Socio-Demographic Characteristics

A total of 190 accident victims were sampled from the Accident and Emergency Centre of all the three hospitals within Tamale metropolis. As shown in Table 1, majority (36.6%) were within the age group of 20-29 years. Most (69.2%) of the accident victims were males with 37.9% indicating they had secondary or vocational education. Majority (92.6%) of the victims had no formal motorcycle riding training.

Table 1. Socio-demographic characteristics of accident victims

Variable	Frequency (n)	Percent (%)
Gender		
Male	129	67.9
Female	61	32.1
Age		
<20	39	20.5
20-24	27	14.2
25-29	33	17.4
30-34	25	13.2
35-39	23	12.1
40 above	43	22.6
Educational status		
None	41	21.6
Primary	39	20.5
Secondary/Vocational	72	37.9
Tertiary	28	14.7
Motorcycle riding training school attendance		
Yes	14	7.4
No	176	92.6

Data presented as frequency and percent

3.2 Association between Injury Outcome and Some Selected Variables

Out of the 190 motorcycle-related accidents, 78.9% victims were treated and discharged, 17.4% were disabled while 3.7% died. Majority of the victims were males with reports of lower extremity injury (n=43, 22.6%) or upper extremity injury (n=59, 31.5%). The injury mechanism was mainly lateral impact crash with rear impact collision being the least (Table 2).

Injury mechanism was significantly linked with injury outcome (F-test = 22.64, p = .002). Victims who had frontal impact collision and died (71.4%) were significantly (p<0.05) more than those who were treated and discharged (26.7%).

Injury location was significantly linked with injury outcome (F-test = 24.74, p < .00). Accident victims with upper extremity injury who became disabled (18.2%) were more than those treated and discharged (16.7%) and those who died (0.0%) (Table 2).

On the other hand, majority of the accident victims who had lateral impact (45.3%) and rear impact collision (28.0%) were treated and discharged compared with those who were disabled (39.4% vs 24.2% respectively) and/or

dead (14.3% vs 14.3% respectively), although these were not statistically significant (Table 2).

3.3 Association between the Use of Crash Helmet and Some Selected Variables

Out of the 190 victims involved in the motorcycle-related accidents, 64.2% were not wearing crash helmet. There was significant association between the use of helmet and injury outcome. More (23.0%) of the accident victims who were not in crash helmet were disabled compared with 8.8% who wore crash helmet. Among victims who died, 5.7% did not have a crash helmet on. For those who were treated and discharged, more (91.2%) wore crash helmet compared with 71.3% who did not wear it (Table 3).

There was no significant relationship between gender, age, educational status, location of injury and the use of crash helmet.

4. DISCUSSION

Injury mechanism is an important factor for determining the cause as well as the fatality of the accident. In this study the main injury mechanism was frontal impact with lateral and rear impact coming second a third respectively. These findings are similar to that of Hui *et al.*, [6] and Peek-Asa and Kraus [12] who reported more frontal impact collision than the other collisions.

Table 2. Association between injury outcome and some selected variables

Variable	Injury outcome of motorcycle accident			F-test	p-value
	Discharge, n= 150(%)	Disable, n= 33(%)	Dead, n= 7 (%)		
Gender					
Male	104 (69.3)	21 (63.6)	4 (57.1)	5.051	.11
Female	46 (30.7)	12 (36.4)	3 (42.9)		
Injury Mechanism					
Frontal impact collision	40 (26.7)	12 (36.4)	5 (71.4) [#]	22.64	.002
Lateral impact collision	68 (45.3)	13 (39.4)	1 (14.3)		
Rear impact collision	42 (28.0)	8 (24.2)	1 (14.3)		
Location of injury					
Abdomen	28 (18.7)	9 (27.3)	3 (42.9)	24.74	< 0.0001
Back	13 (8.7)	1 (3.0)	0 (0.0)		
Chest	21 (14.0)	5 (15.2)	0 (0.0)		
Head and neck	22 (14.7)	5 (15.2)	1 (14.3)		
Lower extremity	35 (23.3)	5 (15.2)	3 (42.9)		
Spine	6 (4.0)	2 (6.1)	0 (0.0)		
Upper extremity	25 (16.7)	6 (18.2) [*]	0 (0.0)		

(*) for comparison between disability and dead. ([#]) for comparison between discharged and dead. P-value <0.05 considered statistically significant

Table 3. Association between the use of crash helmet and some selected variables

Variable	Use of crash helmet		X ²	p-value
	Yes, n=68(%)	No, n=122(%)		
Gender				
Male	49 (72.1%)	80 (65.6)	0.84	.36
Female	19 (27.9)	42 (34.4)		
Age				
<20	14 (20.6)	25 (20.5)	0.00	.98
20-24	10 (14.7)	17 (13.9)	0.02	.88
25-29	8 (11.8)	25 (20.5)	2.32	.13
30-34	9 (13.2)	16 (13.1)	0.00	.99
35-39	7 (10.3)	16 (13.1)	0.33	.57
40 above	20 (29.4)	23 (18.9)	2.78	.09
Educational Status				
None	15 (22.1)	36 (29.5)	1.23	.27
Primary	16 (23.5)	23 (18.9)	0.59	.44
Secondary/Vocational	27 (39.7)	45 (36.9)	0.15	.70
Tertiary	10 (14.7)	18 (14.8)	0.00	.99
Location of injury				
Head and neck	6 (8.8)	22 (18.0)	2.95	.09
Other body parts	62 (91.2)	100 (82.0)		
Injury Outcome				
Discharge	63 (91.2)	87 (71.3)	11.96	.001
Disable	5 (8.8)	28 (23.0)	7.40	.01
Dead	0 (0.0)	7 (5.7)	4.05	.04

Data presented as frequency (percent). Categorical variables compared using chi-square and $p < 0.05$ considered statistically significant

Studies have reported that the risk of death from motorcycle-related accidents for every kilometre travelled is 20 times higher than from a car crash [13]. From this study, persons involved in frontal impact injuries were more likely to die than being treated and discharge or coming out of the injury with disability which is consistent with what was reported by Hui et al., [6].

In our study, extremity injuries were the most common injury among the motorcycle riders followed by head and neck injury. There was no significant disparity between upper and lower extremity injuries though more people had lower extremity injuries. Persons with upper extremity injuries were more likely to sustain a disability after treatment. Previous studies have reported that motorcycle riders are more prone to extremity injuries due to direct impact exposure [6,14,15]. According to Hurt et al., [15], motorcycle fuel tanks which is in contact with groin area and handlebars where the rider holds are common injury agents. In most frontal impact accidents such as observed from this study, collision with frontal objects may also cause injuries to the extremities.

Injuries to head and neck following motorcycle-related accidents are common injuries which

result in serious morbidity and mortality. Several studies are consistent that the use of crash helmet reduces the risk of head and neck injury severity among motorcycle users [4,16-18]. The use of crash helmet is said to be very low in developing countries despite the existence of regulations that mandates its use [19-21]. In our study, majority of the victims of motorcycle-related accidents were not using crash helmet. Our finding agrees with previous studies by Rice et al., [18] who reported that 60.2% of the accident victims were not wearing crash helmet, however, this is not in line with findings of Liu et al., [22] who recorded low (19%) non-users of crash helmet by accident victims. Accident victims who were not wearing crash helmet ended up being disabled and/or dead compared with those who wore crash helmet. These findings agree with previous studies [4,16-18]. Other studies conducted in the USA [23] and India [24] reported similar findings to what was reported in this study.

In northern Ghana, motorcycles are the common means of transport for which majority of the riders are young males. This study observed that males were more involved in motorcycle-related accidents compared with females. Some studies

have reported significant association between increased risk for young males and a greater chance of engaging in risky behaviours, such as speeding, alcohol consumption or drugs, etc., compared with females [25, 26]. According to Kelley-Baker and Romano [27] female riders are less involved in speeding-related crashes and are less prone to accident and injuries compared with males. This may have accounted for the relatively low number of females involved in motorcycle-related accidents from this study.

5. LIMITATION

The study had the following limitations; as a retrospective study, we were dependent on reports from the Accident and Emergency Centres regarding injury mechanism and outcomes. Data consisted of accident victims brought directly or transferred to the three hospitals which may have allowed for possible selection bias, thus, some accident victims with minor injuries could have been examined and treated without reporting to the Accident and Emergency Centre of the three selected hospitals.

6. CONCLUSION

The rates of upper and lower extremity injuries as well head and neck injuries were high among persons involved in motorcycle-related accidents especially from frontal impacts. Extremity injuries were likely to result in disability and mortality. Even though the use of crash helmet has been shown to reduce the risk of fatal injuries to head and neck in the event of an accident, only few accident victims used helmets. Therefore, the study recommends that; the need for more capacity building to manage head, neck, upper and lower extremity injuries at the Accident and Emergency Centres. Regular training programs should be conducted by law enforcement authorities in northern Ghana to train motorcycle riders and educate them on road traffic regulations. Compliance to the use of crash helmet by motorcyclists should strongly be enforced. Further prospective studies are needed to delineate these injury patterns and ascertain reason behind non usage of crash helmet by motorcyclist in the Metropolis.

CONSENT

It is not applicable.

ETHICAL APPROVAL

Ethical clearance was sought from the Ethical Review Board of the School of Allied Health

Sciences and the Tamale Teaching Hospital, Tamale, Ghana

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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