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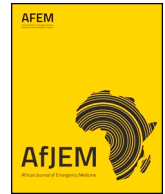
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ORIGINAL ARTICLE

Patterns and outcomes of paediatric trauma at a tertiary teaching hospital in Kenya

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A B S T R A C T

Introduction: Trauma continues to be a major cause of morbidity and mortality especially in the paediatric population of low- and middle-income countries such as Kenya. The aim of this study was to establish the profile and outcomes of admitted paediatric trauma cases at the Aga Khan University Hospital, Nairobi.

Methods: This retrospective, descriptive study involved a 12-month chart review (January 2016–December 2016). A total of 218 records were identified of which 144 were reviewed.

Results: Most injuries were amongst boys (65.3%) and the very young (mean age 6), occurred in private residences (42.4% homes, 25.7% residential institutions), were typically caused by falls (56.3%) or penetrating trauma (13.2%), mostly resulted in extremity fractures (45.8% closed, 4.9% open) and burn or head injuries (in infants and small children), and got very little or no pre-hospital care (51.4% no care). Additionally, children with burns, brain injuries, or poly-trauma had the longest hospital stays and highest rates of mortality. A more detailed description of the patterns and outcomes seen are included in the study.

Discussion: Paediatric injuries remain a major public health problem and contribute a substantial proportion of all paediatric surgical admissions at the Aga Khan University Hospital in Nairobi. Based on the patterns and outcomes seen in this study, we therefore recommend for Nairobi (and possibly Kenya) to establish greater supervision and safety measures for children; targeting safety interventions at all children but particularly at boys, the very young, at home and in residential buildings; building pre-hospital emergency care that can accommodate children; and equipping paediatric trauma hospitals to especially handle bony fractures, burns, head injuries, and poly-traumas. A bespoke trauma registry would benefit the hospital, and likely the country as a whole.

African relevance

- Paediatric injuries remain a major public health problem in Sub-Saharan Africa
- Injuries contribute a substantial proportion of all paediatric surgical admissions

Introduction

Trauma is a significant cause of morbidity and mortality, of which more than 90% occurs in low- and middle-income countries (LMICs) [1]. In the general population, there are 32% more deaths from injuries than from HIV, tuberculosis, and malaria combined [2]. This is especially true for paediatric populations, as trauma is the greatest cause of morbidity and mortality in paediatric and adolescent populations worldwide [3], and accounts for a significant burden in countries with limited resources [4]. Furthermore, although paediatric trauma is a global phenomenon amongst many LMICs, sub-Saharan countries are

disproportionately affected [5]. Naidoo and Muckart even reported that Africa has been labelled the most dangerous place in the world to be a child [6].

Kenya is no exception to this. According to World Health Organization, Kenya has a particularly high burden of injuries, accounting for 88.4 deaths per population of 100,000 per year [7]. However, despite recent attempts to prioritise injury prevention in Kenya, trauma care and trauma care systems (for both adults and children) have not been adequately assessed [8]. Given such a heavy paediatric trauma burden on sub-Saharan countries and on Kenya, there is thus a need for research and policy development to help curb the related morbidity and mortality; but first, documentation of causes, morbidity, and mortality are essential for planning, implementation and evaluation of these policies. This study aims to describe the characteristics and distribution of different types of paediatric traumas at the Aga Khan University Hospital in Nairobi, Kenya, and the morbidity and mortality associated with those traumas.

For comparison, in 2009 the prevalence of presenting trauma in the

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United States of America (USA) was 620 per 10,000 children aged zero to 20 years per year. Boys accounted for 62% of all these incidents, while 57% of all these incidents were by children younger than six years [9]. The study also showed that a major cause of hospitalisation secondary to trauma was road traffic accidents (RTA, 46%), and falls accounted for 34%. Non-transport related trauma and natural disasters followed with 18% and 2%, respectively. A different study also done in the USA showed that the leading mode of injury was road traffic accidents (RTA) for ages ten to 18 years and falls for ages zero to nine years. Fire was the second leading mode of injury among one-year-olds, but not a major cause in other age groups. Penetrating trauma was the mode of injury for 21% of injuries among adolescents 14–18 years old. Injury severities were highest for children less than one year old and adolescents 14–18 years old [10].

For a closer comparison, one study in Nigeria showed that 71% of paediatric trauma cases involved boys, while 37.4% of all cases involved children younger than six years [11]. The study also showed 54.2% of all paediatric injuries were domestic injuries, followed by RTA and falls from heights at 38.7% and 1.4% respectively. The type of injuries varied according to different age groups. Lacerations and fractures mostly occurred in children aged between six to ten years while children aged between zero to five years were more susceptible to head and burn injuries [11]. According to a study done by Naidoo and Muckart in 2015 in South Africa [6], trauma accounted for 15.9% of all paediatric patients admitted during the study period. Females accounted for 46.4% of them, and males 53.6%, with a median age of seven years. Sources of admission were directly from the scene in 21.0% of cases, from a primary healthcare facility in 26.0%, from a regional hospital in 31.0%, and from a tertiary facility in 22.0%. That study suggested that although falls account for the majority of the childhood injuries they studied, RTA, drowning and burns were the three common mechanisms causing particularly severe injuries in children in their population [6].

Methods

This was a retrospective descriptive study, which involved a chart review covering twelve months from January 2016 to December 2016. The study examined the patient charts of children suffering from traumas who accessed the emergency centre (EC) of the Aga Khan University Hospital, Nairobi. The study then descriptively analysed for demographics, injury mechanism and severity, procedures, diagnoses, management and outcomes of those paediatric trauma patients.

The study was conducted at the Aga Khan University Hospital, Nairobi, a tertiary and teaching hospital located in Kenya's capital, Nairobi. The study was based in the Paediatric Accidents and Emergency Department. The unit runs 24 hours per day and has an average census of 100 patients in 24 hours.

Non-probability sampling was done using a purposive sampling method, where the principle investigator identified files meeting the criteria from the medical records department. Inclusion Criteria were 1) age < 15 years, and 2) admitted through the paediatric emergency centre (EC) following trauma or 3) died after assessment in the paediatric EC following trauma. Then excluded from the study were 1) isolated pathological fractures, 2) late effects of injury (effects as sequelae to trauma), 3) insect bites, 4) foreign bodies, 5) psychological trauma, and 6) birth trauma. Patients greater than 15 years old are seen in the adult EC, and so > 15 year old patients were excluded from the study.

Data was collected primarily from the patients' medical records using a data sheet (see Appendix I). The data sheets were stored in a lockable cupboard at all times and the data was then transferred to a password protected and encrypted SPSS database. No patient identifying data was entered in the database. Documents were analysed over a period of three months.

All data sheets were checked for completeness and the data entered

into SPSS VERSION 20. Data cleaning was done via manual checking and geographical methods, and extreme values were removed.

Descriptive statistics was used to analyse the data in terms of age, sex, and details of injury event, clinical presentation, procedures, investigations, clinical management, disposition and outcomes of all trauma patients admitted to the hospital via the paediatric emergency centre (EC). Inferential statistics were used to make inferences about the populations. IBM SPSS Statistics 20 was used to analyse the data. Main data was summarised using mean, proportion, percentages, and standard deviations.

The study was initiated after appropriate approval was obtained from the Aga Khan University Research Ethics Committee (Ref no.2017/REC-35(VL)).

Results

Total adult and paediatric admissions for the whole hospital for the year 2016 were 2385. Trauma represented 9.14% of all the admissions. For the year 2016, a total of 218 of those admissions were paediatric patients admitted following trauma. Medical records were not available for 40 patients, and 34 patients did not meet the inclusion criteria, thus a total of 144 patients were included in the study (Fig. 1).

The average age in this study was six years old and Fig. 2 shows a breakdown of the study population by gender and age. Table 1 summarises the patients' injuries and demographics. Of note, the vast majority of patients were under ten years old, and male. Most injuries (68.2%) also occurred in a place of residency, such as a home or apartment building. A large majority did not arrive by ambulance, and almost all received only analgesia or no pre-hospital intervention at all. Just over half of the injuries were due to falls, and just under half of the injuries resulted in closed fractures with, not surprisingly, the most frequent location of injury being the extremities or bony pelvis. Fig. 3 shows a sub-analysis of different injuries by age group. Head injuries and burns occur more frequently amongst zero- to four-year olds. Additionally, out of the 144 charts included in the study, 138 were deemed accidental, one as non-accidental (i.e. assault), and five were undetermined.

See Table 2 for a breakdown of patients' dispositions from the paediatric emergency centre (EC). Not shown in Table 2 is that the average hospital stay was two days, with the longest stay being 19 days. The majority of the patients who required prolonged hospital stays were patients with poly-trauma and burns.

Discussion

This study provides important new information on paediatric trauma cases treated at the Aga Khan University Hospital, Nairobi, which can give insight into paediatric traumas in at least one significant area in Kenya, a low-income sub-Saharan African country.

The patients in this study were predominantly male 65.3% (n = 94). This finding is similar to previously done studies such as those by Botchey et al. in Kenya in 2017 [12], Elachi et al. in Nigeria in 2015 [13], and Chokotho et al. in Malawi in 2014 [14]. Differences in

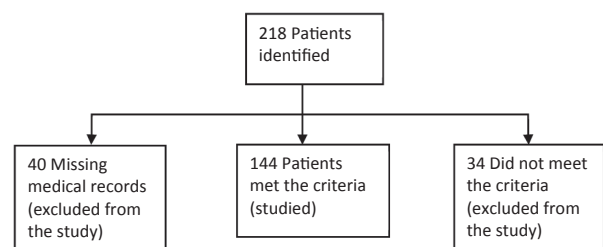


Fig. 1. Patients for the study.

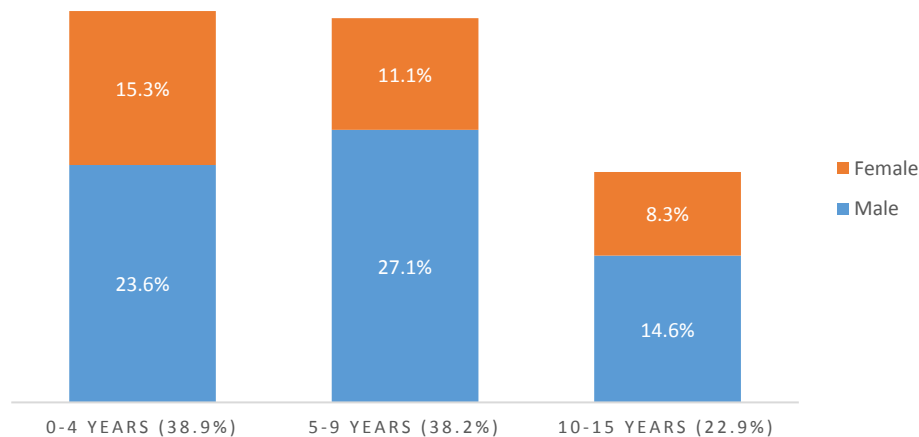


Fig. 2. Gender by age groups, all percentages are of the total studied population (n = 144).

Table 1

Patient demographics and description of injuries. All percentages are of the total studied population (n = 144).

Patient demographics	Description of injuries				
	n	%			
<i>Age</i>		<i>Mechanism of injury</i>			
0-4 years	56	38.9%	Falls	81	56.3%
5-9 years	55	38.2%	Penetrating trauma	19	13.2%
10-15 years	33	22.9%	Blunt trauma	17	11.8%
<i>Gender</i>			Road traffic accident	16	11.1%
Male	94	65.3%	Scalding burn	9	6.3%
Female	50	34.7%	Dry burn	1	0.7%
<i>Place of injury</i>			Other	1	0.7%
Private homes	61	42.4%	<i>Sustained injury</i>		
Apartment buildings, estates	37	25.7%	Closed fractures	66	45.8%
School	24	16.7%	Concussions	20	13.9%
Streets, roads, highways	14	9.7%	Deep lacerations	17	11.8%
Trade areas	4	2.8%	Burns	10	6.9%
Athletics	2	1.4%	Open fractures	7	4.9%
Unknown	2	1.4%	Avulsions, amputations	5	3.5%
<i>Means of arrival</i>			Organ injury	5	3.5%
Private means	121	84.0%	Others	14	9.8%
Ground ambulance	21	14.6%	<i>Injury location</i>		
Air ambulance	2	1.4%	Extremities, and bony pelvis	87	60.4%
<i>Pre-hospital interventions</i>			Head and neck	27	18.8%
None	74	51.4%	Face	13	9.0%
Analgesia	56	38.9%	Skin	10	6.9%
Splints	5	3.5%	Internal organ compartments	7	4.9%
<i>Dressings</i>			<i>Intent of injury</i>		
Other	5	3.4%	Accidental	138	95.8%
			Non-accidental, assault	1	0.7%
			Undetermined	5	3.5%

playtime behaviour between genders may be one reason for such findings, as well as higher activity levels, greater freedom to play alone, and increased involvement in risky sports among males. In this study, children in the younger age groups were the most commonly involved, with the mean age being six years, a finding similar to the study done by Bhatti et al. in Oman in 2016, another developing country [15]. Most of the injuries occurred in private homes, accounting for 42.4%, with an additional 25.7% happening in other residential buildings such as apartment complexes. This finding is echoed by Jalalvandi et al. in Iran in 2015, who found that 67.4% of traumatic injuries occurred in homes [16]. Similarly, a study in Tanzania by Simon et al. in 2013 found that 57.3% of injuries occurred in homes [17]. This could be a reflection of children this young often being allowed to play at home or in local streets in Nairobi unattended, but this is a hypothesis that would need

further investigation. Regardless, this still suggests the need for more parental or adult supervision for children, especially boys, and those under the age of six. This also highlights private residences as a critical target for prevention of paediatric injuries.

The most common mechanism of injury was falls, accounting for over half of the trauma-related injuries. This finding is similar to another study done in Kenya's Kenyatta National Hospital, which found that falls accounted for 40% of injuries in children from birth up to four years of age, and 46% of children aged five to 17 years [12]. One hypothesised cause could be the lack of safety measures for unsupervised children, such as a lack of helmets and protection pads for children riding bikes but this also requires clarification in future studies. In any case, this may suggest the need for protective gear such as helmets and padded play areas in order to reduce the burden of injury from falls. Road traffic accidents (RTA) were also responsible for a significant number of admissions, which is consistent with the high burden of RTA injuries across many LMICs. Furthermore, while reviewing the charts in this study we anecdotally noticed that most children involved in road traffic incidents were pedestrians, and a number were unrestrained motor vehicle passengers, though the documentation wasn't thorough enough to determine a concrete percentage. Regardless, this suggests the need for parental education and strict enforcement of car safety measures, such as street crossing safety, infant car seats, and child seat belt laws.

Results of this study also showed that closed fractures of the extremities including the bony pelvis were the most common type of injuries across the age groups. This is similar to a study in India by Kundal, Debnath and Sen in 2017 that showed that fractures were the most common type of injury [4]. Simon et al. in Tanzania also showed that head and neck (32.7%) as well as musculoskeletal (28.0%) injuries were the most frequent type of injuries seen [18]. Of particular note though, children from birth to four years in this study accounted for 80% of burns and 55% of head injuries; this finding was similar to the study by Botchey et al. in 2017 where burn injuries were the most common mechanism of injury in the age category under five years [12]. This sheds light on the susceptibility of very young children and infants to burns and head injuries. This could possibly be attributed to the still developing motor functions of these children, or their inability to properly understand or avoid the dangers of hot objects and falls. Additionally, such young children will have proportionally larger heads to their bodies than older children, making them more prone to head injury during a traumatic incident. Overall though, this study suggests that paediatric trauma centres in Kenya also especially need to be prepared to handle higher volumes of extremity fractures, and also handle infant and very small child head and burn injuries.

This study also showed that 51.4% of injured children did not receive any pre-hospital care, and that 84% were transported to the

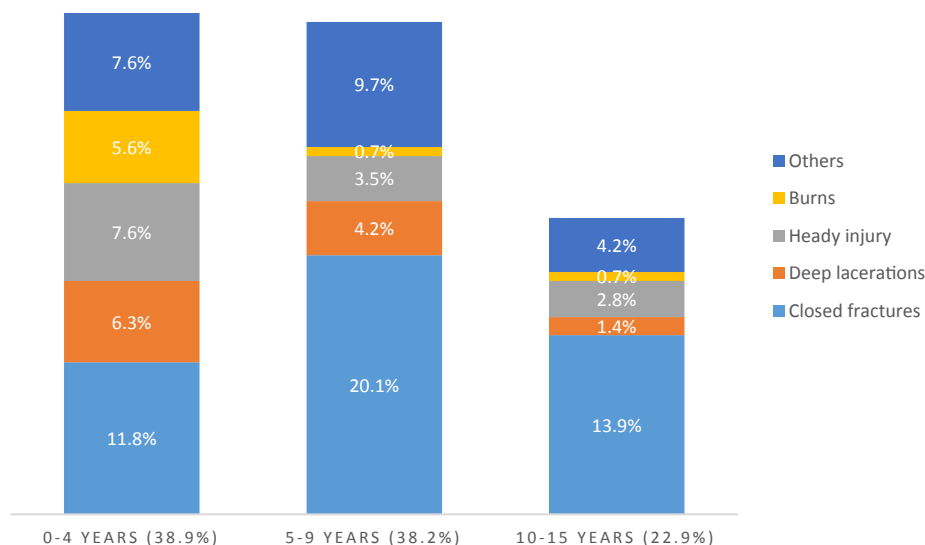


Fig. 3. Sub-analysis of sustained injuries by age groups. All percentages are of the total studied population (n = 144).

Table 2

Patient dispositions, all percentages are of the total studied population (n = 144).

	n	%
<i>Disposition from EC</i>		
Ward	104	72.2%
Operating theatre	25	17.4%
Paediatric high dependency unit (PHDU)	8	5.6%
Transfer to outside hospital	4	2.8%
Intensive care unit	3	2.1%
<i>Required surgery while admitted</i>		
Yes	103	71.5%
No	41	28.5%
<i>Final disposition</i>		
Discharged home	131	91.0%
Transferred out	9	6.8%
Died in hospital	3	2.1%
Left against medical advice	1	0.7%

hospital via private means. Previous studies have suggested that pre-hospital care of injured paediatric patients is the most important factor in determining outcomes following injury. Unfortunately, in LMICs, trauma care systems rarely exist. Injured children are most often taken directly to the nearest hospital by laypeople with no formal training in transportation and resuscitation of trauma patients. The lack of pre-hospital care systems leads to many injured children arriving at the hospital clinically compromised due to the time lag, the type of first aid received (or not), and the mode of transportation to the hospital [19]. If this is true, then the development of Kenya's pre-hospital emergency care system, including well trained personnel, is an area of great need that can improve paediatric patient outcomes.

As for other patient outcomes, the average hospital stay was two days, with most of the longest stays belonging to patients with poly-trauma or burns (19 days). According to Simon et al. (2013), the length of hospital stay has been reported to be an important measure of morbidity among trauma patients, and has an impact on patient outcomes [18]. Prolonged hospital stay has been associated with increased burden on hospital reserves as well as increased costs of health care. Thus, emergency care providers should be on extra high alert for burn or poly-trauma patients, and the extra resources they will likely require.

This study also showed a 2.1% mortality rate amongst children admitted with traumatic injuries at the Aga Khan University Hospital, which is low compared to studies from other low- and middle-income

African countries. The study by Simon et al. in Tanzania showed a 12.7% mortality rate [18], while a different study in Nigeria showed a mortality rate of 9% [20]. This difference could be attributed to the fact that the two mentioned studies were done in public hospitals whereas this study was done in a private hospital, meaning a difference in settings. Additionally, injuries especially responsible for mortality included severe traumatic brain injuries and poly-trauma, suggesting that these types of injuries be targets for prevention, intervention, or research.

The study had a number of limitations, first being missing medical records for the study. The study was performed in a single centre that serves a large heterogeneous population. The study only looked at paediatric patients who had injuries who were admitted; there were more paediatric patients with injuries who were evaluated and discharged home as outpatients. Thus, the contents of this study only represent the more severely injured trauma patients. This study only represented the sickest paediatric patients, and not the entire paediatric population in Nairobi as a whole.

Conclusion

Paediatric injuries remain a major public health problem and contribute a substantial proportion of all paediatric surgical admissions at the Aga Khan University Hospital in Nairobi. Most injuries were amongst boys and the very young, occurred in private residences, were typically caused by falls, resulted in extremity fractures (or burn and head injuries in infants and small children), and got very little or no pre-hospital care. Additionally, children with burns, brain injuries, or poly-trauma had the longest hospital stays and highest rates of mortality. It is therefore recommended that greater supervision and safety measures for children are needed, particularly targeting boys and the very young; the home and other residential buildings should be the primary targets for injury prevention; pre-hospital emergency care in Kenya should be further developed, and also be able to handle children; and paediatric trauma hospitals need to be especially equipped to handle bony fractures, and also handle burn and head injuries in infants and small children—as these are the most common injuries. They should also be optimised to handle burns, brain injuries and poly-traumas, as these carried the highest morbidity and mortality. Finally, a trauma registry system would be beneficial for the hospital and perhaps the whole country. This will enable further research.

Conflict of interest

The authors declare no conflict of interest.

Dissemination of results

The results of this study were presented to the Paediatric Accident and Emergency department and the results were also presented at The Aga Khan University Early Career Health Researchers' Conference.

Authors' contributions

Authors contributed as follows to the conception or design of the work; the acquisition, analysis, or interpretation of data for the work; and drafting the work or revising it critically for important intellectual content: AN, JS, JM and EN each contributed 25%. All authors approved the version to be published and agreed to be accountable for all aspects of the work.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.afjem.2018.12.004>.

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