

Original Article

# Frequency of morbidity, mortality and renal trauma in blunt and firearm accidents in pediatric population.

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## Abstract

**Background:** Renal Trauma is one of the significant causes of deterioration, morbidity, and mortality in the pediatric age group around the globe. Firearm injuries are among one of the essential causes for renal trauma. Overall, trauma is the leading cause of death and accounts for approximately 50% of mortality in children over 1 year of age. Therefore, the current study aims to determine the frequency of morbidity, mortality and renal trauma in blunt and firearm accidents in pediatric population.

**Methodology:** A total of 180 children, aged up to 15 years with blunt and penetrating trauma, including firearm injuries, were enrolled in our study. All patients with in the inclusion criteria of the study, who were presented in the emergency department were evaluated and resuscitated by a pediatric surgeon. Patients indicated with renal trauma were operated and were post-operatively managed in the pediatric surgery ward. All patients included were followed as an outpatient. The data of this descriptive case series were collected prospectively and was analyzed on SPSS version 22.0.

**Results:** Out of 180 patients 110 (61.11%) were male and 70 (38.89%) were female with mean age of  $8.5 \pm 2.9$  years. Majority of the patients had blunt trauma (54.44%) followed by firearm injuries (60, 33.33%). While penetrating trauma were observed in 22 patients (12.22%). Overall Renal trauma was observed in 40 (22.2%) of patients. Out of 40 patients, 20 (50%) patients had blunt, while 14 (35%) had firearm and 05 (12.5%) had penetrating abdominal trauma. Majority of renal injuries were Grade II (60%) followed by Grade III (17.5%), Grade IV (12.5%) and Grade I (10%) injury. The major morbidities noted in firearm injured patients were surgical site infection that was reported in 33.33% patients, limb deformity in 6.66% and neurological deficit in 5% patients. Overall Mortality was observed in 6.6% patients and firearm injuries was responsible for 8.33%.

**Conclusion:** Firearm injuries are one of the significant causes of trauma in children. The renal trauma was observed in 22.2% of cases, and all were managed conservatively. The frequency of morbidity and mortality secondary to firearm injuries was high as compared to other studies.

## Keywords

Pediatric Trauma, Pediatric Renal Trauma, Firearm Injuries, Gunshot Wounds, Morbidity, Mortality.



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## Introduction

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According to World Health Organization (WHO) reports in 2014, it was estimated that "injuries" will be one of the leading diseases by 2020 and would account for 20% of all disability-adjusted life year losses for the world population<sup>1</sup>. Chandran et al., reported that traumatic injuries causes over 5 million deaths annually, and out of this number, 830,000 are pediatric population. The majority of these deaths occur mostly in lower and middle-income countries<sup>2</sup>.

Pediatric trauma has also been reported as the primary cause of death after first year of life<sup>3</sup>. Many studies reported that the estimated direct medical cost associated with trauma is almost 10% of medical expenditure<sup>4-6</sup>. The classic recognized patterns of injuries determined are blunt, penetrating and firearm injuries<sup>7</sup>. In the pediatric population, road traffic accidents and falls are the leading cause of blunt trauma and are the major cause for the associated morbidity<sup>8</sup>. Penetrating injuries are usually due to sharp objects and firearms. Stray bullets are a common cause of intentional penetrating injuries in the pediatric population<sup>9,10</sup>. Salah et al., reported a significant morbidity and mortality with stray bullets and civilian fights<sup>11</sup>. Studies suggest that the majority of pediatric trauma patients are managed non-operatively. Common operative indications include cranial, musculoskeletal, thoracic, intestinal injuries and uncontrolled bleeding from solid organs including splenic, liver, and renal<sup>12</sup>. Management of gunshot wound is also challenging and contribute significant morbidity and long-term disabilities<sup>13</sup>.

Renal trauma is also consistently reported to involve 10% of pediatric patients presenting with abdominal trauma and contributes significantly to morbidity and mortality<sup>14</sup>. In developing countries, morbidity and mortality due to renal trauma are higher and still underreported<sup>15</sup>. Hyder et al., reported that only 17% of pediatric patients at the emergency department are properly triaged in Pakistan<sup>16</sup>.

The aim of this prospective study is to identify the traumatic injury patterns in the pediatric

population and its associated morbidity and mortality. Since renal trauma is frequently observed in our part of the world, and to our knowledge, it is still underreported. Moreover, this study data will help understand the injury pattern in relation to the age, gender and subsequent morbidity and mortality in the pediatric population.

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## Methodology

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The study was conducted at Jeejal Mau hospital Hyderabad from March 2015 to March 2020. A prospective sample of 180 children aged up to 15 years with blunt and penetrating trauma, including firearm injuries were included in this descriptive case series. Patients with a previous history of trauma were excluded from the study. Moreover, patients meeting the inclusion criteria were enrolled in the study from the accident & emergency department after obtaining consent from parent's /guardians.

Data were recorded on the structured performa, and details related to children who sustained blunt and penetrating injuries were entered. The data included demographic details like age, gender, weight, hospital registration number. Physical examination and detailed local examination included a number of entry and exit wounds on the body, types of superficial wounds.

Initial treatment was focused on general stabilization of the child with intravenous crystalloids, urinary output measurements, NG tube placement in case of abdominal wounds with suspected visceral injuries, chest tube placement in cases of injuries to the chest with suspected pneumo- or hemothorax were instituted. Blood samples were sent for CBC, grouping and cross match. After initial stabilization, patients were subjected to X-rays of various body regions depending upon the site of injuries. In cases of surgical intervention, findings related to organ system involvement, the viscera injured type of injuries, a surgical procedure was done. Patients were monitored in Surgical ICU, and the clinical course of the patient was documented. Investigations like ultrasound, CT scans were done when injured at the abdomen, chest, and soft

tissues to localize the bullet/pellet and need a surgical procedure to be adopted. Associated injuries like fractures were also noted. The patients were followed in OPD after 1 week of discharge for assessment of wounds and general condition, and further visits were advised according to the site of injury and system involvement. The final outcome was in terms of discharge from hospital in stable condition or death was mentioned. A cause of death was noted as well.

The study data was analyzed through SPSS version 22.0. Descriptive statistics were used to calculate percentages, mean and standard deviation while the numerical data (like age) were expressed as

mean and standard deviation. The categorical data like gender, type and mechanism of injury, organ system involved, and final outcome in terms of survival/death was expressed in frequency and percentages.

## Results

Out of 180 patients, there were 110 males (61.11%) and 70 females (38.89%). The mean age of children in our study was  $8.5 \pm 2.9$  years, majority of them were between 6-10 years of age (54.44%) with a male predominance (58.18%) (Table 1).

**Table 1: Baseline characteristics.**

Variables		n(%)
<b>Gender</b>	Male	110(61.11)
	Female	70(38.89)
<b>Age group</b>	≤5 years	22 (12.23)
	6 – 10 years	98 (54.44)
	11-15 years	60 (33.33)

Most of the patients (54.44%) presenting to us had blunt trauma to various parts of the body (n=98). Penetrating trauma accounted for 12.22% patients and firearm injured patients were around 33.33%. Overall male children were predominant in our study. In blunt and penetrating injuries due to other causes, there was also male predominance. Mechanism of injuries includes cross-firing bullet injuries, direct bullet injuries, stray bullet injuries, fall injuries, fight, glass cuts, knife injuries and road traffic accidents (Table 2). In patients with firearm injuries, the majority sustained stray bullet injury was around 75%, while 13.33% sustained direct bullet injuries and 11.66% sustained cross-firing bullet injury. Blunt trauma and firearm injuries were more frequent in the male gender.

**Table 2: Types and mechanisms of injuries.**

Variables		n(%)
<b>Diagnoses</b>	Blunt Trauma	98(54.44)
	Firearm Injuries	60(33.33)
	Penetrating Injuries	22(12.22)
<b>Mechanisms of Injuries</b>	Cross Firing Bullet Injury	7(3.88)
	Direct Bullet Injury	8(4.44)
	Fall Injuries	33(18.33)
	Fight, Glass, Knife Injuries	45(25)
	Road Traffic Accidents	42(23.33)
	Stray Bullet Injury	45(25)

Results shows that majority of renal injuries were Grade II (60%) followed by Grade III, Grade IV and Grade I, respectively. Moreover, in the grade IV renal trauma group, 2 patients had a nephrectomy, and 3 were managed conservatively (Table 3)

**Table 3: Grade distribution of renal trauma and management.**

Grades	n(%)	Management
Grade I injury	4(10)	Conservative
Grade II injury	24(60)	Conservative
Grade III injury	7(17.5)	Conservative
Grade IV injury	5(12.5)	Conservative (n=3); Nephrectomy (n=2)

Overall, the results shows that the major morbidities in pediatric trauma were noted in firearm injured patients. Commonest was surgical site infection in 33.33% of patients that was followed by limb deformities in 6.66% and neurological deficit in 5% patients. The outcome in children with trauma was variable. Overall, there was a mortality of 6.6%, with most of the patients in 6 – 10 years age range. Moreover, in firearm injured patients, 8.33% passed away, with males in majority (Table 4a & b).

**Table 4(a): Morbidity in pediatric trauma.**

Variables	n(%)
Surgical Site Infection	20 (33.33)
Limb deformity	4(6.66)
Neurological deficit	3(5)

**Table 4(b): Age and gender based distribution of mortality in pediatric trauma.**

Age Group	Gender	Outcomes overall		Outcomes in Firearm Injuries	
		Discharge	Expired	Discharge	Expired
≤5 years	Male	14	0	3	0
	Female	6	2	2	0
6-10 years	Male	60	5	14	3
	Female	32	2	11	1
11-15 years	Male	30	2	18	1
	Female	27	1	7	0

## Discussion

Developing world, currently is in the process of developing low cost models to minimize trauma-related morbidity and mortality in the pediatric population<sup>17</sup>. In our study, the male gender was more predominant as compared to female. Literature review of other Asian counties also report predominance of the male population<sup>18,19</sup>. Data from other Asian countries reported that age group of 10 to 14 years is more commonly presented with trauma as compared to a more frequent age group of 6 to 10 years that is observed in this study<sup>18, 19</sup>. Worldwide, blunt trauma is the

common mode of injury in adult as well as pediatric population<sup>7</sup>. Our data also report blunt trauma as more frequent observation among the patients. Very interestingly, firearm injury encompassed the 2nd common cause of pediatric trauma in our population. It was also reported that victims of stray bullets were the largest group affected with firearms. Data from the developed world report 53% of firearm injuries are due to homicide, 38% were due to suicide, and 6% are due to the unintentional handling of guns<sup>9</sup>. Surprisingly data from our neighboring country also report firearms as an uncommon cause of pediatric trauma<sup>20</sup>. Contrary to the literature, these modes of firearm

injury are uncommon in children of our society. The current study shows that only 7 out of 180 patients had an accidental injury while playing with a gun kept in the house. According to the current study majority of children became victims of stray bullets resulting from aerial or cross-firing. It is also found that the majority of patients (75% in the current study) had stray bullets resulted from ceremonial firings as injuries are of unknown or unintentional origin, therefore not reported. As most injuries resulted from the stray bullet, not the direct targeting, the projectile had to travel a longer distance; thus, its intensity decreases in resulted in less severe injuries. This suggest that not all patients presented through the emergency department required emergency exploration. However, these patients required aggressive management of resuscitation and keen observation. Although it was seen that projectile despite at critical position like in the vicinity of the heart does not cause any significant damage to the patient, but they may cause significant morbidity in certain locations like in the two of the cases in our study where hit by a bullet causing spinal cord injury leading to permanent lower-limb paralysis. Intensity and distance travelled by the projectile determined the severity of damage as other paravertebral injuries did not result in major damage and were retrieved on local exploration. This was also seen in a patient with facial injuries where bullets cross the midline and lodge in the opposite side without damaging the vital structures.

In terms of solid organ injuries, one of the vital organs injured during trauma is the kidney. Data from the USA revealed that female genitalia (37.7%) is one of the most common organ that sustained injuries followed by penises (21.6%) due to various sports and exercise activities<sup>21</sup>. Based on multiple data reported, McGeady et al. also reported 27.8% to 68.1% external genital injuries of all urogenital trauma, and also reported renal trauma as 3.9 to 4.6% of all urogenital trauma<sup>22</sup>. The current study shows that renal trauma contributes for up to 22.2% of injuries in association with other injuries in the pediatric population, which is significantly high compared to

the one that are reported in other study findings. Mike et al. reported that almost 70% of his 61 patients sustained blunt injuries, and 30% population sustained penetrating injuries<sup>23</sup>. He also reported that the majority of blunt abdominal were managed conservatively. In comparison, our study also reports that 50% of renal trauma were due to blunt injuries, while 35% were because of firearm injuries and 15% due to penetrating trauma. Regarding grades of renal injury in the current study, the majority of our patients had Grade II renal injuries (60%) followed by Grade III (17.5%), Grade IV (12.5%) and Grade I (10%). Most of the renal trauma patients in our study were managed conservatively on bed rest, intravenous fluids, blood transfusion, which is consistent with the past published literature<sup>24</sup>. It was observed that patients having penetrating injuries had associated abdominal and vascular injuries. Only two patients had nephrectomies, which is unavoidable in life-threatening bleeding and non-salvageable kidneys<sup>25</sup>.

In our study, total 4 deaths are reported due to cross-firing. The time-lapse between the trauma and the presentation is very important as this is the "golden hour" in which life should be saved. Therefore, every effort should make to transport the patient properly to the hospital, or there should be facilities available for trauma care of pediatric patients in nearby hospitals in order to avoid the waste of critical time.

In the current study, out of 60 firearm patients, 24 were not explored due to different reasons. 11 patients had pellets at multiple sites, all of them could not be retrieved. While in the rest of the patients, the location of bullet/projectile was present in such a critical place from where removal might cause more damage. Five patients with firearm injuries were expired due to hypovolemic shock and sepsis. The average hospital stay was more than a week. Thus, this avoidable problem causing an increased load on the hospital, which is already overburdened with patients suffering from other systemic diseases.

Although most firearms cause non-fatal injuries in children, as seen in the current study (91.66%) but apart from the physical morbidity, these children do have mental and psychological disturbance as well and they might sustain life-long effects. Previous studies also support this observation. The pallet injuries in patients were although stable, but at times they may cause severe consequences, and all the pallets or bullets can lead to poisoning, therefore, a periodic blood level should be done. One of the landmark study i.e. PAPSA Research Study, compared the epidemiology, mechanism of injury, injuries sustained, management, morbidity and mortality in low to middle-income countries (LMIC) vs high-income countries (HIC)<sup>26</sup>. It was concluded that the spectrum of pediatric trauma varied significantly in LMIC and emphasized the need for trauma registries for future research and developing local protocols to minimize the morbidities<sup>26</sup>. Data from this single-center study may help develop policies for the management of blunt trauma and implement laws on ceremonial gun firings, which are the leading cause of unintentional firearm injuries to innocent populations.

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## Conclusion

It is concluded that pediatric trauma resulting from blunt Injuries and firearms is increasing continuously in our part of the world. Firearm injuries, specifically from stray bullets, are a major cause of morbidity and mortality. Moreover, renal trauma is significantly high in our country and needs screening in every trauma patient. It is also seen that the majority of renal trauma in the pediatric population can be conservatively manageable. Firearm contributes significant morbidity in terms of wound infection and complications in pediatric age. These may result in serious complications or even deaths of innocent children and increase the workload on healthcare professionals.

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## Conflicts of Interest

The authors have declared that no competing interests exist.

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