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Brief Report

A Comparative Gender Analysis of Injury Characteristics, Treatments and Outcomes among Persons Seeking Emergency Care in Kigali, Rwanda

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Abstract: In high-income nations, gender has been associated with injury characteristics. This study evaluated injury epidemiology and care based on gender at the Centre Hospitalier Universitaire de Kigali in Rwanda. Patients presenting to the emergency department with acute injuries were prospectively enrolled from 27 January–28 June 2020, and descriptive statistics were performed with comparisons between males and females. Of 601 patients, 25.6% were female and 74.4% were male. There were gender differences in the mechanism of injury, with females more likely to be injured in falls (43.5% versus 23.0%, $p = 0.001$); meanwhile, males were more likely to suffer road traffic accidents (52.6% versus 39.6%, $p = 0.006$). The severity of injury was similar between genders based on the mean Kampala Trauma Score (14.4 versus 14.7, $p = 0.09$). Females were more likely to have been transported by prehospital services (87.7% versus 72.9%, $p = 0.001$), and less likely to receive acute treatment during the first six hours of care (67.5% versus 78.1%, $p = 0.009$). There was no significant difference in mortality between females and males (2.0% versus 1.3%, $p = 0.568$). This study highlights differences in the epidemiology and care between males and females presenting for emergency injury care in Rwanda. These findings can inform future research and developments in gender-centered healthcare delivery.

Keywords: Rwanda; injury care; trauma; gender; emergency care; global health

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1. Introduction

Every year, more than one billion people suffer injuries resulting in 4.4 million deaths; this accounts for nearly 8% of annual global mortality. Furthermore, for every injury-related death, there are 20 to 50 people that will suffer injury-related disabilities [1]. Gender has been associated with injury, with prior studies finding that males have greater incidence and severity of injuries, more frequent care-seeking behaviors and worse outcomes compared to females [2,3]. Differences in care delivery between males and females with injuries have also been found during pre-hospital interventions [1].

The majority of data on the intersection of gender and injury comes from high-income nations, and there is a paucity of data on gender and injury in low- and middle-income countries (LMICs) [4]. In Rwanda, sociocultural differences based on gender are well documented, but there exists little understanding of gender aspects in relation to injury and emergency care [5]. In order to better understand the role of gender on the epidemiology,

treatments and outcomes of patients with acute injuries, this study evaluated characteristics between males and females presenting to an emergency department (ED) in Kigali, Rwanda.

2. Methods

2.1. Study Design and Setting

This study was a secondary analysis of a prospective observational study evaluating acute injury care at the ED of the Centre Hospitalier Universitaire de Kigali (CHUK) in Kigali, Rwanda, conducted between January through June 2020 [6]. The research was approved by the CHUK ethics committee, the University of Rwanda College of Medicine and Health Sciences and the institutional review board of Rhode Island Hospital (Lifespan IRB00000396).

CHUK is a tertiary care hospital that serves the entire Rwandan population as a public referral center for serious injuries. The CHUK has approximately 40 emergency beds and 500 inpatient beds with surgical and medical specialty consultant services, and has the country's sole emergency medicine (EM) training program. The hospital facility has on-call operating theaters, laboratory medicine services and subspecialty consultation providers available as needed. The ED at the CHUK is the primary treatment area for injured persons. The CHUK ED receives trauma patients in the acute injury period, as well as transfers from lower-resourced district and regional health centers in Rwanda.

2.2. Study Population

Patients were eligible for inclusion in the parent study if they met the following criteria: (1) age $\geq$ 15 years old, (2) presenting for injury care. Patients with concurrent medical needs unrelated to the index injury, pregnant patients, those <15 years old, those unable or unwilling to provide informed consent and legal prisoners of the state were excluded. In the current analysis focusing on adults with injuries, persons <18 years were excluded.

2.3. Data Collection and Management

All patients presenting for ED injury care were continuously screened during the enrollment periods. To avoid impeding clinical care, patients were screened after initial triage and stabilization had been completed by the ED staff. Screened patients meeting the inclusion criteria and providing informed consent were enrolled. If a patient was unable to consent due to incapacity, informed consent was obtained from a legally authorized patient representative if possible. Dedicated study personnel trained in the standardized research protocols collected structured information during the data collection periods via hourly patient assessments from time of arrival through the first six hours of care. The participants were not asked how they self-identified, as binary presentation of gender is commonly accepted in Rwanda given the current social, cultural and political norms. Rwanda is known as an example of an inclusive society that promotes, among others, gender equality, and does not criminalize against homosexuality. However, conversation about non-binary pronouns is extremely rare in the country [7]. Thus, for the purposes of this study, participant gender was binary, being either male or female and obtained from the gender listed at time of triage by the clinical staff who were independent of the study personnel.

Data on sociodemographic and epidemiologic variables and data on acute treatments through the first six hours of ED care were collated. The treatment variables of interest were the following: intubation, immobilization/splinting, wound care, tourniquet, parenteral medications/blood products, thoracostomy and point-of-care ultrasound. The injury severity was characterized using the Kampala Trauma Score (KTS), a validated scale in LMIC settings [8,9]. A lower KTS ($\leq$12) identifies a more severe injury condition [8]. The shock index at the time of triage was calculated using heart rate divided by systolic blood pressure and dichotomized at a cut point of >0.9, as has been used in prior studies [10]. If ED disposition was not completed within the first six hours of care, patient charts

were reviewed to identify disposition status using a previously validated data extraction approach [11].

2.4. Statistical Analysis

STATA Version 15.0 (Stata Corp; College Station, TX, USA) was used for all analyses. Descriptive analyses using frequencies with percentages, medians with interquartile ranges (IQR) or means with standard deviations (SD) were performed as appropriate. The normality was evaluated through graphical distributions for continuous variables. Categorical variables were described using frequencies with percentages. Comparisons based on participant gender were conducted with the *t*-test, Mann–Whitney U test, Pearson's chi-squared test or Fisher's exact test as appropriate, based on variable type and distribution. The ED injury care variables were aggregated and coded as binary with receipt of any intervention being indicative of treatment. Due to the occurrence of the COVID-19 pandemic which initiated during the study period, cases were also stratified by time period based on whether care occurred pre-COVID-19 or during the COVID-19 pandemic.

3. Results

A total of 864 patients presenting for injury care were screened for inclusion, of which 601 were enrolled and included in the analysis. In the study population, 447 (74.4%) identified as male, and 154 (25.6%) as female. The median age of the study population was 32 years (95% CI: 25–43).

The most common injury mechanisms were road traffic accidents (RTAs) (49.3%), followed by falls (28.3%). The most common anatomical regions of sustained injuries were to the lower extremities (40.4%), craniofacial region (34.3%) and upper extremities (31.5%). The median time between injury occurrence and ED presentation was four hours (95% CI: 1.2–17), with 22.3% of patients being transported by prehospital services. A total of 75.4% of patients received emergent ED treatment during the first six hours of care, and 54.7% underwent surgical consultation during the first six hours of care. For ED disposition, 52.4% of patients were discharged, 39.1% were admitted to the hospital and 1.8% died (Table 1).

Table 1. Population characteristics.

Variable	n (%) or Median [Interquartile Range]
Age (years)	32 [25–43]
18–24	138 (23.0%)
25–44	336 (55.9%)
45–64	92 (15.3%)
≥65	35 (5.8%)
Gender	
Male	447 (74.4%)
Female	154 (25.6%)
Mechanism of Injury [a]	
Road Traffic Accident	296 (49.3%)
Fall	170 (28.3%)
Burn	17 (2.8%)
Stab or Laceration	43 (7.2%)
Physical Assault	35 (5.8%)
Electrocution	1 (0.2%)
Gunshot	1 (0.2%)
Other Blunt	34 (5.7%)
Other Penetrating	7 (1.2%)
Other	55 (9.2%)

Table 1. *Cont.*

Variable	n (%) or Median [Interquartile Range]
Anatomical Regions of Injury [a]	
Craniofacial	206 (34.3%)
Neck	24 (4.0%)
Chest	59 (9.8%)
Abdomen or Pelvis	45 (7.5%)
Upper extremity	189 (31.5%)
Lower extremity	243 (40.4%)
Genitalia	7 (1.2%)
Cervical Spine	20 (3.3%)
Thoracic Spine	11 (1.8%)
Lumbar Spine	13 (2.2%)
Time from Injury to ED Presentation (hours)	4 [1.2–17]
Systolic Blood Pressure (mm Hg)	129 [119–139]
≥90	592 (98.5%)
<90	9 (1.5%)
Glasgow Coma Scale	
13–15	553 (92.0%)
12–9	27 (4.5%)
8–3	11 (1.8%)
Missing	10 (1.7%)
Kampala Trauma Score	15 [14–15]
Shock Index	
<0.9	547 (91.0%)
≥0.9	54 (9.0%)
Patient Transferred from Another Health Facility	
Yes	268 (44.6%)
No	333 (55.4%)
Patient Transported by Prehospital Services	
Yes	134 (22.3%)
No	462 (76.7%)
Missing	6 (1.0%)
Past Medical History [a]	
None	510 (84.9%)
Cardiac Condition	13 (2.2%)
Pulmonary Condition	6 (1.0%)
Renal Condition	2 (0.3%)
Neurologic Condition	1 (0.2%)
HIV	13 (2.2%)
Diabetes	5 (0.8%)
Cancer	0 (0.0%)
Other	41 (6.8%)
Unknown	23 (3.8%)
Emergent Treatment During First 6 Hours of ED Care	
Yes	454 (75.4%)
No	148 (24.6%)
Surgical Consultation During First 6 Hours of ED Care	
Yes	329 (54.7%)
No	274 (45.3%)
Disposition	
Discharged from Emergency Department	315 (52.4%)
Admitted to Hospital	235 (39.1%)
Transferred to Another Health Facility	6 (1.0%)
Died	11 (1.8%)
Eloped or Withdrew	3 (0.5%)
Missing	31 (5.2%)

Table 1. *Cont.*

Variable	n (%) or Median [Interquartile Range]
Period of Injury Care Presentation	
Pre-COVID-19	408 (67.9%)
Intra-COVID-19	193 (32.1%)

[a] The percentages for these variables do not add up to 100% because the categories within the variable are not mutually exclusive.

In assessing the patients stratified by gender, the median age of females was older than males at 35 years versus 32 years ($p = 0.049$). There were few statistically significant differences in pre-existing medical conditions when compared by gender, although females were more likely to have cardiac conditions compared to males (4.6% versus 1.3%, $p = 0.018$). Differences in the mechanism of injury were found, with females more likely to have been injured by a fall (43.5% females versus 23.0% males, $p = 0.001$). Males were more likely to have been in an RTA (52.6% males versus 39.6% females, $p = 0.006$), present with a stab or laceration (9.0% males versus 2.0% females, $p = 0.004$) or have been physically assaulted (6.9% males versus 2.6% females, $p = 0.047$). Anatomical distributions of the injuries were similar between males and females, with the exception that males were found to more commonly have abdominal or pelvic injuries (9.0% males versus 3.3% females, $p = 0.020$) and cervical spine injuries (4.5% males versus 0.0% females, $p = 0.008$) (Table 2).

Table 2. Comparison of participant characteristics stratified by gender.

Variable	Female (n = 154)	Male (n = 447)	*p*-Value
Age (years): median [IQR]	35 [25–48]	32 [25–42]	0.049
Age (years)			
18–24	38 (24.7%)	100 (22.4%)	
25–44	70 (45.5%)	266 (59.5%)	0.007
45–64	32 (20.8%)	60 (13.4%)	
≥65	14 (9.1%)	21 (4.7%)	
Mechanism of Injury [a]			
Road Traffic Accident	61 (39.6%)	235 (52.6%)	0.006
Fall	67 (43.5%)	103 (23.0%)	0.001
Burn	7 (4.6%)	10 (2.2%)	0.136
Stab or Laceration	3 (2.0%)	40 (9.0%)	0.004
Physical Assault	4 (2.6%)	31 (6.9%)	0.047
Electrocution	0 (0.0%)	1 (0.2%)	0.557
Gunshot	1 (0.7%)	0 (0.0%)	0.088
Other Blunt	8 (5.2%)	26 (5.8%)	0.773
Other Penetrating	2 (1.3%)	5 (1.1%)	0.857
Other	8 (5.2%)	47 (10.5%)	0.048
Regions of Injury [a]			
Head or Face	43 (27.9%)	163 (36.5%)	0.054
Neck	5 (3.3%)	19 (4.3%)	0.583
Chest	13 (8.4%)	46 (10.3%)	0.506
Abdomen or Pelvis	5 (3.3%)	40 (9.0%)	0.02
Arm	54 (35.1%)	135 (30.2%)	0.262
Leg	72 (46.8%)	171 (38.3%)	0.064
Genitalia	1 (0.7%)	6 (1.3%)	0.489
Cervical Spine	0 (0.0%)	20 (4.5%)	0.008
Thoracic Spine	5 (3.3%)	6 (1.3%)	0.128
Lumbar Spine	6 (3.9%)	7 (1.6%)	0.086

Table 2. *Cont.*

Variable	Female (n = 154)	Male (n = 447)	*p*-Value
Time from Injury to ED Presentation (hours): median [IQR]	4 [1.5–17]	4 [1–17]	0.77
Systolic Blood Pressure (mm Hg)			
≥90	153 (99.4%)	439 (98.2%)	0.315
<90	1 (0.7%)	8 (1.8%)	
Glasgow Coma Scale			
13–15	150 (97.4%)	413 (92.4%)	0.056
12–9	4 (2.6%)	23 (5.2%)	
8–3	0 (0.0%)	11 (2.5%)	
Kampala Trauma Score: Median [IQR]	15 [14–15]	15 [14–15]	0.009
Shock Index:			
<0.9	136 (88.3%)	411 (91.9%)	0.174
≥0.9	18 (11.7%)	36 (8.1%)	
Patient Transferred from Another Health Facility			
Yes	85 (55.2%)	248 (55.5%)	0.951
No	69 (44.8%)	199 (44.5%)	
Patient Transported by Prehospital Services			
Yes	18 (11.7%)	116 (26%)	0.001
No	135 (87.7%)	326 (72.9%)	
Missing	1 (0.7%)	5 (1.1%)	
Past Medical History Not Due to Injury [a]			
None	121 (78.6%)	389 (87.0%)	0.012
Cardiac Condition	7 (4.6%)	6 (1.3%)	0.018
Pulmonary Condition	3 (2.0%)	3 (0.7%)	0.169
Renal Condition	0 (0.0%)	2 (0.5%)	0.406
Neurologic Condition	1 (0.7%)	0 (0.0%)	0.088
HIV	4 (2.6%)	9 (2.0%)	0.667
Diabetes	2 (1.3%)	3 (0.7%)	0.46
Other	14 (9.1%)	27 (6.0%)	0.195
Emergent Treatment During First 6 Hours of ED Care			
Yes	104 (67.5%)	349 (78.1%)	0.009
No	50 (32.5%)	98 (21.9%)	
Surgical Consultation During First 6 Hours of ED Care			
Yes	72 (46.8%)	257 (57.5%)	0.021
No	82 (53.3%)	190 (42.5%)	
Disposition			
Discharged from ED	91 (59.1%)	224 (50.1%)	0.054
Admitted to Hospital	48 (31.2%)	187 (41.8%)	0.019
Transferred to Another Health Facility	3 (2.0%)	3 (0.7%)	0.169
Died	2 (1.3%)	9 (2.0%)	0.568
Eloped or Withdrew	0 (0.0%)	3 (0.7%)	0.308
Missing	10 (6.5%)	21 (4.7%)	0.59
Period of Injury Care Presentation			
Pre-COVID-19	112 (72.7%)	296 (66.2%)	0.136
Intra-COVID-19	42 (27.3%)	151 (33.8%)	

[a] The percentages for these variables do not add up to 100% because the categories within the variable are not mutually exclusive.

Males had greater injury severity compared to females, as quantified by lower (more severe) mean Kampala Trauma Scores (14.4, SD: ±1.00 versus 14.7, SD: ±0.77, $p = 0.002$). Compared to males, females were less likely to have been transported by prehospital services (87.7% females versus 72.9% males, $p = 0.001$) and also less likely to undergo surgical consultation (46.8% versus 57.5%, $p = 0.021$). When evaluated in aggregate, females

were less likely than males to have received acute treatment during the first six hours of care (67.5% versus 78.1%, $p = 0.009$). When individual treatment variables were compared, there were significant differences in females as compared to males for intubation, 0.0% versus 4.4% ($p = 0.034$) and for IV fluid administration, 27.9% versus 48.0% ($p < 0.001$). There was no significant differences identified based on gender for receiving treatments of immobilization/splinting, wound care, tourniquet, parenteral medications/blood products, thoracostomy or point-of-care ultrasound. There was no significant difference in mortality between females and males (2.0% males versus 1.3% females, $p = 0.568$), and no differences in whether they were transferred from another health facility (55.2% females versus 55.5% males, $p = 0.951$). There were also no significant differences in proportions of trauma presentations by gender based on the time period between pre-COVID-19 vs. during the COVID-19 pandemic ($p = 0.136$) (Table 2).

4. Discussion

This study observed significant differences in injury patterns, trauma severity and care between males and female patients presenting to ED in Kigali, Rwanda. These results can begin to inform our understanding of the potential role of gender in the epidemiology, treatments and outcomes of patients suffering injuries in Rwanda and other similar LMIC settings.

Consistent with prior literature that shows higher burdens of trauma in males, male patients constituted nearly three-quarters of the patients included in this study (74.4% versus 25.6%) [2,3]. The population of injured patients in this study was also young, consistent with literature from other LMICs showing that traumatic injuries primarily occur in younger populations [3,9]. Furthermore, the age distributions shown in the population based on gender with a more consistent distribution of ages for females is similar to prior injury populations from Europe [12], as is the anatomical distribution of injuries, with high frequencies of extremity injuries observed [13]. However, the extent of clinical instability reflected in parameters of blood pressures, SI, GCS and mortality was low in the overall population and not significantly different between genders, which is not completely consistent from parameters reported from other higher-income settings; this suggests that the study setting served a less severely injured population [12]. This is as well reflected in the high proportion of injured persons transferred from other facilities and the low proportion of those that were brought by formal prehospital services, speaking to the unique characteristics of injury treatment and prehospital care profiles in the Rwanda setting.

The female patients in the study population were found to have a lower injury severity. The greater injury severity in males may be due to differential profiles of mechanisms of injuries between genders, as males had more frequent rates of road traffic accidents, stab wounds, and assault, which have been shown to be associated with more severe injuries in comparison to other mechanisms of trauma such as falls [2,3]. The differences observed in acute interventions and surgical consultations, with males receiving these interventions significantly more than females, could as well stem from the greater injury burden; however, gender bias in care provision is possible, but cannot be discerned from the current data. The mortality events in this study population were low overall, with no significant differences observed in the outcomes; this may indicate that the severity of injury was addressed during clinical care. However, given the low event rate for mortality, further research with larger sample sizes is needed to more accurately evaluate differential outcomes based on gender in LMIC populations of injured persons. Additionally, although not assessed in the current report, future study assessing post-injury disability in relation to patient gender would be informative to care delivery and systems development.

This study has limitations. Firstly, it was conducted at a single, tertiary academic hospital, and therefore the study results may not be completely generalizable to alternative settings. The current report is a post hoc secondary analysis and as such, the presented data did not have the ability to differentiate between unintentional and intentional injuries, such as intimate partner violence. Although the literature has shown an increase in intentional

injuries such as interpersonal violence during the COVID-19 pandemic, the current study was not able to evaluate this [14,15]. Data collection was halted during the first Rwandan national lockdown period from the COVID-19 pandemic. Although this study showed a consistent gender distribution of patients presenting for injury care before and during the COVID-19 pandemic, it is possible that there could have been differences in the population across time periods that were not assessed. As well, the lack of ability to assess differences in the types of pre-hospital care and aspects relating to transfer logistics, such as duration and location of injury in the study population that could have impacted ED-based treatment provision, is a limitation. Finally, as this study did not explicitly ask participants how they self-identified, gender was assigned at time of triage by clinical staff. Given current cultural norms in Rwanda, binary presentation of gender is commonly accepted, minimizing the potential for inaccurate designation [7]. However, it is possible there could have been misclassification of a patient's gender as compared to their biological sex, which could be an influential factor in injury risk, characteristics and care.

This study highlights differences in epidemiological and care characteristics between males and females presenting for emergency injury care in Rwanda, and found key differences in injury patterns, trauma severity and care delivery. These foundational findings can be used inform future research and developments in gender-centered injury care in Rwanda and other similar settings.

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