East African Medical Journal Vol. 93 No. 1 January 2016
INJURY PATTERNS AND MORTALITY RATES OF MOTORCYCLE-RELATED HEAD INJURIES IN KENYA
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S. J. KIPLAGAT and T. STEYL

ABSTRACT

***Background*: Motorcycles are an emerging means of public transportation in many developing countries and has a poor safety record when compared to other road users. Subsequently, motorcycle injuries have been on the rise and head injuries are the leading cause of death, severe injury and disability globally.**
***Objectives*: To determine the injury patterns and mortality rate of motorcycle-related head injuries.**
***Design*: A retrospective descriptive study.**
***Setting*: Moi Teaching and Referral Hospital**
***Subjects*: All motorcycle-related head injuries from the year 2010 to 2013.**
***Results*: One hundred and fourteen files were reviewed. The study sample was predominantly male (n=106; 93%) with a mean age of 30.2 years (SD=14.01). More than half of the patients sustained skull fractures and intra-cranial haemorrhage (n=68; 59.6%). About 9.6% (n=11) of the patients succumbed to their injuries out of which 63.6% (n=7) sustained severe head injuries. There was a significant association between helmet use and the mortality rate of patients (χ^2=5.684; p=0.017). The use of helmets also had an influence on the type of injury sustained (p=0.004) as patients not wearing helmets sustained more serious injuries such as skull fractures, intra-cranial bleeding, cerebral oedema and diffuse axonal injuries.**
***Conclusion*: There is a relationship between helmet use, the type of injury sustained and the mortality rate of the patients. Hence, the need for public education programmes on motorcycle safety and helmet use to curb the negative impact of motorcycle-related injuries on the society and economy.**

INTRODUCTION

Motorcycles are most common referred to as 'boda boda' in Kenya and Uganda, 'mototaxis' in Brazil and 'motorised two wheelers' by the World Health Organization (1-3). Motorcycles were invented in the 1800s and were mostly used in the World War II (4). In Kenya, motorcycles have been in use since the 1960s to carry goods across the Kenyan-Uganda border; thus getting the name 'boda boda' (5). Unlike its previous use, motorcycles are now emerging as an important means of public transportation in many developing countries, including Kenya. Subsequently, there has been a rapid increase in motorcycle injuries and head trauma is the leading cause of death, severe injury and disability among motorcycle users (2).

Helmets are associated with head injury severity and mortality, with the risk of a head injury and death being reduced by 69% and 42% respectively among those who wear helmets (6). Moi Teaching and Referral Hospital receive many patients with motorcycle-related head injuries. However, comprehensive statistics on the injury patterns of these head injuries and the mortality rate of patients injured is lacking. Therefore, the purpose of this study was to investigate the injury patterns of motorcycle-related head injuries, the mortality rate as well as the influence of helmet use on the severity of the injury.

MATERIALS AND METHODS

Subject: The population consisted of riders and passengers who sustained head injuries due to motorcycle accidents and admitted at Moi Teaching and Referral Hospital. Total population sampling was employed in the study whereby all the medical records for patients who sustained motorcycle-related

head injuries and admitted between 1st January 2010 and 31st December 2013 were accessed.

Data collection instrument: The instrument was developed based on literature (7) and the study objectives in order to extract data from the medical records. A draft of the data extraction form was subjected to peer review by three physiotherapists to assess content validity. Adjustments were made to the sheet based on their observations. The data extraction form was also pre-tested on ten medical records for patients with motorcycle-related head injuries in the year 2014. These records were not included in the main study. Modifications were made to both section A and B. Section A sought information on the demographic characteristics of participants, which included age, gender, level of education and occupation. Section B was used to obtain information on the status of the motorcycle user, type of injury sustained, helmet use and the outcome of the patient.

Retrieval of data: Prior to commencement of the study, permission and ethical clearance to conduct the study was obtained from the University of the Western Cape's Senate Higher Degrees and Ethics committee. Further permission was granted from the Institutional Research Ethics Committee (IREC) of Moi Teaching and Referral Hospital and from the Director of Moi Teaching and Referral Hospital.

Patients who sustained motorcycle-related head injuries were identified in MTRH's admission database using a list of ICD 10 WHO codes (V20-V29 and S00-S09). The first name, surnames and the file number of patients were retrieved. Thereafter, the files of patients who sustained motorcycle-related head injuries were hand-searched from the central records department. Data were collected from the files using the data collection instrument by the researcher and a trained research assistant.

Data analysis: Data obtained from the files were analysed using SPSS version 21. Descriptive statistics were employed to summarise the socio-demographic data of the patients. The results were presented using descriptive statistics: mean, standard deviation, frequency, percentages in bar / pie charts and tables. Significant differences were tested for using the Chi-square test. Statistical significance was set at an alpha level of 5% ($p < 0.05$).

RESULTS

A total number of 230 patients with motorcycle-related head injuries were admitted to the Moi Teaching and Referral Hospital during the study period (January 2010 to December 2013). Pedestrians who sustained motorcycle-related head injuries and files with incomplete and missing values were excluded. A total of 114 files were included in the data extraction process.

The study sample was predominantly male 93% (n=106) as compared to female 7% (n=8) with a male to female ratio of 13:1. The mean age of the study sample was 30.2 years (SD=14.01). The majority of patients were in the age group of 21 to 30 years (40.4%; n=46). Almost half of the patients had primary education (47.4%; n=54) while more than a third had secondary education (34.2%; n=39). The occupation of most of the patients was boda boda (motorcycle) operators 46.5% (n=53), followed by farmers 19.3% (n=22) and students 15.8% (n=18). The report on status of the motorcycle user showed that majority of the patients (60.5%, n=70) were motorcycle riders (Table 1).

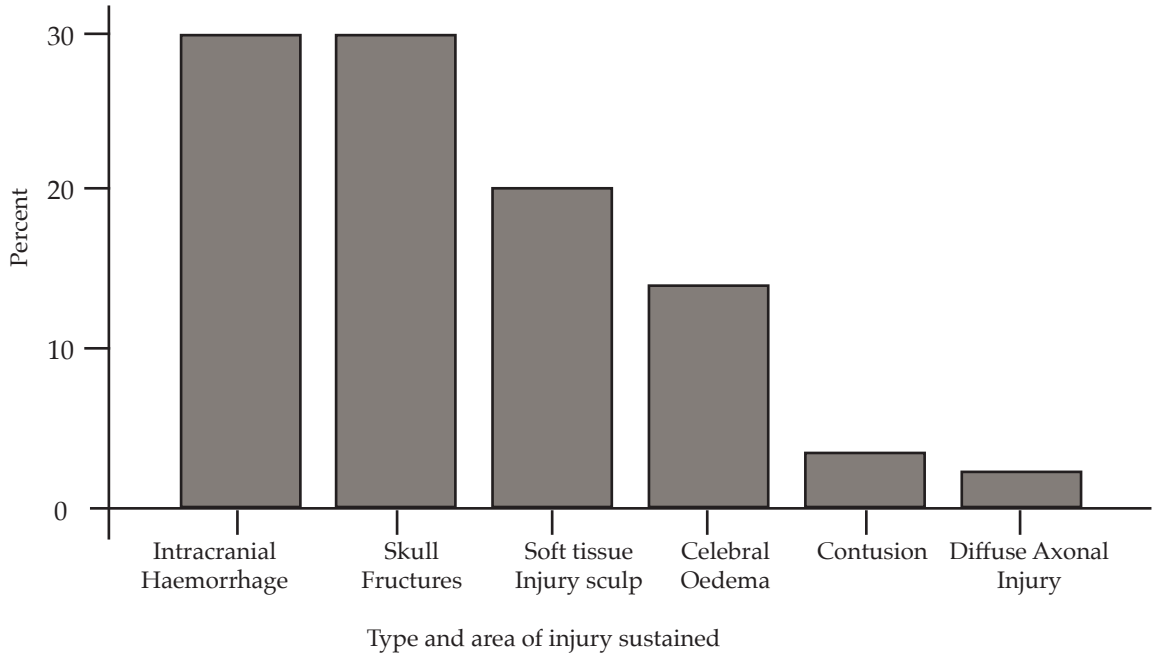
Table 1
Socio-demographic characteristics of patients with motorcycle-related head injuries

Characteristics (n)	Frequency (%)	Percentage
Gender		
Male	106	93
Female	8	7
Age (Mean = 30.2 years, SD=14.01)		
<20	21	18.3
21-30	46	40.4
31-40	28	24.6
41-50		97.9
>50	10	8.8
Level of Education		
Primary	54	47.4

Secondary	39	34.2
Tertiary	13	11.4
Not at all	8	7.0
Occupation		
Formal employment	9	7.9
Casual	6	5.3
Child/student	18	15.8
Businessmen	6	5.3
Farmers	22	19.3
Motorcycle operators	53	46.5
Status of motorcycle user		
Rider	70	60.5
Passenger	44	39.5

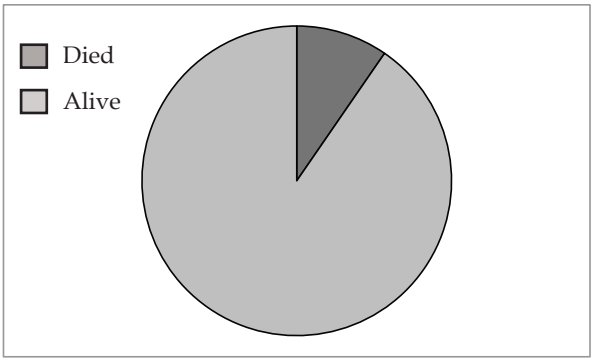
Type of head injury sustained: More than half of the patients with motorcycle-related head injuries sustained skull fractures or intra-cranial haemorrhage (59.6%; n=68), whereas soft tissue injury of the scalp and cerebral oedema accounted for 20.2% (n=23) and 14% (n=16) respectively. Only a few patients sustained a contusion (3.5%; n=4) and diffuse axonal injury (2.6%; n=3). Four types of intra-cranial haemorrhages were registered, namely intra-cerebral haemorrhage (13.2%; n=15) followed by epidural, subdural and intra-ventricular haemorrhage at a percentage of 9.6, 5.3 and 1.8 respectively.

Figure 1
Patterns of head injuries sustained



Mortality rate of patients with motorcycle-related head injuries (n=114): Figure 2 below presents the number of patients who died due to motorcycle-related head injuries. Of the 9.6% (n=11) of the study sample who succumbed to their injuries, 63.6% (n=7) sustained severe head injuries.

Figure 2
Outcome of the patients with motorcycle-related head injuries



Helmet use: Information on helmet use was recorded in 60 patient folders, accounting for only 52.6% of the study sample. Among the 60 documented cases, the majority of the patients (83.3%; n=50) did not wear a helmet during the time of the accident.

Results indicate that out of the 10 patients who wore helmets during the accident, eight (80%) survived the accident while two (20%) of the patients succumbed to their injuries. There was a significant association between helmet use and the outcome of the patient (χ^2=5.684; p=0.017) at 95% level of confidence.

None of the patients wearing helmets sustained intra-cranial haemorrhage, cerebral oedema and contusions while more than half sustained soft tissue injuries of the scalp (54.5%). The patients without helmets sustained more intracranial haemorrhages, skull fractures, cerebral oedema, contusions and diffuse axonal injury. Helmet use was found to be statistically significant with the injury sustained (p=0.004).

DISCUSSION

This study was designed to determine the injury patterns and mortality rate of patients who sustained motorcycle-related head injuries and the associated helmet use. Almost one third of the patients sustained skull fractures (29.8%) and intra-cranial haemorrhage (29.8%) respectively, followed by soft tissue injury to the scalp (20.2%) and cerebral oedema (14%). Research (8) reported 63% contusions, 27% skull fractures and 15% for both sub-dural and sub-arachnoid haemorrhages while (9) reported 32.4% skull fractures and 14% intra-cranial injuries (mainly focal injury and epidural haematoma) as the most common injuries sustained. The type of injuries sustained varies between studies. This could be due to the fact that different codes were used in the studies to classify the type of injury sustained.

The injuries sustained in the present study were associated with helmet use. None of the patients wearing helmets sustained intra-cranial haemorrhage, cerebral oedema and contusions. This suggests that helmet use has an influence on the type of injuries sustained. Research (10)found that riders not wearing helmets during the time of the accident sustained more severe injuries. In addition, they also had a 41% increase in trauma-induced brain haemorrhage such as subdural, epidural and subarachnoid haematomas compared to riders wearing helmets. A similar study found that riders not wearing helmets are more likely to sustain intra-cranial haemorrhage and cerebral injury compared to riders wearing helmets (11). The researchers concluded that helmet use protects against head injuries of all types and locations.

A mere 16.7% of the 60 participants wore a helmet during the time of the accident. The prevalence of helmet use in the present study is higher than the prevalence of 0.3% helmet use in Nigeria (12) and 6% in Iran (9). Some studies from African countries have reported no helmet use among the motorcycle users (13, 14). However, helmet use in this study is lower than those reported in other studies for example 56.8% in USA (15) 43.1% in India (16), 33% in Ireland (8)and 34.3% in Jamaica (17). The difference in helmet use depends on legislation and enforcement across countries. The result from the present study strongly suggest for the Kenyan government to re-look the legislation regarding helmet use in the country and implement more strict laws and fines to encourage the use of helmets by each and every motorcycle rider and passenger.

The patients who succumbed to their injuries were 9.6%; a figure consistent with a study by (17) who reported a mortality rate of 8.4%. The finding from the present study is low compared to studies done in Nigeria by (13 and 18) who reported mortality rates of 15.1% and 16.0% respectively. A higher number of deaths were reported in the United Kingdom where 56.8% of the 146 patients died due to their head and facial injuries (18). The study furthermore reported a significant association between helmet use and the outcome of the patients (died or alive). A study by (17) did not find any significant association between patients who succumbed to injury and helmet use. However, a systematic review on helmet use among motorcycle users showed that helmets reduces the risk of death by 42% (19).

In conclusion, this study reports on the injury patterns and mortality rate of motorcycle-related head injuries in Kenya. Helmet usage was also reported. Despite the legislation on helmet use among motorcycle riders and passengers in Kenya, less than a quarter of the patients (16.7%) wore a helmet during the time of the accident. The mortality and morbidity rates of motorcycle users in Kenya can be reduced significantly if they adhere to the existing helmets law. The importance of strict rules and regulations regarding compulsory helmet use by the motorcycle users and proper training cannot

be emphasised enough. Public education campaigns regarding adherence to safety measures when using a motorcycle should be rolled out in Kenya.

ACKNOWLEDGEMENT

To County Council of Ostergotland-Sweden for sponsoring the study.

REFERENCES

1. Naddumba, E. K. A cross-sectional retrospective study of boda boda injuries at Mulago Hospital in Kampala-Uganda. *East and Central African Journal*. 2004; **9**: 44-48.
2. World Health Organisation Helmets a road safety manual for decision-makers and practitioners. (2006). Cited March *25, 2013, Available from:* http//:*www.who.int/violence/injury/road/ traffic/helmet/manual*
3. Carrasco, C. E., Godinho, M., Barros, M. B. A. and Rizoli, S. Fatal motorcycle crashes: a serious public health problem in Brazil. World Journal of Emergency Surgery. 2012; **7**: 22-25.
4. Chadwick, I. An overview of the British motorcycle industry and its collapse. (2001) Cited September 2013, 8, Available from: http://www.ianchadwick.com/motorcycles/britbikes.
5. Nesoba, D. Motorcycle Boom Tied to Increase in Road Accidents in Kenya. 2010. Cited July 31, 2014, Available from: http://www.globalpressjournal.com/africa/kenya/
6. Liu, B. C., Ivers, R., Norton, R., Boufous, S., Blows, S. and Lo, S.K. Helmets for preventing injury in motorcycle riders. Cochrane Database of Systematic reviews (2008) Cited September2014Availablefrom:http://info.onlinelibrary.wiley.com/userfiles/ccoch/file/Safety_on_the_road/
7. Labelle, J. and Swaine, B.R. Reliability associated with the abstraction of data from medical records for inclusion in an information system for persons with a traumatic brain injury. *Brain Injury Journal*. 2002; **16**: 713-727.
8. Murphy, R. K. J., McEvoy, L., Kelleher, M. O., Bolger, C. and Phillips, J. The burden of motorcycle-related Neuro-trauma in Ireland and associated helmet usage. *British Journal of Neurosurgery*. 2009; **23**: 162-164.
9. Zargar, M., Khaji, A. and Karbakhsh, M. Pattern of motorcycle-related injuries in Tehran, 1999 to 2000: a study in 6 hospitals. *Eastern Mediterranean Health Journal*. 2006; **12**: 81-87.
10. Lin, M. R., Hwang, H. F. and Kuo, N. W. Crash severity, injury patterns and helmet use in adolescent motorcycle riders. *Journal of Trauma*. 2001; **50**: 24-30.
11. Sarkar, S., Peek, C. and Kraus, J.F. Fatal injuries in motorcycle riders according to helmet use. *Journal of Trauma-Injury, Infection, and Critical Care*. 1995; **38**: 242-245.
12. Bello, J., Nasir, A., Solagberu, B., Ofoegbu, C. and Abdur-Rahman, L. Motorcycle transport: a threat to road safety in a community in Sub-Saharan Africa. *Injury Prevention*. 2012; **18**: 191-192
13. Emejulu, C., Jude, K., Ofodile, C. and Nottidge, T. The burden of motorcycle-related neurotrauma in South-East Nigeria. *Journal of Clinical Medicine and Research*. 2009; **1**: 013-017.
14. Solagberu, B., Ofoegbu, C., Nasir, A., Ogundipe, O., Adekanye, O. and Abdur-Rahman, L. Motorcycle injuries in a developing country and the vulnerability of riders, passengers and pedestrians. *Journal of the International Society for Child and Adolescent Injury Prevention*. 2006; **12**: 266-268.
15. Cook, L. J., Kerns, T., Burch, C., Thomas, A. and Bell, E. Motorcycle Helmet Use and Head and Facial Injuries: Crash Outcomes in CODES-Linked Data. Springfield, VA; 2009
16. Pruthi, N., Chandramouli, B. A., and Devi, B. I. Patterns of head injury among drivers and pillion riders of motorised two-wheeled vehicles in Bangalore. *The Indian Journal of Neurotrauma*. 2010. **7**: 123-127.
17. Crandon, I. *et al*. The impact of helmets on motorcycle head trauma at a tertiary hospital in Jamaica. *British Medical Research Notes*. 2009; **1756**: 162-172.
18. Nwadiaro, H. C., Ekwe, K. K., Akpayak, I. C. and Shitta, H. Motorcycle injuries in north-central Nigeria. *Nigerian Journal of Clinical Practice*. 2011; **14**: 186-189.
19. Ankarath, P. V. G., Barlow, I., Bellamy, M. C., Matthews, S. J. and Smith, R. M. Injury patterns associated with mortality following motorcycle crashes. *Injury*. 2002; **33**: 473-477.