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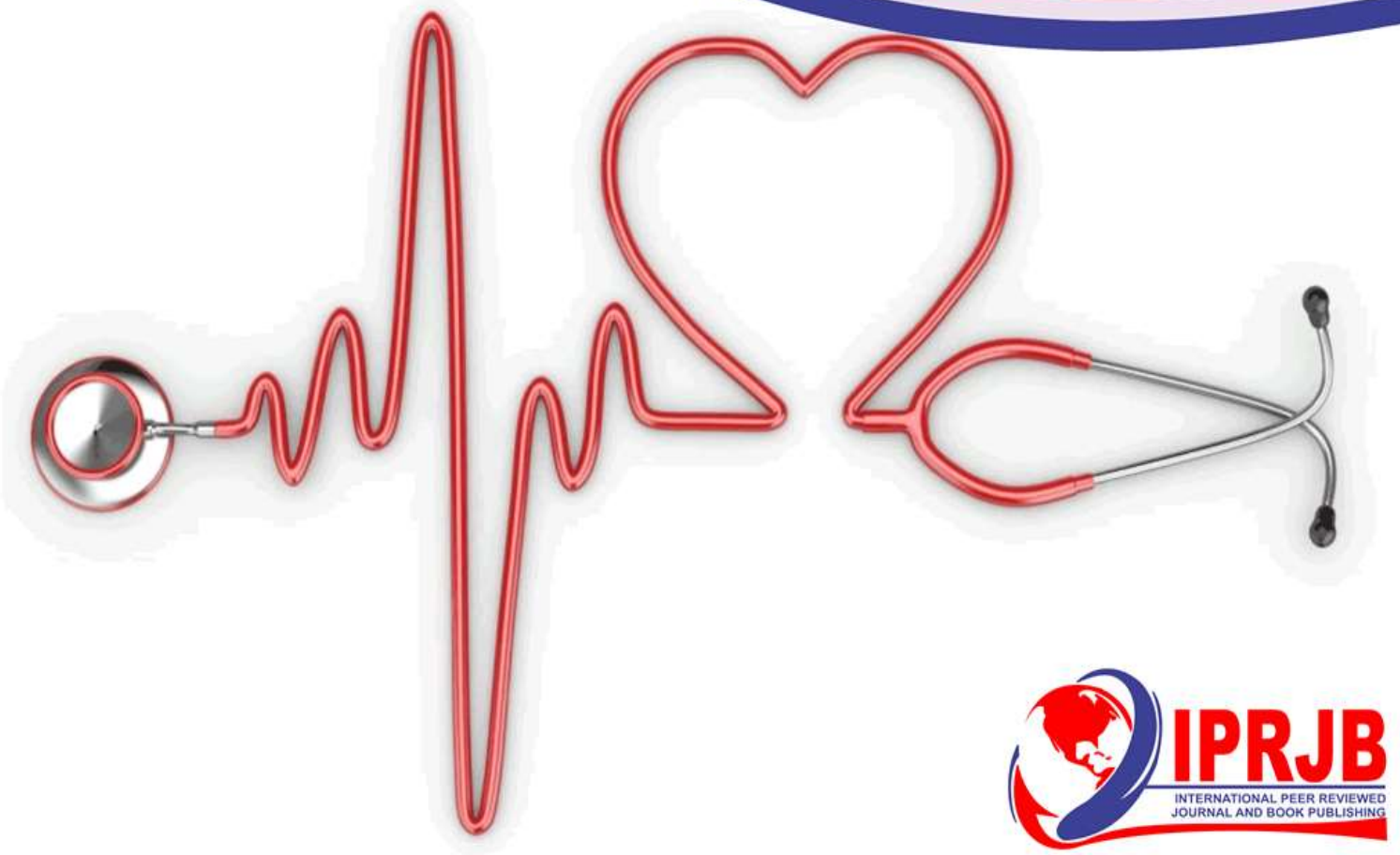

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Burden and Severity of Injuries at the Emergency Department of a Tertiary Hospital in Botswana- Princess Marina Hospital

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Abstract

Purpose: Injuries constitute a leading and growing cause of emergency department (ED) visits in sub-Saharan Africa. Characteristics of ED injury patients have been well-described in many parts of the world; however, data remain scarce throughout Africa, Botswana included. We aimed to describe in detail injury-related ED visits at an urban public referral hospital in Botswana.

Methodology: We conducted a retrospective chart review of all patients who presented to Princess Marina Hospital in Gaborone, Botswana, over a period of 4 randomly selected consecutive months. Demographic data, injury mechanism, type, severity and ED disposition were abstracted from the medical record into a Microsoft Access database designed for this study. Study variables were analyzed with summary statistics for frequencies, percentages, means, medians and relationships using SPSS. Injury severity was calculated for each patient using the modified Kampala Trauma Score.

Results: 6715 ED visits occurred during the study period, and 1709 (25.5%) were injury related. Of these, 63.9% were male, 24.7% <14 years old, 6.7% age 14-19, 49.1% 20-40, and 19.5% >40. 35.9% were due to falls, 23.6% assault and 18.8% road traffic crashes. 40.5% isolated soft tissue injuries, 34.7% isolated extremity injuries, 9.4% multiple injuries and 5.3% head and neck injuries. Kampala Trauma Score II (KTS) was available for 76% of patients. 1.7% scored ≤6, 5.9% 7-8, and 92.4% 9-10. For patients with KTS ≤6, 18% died in the ED, 82% were admitted and 0% discharged home. For KTS 7-8, 0% died, 93.5% were admitted, 6.5% were discharged home. For KTS II 9-10, 0% died, 26% were admitted, 74% were discharged home.

Unique Contribution to Theory, Practice and Policy: This study is among the first in Botswana to assess the burden of injuries using a validated injury severity scoring tool. Based on the study findings and applicability of the KTS II in our setting, we recommend that PMH ED incorporates and promotes a severity scoring system to help in planning and resource allocation. PMH ED receives many low acuity injuries therefore improving the availability of basic resources in local clinics may reduce overcrowding. Future studies should aim to involve multiple centers to get a true representation of injury burden in Botswana.

Keywords: *Injury Burden, Trauma, Epidemiology, Princess Marina Hospital, Botswana*

INTRODUCTION

Injuries are a major health and economic concern worldwide and a leading cause of death during the first four decades of life (Pfeifer et al., 2016). Worldwide, over five million people die each year as a result of injuries. This accounts for 10% of all-cause mortality and translates into 1.7 times the number of deaths caused by HIV/AIDS, tuberculosis and malaria combined (WHO, 2014). World Health Organization (WHO) estimates that in 2030 non-communicable diseases will be responsible for 70% of all deaths with 40% increase in deaths mostly due to road traffic collisions (WHO, 2007).

The 2013 Global Burden of Injury study estimated that 973 million people worldwide sustained injuries that warranted some type of healthcare intervention. Injuries accounted for 10.1% of the total Global Burden of Disease (GBD). In the same report, nearly 5 million people died from injuries with major causes of death being road traffic collisions (RTCs) (29.1%); self-harm (17.6%); falls (11.6%) and assaults (8.5%)(Haagsma et al., 2016).

The burden of injuries is higher in LMICs where more than 90% of injuries are said to occur. These are regions mostly without proper trauma surveillance systems or reliable local statistics (Hofman et al., 2005; Peden M, 2002). These countries also disproportionately have the lowest health budgets(Taira et al., 2009).

Another obstacle faced by LMICs in trauma care is lack of reliable and organized Emergency Medical Services (EMS). This lengthens the critical time interval before trauma victims receive appropriate care, contributing to worse outcomes.(Mock et al., 1998)

In Botswana there is paucity of data regarding burden of injuries. Valuable information can be obtained from trauma audits such as this study, to inform policy makers and public health authorities on the state of injuries and their contribution to the burden of disease in the country. In 2014, an epidemiologic study at Princess Marina Hospital found that trauma related visits accounted for 22.3% of all ED encounters. (Chandra et al., 2014) This study however lacked specific details on this burden- such as mechanisms, severity of injuries, disposition of injured patients etc.

PMH does not have a formal trauma surveillance tool and data is collected into logbooks. PMH sits at the peak of the public hospital referral system with the broadest of available sub-specialties and is affiliated to the University of Botswana. This hospital, with a 567 -bed capacity represents a primary and district hospital for the local population of the city of Gaborone as well as a tertiary hospital for the rest of the country. Gaborone is the largest city in Botswana, with an area of 100 200 ha (Kalabamu & Lyamuya, 2021), and home to more than 232,000 people. (Chiguvi, 2022)

This study was set to establish the epidemiology, demographic data and characteristics of injury presentations to the Emergency Department of the largest public hospital in Botswana.

METHODOLOGY

Study Design

A retrospective descriptive cross-sectional study was undertaken at the Emergency department of Princess Marina Hospital (PMH), a tertiary government hospital.

Study Population

All pediatric and adult patients who presented to the ED with injuries from 01 January 2017 to 30 April 2017.

Sample Size

The entire population of patients who presented with injuries during the study period was studied.

Inclusion Criteria

All pediatric and adult patients who presented with injury to PMH ED during the study period.

Exclusion Criteria

All non-injury patients.

Data Collection Techniques

Patients presenting to PMH ED have paper files opened in which their demographic, triage and medical data are recorded. Copies of these records from the stated period were retrieved by the principal investigator. Initially, all presentations to the ED during this period were counted. Those who presented with any form of injuries were identified to calculate the incidence of injuries. Data in line with the study objectives were extracted into a pre-designed Microsoft Access 2010 data collection tool. This tool was designed to capture variables adequate to meet the minimum requirements for the WHO Dataset for Injury (DSI) (WHO, 2020) – patient demographic data, triage data (vital signs, Glasgow Coma Score), triage, consultation and ED disposition times, setting of injury, transportation, mechanism of injury, diagnosis (anatomic patterns).

For each patient, an attempt to calculate the Kampala Trauma Score (KTS II) was made and the answer was recorded in the database. The KTS is an injury severity assessment tool that has been validated in both children and adults and found to be applicable in resource-constrained regions as it requires only a minimal data set and correlates well with mortality and need for hospital admission. A KTS II score of 9-10 suggests mild injury; 7- 8 suggests moderate injury; ≤6 suggests severe injury(MacLeod et al., 2003). Investigators estimated the number of serious injuries based on recorded anatomic injuries and diagnoses. These included multiple injuries, internal organ injuries, major fractures (excluding hand and foot), second- and third-degree burns (excluding first degree burns).

Data Analysis and Presentation

Analysis of data was done using SPSS for Windows version 20.0. (IBM Corp, Armonk, NY, USA). Study variables were analyzed with summary statistics for frequencies, percentages, means, medians and relationships. Data was presented in tables, bar charts, graphs and box and whisker. A level of significance for associations was set at $p<0.001$.

RESULTS

A total of 6715 patients visited PMH ED during the 4-month study period. However, we counted four days on which files could not be located despite a thorough search. Injury data were recorded from 1709 (25.5%) patient files. Demographic and triage data summarized in **Table 1** shows that most injury victims were males 63.9%. The median age was 27 years. The

most frequently affected age group was the 20 - 40 years (49.1%). Pediatric (<14 years) and geriatric (age >64 years) accounted for 24.7% and 3.7% respectively.

Most patients were triaged yellow and orange with proportions of 54.2% and 37.2% respectively while 5.7% were triaged red. Only 0.1% were dead on arrival (blue). On average patients waited 3 hours from triage to consultation time. The average ED length of stay was 5:45:25 hours.

Data were adequate to calculate the KTS II for 76% of patients. Limitations were primarily due to missing systolic BP (n=371) and/or respiratory rate (n=36). A severe KTS score was recorded in 1.3% of patients while 70.1% had mild injuries. Only 4.6% of injuries were reported to have occurred at work.

Table 1: Demographic and Triage Characteristics of Injured Patients Presenting at PMH Emergency Department

Variable	Frequency	Percent
GENDER		
Female	617	36.1%
Male	1092	63.9%
AGE GROUP		
<14	422	24.7%
14-19 years	114	6.7%
20-40 years	839	49.1%
>40 years	334	19.5%
INJURY AT WORK		
Yes	79	4.6%
No	1630	95.4%
TRIAGE CODE		
Red	97	5.7%
Orange	636	37.2%
Yellow	927	54.2%
Green	47	2.8%
Blue	2	0.1%
KTS II SCORE		
6	22	1.3%
7 - 8	77	4.5%
9 - 10	1198	70.1%
KTS not applicable	412	24.1%
LENGTH OF STAY (MM)		
0-59	65	3.8%
60-179	310	18.1%
180-299	458	26.7%
≥300	872	51.0%
Missing data	4	0.2%
AVARAGE LENGTH OF STAY (HH:MM:SS)	5:45:25	
AVARAGE WAITING TIME (HH:MM:SS)	3:01:39	

HH –hours; MM*- minutes; SS*-seconds; KTS II* Modified Kampala Trauma Score*

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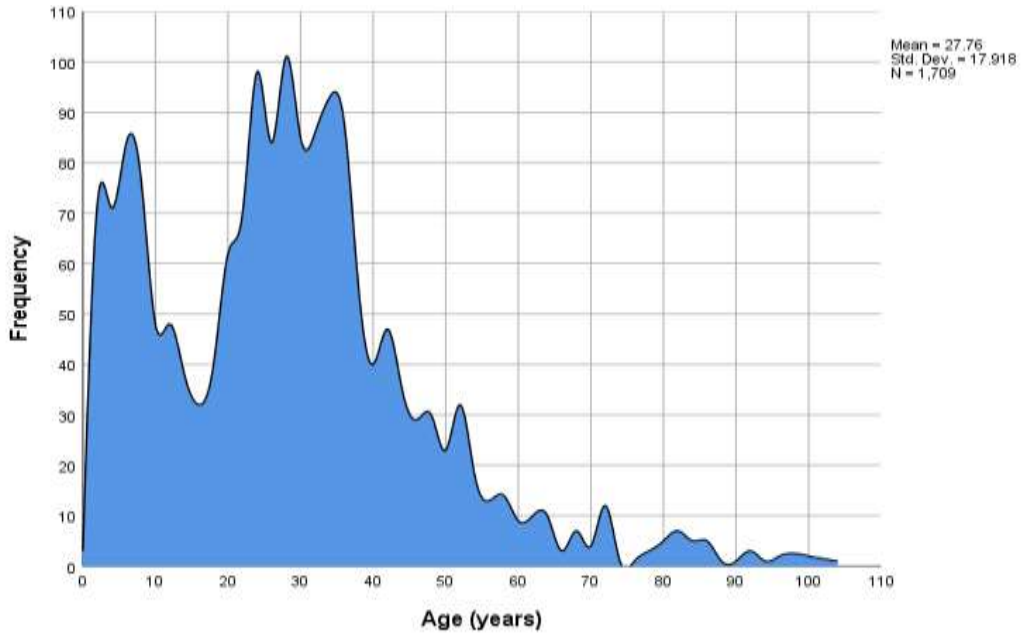
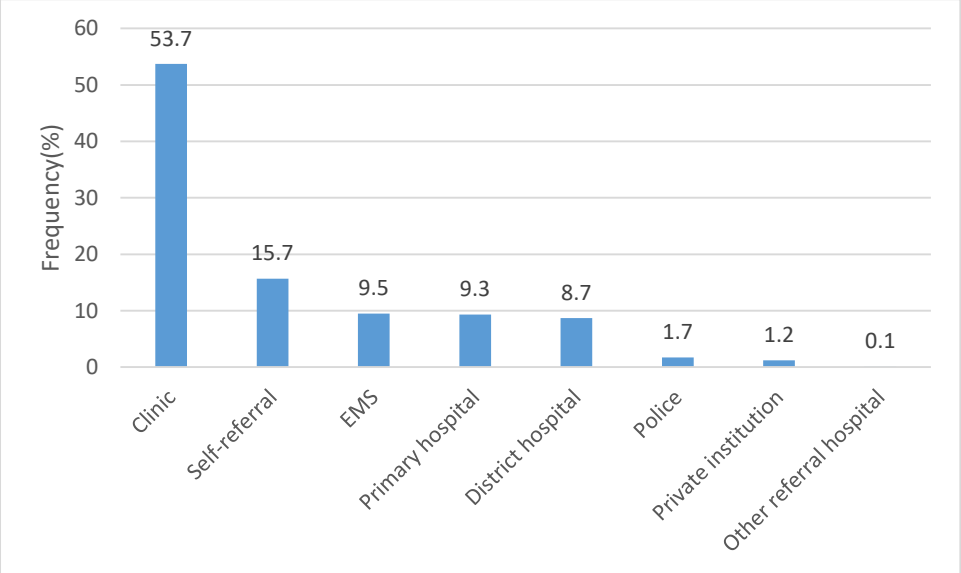


Figure 1: Age Distribution of Injured Patients Presenting to Princess Marina Emergency Department

There was a bimodal age distribution of injuries with peaks at 0-14 years and 20-40 years age groups (Figure 1).

A summary of referral patterns is shown in **Figure 2**. Most victims (53.7%) were referred from local clinics. A significant number of patients (15.7%) were self-referred. EMS usage was 9.5% of referrals.



EMS - Emergency Medical Services*

Figure 2: Referral Patterns of Injured Patients to PMH ED

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From **Table 2** the injury mechanism was recorded for 95.2% of the patients. The most common mechanism was falls (35.9%). Children were the most likely to sustain injuries via this mechanism (41% of all falls). In the 20–40-year age group, the leading mechanism was assaults- accounting for 71% of all assaults. This age group also contributed significant proportions in other injury mechanisms; RTCs (60.9%), sporting injuries (60.8%) and work-related injuries (73.2%). Falls were the leading cause of injuries in patients >40 years old - accounting for 26.9% of all injuries in the age group. Regarding burns, though generally infrequent, 51.4% occurred in the pediatric population. Other than road traffic crashes, other forms of transport are rarely the cause of injuries – 1.9% of all mechanisms. There was a statistically significant association between age category and mechanism of injury, p-value < 0.001.

Table 2: Mechanisms of Injuries in Different Age Groups in Patients Presenting to PMH ED

	Age n (%)				Total
Mechanism of injury	**<14 years**	**14-19 years**	**20-40 years**	**>40 years**	
Fall	252(41.0%)	36(5.9%)	161(26.2%)	165(26.9%)	**614(35.9%)**
Assault	28(6.8%)	27(6.8%)	296(71.3%)	63(15.2%)	**414(23.6%)**
RTC*	42(13.0%)	19(5.9%)	196(60.9%)	65(20.2%)	**322(18.8%)**
Sporting injury	23(22.5%)	16(15.7%)	62(60.8%)	1(1.0%)	**102(6.0%)**
Injured by work equipment	0	2(2.8%)	52(73.2%)	17(23.9%)	**71(4.2%)**
Burn	18(51.4%)	3(8.6%)	13(37.1%)	1(2.9%)	**35(2.0%)**
Injury from other forms of transport	13(45.5)	2(45.5)	13(39.4)	5(15.2)	**33(1.9)**
Injured by animal	9(27.3%)	1(3.0%)	16(48.5%)	7(21.2%)	**33(1.9%)**
Drowning	2(100%)	0	0	0	**2(0.1%)**
Self-inflicted injury	0	0	1(100)	0	**1(0.1)**
Unknown	35(42.7%)	8(9.8%)	29(35.4%)	10(12.1%)	**82(4.8%)**
P-value	<0.001				**1709**

RTC – Road Traffic Collision*

Emergency department diagnoses were recorded in 97.4% of files **(Table 3)**. Soft tissue injuries (STIs) were the most frequent diagnoses across all age groups with a 40.5% proportion. Upper and lower limb fractures & dislocations accounted for 22.4% and 12.3% of diagnoses respectively. Upper limb fractures and dislocations were most frequent in pediatric population as 42.8% of these injuries occurred in this group. In contrast lower limb fractures and dislocations were most frequent in the 20 to 40 years age group (43.8%). Of note 73.6% of all sexual assaults were in the pediatric group. There was a statistically significant association between the type of injury and patient's age p- value <0.001.

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Table 3: Types of Injuries in Different Age Groups in Patients Presenting to PMH Emergency Department

	Age in year's n (%)				Total
Injury sustained	<14	14-19	20-40	>40	
STI*	135(19.5%)	51(7.4%)	386(55.8%)	120(17.3%)	692(40.5%)
Upper limbs fractures & dislocations	164(42.8%)	17(4.4%)	133(34.7%)	69(18.0%)	383(22.4%)
Lower limbs fractures and dislocations	29(13.8%)	11(5.2%)	92(43.8%)	78(37.1%)	210(12.3%)
Brain + skull/head +facial injuries	19(20.9%)	4(4.4%)	50(54.9%)	18(19.8%)	91(5.3%)
Vascular/nerve/spinal/tendon injury	4(10.5%)	0	25(65.8%)	9(23.7%)	38(2.2%)
Burns	18(48.6%)	3(8.1%)	13(40.5%)	1(2.7%)	35(2.0%)
Sexual assault	14(73.6%)	3(15.8%)	1(5.3%)	1(5.3%)	19(1.1%)
Abdominal injuries	1(5.6%)	3(16.7%)	11(61.1%)	3(16.7%)	18(1.1%)
Thoracic injuries	1(6.3%)	2(12.5%)	12(75.0%)	1(6.3%)	16(0.9%)
Drowning	2(100%)	0	0	0	2(0.1%)
Multiple injuries	32(20.1%)	16(10.1%)	84(51.6%)	29(18.2%)	161(9.4%)
Unknown	3(15.9%)	4(15.9%)	32(72.7%)	5(11.4%)	44(2.6%)
p-value	<0.001				

STI* – Soft Tissue Injury

Figure 3 shows final disposition of patients from ED. Most patients (66.8%) were discharged home while 13.9% and 9.2% were admitted to orthopedic and surgical wards respectively. Fifty-eight patients (3.4%) were admitted via operating theatre while 10 (0.6%) were admitted directly to ICU. Four (0.2%) patients died in the ED while two were brought in dead (BID) and 45(2.6%) left against medical advice.

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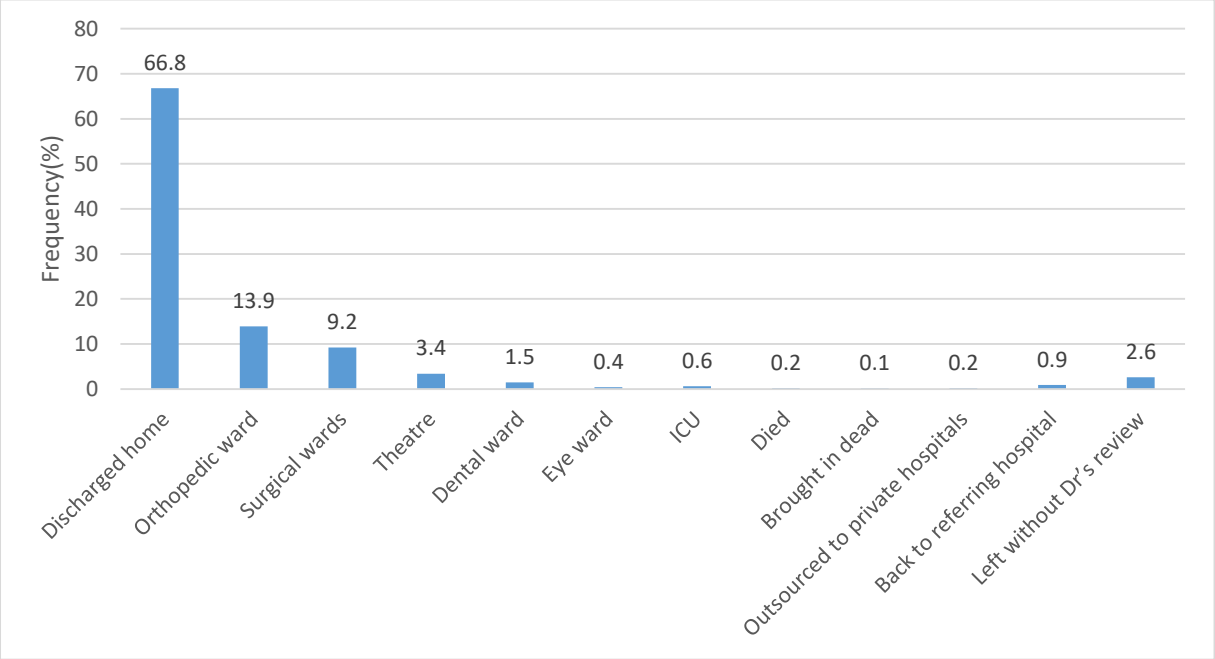

ICU – Intensive Care Unit*

Figure 3: PMH Emergency Department Final Disposition of Injured Patients

From **figure 4**, waiting time was shortest among patients with the most severe injuries, i.e., KTS II ≤6. The median patient with KTS II ≤6 was seen immediately upon triage. Longer waiting time is noted among all the remaining KTS II categories. The median times in HH:MM: SS were 1:45:59; 2:29:00 and 2:31:30 for scores of 7- 8, 9 -10 and 'KTS II not applicable' categories respectively. For patients whom the KTS II was not applicable because they left against medical advice, waiting time was calculated from triage time to the time recorded when they left the ED.

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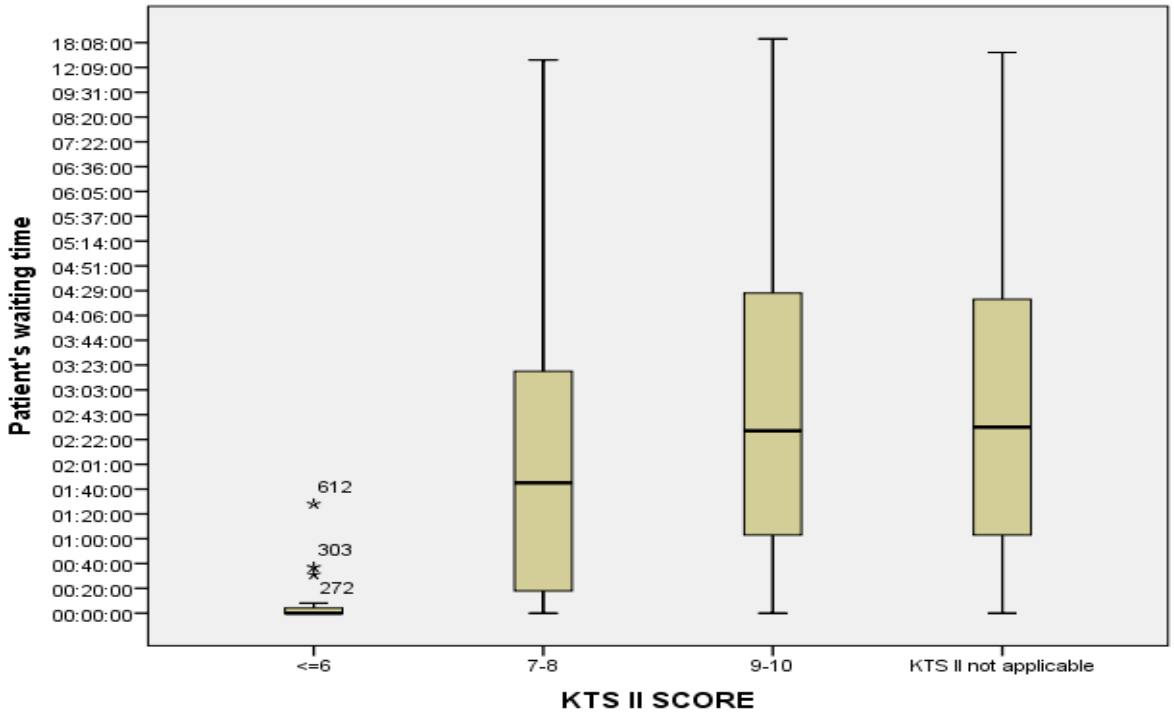

Figure 4: Emergency Department Waiting Times According to KTS II Score

Discussion

Through retrospective review of trauma patient files, this study aimed to determine the burden of injuries in patients presenting to the PMH ED. The findings of the study can be used to inform the need for development of a local trauma registry and trauma teams. The findings of this study address multiple topics of public health interest regarding the state of injuries in the country.

It was found that 25.5% of all PMH ED presentations were due to injuries. This number is higher compared to a previous study at the same facility that estimated injuries to represent 20% of presentations(Chandra et al., 2014). This increase may be explained by an expanded population in and around Gaborone; improvement in the health system and accessibility and/or health seeking behavior. Also, this study included burns, drowning and sexual assault victims which were excluded in other audits. A high number (71%) of sexual assault victims also suffer general body injuries (Zilkens et al., 2017).

Males were more likely to sustain injuries, 64%. The injury burden was particularly higher in younger males with 93% being ≤50 years old. This socio-demographic distribution of injuries has been reported in similar regional and international studies (Isaac M. Botchey, Jr. et al., 2017; Chalya et al., 2012; Cox et al., 2018; Demyttenaere et al., 2009; Dhaffala et al., 2013; Haagsma et al., 2015; Juillard et al., 2011; Kobusingye & Lett, 2000; Laing et al., 2014; Lozano et al., 2013; Lutge et al., 2016; Seidenberg et al., 2014; Taibo et al., 2016; Vosswinkel et al., 2014) . The median age of 27 years was like other regional studies (I. M. Botchey, Jr. et al., 2017; Mwandri & Hardcastle, 2018; Seidenberg et al., 2014). This age distribution of injuries has major socio-economic implications on communities as the most economically productive age groups are impacted (Chandran et al., 2010).

A bimodal age distribution of injuries (Figure 1) with one peak ≤10 years and another at 25 - 30 years has similarly been described in other studies (C Samuel et al., 2009; Seidenberg et al., 2014). Twenty five percent of injuries occurred in children under 14 years of age while 55% occurred in the 20 – 40 years age group.

Local clinics within Gaborone were responsible for the largest proportion of referred patients, 54%. This high referral rate is likely due to lack of basic resources such as surgical, laboratory and radiology in most clinics. In some clinics doctors work daytime shifts only and patients who present outside operating hours are deferred to PMH. The second largest group were self-referred patients. This may result in many low acuity presentations to the ED. Public education is likely to improve this and help de-congest the ED.

EMS usage was low, representing 9.5% of presentations. As with other SSA countries, EMS is relatively new and low usage is frequently reported. Its usage was reported to be 8.1% in Mthatha, South Africa, while in Lusaka, Zambia only 5.8% of the injured arrived by EMS (Dhaffala et al., 2013; Seidenberg et al., 2014). Lack of EMS result in inappropriate pre-hospital handling and care of trauma victims. Improving accessibility and ambulance availability will likely improve public perception and usage of EMS(Sultan et al., 2019).

The 3 most common mechanisms of injuries were falls, assaults and RTCs respectively. Combined, they accounted for 78.3% of all injuries. Similar observations were made in other SSA studies; Seidenberg et al.(Zambia) (Seidenberg et al., 2014), and Schuurman et al (South Africa) (Schuurman et al., 2015). Mwandri et al. and Cox et al. noted that falls were most common in pediatric age, while assaults and RTCs were most common in young adults (Cox et al., 2018; Mwandri & Hardcastle, 2018).These results were expected since this study was done in a youth-clustered, rapidly developing and industrialized city (Statistics-Botswana, 2011). In LMICs injury burden is thought to be fueled by rapid industrialization, poor road infrastructure with high motorization, poor visibility and reckless driving (Gopalakrishnan, 2012).

Soft tissue injury (STI) was the most frequent diagnosis, 40% of all diagnoses. This diagnosis included sprains, strains, bruises, minor puncture wounds, and minor lacerations. Mwandri et al. also found STIs to be most prevalent, followed by long-bone fractures and head injuries(Mwandri & Hardcastle, 2018). In Tanzania, Chalya et al. found STIs, fractures and head injuries to be the most common diagnoses(Chalya et al., 2012). A local study that focused on orthopedic injuries found that STIs were the third most common diagnoses in patients admitted to orthopedic wards(Manwana et al., 2018).

Fractures/dislocations of the upper limb were the second most common diagnoses (22.4%), while those of the lower limbs were third (12.2%). These findings were similar to those from regional studies (Chalya et al., 2012; Mwandri & Hardcastle, 2018). Such findings are worrisome because orthopedic injuries, especially in the young population, are associated with substandard quality of life and long-term disability (Balogh et al., 2012).

Traumatic brain injury (TBI) is the most common cause of death and disability in trauma patients especially younger patients in developing countries (Hawryluk & Bullock, 2016). It was the fourth most common diagnosis in this study. Thoracic and abdominal injuries were less common. Two noted studies in SSA have reported higher incidences than this study (Demyttenaere et al., 2009; Dhaffala et al., 2013).

This study is one of the first in Botswana to apply a validated injury severity scoring system. It was found that most presentations were non-severe (77%), with KTS II of 9-10. Only 1.3% had KTS II of ≤6, (severe injuries). In a significant portion of patients, the score was not applicable for reasons such as the patient having left before being reviewed by the doctors; missing vital signs or brought in dead. Systolic Blood Pressure (SBP) was missing mostly in pediatric files owing to the unavailability of pediatric BP cuffs. This became a major limiting factor in calculating the KTS II score in this group.

Most patients (66.8%) were treated and discharged from the ED. This finding is like data from other similar studies done in the ED (Demyttenaere et al., 2009; Weeks et al., 2014). For those that leave against medical advice (AMA), (2.6% in this study) their reasons usually include prolonged ED waiting; a decision to seek service in other health facilities or intoxication (Alfandre, 2009). Reasons for AMA were beyond the scope of this study.

About thirty percent (30.2%) of patients were admitted to various departments within PMH. The majority were admitted to the orthopedic wards (45.8% of all admissions). This finding is consistent with upper and lower extremity fractures and dislocations being the second and third most common diagnoses among injured patients.

Trauma is a leading cause of ICU utilization especially in patients admitted directly from the Emergency Department (Chalya et al., 2011; Olajumoke et al., 2014). We found that 0.6% of patients were admitted directly to the ICU.

ED waiting times and Length of stay (LOS) are key indicators for performance and operational efficiency (Rathlev et al., 2012). Prolonged waiting time and LOS can lead to client dissatisfaction, worsening of disease and poor outcomes (Affleck et al., 2013; McGillivray, 2003; Parker & Marco, 2014). The average waiting time was 3 hours while LOS was 5 hours and 45 minutes. Fifty-one percent of patients stayed for more than 8.3 hours in the department. Only 3.4% left the ED within an hour of arrival.

The reasons for the prolonged times are likely ED overcrowding, limited number of examination beds and understaffing. Limited bed capacity in the wards/operating theatre can also lead to bed-boarding in the ED (Derlet & Richards, 2008).

Limitations of Study

The study was conducted over a short period therefore seasonal variations in injury epidemiology were unaccounted for by the findings.

Being a retrospective review, the study relied on documented information only. This study reflects experiences at a tertiary center with its own protocols and this limits its generalization. Some findings, such as triage characteristics may have been impacted by treatments given at referring facilities or as prehospital care.

Patients who die in the prehospital setting are routinely diverted to local clinics to decongest the ED. This referral bias may explain the low count of 'brought in dead' patients. These patients are likely the most severely injured.

Ethical considerations: Permissions to undertake the study was granted by the University of Botswana Office of Research and Development, reference number: UBR/RES/IRB/BIO/GRAD/024, Ministry of Health through Health Research and Development Division, reference number: HPDME:13/18/1 and Princess Marina Hospital's

Ethics Committee with a waiver of consent granted for a low-risk study, reference number: PMH5/79(402-2-2017).

CONCLUSIONS AND RECOMMENDATIONS

Injuries contribute a significant percentage to the burden of diseases presenting at the PMH ED. Younger people, particularly males are the most affected. Parental guidance in children and measures to reduce RTCs and interpersonal violence are key areas to target to reduce injury burden.

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