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A trauma registry experience from the main referral center of Honduras: A call for action

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ABSTRACT

Background: Honduras is one of the most violent countries in the world and it has limited epidemiological data that describes the extent of intentional and unintentional injuries. This research is needed to develop and inform prevention programs in Honduras, as well as to spread international awareness.

Methods: A cross-sectional study was carried out on a paper-based injury surveillance system (InSS) with the help of Honduras' University Medical School Hospital (UMSH), the main referral medical center in Tegucigalpa-Honduras. Descriptive statistics and bivariate analysis were carried out using data from all registered injuries in 2013.

Results: Of the 17,971 injuries reported, intentional injuries made up 18.14% of all injuries. Interpersonal violence from gun violence, robberies, and physical altercations accounted for 14.68%. Self-inflicted injuries made up 3.46% of injuries, with suicide falls and poison intoxications being the most frequent (1.9% and 1.2%, respectively). Sexual harassment was minimally reported (0.27%, n = 48). Unintentional injuries made up 81.79% of the total injuries. The most common causes of unintentional injuries were falls (38.01%) and road traffic injuries (16.65%). Motorocyclists made up 35.4% of those injured by road traffic accidents. In general, injuries occured during the weekend and mainly affected men during the ages when they would be most likely to work and maintain jobs. The modified Kampala trauma score (M-KTS) showed that most of the injuries were mild (range 3–11), with 59.59% of the patients with a M-KTS of 9, and an overall mortality rate of 0.65% (n = 117).

Conclusion: The description of injuries provides the basis for prevention. The disproportionate number of unintentional injuries (4:1) seen in Honduras' referral hospital calls for further research in: 1) trauma care logistics and emergency systems, 2) mortality and lethality of intentional injuries, and 3) analysis of the types of unintentional injuries. Further research is necessary to evaluate interventions and identify the socioeconomic effects of injuries in the region.

Introduction

According to the World Health Organization (WHO), injuries are classified as being intentional or unintentional and include those that are self-inflicted, caused by interpersonal violence, or due to road traffic events, disasters, drownings, fires, wars, poisonings or falls. They cause more than five million deaths per year worldwide and contribute to 9% of global mortality and 16% of all disabilities [1]. It is estimated that over 90% of fatal injuries worldwide occur

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in low- and middle-income countries (LMIC), and primarily affect the young and economically active population [1,2].

In order to effectively manage and prevent injuries, it is important to identify their burden on a country and the factors that cause and influence them [2,3]. The two leading causes of injuries worldwide – violence and road traffic events – result in more than 1.6 million deaths per year and 1.2 million deaths per year, respectively [1,4,5]. Injuries cause incalculable costs to the society, economy, legal system, and healthcare systems [1,2].

According to the WHO, nearly 500,000 people are murdered annually. The highest rates of homicide occur in the Americas (28.5 per 100,000 inhabitants) [4]. Intentional injuries pose a significant burden on LMICs and their economies because they predominantly affect young working males [4]. In 2014, Honduras was ranked as the world's most violent country [6], with homicide rates of 85.5 per 100,000 inhabitants. Males were mainly affected (91.6%) and were injured predominately with firearms (83%) [4]. The country's violence was concentrated in the cities of San Pedro Sula and Tegucigalpa [7]. From our knowledge, scarce information is available regarding intentional and non-intentional injuries in the country or its capital city.

Through initiatives and funding by the CDC, Pan-American Health Organization (PAHO) and the United Nations Development Programme (UNDP), the most important medical center in Honduras – the University Medical School Hospital (UMSH) in Tegucigalpa – implemented a paper-based injury surveillance system (InSS) in 2005 that registered all injuries in the hospital emergency department [8].

The goal of the InSS was to provide basic epidemiological data on injury profiles and patient socioeconomic backgrounds that could be used for primary prevention strategies. Since Honduras lacks a trauma registry, the InSS provides the best available information to carry out any evidence-based research [9]. This registry has been maintained for more than a decade by the efforts of the UMSH [8,9]. The registry has been upkept despite changes in the health administration, political climate, and a lack of resources. [9,10].

This study aims to describe the most common injuries experienced in Honduras' main referral center in Tegucigalpa – the UMSH. It was approved by the Institutional Review Board (IRB) at the University of Pittsburgh with code PRO17080111. The objective of the study is to provide basic information on injury epidemiology to promote further research in Honduras and aid policymakers as they implement targeted strategies.

Material and methods

Cross-sectional study describing the InSS in UMSH from January 1st, 2013 until December 31st, 2013. The hospital has a total of 1055 beds and sees roughly 87,000 patients each year, of whom 15% are trauma patients. The hospital covers the metropolitan region of Tegucigalpa in the Central District of Honduras, home to 1.8 million inhabitants. It is the main referral center for 64 primary care health centers and five hospitals.

Trauma patient information is first hand written onto an InSS document and later transferred to an electronic database. This written form is completed by the health care staff (nurse or physician) upon the patient's arrival to the emergency room (ER). The information is provided by the patient, relative, or accompanying person – police, firefighters, paramedics or first responders. The form is then included in the clinical chart. The document contains basic patient information (age, date of birth, marital status), descriptions of injuries (time, activity during the injury, location/site, mechanism, damage caused such as edema, fracture, contusion, deformity, or multiple organ dysfunction syndrome, and injury intentionality), clinical evaluation (vital signs, airway status, and Glasgow coma scale [11]), and a treatment plan. It also includes questions about alcohol or drugs use. In the case of a road traffic collision, the InSS includes specific questions about the type of road collision, the type of vehicle (if any) the patient was using, the type of vehicle that injured the patient, and the use of safety equipment such as helmets and seatbelts. In the case of a suicide attempt, the registry includes questions about the precipitating factors [12]. The disposition of the patient was also included (whether the patient was treated and discharged, hospitalized, died in the ER, or was observed). The patient's final status after the hospitalization (whether the patient was dead or alive) was also included in the chart.

After the patients were discharged from the hospital, the information on their form was added to a central database by trained technicians who digitalized the information. All data from the InSS was exported to Stata 15® (StataCorp, TX, USA) for quality control and analysis. Quantitative variables were described with central tendency (mean) and dispersion measures (standard deviation [SD], range). Categorical variables were described with frequencies and percentages.

A modified Kampala trauma score (M-KTS) was calculated as a means of predictingmortality [13]. Injuries were categorized as either intentional or unintentional. Intentional injuries included self-inflicted injuries and violent interpersonal injuries. Unintentional injuries included falls and road traffic collisions.

Results

General description of injured patients

In 2013, a total of 17,971 patients were registered in the InSS due to a traumatic event. Unintentional injuries were the most common and affected 81.79% (14,699) of patients. The frequencies of injuries by type are described in Table 1. Most patients were treated and discharged on the same day of arrival (54.9%, 9855 patients). 44.7% of patients were admitted to the hospital (8021). The male to female ratio was 2:1, and the average age was 26± (Standard Deviation) 20 years. The age distribution was skewed to the right with peaks between ages 15–19 years (12.84%), 20–24 years (12.04%), and 10–14 years (11.76%; see Fig. 1 and Table 2). Males were more affected by interpersonal violence between the ages of 15 and 40 years compared to women (Fig. 2). Most of the patients had some form of education (78.03%), but only 11.84% of patients completed primary school. Most of the patients came from the Central District of Honduras, Tegucigalpa (82.62%).

Drug and alcohol use at the time of the injury was rarely recorded. Information on drug use was missing in 76.45% (13,739) cases, while information on alcohol use was missing in 73.75% (13,253) cases. Of those patients who did have information on drug and alcohol use, 74 patients (0.41%) tested positive for drugs and 760 patients (4.23%) tested positive for alcohol.

The Glasgow coma scale was 15 for 99.65% (17,909) of the patients. The M-KTS ranged from 3 to 11, with 59.59% of patients

Table 1
Injuries in the main referral center in Honduras, 2013.

Type of injury	n (%)
Injuries	17,971 (100)
Intentional injuries	3260 (18.14)
Interpersonal violence	2638 (14.68)
Self-inflicted injuries	622 (3.46)
Unintentional injuries	14,699 (81.79)
Falls	6830 (38.01)
Road traffic injuries	2993 (16.65)
Other unintentional injuries	4,876 (27.13)

Intentionality of the injury was reported in 17,959 (99.93%) patients.

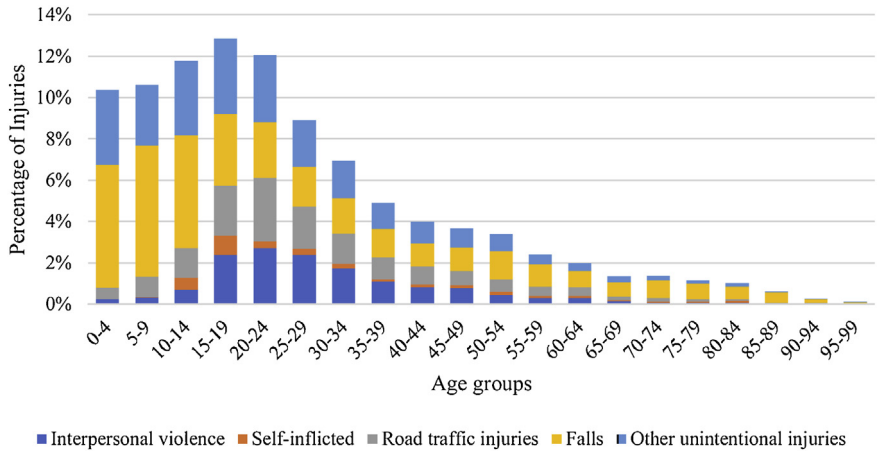

Fig. 1. Age distribution based on the type of injury.
Legend: Data for age was available for 17,913 (99.68%) patients. Source: UMSH.

Table 2
Characteristics of patients with injuries in a referral center in Honduras by injury type, 2013.

Characteristics	All Injuries (n = 17,971)	Unintentional Injuries (n = 14,699)	Intentional Injuries	
			Self-inflicted injuries (n = 622)	Interpersonal violence (n = 2638)
Sex, n (%)				
Male	12,257 (68.20)	9636 (78.62)	388 (3.17)	2226 (18.16)
Female	5,672 (31.56)	4958 (87.41)	308 (5.43)	401 (7.07)
Age, mean (SD)	26.02 (19.87)	25.30 (20.56)	27.95 (21.15)	29.41 (14.51)
0–17 years, n (%)	7332 (40.90)	6532 (89.13)	328 (4.48)	469 (6.40)
18–45 years, n (%)	7598 (42.39)	5577 (7345)	226 (2.98)	1790 (23.57)
46–98 years, n (%)	2995 (16.71)	2479 (82.88)	142 (4.75)	370 (12.37)
Location, n (%)				
Home	6,536 (36.39)	5659 (86.53)	407 (6.22)	470 (7.19)
Public locations	6,441 (35.85)	4830 (74.97)	120 (1.86)	1491 (23.14)
Work place	1,518 (8.45)	1281 (84.33)	65 (4.28)	172 (11.32)
Activity, n (%)				
Working	3,385 (1884)	2763 (81.62)	135 (3.99)	485 (14.33)
Free time activities	5,948 (33.10)	4983 (83.78)	329 (5.53)	633 (10.64)
Travelling/moving	4,367 (24.30)	3718 (85.14)	58 (1.33)	590 (13.51)
Pregnancy, n (%)[a]	75 (1.31%)	63 (84)	3 (4)	9 (12)
Injury type, n (%)[b]				
Contusion	9,461 (52.65)	8546 (90.33)	176 (1.86)	733 (7.75)
Closed fracture	2,019 (11.23)	1816 (89.95)	122 (6.04)	79 (3.91)
Traumatic Brain Injury, n (%)	3588 (19.97)	2991 (83.36)	20 (0.56)	576 (16.05)
Hospitalization, n (%)	8021 (44.63)	5696 (71.01)	605 (7.54)	1711 (21.33)
Died, n (%)	115 (0.64)	67 (58.26)	6 (5.22)	42 (36.52)

SD: Standard deviation.
[a] Calculated only for women (n = 5714).
[b] Calculated only for contusions and closed fractures (n = 11,472).

with a M-KTS of 9, 31.58% of 8, and 7.68% of 7. Mortality rate in the ER was 0.33% (59) and in-hospital mortality rate was 0.32% (58). Overall mortality was 0.65% (117).

Intentional injuries

Intentional injuries made up 18.14% (3260) of all recorded injuries. Males were injured in 78.90% (2572) of cases, resulting in a male-to-female ratio of 4:1. The average age was 29.68 ± 15.87 years with a range from 0 to 97 years. The most affected groups were 15–19 years of age (18.25%,) followed by individuals ages 20–24 and 25–29 years, representing 16.72% and 14.85%, respectively (Figs. 1 and 2). The Glasgow coma scale was 15 in 99.33% of patients. The M-KTS ranged from 4 to 11, with 63.28% of patients with an M-KTS of 9, 29.85% with an M-KTS of 8, and 5.49% with an M-KTS of 7. Most of these injuries occurred on Saturdays (17.70%) and Sundays (20.12%). The most common mechanism of injury was with a firearm, representing 30.06% of cases. Other common mechanisms of injury included white arms/cutting objects (24.66%) and blunt trauma (22.79%). In the ER, 71.04% of patients were hospitalized, 27.98% were treated and sent home, and 0.71% died in ER. During the hospitalization, 0.80% of the patients died.

Interpersonal violence

Interpersonal violence made up 80.92% of the intentional injuries and 14.68% of total injuries (2638 patients). Most of the victims were male (84.4%), with a mean age of 29.4 ± 14.5 years (range 1–98). The age distribution was skewed to the right, with the most affected group between 18–45 years of age (67.85%). Peaks in the age distribution were found between 20–24 years of age (18.46%), 15–19 years of age (16.26%), and 25–29 years of age (16.19%, see Figs. 1 and 2). 99.33% (3238) of the patients had a Glasgow coma scale score of 15. The M-KTS was 9 for 63.28% of patients, 8 for 29.85% of patients, and 7 for 5.49% of patients (range 4–11).

When the victim knew the aggressor (missing data = 948, 35.94%), the aggressor was either a friend (11.3%) or a possible gang

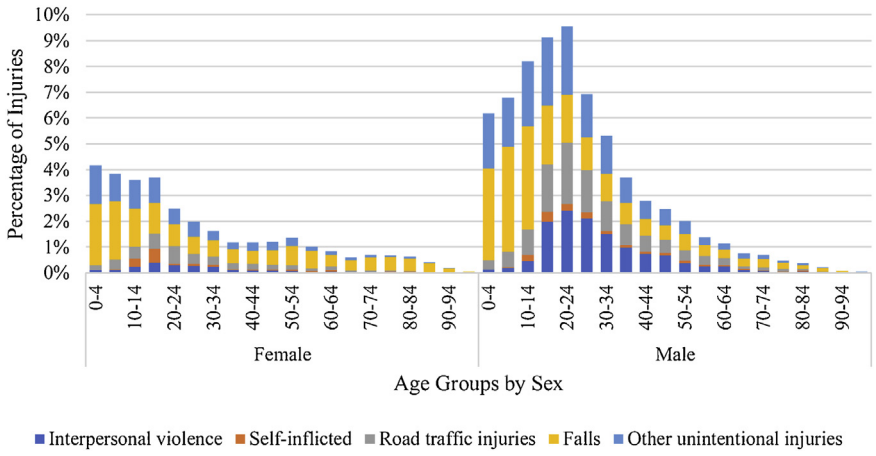

Fig. 2. Age distribution by Sex based on the type of injury.
Legend: Data for age and sex combined was available for 17,884 (99.52%) patients. Source: UMSH.

member (7.85%). Robberies (17.6%) and physical altercations (16.9%) were the main modes of aggression. Drug and alcohol testing was carried out on 586 victims of aggression. Of those tested, 37% were positive for drugs and 40.9% were positive for alcohol. Although the alcohol and drug levels of the aggressors were oftentimes unknown, 20 (0.76%) aggressors tested positive for drugs and 83 (3.11%) were found to be intoxicated. Sexual abuse was reported in 0.27% (n = 48) of all cases.

Interpersonal violence was most commonly caused by gunshot (36.20%), white arms (28.32%), and blunt trauma (26.99%). It occured almost twice as often on the weekend (Saturday 18.50%, Sunday 22.25%) than on the weekdays (Monday 13.65%, Tuesday 11.30%, Wednesday 12.51%, Thursday 11.07%, and Friday 10.50%). 64.86% of patients who presented to the ER were hospitalized, 34.04% were treated and sent home, and 0.83% died. Among hospitalized patients, 0.80% died.

Self-inflicted injuries

There were 622 (3.46%) cases of self-inflicted injuries in 2013. Most of the patients were male (55.6%) with a mean age was 30.8 ± 20.6 years (range 8–94). The most affected age groups were those between 15–19 years of age (26.69%) followed by those between 10–14 (16.56) and 20–24 (9.32) years of age. Suicides were most frequently attempted on Wednesdays (16.24%) in the months of April (12.38%), October (10.29%), November (9.97%) and December (9.81%). A physical altercation or internal conflict with a partner or family member precipitated the injuries in 14.5% of the cases. The predominant mechanisms of injury were suicidal falls (46.25%) and poison intoxications (36.98%), resulting in organ failure (25.5%), open fractures (25.2%) and closed fractures (17.5%). Of the 308 female patients, 0.97% were pregnant.

A total of 605 patients (97.27%) were admitted to the hospital. One patient died in ER (0.16%) due to an ingested poison. The Glasgow scale was 15 for 99.84% (621) of patients, and the M-KTS was 9 for 76.37% of patients and 8 for 22.35% the patients (range 6–9). During the in-hospital care, 5 (0.80%) patients died, two were in the hospital due to poison ingestion, and three were there due to a firearm injury.

Unintentional injuries

Of the 14,699 (81.79%) patients who experienced unintentional injuries, most were men (65.84%) with a mean age of 25.2 ± 20.6 years (range 1–98 years). The frequency of unintentional injuries decreased as the age of the patients increased. Almost half of the patients who experienced unintentional injuries were less than 18 years of age (44.96%), with the most affected age groups between 10–14 (12.81%), 5–9 (12.52%), and 1–4 (12.35%) years old (Figs. 1 and 2).

Most of the unintentional injuries (94.33%) were falls (6830, 46.47%), followed by road traffic injuries (2993, 20.36%), blunt trauma (2,003, 13.63%), cuts with sharp objects (768, 5.22%), foreign body injury (361, 2.46%), exposure to a hot gas/liquid (266, 1.81%), exposure to fire, heat or smoke (201, 1.37%), animal/insect bites or stings (160, 1.09%), intoxication/poisoning (152, 1.03%), and crush injury (132, 0.90%) among others.

Of the women who experienced an unintentional injury, 1.24% were pregnant. Most of the patients were stable upon arrival to the hospital with a Glasgow score of 15 for 99.73% (15,659). The most commonly injured anatomical sites were the musculoskeletal system (49.32%) and the brain (14.46%). Unintentional injuries occurred most frequently on Sundays (15.85%), Mondays (14.95%) and Saturdays (14.12%) during the months of April and August (10.45% and 10.12%, respectively). The M-KTS was 9 for 58.78% of the patients, 8 for 31.96%, and 7 for 8.16% (range 3–11). Only 0.24% (36) of patients died. Of these, 66.67% died due to a road traffic injury and 25% died due to a fall. 60.82% (8940) of patients were treated and sent home on the same day. During the hospitalization, 0.22% (32) died. 59.38% of these deaths were due to a road traffic injury and 25% were due to a fall.

Falls

The hospital treated 6830 (38.01%) fall patients. Most were male (59.5%), with a mean age of 25.3 ± 23.4 years (range 1–98 years). More than half of those affected (52.69%) were between 1 and 17 years of age. The age distribution was skewed to the right, with a peak from 5 to 9 years of age (16.6%), 1–4 years of age (15.58%), and 10–14 years of age (14.32%; see Figs. 1 and 2).

Falls most commonly resulted in contusions (65.4%), followed by closed fractures (17.9%) and sprains (3.7%). Among the afflicted women, 1.17% were pregnant. Traumatic brain and musculoskeletal injuries were recorded in 21.3% and 61.5% fall patients, respectively. Most falls occurred on Sundays (16.03%), Mondays (15.51%), and Wednesdays (14.55%) in the months of April (11.46%), May (10.85%), and August (10.82%). The Glasgow coma scale for patients with this type of injury was 15 for 99.84% (6819). The M-KTS was 9 for 55.55% of the patients, 8 for 33.41%, and 7 for 10.19% (range 4–11). In the ER, 0.13% patients died and 67% were treated and discharged. During the hospitalization, 0.12% patients died.

Road traffic injuries

Road traffic collisions made up 16.65% (2993) of all injuries. Males were affected more often than females (ratio 3:1; see Fig. 2).

The mean age of victims was 28.4 ± 16.84 years (range 1–98 years) with a distribution skewed to the right. Peak frequencies occurred in the 20–24 age group (18.41%), 15–19 age group (14.47%), and 25–29 age group (12.2%; see Figs. 1 and 2).

Drivers (37.9%), as opposed to front seat (30.0%) and backseat passengers (22.9%), were most frequently the injured person in a road collision. Most victims were driving motorcycles at the time of their collision (35.4%), followed by pick-up trucks (10.5%) and private cars (7.4%). Protective equipment was not commonly worn at the time of the accident, and 39.9% of patients reported using neither a helmet nor a seatbelt. Of the female victims of traffic collisions, 1.43% were pregnant.

Traffic victims had a Glasgow score of 15 in 99.63% (2982) of the cases. Of the 865 patients who experienced traumatic brain injury (28.9%), 10.5% had open brain injuries and 89.5% had closed brain injuries. There were 73 cervical traumas (1.4% open injuries), 201 thoracic traumas (3% open injuries), 99 abdominal traumas (3% open injuries) and 1311 musculoskeletal injuries (11.1% open injuries). Contusions made up the greatest injuries (64.62%), followed by closed fractures (13%), open fractures (5.45%) and lacerations (4.6%). Most traffic collisions occurred on Saturdays (16.74%) and Sundays (16.24%) during the months of December (10.83%) and January (9.66%). Most patients were admitted to the hospital (59%). The M-KTS was 9 for 57.83%, 8 for 31.97%, 7 for 8.89% (range 4–11). 0.80% of patients died in the ER. 0.63% of patients died during their hospitalization.

Discussion

Characterizing the intentional and unintentional injuries in Honduras is perhaps the first step in creating meaningful public health changes in the country, especially since little epidemiological data has been published [8,9,14]. Our goal is to provide objective statistics on the most common injuries in Honduras in order to help create targeted and scientifically-based interventions.

There is a great need for an organized trauma system in Honduras, especially given the disproportionate number of unintentional injuries seen at the UMSH compared with that seen globally [1]. It is also concerning, that the largest referral center in Honduras has such low patient mortality rates and does not see very severe injuries. UMHS should be taking care of the most severe patients in the country, but the severity of injuries found using M-KTS was mild for most cases. In addition, it is important to obtain pre-hospital data in order to better understand why severely injured patients may not be getting to UMSH. For example, data describing transport times to the hospital based on injury severity would help create a stronger pre-hospital system overall.

A study based on a trauma registry from two referral centers in Cali, Colombia described 17,431 injured patients. 14.7% of the injuries were intentional. Falls were the most frequent mechanism of injury (37.3%), and only 0.8% of the patients died in ER [15]. These results are similar to those described in this study where intentional injuries reached 18.41%, falls were the cause of 38.01% of injuries, and mortality was 0.65%. A similar mortality rate (0.5%) was also described in Lilongwe, Malawi [16]. These outcomes could be explained by the low severity of injuries, a patient selection process for taking those with higher probability to survive to the hospital [17], or the lack of a registry when the patient arrives dead.

Intentional injuries

Intentional injuries due to violence made up 14.68% (2638 cases out of 17,971) of all injuries recorded in the InSS. This may be an underestimate, especially since Tegucigalpa has a high homicide rate (102.2 per 100,000 inhabitants in 2012 [6]), and less violent countries with hospital-based registries have reported higher rates of intentional injuries (i.e., Jamaica, 38%) [18]. This may be due to the fact that many victims of homicide are found dead before arriving to the hospital and are not registered in the ER. In Pakistan, Khan et al compared outcomes of trauma patients arriving to the hospital within an hour or later, and there was no significant difference in mortality. This was attributed to a selection bias for patients who would survive to reach the hospital [17]. Therefore, intentional injuries may be wrongfully neglected from secondary and tertiary prevention strategies.

Patients injured by gunshot made up 5.31% (955/17.971) of cases in the UMSH. Similar results were described in Jamaica (7%) and Cali (8.2%) [15,18]. Most intentional injuries occurred amongst males ages 15 through 29 years, which may be associated with gang-related violence. A 2001 cross-sectional study in Tegucigalpa described 30,000 cases of adolescents participating in juvenile gangs [14]. There may be a connection between the high incidence of young adults involved in juvenile gangs and the age and gender profile of intentional injuries recorded in the InSS. Programs aimed at decreasing intentional injuries in Honduras may benefit from focusing on the young male demographic and strategies that decrease involvement in juvenile gangs.

It is important to note that, despite the amount of missing data in this study, both the victims of aggression and the aggressors tested positive for alcohol and drugs. The alcohol-attributable burden of injury is significant in Latin America, but from our knowledge, there are few ER studies from this region to support effective alcohol policies [19,20]. It would be in the interest of the Honduran government to implement a universal drug and alcohol-screening test of all trauma patients to increase surveillance and establish targeted strategies to decrease the injury burden.

Sexual violence is also a growing concern in Honduras. Although a 2010 report from Tegucigalpa showed that 44.4% of adolescents and 54% of adults experienced sexual violence in the span of that year [21], these rates are not even close to those reflected in the InSS (0.27%). Further research on sexual violence in Honduras is needed to identify why these gaps in information exist. Interventions that facilitate the reporting of sexual harassment and ensure the safety of victims would be of great benefit.

Self-inflicted injuries in Honduras' referral center were most frequently due to suicidal falls (43.25%) and poison intoxication (36.98%). In a study aimed to estimate self-inflicted injuries amongst children (<18 years old) in the United States, poison was the most frequently reported mechanism, accounting for up to 70% of cases [22]. This suggests that nearly twice as many individuals in the US chose to use poison as the mechanism of self-infliction when compared to individuals in Honduras. Also, while females were the predominant gender attempting suicide in America, males were the predominant gender attempting suicide in Honduras (55.63%).

Unintentional injuries

Unintentional injuries occurred four times more frequently than intentional injuries (4.5:1). Other trauma registries/in-hospital surveillance systems have shown smaller ratios when comparing unintentional and intentional injuries. Cali-Colombia described a ratio of 2:1 [15], while Lilongwe-Malawi also described a ratio of 2:1 [16] and Jamaica described a ratio of 1.6:1 [18]. This may be due to a selection bias for transporting survivors of injuries to hospitals [17], the lack of an emergency/trauma system for referrals [15], or the lack of preventive strategies to decrease unintentional injuries.

Falls and road traffic injuries were the most common causes of unintentional injuries. Road traffic injuries are perhaps the most

feasible to combat through stricter road safety regulations. Low-income countries have significantly less compliance with seatbelt and helmet laws [5] – which is consistent with our data that states that nearly 40% of traffic injury patients used neither helmets nor seatbelts at the time of their injuries. This low compliance can be attributed to poor law enforcement and awareness [23]. Implementing seatbelt and helmet-related safety laws have shown to decrease the incidence of traffic-related injuries in middle-income countries [5,24]. Also, a meta-summary of road traffic injury prevention initiatives in LMIC showed that legislative initiatives were the most successful when they were combined with strong law enforcement [5,25]. Brazil, for example, saw a significant ($p < 0.05$) reduction in road traffic fatalities (7.2%–16%) and injuries (1.8%–2.3%) when legislature was implemented that decreased the legal blood alcohol limit from 0.06 g/L to 0.02 g/L. The legislative measures were most effective in areas where the police enforcement was the greatest [26]. Implementing similar strategies in Honduras could be highly beneficial.

It is interesting to note that 52.69% of patients who presented to Honduras' medical referral center due to falls were between 1 and 17 years old. Similar findings were described in Jamaica [18] and Lilongwe-Malawi [16]. In contrast, the incidence of falls in the US follows a different distribution, with 32.3% of falls occurring in older adults (65+), 35.3% occurring in middle-aged adults (ages 45–64), and 32.3% occurring in young adults (ages 18–44) [27]. These differences may be due to the fact that Hondurans enter the workforce at a younger age, and thus, are susceptible to work-related injuries earlier. There may also be a lack of proper primary prevention measures at home or at schools to avoid injuries at younger ages. Further research is necessary to understand the cause of the increased incidence of falls in children and young adults in Honduras.

Future steps

There is a great need to standardize trauma systems in LMIC and to create comprehensive electronic trauma registries that guide policy-makers' decisions. Future steps for the UMSH registry should focus on creating a national electronic platform such as the one created in Jamaica with the Jamaica Injury Surveillance System (JISS) [18]. This could be carried out with the support of the new WHO trauma registry [29].

The use of a paper-based trauma surveillance system is sustainable and reliable; however, there are some limitations with combining databases and providing real-time data collection [28]. Nevertheless, surveillance systems like this one which rely on few variables [30], provide basic information to inform decisions on resources allocation, training for health care providers, and mapping injuries. This allows for effective secondary and tertiary prevention strategies. The InSS in Honduras has been upkept by its administrators and international collaborations, but further aid is needed to guarantee its efficiency, evolution, and future sustainability. Fogarty grants, USAID grants, US National Institute of Health (NIH) research projects, and local government resources can have a major effect on the future of violence in Honduras [8].

Limitations

Although our study has many of the limitations inherent to observational studies that utilize databases, our data quality is high for the most relevant variables - age, sex, mechanism of injury and type of injury. Missing values for each of these variables did not exceed 1% of the dataset (0.26%, 0.23%, 0.47%, and 0.07%, respectively). Nevertheless, missing data for vital signs such as heart rate, respiratory rate, and blood pressure limited the calculation of robust trauma scores. The lack of sufficient data on patient drug and alcohol levels also limited our conclusions on this topic. Studies conducted in Malawi and Haiti showed that prospective versus retrospective data collection for trauma patients resulted in important variables being lost in both processes and suggested the need for combined data collection [31,32]. The InSS in Honduras can be further improved by including retrospective data, as this will allow for a better categorization of injury severity and a better understanding of the effects of psychotropic substances on injuries. Utilizing a paper-based system as opposed to a computerized one also potentially introduced variability and augmented the loss of information. Further efforts towards an electronic surveillance system and a trauma registry are required.

The InSS form itself also has some limitations. For one, it does not describe injuries based on the International Classification of Disease (ICD) coding system. This makes it difficult for future researchers to objectively categorize Honduras' injuries. Also, the InSS does not utilize injury severity scoring when describing its patients. The available data in the InSS is, however, sufficient to indirectly derive a measure of severity such as the modified Kampala Trauma Score (M-KTS) as we did in the study [13]. Given that the WHO has prepared a minimal dataset for trauma registries [29], the information that we have gathered on Honduras could potentially be useful for WHO's initiative and could better assess the surveillance capacity of LMIC countries. Further discussions about the InSS in Honduras are in process and options are being evaluated towards its evolution and sustainability [9].

Another limitation of this study is the lack of a comparison group. Given that this is the country's first report of an injury database, further research should be carried out to establish comparisons amongst other countries and understand the injuries in a global context. This research is the first step in a series of future investigations aimed to better understand injuries in Honduras and enhance the country's trauma surveillance. The Trauma Registry recently implemented in Cali-Colombia [15] could be also adapted to Honduras since Cali is also one of the most violent cities in the world and the city's experience can be translated to other countries with similarly violent situations.

Finally, the analyzed time period corresponds to a single year, limiting the analysis of temporal trends or the use of more robust statistical methods. Nevertheless, we considered it important to include some information about the temporal characteristics of the injuries in order to provide clarity about the accuracy of the data and for future reference.

Conclusion

Injuries are a public health concern in Honduras. Although the country's main trauma center predominantly sees unintentional injuries, it is still important to characterize the intentional injuries given Honduras' history of violence and high homicide rates. By describing potential risk factors for intentional and unintentional injuries, we hope to provide information that can be used to generate and test effective injury prevention strategies, and therefore, build the country's capacity for injury management. Additionally, we hope that countries with similar high rates of injuries can use this research as a tool to augment their data capacities and own policies.

Further research is required on: 1) trauma care delivery and trauma system research in order to identify areas where resources can be better allocated and trauma patients can be better directed to different hospitals, 2) mortality and lethality of intentional injuries based on the hypothesis that those patients are not arriving to the hospitals, and therefore, are not registered in the InSS, and 3) analysis of the types of unintentional injuries with an emphasis on the most affected subgroups of the population

(children and young adults). Finally, the burden of injuries in Honduras must be further understood and the effectiveness of the country's preventive interventions must still be assessed.

Conflict of interest statement

Nothing to declare.

Disclosures of funding received for this work

Nothing to declare.

Ethical standards statement

This study was approved by the Institutional Review Board of the University of Pittsburgh with code PRO17080111.

Author contributions

CR collected the data, reviewed the manuscript, and approved the final version of the manuscript. FJBE cleaned the database, analyzed the data, wrote the manuscript, reviewed the manuscript, and approved the final version of the manuscript. CRL and AM wrote the manuscript and approved the final version of the manuscript. MTM reviewed the manuscript and approved the final version of the manuscript. JCP reviewed the manuscript and approved the final version of the manuscript.

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