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ORIGINAL SCIENTIFIC REPORT

Epidemiology of Traumatic Injuries at an Urban Hospital in Port-au-Prince, Haiti

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Abstract

Background Traumatic injuries represent a major burden of disease worldwide. Haiti lacks statistics on the epidemiology of traumatic injuries, as there is no formal injury surveillance program. This study will assess the burden of traumatic injuries in an urban trauma center in the capital city of Port-au-Prince, Haiti.

Methods A retrospective, cross-sectional chart review study at an urban trauma hospital was carried out for the period December 1, 2015, to January 31, 2016. Data were obtained through the hospital's main patient logbook, medical charts, and trauma registry forms. Data on medical documentation, demographics, and injury characteristics were collected and analyzed using descriptive statistics.

Results A total of 410 patients were evaluated for treatment of traumatic injuries during the 2-month study. The mean age in years was 30, with 66.3% male and 78.4% less than 41 years of age. There were 6.6 injuries per day and no correlation between frequency of injury and day of the week. Road traffic accidents accounted for 43.0% of trauma modes. The mean and median length of stay were 6.6 and 3.0 days. 9.0% of patients suffered severe trauma (ISS $\geq$ 16). 21.0% of patients with traumatic brain injury suffered severe head injuries. Extremity trauma was the most frequently injured anatomical region (50.0%). 22.7% of patients were admitted, and 15.1% patients underwent at least one surgical procedure.

Conclusions Road traffic accidents are the primary reason for injury; thus, prevention initiatives and improved trauma care may provide substantial public health benefits.

Introduction

An estimated 5.8 million lives are lost worldwide due to traumatic injuries each year, accounting for more 10% of the world's deaths, and representing 32% more lives than tuberculosis, malaria, and HIV/AIDS combined [1, 2]. Approximately 90% of the burden of disease due to trauma falls on LMICs, which contributes to immense socioeconomic consequences for countries early in development [3–5]. Although trauma systems in developed countries have been shown to dramatically reduce morbidity and mortality resulting from traumatic injuries, these systems are rarely implemented in developing countries due to financial, infrastructural, and human resource barriers [6–9]. Trauma continues to be one of the greatest global public health challenges of our time, contributing to millions of deaths and injuring more than 100 million individuals each year [2, 10–12].

Haiti, a nation of 11 million inhabitants, is the poorest country in the Western Hemisphere. Prior to the 2010 Haitian earthquake, it was estimated that there were 25

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doctors per 100,000 inhabitants and 49 major hospitals, reaching an estimated 60% of the population [13]. Following the 2010 earthquake, the public health system was left in complete turmoil following the collapse of 30 of the 49 major hospitals and the death of countless trained health professionals [14]. It is estimated that over 250,000 people died due to various injuries, as the lack of any organized emergency trauma care system exacerbated the situation. Although Haiti is transitioning from the emergency stage to the reconstruction stage, it is imperative that reforms of the health-care system are identified as a priority. Injuries due to trauma, and in particular traffic-related accidents, continue to rise due to poor road infrastructure and the lack of road safety enforcement, coupled with inadequate pre- and in-hospital trauma care. The Hospital Bernard Mevs Project Medishare (HBMPM) is the only trauma, critical care, and rehabilitation hospital, thus significantly limiting access to critical care for the injured [15].

At the current state, Haiti has no formal injury surveillance system and no critical care and trauma network [16]. Little is known about the epidemiology of traumatic injuries in Haiti and the economic burden imposed on the health system and on society. To date, a few studies have been conducted on the epidemiology of traumatic injuries. A study published in 2014 found that four of six major hospitals in the Central region of Haiti reported treating 250 or more trauma patients per month [17]. Previous numbers reported by the University Hospital Mirebalais in 2013 revealed that out of 13,781 patients seen in the opening year of the hospital, 2520 (18%) of patients sustained trauma, an estimated 210 patients per month [18]. These studies confirm a high burden of traumatic injuries in the Central region of Haiti. In the Northeast region of Haiti, two studies have focused on trauma. A cross-sectional study conducted in 2012 found that approximately 25% of all acute care and emergency patients sustained trauma [16]. A more recent cross-sectional study conducted in late 2013 in three public hospitals in the Northeast region provided baseline epidemiological data for trauma. The study found that these hospitals jointly treated an average of 6.3 patients per day [19]. On a national level, a trauma capacity assessment was conducted in 2014 which surveyed 12 hospitals in the 10 geographical departments of Haiti [20]. The cross-sectional study provided basic epidemiological data that revealed that emergency rooms (ERs) across the country see large volumes of trauma. During a 1-week surveillance of trauma cases presenting to ERs, secondary health facilities treated an average of 35 trauma cases a week, and tertiary facilities 59 trauma cases a week.

Although these studies provide crucial information on the burden of trauma in Haiti, the data are not sufficient to define the burden of traumatic injuries on the Haitian people. Despite global interest on trauma and road safety, little is known about the epidemiology of trauma in Haiti, mainly the common mechanisms of trauma and patterns of injuries presenting across the country. An epidemiological study in an urban trauma hospital in the capital city of Port-au-Prince will add to the dearth of information with the goal of informing public health policies.

Materials and methods

This retrospective, hospital-based, cross-sectional chart review study was conducted for the period December 1, 2015, to January 31, 2016, at the Hospital Bernard Mevs Project Medishare (HBMPM), located in the capital city of Port-au-Prince, Haiti. The study was approved by the HBMPM administration and the Institutional Review Board of McGill University (Study number: A06-E46-17A). All patients presenting for evaluation and treatment of traumatic injuries during the study period were eligible for inclusion. Traumatic injuries were defined as "an injury or wound to a living body caused by the application of external force or violence" [21].

Data were obtained through review of the hospital's main patient logbook and patient medical records. The main patient logbook contains basic patient information including: date of presentation, age, gender, symptoms/diagnosis, and reason for evaluation. Patients included in the study were identified using symptoms, diagnosis, and the reason for evaluation found in the main patient logbook. Patient medical records were then extracted for confirmation of traumatic injury and for further data collection. Patients with non-traumatic injuries were subsequently excluded. Trauma registry forms were introduced at HBMPM in 2010 and are available in the emergency department. These forms provide demographic information, admission and injury date and time and discharge date and status, mechanism and place of injury, severity of trauma through baseline vitals, level of consciousness, number and type of injury, and whether surgery was performed. These forms are stored in each patient's medical dossier if completed. All medical records were retrieved with the assistance of the HBMPM staff on-site.

Abbreviated injury scale (AIS) scores, maximum abbreviated injury scores (MAIS) and injury severity scores (ISS) were derived uniquely from patient medical records through patient diagnoses [22]. Injury severity classification for traumatic brain injuries (TBI) were classified based on a method developed by Brasure et al. [23]. Data on anatomical region of injury were categorized into blunt or penetrating injuries. Patients with both blunt and penetrating injuries to the same anatomical region were marked as penetrating. Multiple injuries to the same anatomical region were indicated as a single injury to the respective anatomical region in this study.

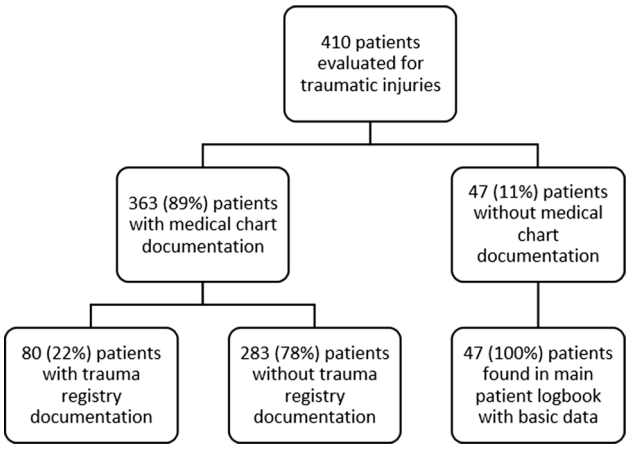

Fig. 1 Study population and documentation

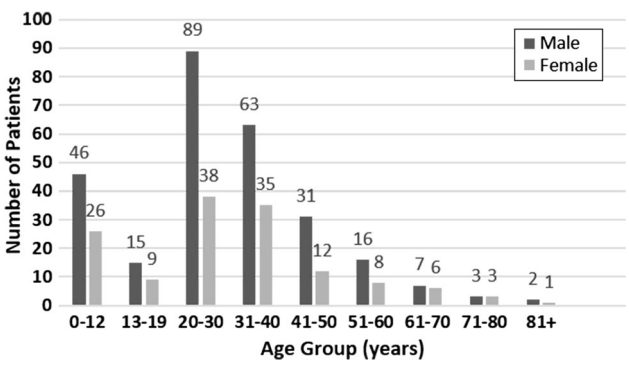

Fig. 2 Distribution of patients evaluated for traumatic injuries by age group and gender ($n = 410$)

All data analysis and descriptive statistics were conducted using SPSS MAC, version 22.0 (SPSS Inc, Chicago, IL). Mean values were reported with standard deviations (SD) and median values with interquartile ranges (IQR). Temporal variations in injury patterns were explored using linear regression analysis (95% confidence interval).

Results

During the study period, a total of 410 patients were evaluated for traumatic injuries. There was medical chart documentation for 363 (89.0%) patients (Fig. 1). There was major variability in data capture in the medical records and trauma registry forms. Trauma registry forms were available for less than 20% of patients in the study. (Fig 1). The mean and median age in the overall study population were 30 years (SD = 17.0, IQR = 18). The majority of patients presented with traumatic injuries were male (66.3%) and less than 41 years of age (78.4%). Children aged less than 13 years represented 17.6% of the study population (Fig. 2).

A total of 213 and 197 patients presented for treatment of traumatic injuries in December 2015 and January 2016, respectively, representing an average of 6.6 patients per

Table 1 Cohort characteristics

Mode of arrival	Total (%) ($n = 113$)
Vehicle	49 (43.4%)
Transferred via ambulance	33 (29.2%)
Motorcycle	12 (10.6%)
By foot	12 (10.6%)
Ambulance	5 (4.4%)
Unspecified	2 (1.8%)
Mechanism of injury	Total (%) ($n = 386$)
Vehicle	166 (43.0%)
Fall	87 (22.5%)
Stab/cut	49 (12.7%)
Gun shot wound	24 (6.2%)
Crush	7 (1.8%)
Burn	1 (0.3%)
Drowning	0 (0.0%)
Other	52 (13.5%)
Vehicle type	Total (%) ($n = 166$)
Motorcycle	50 (30.1%)
Car	34 (20.5%)
Pedestrian	22 (13.3%)
Bicycle	3 (1.8%)
Truck/bus	3 (1.8%)
Unspecified	54 (32.5%)
Safety devices	Total (%) ($n = 81$)
Seatbelt	3 (3.7%)
Helmet	1 (1.2%)
None	72 (88.9%)
N/A	5 (6.2%)
Alcohol consumed	Total (%) ($n = 80$)
Yes	17 (21.3%)
No	60 (75.0%)
Not sure	3 (3.8%)
Place of injury occurrence	Total (%) ($n = 275$)
Street/road/highway	176 (64.0%)
Home	61 (22.2%)
Commercial/work	11 (4.0%)
Farm/countryside	6 (2.2%)
Industry/construction	3 (1.1%)
School/education	2 (0.7%)
Other/unknown	16 (5.9%)
Injury intentionality	Total (%) ($n = 354$)
Unintentional	296 (83.6%)
Intentional	58 (16.4%)

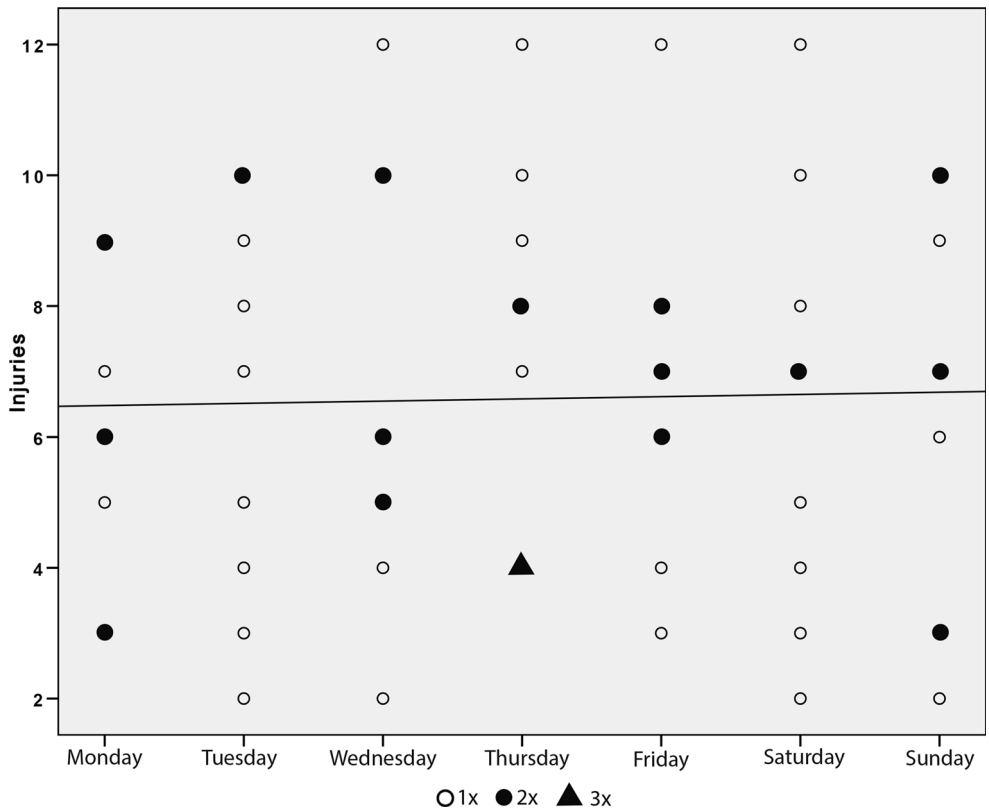

Fig. 3 Frequency of traumatic injuries by day of the week. Line shown represents linear regression line with a 95% confidence interval ($R^2 = 0.02$)

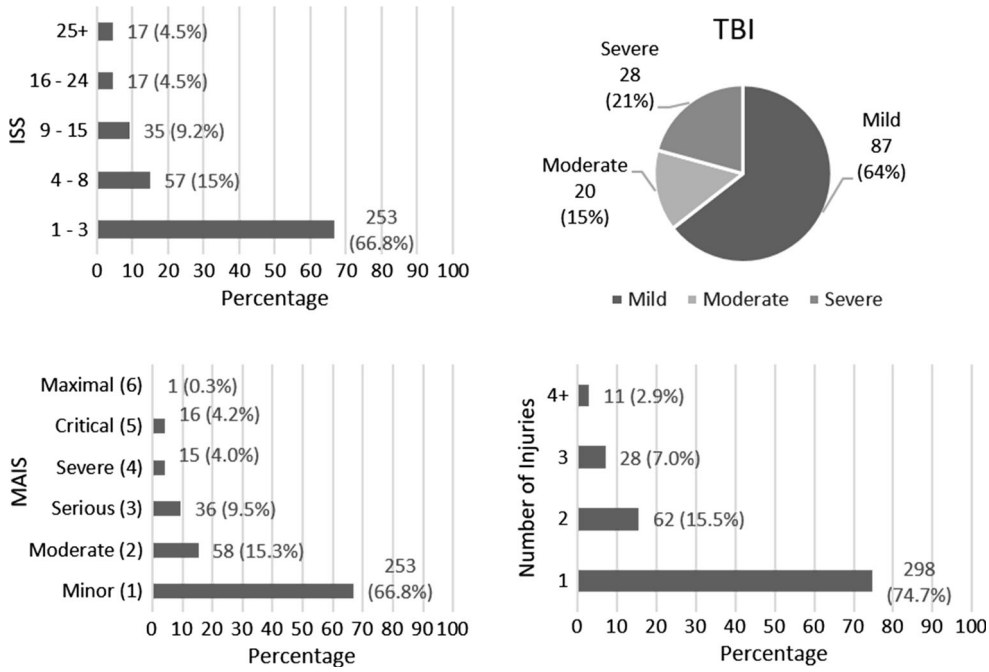

Fig. 4 Injury severity scores (ISS; $n = 379$), maximum abbreviated injury scale (MAIS; $n = 379$), traumatic brain injury (TBI; $n = 135$), and number of injuries ($n = 399$)

day. Figure 3 illustrates the number of trauma patients evaluated by day of the week over the study period. There was no correlation between the day of the week and frequency of traumatic injuries ($R^2 = 0.02$). The mean (SD) and median (IQR) time to treatment were 4.3 (7.4) and 2.0 (3.1) hours. In regard to mode of arrival, transportation via vehicle was most common (43.4%), and 5 (4.4%) patients reported arriving via ambulance (Table 1).

Table 2 Patient injury characteristics

Initial patient disposition from ER	Total (%) ($n = 357$)
Treated and sent home	249 (69.7%)
Admitted	81 (22.7%)
Transferred to other facility	14 (3.9%)
Dead on arrival/died in ER	2 (0.6%)
Refused treatment	11 (3.1%)
Length of stay (days)	Total (%) ($n = 77$)
≤3	41 (53.2%)
4–7	19 (24.7%)
8–14	8 (10.4%)
15–29	6 (7.8%)
30+	3 (3.9%)
Surgery performed	Total (%) ($n = 358$)
Yes	54 (15.1%)
No	304 (84.9%)
Documentation of vitals	Total (%) ($n = 410$)
Pulse	303 (73.9%)
Respiratory rate	281 (68.5%)
Systolic blood pressure	251 (61.2%)
Level of consciousness (AVPU)	Total (%) ($n = 292$)
Alert	279 (95.5%)
Responds to verbal stimuli	4 (1.4%)
Responds to painful stimuli	4 (1.4%)
Unresponsive	5 (1.7%)
Anatomical region of injury	Total (%) ($n = 403$)
Head	142 (35.2%)
Blunt/penetrating	91/51
Neck	12 (3.0%)
Blunt/penetrating	4/8
Face	101 (25.1%)
Blunt/penetrating	27/74
Back	14 (3.5%)
Blunt/penetrating	12/2
Chest	20 (5.0%)
Blunt/penetrating	13/7
Abdomen	8 (2.0%)
Blunt/penetrating	4/4
Pelvis/buttocks	10 (2.5%)
Blunt/penetrating	8/2
Upper limbs	99 (24.6%)
Blunt/penetrating	47/52
Lower limbs	103 (25.6%)
Blunt/penetrating	53/50

Vehicle accidents accounted for 43.0% of trauma modes, followed by falls (22.5%), and stab or cuts (12.7%; Table 1). The vast majority of injuries were recorded as unintentional (83.6%; Table 1). 58 (16.4%) patients were intentionally injured, primarily as a result of physical assault (98.2%) (data not shown for type of intentional injury). Place of injury occurrence was documented for 275 (67.1%) patients, with 64.0% of injuries occurring on a street, road, or highway, followed by 22.2% at home (Table 1). Patient discharge status was available for all patients in the study cohort. 384 (93.7%) patients were discharged alive, 15 (3.7%) patients were deceased, 10 (2.4%) patients were transferred to other health facilities, and 1 (0.2%) patient ran away. Of the 15 deceased patients, road traffic accidents (RTAs) accounted for 7 mortalities at HBMPM during the study period, followed by falls (3), gunshot wounds (1), and unknown (4).

RTAs were responsible for 43% of patients admitted for traumatic injuries. Among patients involved in RTAs, most patients were injured in a motorcycle accident (Table 1). Safety devices and alcohol consumption were recorded for 81 (19.8%) and 80 (19.5%) patients, respectively. The majority of patients reported not wearing any safety devices at all and reported having not been under the influence of alcohol (Table 1).

Initial patient disposition from the ER data revealed that the majority of patients were treated and sent home, and less than a quarter of patients were admitted for further treatment (Table 2). For patients hospitalized due to traumatic injuries, the average (SD) and median (IQR) length of stay were 6.6 (9.0) and 3.0 (5) days (Table 2). 54 (15.1%) patients underwent at least one surgical procedure as a result of traumatic injury (Table 2).

Vital signs for pulse, respiratory rate, and systolic blood pressure were documented in 73.9, 68.5, and 61.2% of medical charts in the study (Table 2). Level of consciousness, using the AVPU scale (alert, responds to verbal stimuli, responds to painful stimuli, unresponsive), was available for 292 (71.2%) patients (Table 2). The majority of patients ($n = 253$; 66.8%) scored a 1 (minor) on the MAIS scale, 94 (24.8%) patients suffered moderate to serious injuries, and 32 (8.5%) patients suffered severe to critical/maximal injuries (Fig. 4). The median injury severity score (ISS) was 1 (IQR = 3); however, 34 (9%) of patients suffered severe trauma (ISS $\geq$ 16) (Fig. 4). Among patients with traumatic brain injuries, the majority sustained a mild head injury (Fig. 4).

Among traumatic evaluations, a single injury was the most frequently documented (74.7%) (Fig. 4). Extremity trauma was the most frequently injured anatomical region (50.0%), followed by head trauma (35.2%), and face trauma (25.1%; Table 2). Blunt injuries represented 259 injuries, penetrating 250, and burn 1. Head injuries were predominantly blunt, face/neck injuries predominantly penetrating, back/pelvis/chest injuries predominantly blunt, and extremity trauma (upper and lower limbs) were approximately half blunt and half penetrating (Table 2).

Discussion

The results of this study provide insight and epidemiological data on trauma at an urban trauma hospital in the capital city of Port-au-Prince, Haiti. To my knowledge, it is the first epidemiological study providing data in the capital. More than 10% of patients in the study cohort lacked medical chart documentation, and more than 75% lacked a trauma registry form. This deficiency limits the results of this study; however, basic patient information was able to be extracted from the main hospital log book. Due to the paper-based archiving system, medical files may be easily displaced and lost; thus, an electronic medical filing system is recommended. Trauma registry forms, although available, are seldom used; thus, personnel must be designated to complete them. Carbon copies of trauma forms, as well as an electronic trauma registry, are essential steps for future research studies and improved trauma surveillance.

Similar to the other studies conducted in LMICs, the vast majority of victims were male and less than 45 years of age [1, 24, 25]. Children aged less than 13 years represented less than 20% of the study population. These numbers are similar to previous studies in Haiti and abroad and may indicate validity in the study results and in the sample population [16, 19]. During the two-month study period, the number of admissions per month was approximately 200, representing an average of 6.6 patients per day evaluated for trauma. This number is consistent with previous studies done in Haiti in tertiary hospitals, regardless of geographical region. It is commonly perceived that injuries in Haiti are more likely to occur on specific days, such as weekends, commerce gatherings, or festivals. This relationship was tested both graphically and statistically using linear regression analysis. There was no correlation between the day of the week and the frequency of injury, consistent with the study done by Aluisio et al. [19] in the Northeast Department of Haiti. Data on mode of arrival reveal that the vast majority of Haitians do not have access to, or have information about, the existing pre-hospital care and EMS systems in Haiti. Although an emergency service does exist, usage is low. Data and studies on the effectiveness and timeliness of such services are limited.

With regard to mechanisms of injury, RTAs were the predominant mechanism in this study, which is consistent with both studies in Haiti and other LMICs [19, 24, 26, 27]. This trend is consistent with the primary mechanism responsible for trauma globally and serves as an important signal for all countries, regardless of economic standing. RTAs continue to pose a huge threat to public safety, and thus, injury prevention programs as well as advanced surgical care for injured patients need to be investigated and potentially prioritized. Motorcycle accidents accounted for almost half of the patients involved in an RTA in this study. This spike is particularly alarming as regulation and enforcement has lagged behind the vast increase in the number of motorcycles on the road following the 2010 earthquake. Motorcycle drivers, although mandated by law to wear a helmet, are rarely penalized for not doing so.

Data on surgical procedures indicated that 15% of all patients required at least one surgical procedure (e.g., open reduction internal fixation), signifying huge costs as surgical procedures range from 20,000 to 50,000 HTG at HBMPM (1 USD is equal to approximately 60 HTG as of January 2016). This is the first epidemiological study on traumatic injuries in Haiti that provides injury severity scores. Although the majority of patients had minor injuries and were discharged the same day, approximately 10% of all trauma patients suffered severe and/or critical injuries. Further, 20% of patients that had a diagnosed brain injury were classified as severe. With four computed tomography scanners (one located at HBMPM) and four neurosurgeons operating in all of Haiti, emergent neurosurgical services are severely limited, and as a result an increase in mortality from head traumas is expected [28–30]. Anatomical region of injury data also revealed that lower and upper extremities were the most frequently injured body parts, followed by head and facial trauma. These findings are consistent with similar findings done in LMICs and in Haiti [19].

Due to the retrospective and hospital-based study design, the study likely suffered from selection bias as only patients presented for care were eligible for inclusion. Misclassification bias was minimized as all patients with trauma-like symptoms were initially included for data extraction, and subsequently excluded if the reason for presentation was medical and not traumatic in nature. Cross-sectional studies do not provide information on the incidence of injuries, which are important to trauma care system development. Although these biases may be substantial, epidemiological data stemming from hospitals provide an important starting point in quantifying the burden of illness.

Conclusion

This study provides data on traumatic injuries in the capital city of Port-au-Prince, Haiti. The majority of patients had minor injuries; however, traumatic brain injury was common. Road traffic accidents are the primary reason for injury; thus, prevention initiatives may provide public health benefits. Medical record documentation was variable, and trauma registry forms were seldom used. Interventions aimed at improving documentation and trauma surveillance to better define the burden of trauma are needed.

Compliance with ethical standards

Conflict of interest Authors declare that they have no conflict of interest.

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