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ORIGINAL ARTICLE

Head injury burden in a major referral hospital emergency centre in Botswana

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A B S T R A C T

Introduction: This study describes the demographics, aetiology, emergency centre diagnosis and severity indicators of patients with head injuries presenting to the largest referral hospital emergency centre in Botswana.
Methods: Cross-sectional retrospective data was collected from July 2015 to September 2015 for all emergency centre head injury presentations at Princess Marina Hospital. Information was extracted from emergency centre records regarding patient demographics, mechanism of injury, clinical observations, diagnosis, and treatment.
Results: Three-hundred and sixty head injury patients presented to the emergency centre in the three months, averaging four per day. 80% were less than 40 years of age and males accounted for 69% of all presentations. 58% of injuries were listed as being accidental, 39% recorded from assaults and 38% from road traffic accidents. The most common emergency centre clinical diagnosis was concussion and the most common radiological diagnosis skull fracture. The median Glasgow Coma Scale was 15 with a range from 3 to 15; and, among patients for whom Revised Trauma Score could be calculated, 79% scored the lowest probability of death in the Revised Trauma Score.
Discussion: Head injury disproportionately overburdened males in this study, and head injury aetiology and demographic picture was similar to regional data. Severity scoring using the Glasgow Coma Scale was only available among 66% of patients and Revised Trauma Score calculable in half of presentations. Only 55% of head injury patients were discharged from the emergency centre, despite the preponderance of low severity scores. Head CTs appear to have been over-utilised and implementation of a Traumatic Head CT guideline for our setting is proposed. This study improves understanding of the burden of head injury in Botswana and advocates for national referral guidelines for patients with head injury in Botswana.

African relevance

- This is the first clinical head injury study in Botswana, a middle-income country in sub-Saharan Africa.
- This study adds to regional trauma data for sub-Saharan Africa.
- This study shows complexities and practicalities of research in low- and middle-income country emergency centres.
- This study advocates for a local head injury head CT guideline that could be replicated in other low- and middle-income countries.

Introduction

Trauma has been increasingly identified as a pressing concern in the developing world. Numerous studies have highlighted that trauma patients in low- and middle-income countries (LMIC) endure greater morbidity and mortality than their counterparts in high-income countries [1–3]. Traumatic Brain Injury is the most common cause of death and disability from trauma, especially among young adults, and is predicted to surpass many diseases as a major cause of death and disability by 2020 [4,5].

Botswana, a landlocked upper middle-income country in sub-Saharan Africa, provides an example of a middle-income country with tremendous opportunities to improve trauma care. Botswana has not yet developed centralised trauma services and has little epidemiological trauma data. Princess Marina Hospital (PMH) located in the capital city, Gaborone, is currently the largest public referral hospital in the

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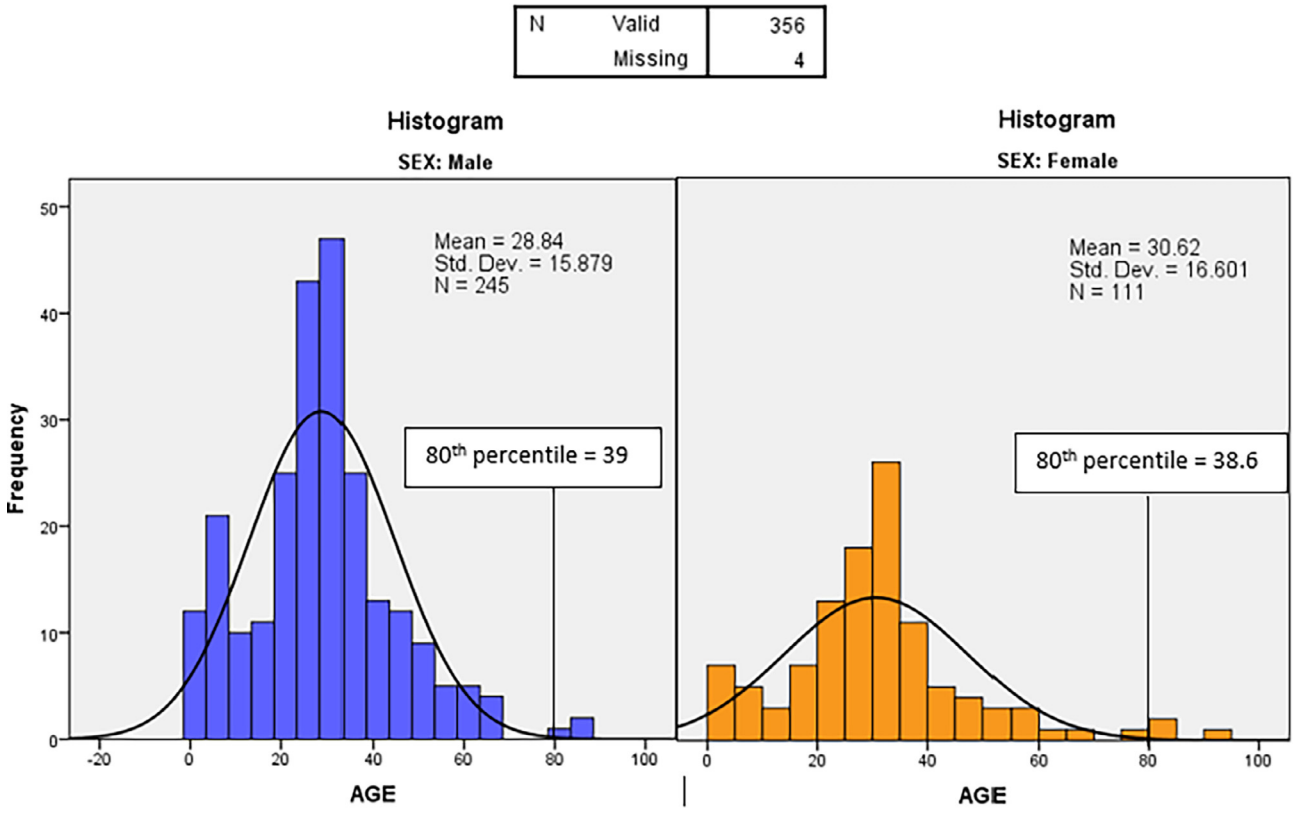

Fig. 1. Distribution of ages of head injury patients according to gender.

country. PMH is a mixed (adult and paediatric) emergency centre (EC) with 24-hour availability of all major surgical and orthopaedic services, including access to computed tomography (CT) scanning and an eight bed combined adult and paediatric intensive care unit. PMH also operates as the primary and district hospital for Gaborone, the capital city with over 230,000 people reported in the 2011 census [6]. A new referral hospital, with a dedicated trauma EC, has been constructed in Gaborone with the aim to improve specialty care in the country. Only one previous paper has looked at presentations to PMH EC and reported traumatic injuries as the third highest presenting diagnosis in 2011 [7]. Trauma types and severity were not studied; but the authors experience is that head injury is a significant burden at PMH. This study aimed to research head injury at PMH EC to investigate the burden of head injury and describe the current state of acute head trauma management in Botswana.

This study aims to describe the burden of head injury presenting to the largest public hospital EC in the country. It discusses the demographics, aetiology, EC diagnosis and severity of head injury presenting to PMH EC in three months of 2015.

Methods

Data was collected retrospectively on all patients with head injury, defined broadly by the researchers to include everything from scalp lacerations to open skull injuries, who presented to PMH EC from July 1, 2015 through September 30, 2015. Patients who were dead on arrival ("brought in dead") were excluded from the study, regardless of injury. A Microsoft Access 2010 database, (Microsoft Corp, Redmond WA, USA) was setup and used to extract relevant information from EC records filled out by medical and nursing staff for each patient. Collection began in July 2015 and EC staff was informed about the objectives of this study at this time.

EC record data collected included patient demographics (age, gender), geographical location of event, place of referral, method of arrival to EC, and times of injury, triage, and doctor examination. Vital signs (mobility, respiratory rate, heart rate, blood pressure, body temperature, mental status, and random blood sugar) were collected directly from corresponding fields on the same EC record. Glasgow Coma Scale (GCS), loss of consciousness, neurologic status, and pupil reaction were recorded from the physician history and physical field. Mechanisms of injury, as described in the physician history notes, were coded according to the WHO International Classification of External Causes of Injury system [8]. RTS was calculated retrospectively for all patients with complete data for GCS, blood pressure, and respiratory rate (citation).

Head injury is a nonspecific term, which includes clinically evident external injuries to the face, scalp, and calvarium, such as lacerations, contusions, abrasions, and fractures, and these may or may not be associated with Traumatic Brain Injury (TBI). TBI were coded using a previously published clinical case definition for neuro-trauma surveillance systems' that defines TBI as any injury to the head associated with any loss of consciousness or confusion/altered sensation and/or documented clear neuropathology (e.g., haemorrhage or fracture seen on CT), or head injury or trauma as a documented cause of death [5,8,9]. Intracranial diagnoses found on CT (e.g., subdural hematoma, intracerebral haemorrhage) were documented as recorded by the medical officer and/or neurosurgeon attending the patient from EC records. The doctors' diagnoses on discharge along with the patient's destination from EC were also recorded.

Ethics committees at the University of Botswana, University of Pennsylvania, Princess Marina Hospital, and Botswana Ministry of Health approved the study.

Results

Two authors retrospectively reviewed all EC records from the study period and a total of 360 patients were identified as having any head injury from July 1 to September 30, 2015. PMH EC unpublished data

lists 4818 patient presentations in this time period, with an inpatient admission rate from the EC of 37% and head injury noted as the sixth most common presentation to PMH EC overall for 2015.

The study included 113 females (31.3%) and 247 males (68.6%). Patients' ages ranged from 1 to 90 years with a mean age of 29.4 (SD = 16.1) and median age of 29.5. In our setting, patients over the age of 13 years are admitted to adult wards. Therefore, 299 (83.1%) were listed as adults, 57 (15.8%) were paediatric patients, and 4 patients had missing age data. The 80th percentile age for female and male patients was calculated at 38.6 and 39.0 years respectively reflecting that 80% of patients presenting with head injury were younger than 39 years for each sex group as shown on Fig. 1. These histograms show the similarities of the age profiles of affected male and female groups as well as the mean ages and the standard deviations.

At triage, 173 patients (48.1%) presented on stretcher and 181 (50.3%) presented walking. A complete four-point set of vital signs (BP, pulse, temperature, and RR) was only recorded for 125/360 (34.7%) of patients. The frequency of individual vital signs recorded at triage was pulse 96.7%, respiratory rate 93.9%, blood pressure 77.5%, and Temperature 45.8%. Oxygen saturation at triage was recorded for 212/360 (58.9%) of patients.

Many patients (36%) were transferred to the EC from external health facilities, such as district or primary hospitals. An additional 33% of patients initially presented to 14 local health clinics in Gaborone city before their referral to PMH EC. Remaining patients were transported by the public or private emergency medical services (EMS) from site of injury (14.4%) or self-referred (12.5%).

The majority of head injury was documented by EC staff as unintentional or accidental in origin (58%), but head injury attributable to assault constituted 39% of the total presentations. Blunt trauma accounted for 83% of head injury, with the predominant vector of injury being road traffic accidents (38%). Penetrating trauma accounted for 8.9% including only one incident involving firearms. The rest were unspecified mechanisms of injury with males outnumbering females in all causes of injury.

Fig. 2 shows the frequency of both clinical and radiological diagnoses from most to least common, as recorded by the treating doctor on the EC record. Concussion was the most common clinical diagnosis and the most common intracranial event recorded was intracerebral haemorrhage. Head CT was performed for 243 patients (67.5%). Of patients who had a head CT, 129 (53%) were recorded as negative for acute cranial or intracranial abnormalities. CT Diagnosis was recorded or not known in 41 (17%).

TBI was coded as previously discussed. One-hundred and two (28%) patients had no loss of consciousness (LOC) recorded with their head injury and 113 (31%) had missing data (i.e., records were unclear regarding if LOC occurred). Another 90 patients had a documented LOC on EC presentation, and another 58 patients were noted to have altered mental status or changes in sensation. Among the remaining patients, another 22 patients were found to have abnormal CT or documented neuropathological diagnosis. Therefore, among the 360 included head injury cases, 170 patients (47%) met the criteria for Traumatic Brain Injury. Of those with TBI, 72% were male and 28% were female, a similar proportion to the overall head injury gender ratio.

GCS was formally documented in 241 (62%) of the 360 records reviewed. Of the patients with a recorded GCS, 204 (84%) were mild (GCS 13–15), 14 (6%) were moderate (GCS 9–12), and 24 (10%) were severe (GCS < 9). The median GCS was 15, and ranged from 3 to 15.

The triage vitals collected by nursing staff documented the AVPU scale in 100% of the records. 84% presentations recorded the patient as alert, 6% as verbal response only, 5% as painful response and 4% as unresponsive.

The Revised Trauma Score (RTS), which is derived from initial systolic blood pressure, respiratory rate, and GCS [10]. Scores range from 0 (worst) to 7.841 (best) and have been validated in predicting survival.

In this study, RTS could be calculated for 178 cases, almost 50%, with 79% of those scoring the highest possible RTS (i.e., lowest probability of death) and the other 21% associated with more severe outcomes (Table 1).

Overall 197 (55%) of the 360 head injury patients were discharged from the EC and 96 (27%) were admitted to an inpatient ward, 33 (9%) transferred to external hospitals, 11 (3%) sent to PMH operation theatre, and 10 (3%) admitted to PMH intensive care unit. Among the discharged patients, 168 (85%) were referred from or presented to the EC from a radius of within 100 km from Gaborone.

Discussion

Our study demonstrates a significant burden of head trauma presenting to the PMH EC, with 360 head injury patients in this three-month period, 150 (42%) requiring admission and 170 patients (47%) meeting TBI criteria. There were over twice as many males as females (67 vs 31%) and 80% of all head injury patients were aged less than 40 years, which is similar to previously published sub-Saharan figures [4]. Head injury aetiology in our study was equally attributable to motor vehicle injuries (38%) and assault (39%), and the majority involved blunt mechanisms (83%).

Limited epidemiological data exists from Botswana, but some local data supports these traumatic burden findings. The 2013 WHO Global Road Safety report for Botswana states a road traffic accident (RTA) death rate of 23.6 per 100,000 population with males accounting for 74% of deaths [11]. Motor vehicle insurance reports in 2012 and 2013 show 69% and 62% respectively of deaths related to RTA were less than 40 years [12]. In a two-year review of spine injuries in Botswana, 80% of patients were aged under 45 and males represented 71% of patients [13]. A recent local survey of 26 Chronic TBI patients had 62% male participants, with mean ages of 31 years among males and 42 years among females [14].

The present study only captures hospital data. Often, assault-related minor injuries are not referred or do not present to hospitals, so the number of head injury from assaults may be underreported. Additionally, the aetiology and demographic statistics in our study may be impacted by not including patients presenting dead on arrival, or regional forensic data at PMH, leading to underreporting of the most severe injuries. The high proportion of mild head injuries with normal GCS, equal RTA and assault aetiologies, but only 55% discharge rate from the EC may also reflect the mixed origins of PMH EC patients, as PMH currently serves as the district and primary hospital for Gaborone as well as the major referral hospital for Southern Botswana.

EC Diagnosis depended entirely on the treating doctor's final assessments recorded on the single page PMH EC record used for all patients, regardless of chief complaint. Concussion was the most common clinical EC diagnosis and skull fracture was the most common radiologic diagnosis. We noted that CT scanning was extensively utilised in evaluation at the PMH EC, with 243 (67.5%) of all head injury patients undergoing CT head imaging at PMH. Although intracranial bleeding was identified in 10% of patients scanned and skull fracture in 17%, the most frequent radiological outcome in the EC record was negative for abnormalities in 129 patients (53%).

Currently PMH EC doctors (predominantly non-specialist medical officers) can access CT head scanning 24 h, seven days a week, with no formal ordering, or out of hours CT reporting system. CT head diagnoses in the PMH EC are generally recorded in the EC chart by treating doctor without formal input from radiologists, neurologists or neurosurgeons. PMH has one of only two public hospital CT machines in the country, with CTs available at no charge for citizens. These CT findings indicate over utilisation of the CT Head in head injury and highlight the need to implement a Traumatic Injury Head CT guideline for PMH EC.

Liberal use of imaging can be responsible for inappropriate allocation of health funds, longer stays in the EC and unnecessary exposure to radiation.

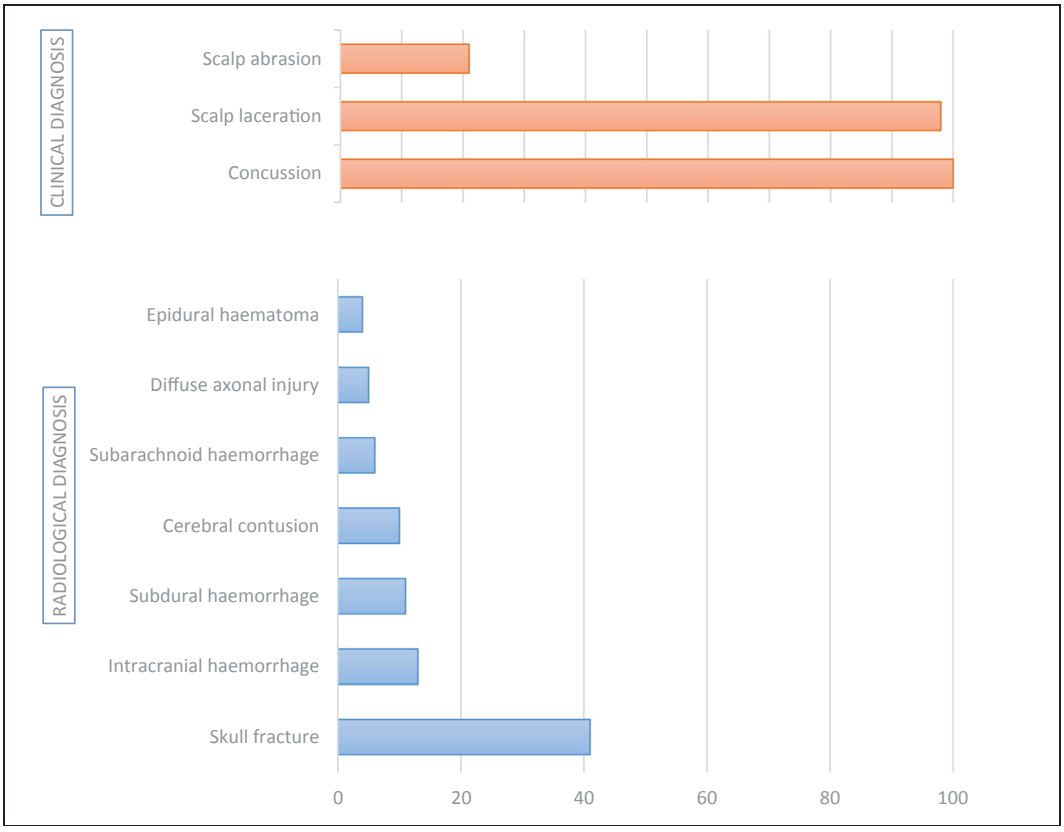

Fig. 2. Bar graph of individual head injury diagnoses by frequency.

Table 1
Frequency of Revised Trauma Score scores.

RTS score	Frequency	Probability of Survival*
3	1	0.361
4	7	0.605
5	13	0.807
6	12	0.919
7	5	0.969
7.841	140	0.988
Missing/unable to calculate	182	

Note. RTS, Revised Trauma Score.
* Probability of survival according to Champion et al. (1989) [10].

This PMH EC guideline is recommended based on the well validated Canadian CT rule (Fig. 3) [15]. On retrospective review of our dataset, eliminating patients who had a CT head in our dataset with GCS < 13, age > 65 and presence of a skull fracture clinically or radiological diagnosis, we found 82 patients who had a normal CT. Unfortunately, data in these patients was absent regarding the other indications for CT on the proposed guideline, but it seems as though a significant reduction in imaging at PMH EC could easily be achieved.

GCS was developed to categorise head injury in the 1970 s and still is widely used in over 80 countries for prognosis and research [5]. A recent study in Malawi confirmed the usefulness of GCS as a mortality marker in a resource limited setting [16]. Amongst PMH EC HI patients who had a GCS recorded; 6% were severe, 10% moderate and the remainder mild. This correlates with our median GCS being 15, the lowest risk of death. The RTS, derived from the GCS and two vital signs, also placed 79% of our patients in the lowest risk of death category. However, only 55% of head injury patients were discharged from the EC, which indicates patients may have had serious injuries not captured by this data or vital signs, or had other significant non-head injury related problems requiring admission.

Our study highlights the limitations of current PMH EC documentation practices for consistently recording vital signs, comorbidities, and thus trauma scoring for any trauma presentation; and presents opportunities for development towards a more integrated and structured trauma care system for PMH and Botswana. Current research has been initiated in Botswana to pilot a trauma registry at PMH and a nearby district hospital. This trauma registry utilises electronic trauma checklists for clinical assistance and research information and is hoped to lead to an establishment of a nationwide trauma registry. Trauma registries would also assist in referral and transport decisions that are a major challenge for Botswana, one of the most sparsely inhabited countries in the world.

Our study is the first of its type attempting to quantify the head injury burden in Botswana. It shows a significant number of head injury presentations, with similar demographics and aetiology to the known worldwide burden of head injury and trauma in LMICs. Lack of a standardised EC trauma admission form in our setting limited our accuracy in discussion regarding diagnostic categories, severity scoring, and disposition. We advocate for introduction of a PMH head injury CT Head guideline in the department and advocate for a national traumatic head injury referral guideline. These study also highlight opportunities in trauma research in Botswana and hopefully encourages others to further study head injury and other trauma processes in Botswana.

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Conflicts of interest

The authors declare no conflicts of interest.

PMH guideline for ordering a CT head (traumatic head injury)

Adults: (age 16 and above) presenting with a head injury, a CT Head should only be ordered if one or more of the following criteria are met:

- ☐ GCS of 12 or less at presentation to the Emergency Centre
- ☐ GCS score <15 at 2 hours after injury
- ☐ Suspected open or depressed skull fracture
- ☐ Any sign of basal skull fracture (haemotympanum, "raccoon" eyes, CSF otorrhoea/rhinorrhoea, Battle's sign)
- ☐ Vomiting ≥ two episodes
- ☐ Age ≥ 65 years
- ☐ Focal neurological deficit
- ☐ Persistent severe headache for more than 2 hours after injury
- ☐ Post traumatic seizure
- ☐ Dangerous mechanism of injury (ejection from a motor vehicle, a pedestrian/cyclist struck by a motor vehicle, fall from height of > 1 metre or 5 stairs).
- ☐ Amnesia for events more than 30 minutes before impact
- ☐ Coagulopathy, or patient on anticoagulants

Children: The same criteria as above should be considered, in addition to

- ☐ Significant scalp hematoma
- ☐ Evidence of any skull fracture

Abnormal behavior for age

If none of the high-risk criteria above are met, DO NOT ORDER A HEAD CT

Do NOT order a skull x-ray. If a skull x-ray has been done PRIOR to the patient's arrival to the Emergency Department and it demonstrates a skull fracture, order a CT Head.

Consider an associated cervical spine injury. If cervical spine injury is suspected, maintain spinal precautions. If a CT Head is ordered and cervical spine injury is also suspected, do a cervical spine CT at the same time as the CT Head.

Isolated "blown pupil" with normal level of consciousness should raise concern for ocular injury

Fig. 3. PMH EC Head CT ordering guideline.

Dissemination of results

An abstract was presented at the International Conference on Emergency Medicine in Cape Town (2016). Results were shared with colleagues, medical students and other health professionals at UB Faculty of Medicine's Research Meeting.

Authors' contributions

MC and TB conceived of the original research idea and collected data. TB and MM performed the data analysis. MC and TB drafted the manuscript. MC, TB and MM revised the manuscript and approved the final version that was submitted.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.afjem.2018.02.003.

References

[1] Hofman K, Primack A, Keusch G, Hrynkow S. Addressing the growing burden of trauma and injury in low- and middle-income countries. Am J Public Health 2005;95(1):13–7.
[2] Razzak JA, Kellermann AL. Emergency medical care in developing countries: is it worthwhile? Bull World Health Organ 2002;80(11):900–5.
[3] Lagarde E. Road traffic injury is an escalating burden in Africa and deserves proportionate research efforts. PLoS Med 2007;4(6).
[4] Hyder AA, Wunderlich CA, Puvanachandra P, Gururaj G, Kobusingye OC. The impact of traumatic brain injuries: a global perspective. NeuroRehabilitation 2007;22(5):341–53.
[5] Hawryluk GWJ, Bullock MR. Past, present, and future of traumatic brain injury research. Neurosurg Clin N Am 2016;27(4):375–96.
[6] Open data for Africa [Internet]. Botswana Statistics. [Cited 3rd April 2017]. Available from: http://botswana.opendataforafrica.org/pqnbol/regional-population.
[7] Chandra A. Epidemiology of patients presenting to the emergency centre of Princess Marina Hospital in Gaborone, Botswana. Afr J Emerg Med 2014.
[8] Thurman DKJRC, WHO Advisory Committee on Neurotrauma Prevention. Standards for surveillance of neurotrauma. Geneva: WHO; 1995.
[9] Evans R. Neurology and trauma. second ed Oxford University Press; 2006.
[10] Champion HR, Sacco WJ, Copes WS, Gann DS, Gennarelli TA, Flanagan ME. A revision of the trauma score. J Trauma 1989;29(5):623–9.

[11] WHO. Global status report on road safety. World Health Organisation; 2015.
[12] MVA Fund Annual Report 2013. Gaborone Botswana: Motor Vehicle Accident Fund; 2013.
[13] Lofvenmark I, Norrbrink C, Nilsson-Wikmar L, Hultling C, Chakandinakira S, Hasselberg M. Traumatic spinal cord injury in Botswana: characteristics, aetiology and mortality. Spinal Cord 2015;53(2):150–4.
[14] Mbakile-Mahlanza L, Manderson L, Ponsford J. Cultural beliefs about TBI in Botswana. Neuropsychol Rehabil 2017;27(1):38–59.
[15] Stiell IG, Wells GA, Vandemheen K, Clement C, Lesiuk H, Laupacis A, et al. The Canadian CT Head Rule for patients with minor head injury. Lancet 2001;357(9266):1391–6.
[16] Qureshi JS, Ohm R, Rajala H, Mabedi C, Sadr-Azodi O, Andrén-Sandberg Å, et al. Head injury triage in a sub Saharan African urban population. Int J Surg 2013;11(3):265–9.