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# Patterns of Multi-System Injuries in Paediatric Trauma: Experience from a Sub-Urban Teaching Hospital in Nigeria

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## ABSTRACT

**Background:** Paediatric trauma remains a significant cause of morbidity and mortality worldwide, particularly in low and middle-income countries where trauma systems are underdeveloped. While the causes of paediatric trauma are well documented, there is limited data on the pattern and distribution of multi-system injuries in sub-urban Nigerian settings.

**Aim:** To describe the pattern of multi-system injuries among paediatric trauma patients presenting to a sub-urban teaching hospital in Nigeria.

**Methods:** This was a prospective observational study conducted over one year involving patients aged 18 years and below who presented with traumatic injuries to the accident and emergency unit and surgical outpatient clinic of a sub-urban teaching hospital in the Niger-Delta region of Nigeria. Data collected included age, sex, mechanism of injury, anatomical regions involved, and number of injured systems. Data were analysed using SPSS version 25.0.

**Results:** A total of 139 paediatric trauma patients were studied, comprising 101 males (72.7%) and 38 females (27.3%), with a male-to-female ratio of 2.6:1. Adolescents aged 10-13 years constituted the largest proportion of cases (42.4%). Road traffic accidents were the leading mechanism of injury, accounting for 61.9% of cases, followed by falls from height (15.9%). Multi-system injuries were observed in 79.9% of patients, while 20.1% sustained single-system injuries. The abdomen was the most frequently injured region (83 cases), followed by the head and neck (61), chest (44), skin (41), extremities (39), and perineum (11).

**Conclusion:** Paediatric trauma in this sub-urban Nigerian setting is predominantly characterized by multi-system injuries, with abdominal trauma occurring more frequently than head injuries. These findings underscore the need for improved trauma assessment protocols, early identification of multiple injuries, and strengthened multidisciplinary trauma care. Preventive strategies targeting road traffic injuries and falls remain crucial in reducing the burden of paediatric trauma.

## Keywords:

Paediatric trauma, Multi-system injuries, Abdominal trauma, Road traffic accidents, Sub-urban, Nigeria.

## Introduction

Trauma is defined as physical injury resulting from the transfer of mechanical energy to the human body and remains a leading cause of morbidity and mortality among children worldwide [1,2]. Globally, paediatric trauma accounts for a substantial proportion of emergency department visits and hospital admissions, and it represents one of the most common causes of preventable death and long-term disability in children and adolescents [3,4]. Despite advances in injury prevention and trauma care in high-income countries, paediatric trauma continues to impose a significant health burden in low- and middle-income countries, where healthcare systems are often ill-equipped to manage complex injuries [5,6].

In children, trauma differs significantly from adult trauma due to anatomical, physiological, and developmental factors [7,8]. The relatively larger body surface area, less protective fat, compliant chest wall, and immature organ systems in children predispose them to distinct injury patterns and increase the likelihood of sustaining injuries to multiple organ systems from a single traumatic event. Consequently, paediatric trauma frequently presents as a multi-system injury, requiring prompt recognition and coordinated multidisciplinary management to prevent adverse outcomes [9].

In sub-Saharan Africa, the burden of paediatric trauma is rising, largely driven by rapid urbanization, increased motorization, inadequate road infrastructure, and limited enforcement of safety regulations [6,10]. Although reliable population-based data remain scarce, available hospital-based studies suggest that injuries contribute substantially to childhood morbidity and mortality in the region. Nigeria, the most populous country in Africa, bears a disproportionate share of this burden [11]. Socioeconomic challenges, delayed presentation to healthcare facilities, limited access to diagnostic imaging, and shortages of specialized trauma care services Socioeconomic challenges,

delayed presentation to healthcare facilities, limited access to diagnostic imaging, and shortages of specialized trauma care services further compound paediatric trauma in Nigeria further compound paediatric trauma in Nigeria [12-14]. Road traffic accidents are consistently reported as the leading cause of paediatric trauma in many Nigerian studies, particularly in sub-urban and rural settings where children are frequently exposed as pedestrians or passengers without appropriate safety measures [12,15]. Falls from height, often related to environmental and recreational activities, also contribute significantly to injury occurrence. These mechanisms of injury are commonly associated with high-energy transfer, increasing the risk of injuries involving multiple anatomical regions [16]. However, most existing studies in Nigeria have focused primarily on the causes and outcomes of paediatric trauma, with relatively limited emphasis on the pattern and distribution of injuries across body systems.

Understanding the pattern of injuries sustained by paediatric trauma patients is critical for several reasons. First, it informs clinical decision-making, including triage prioritization, imaging strategies, and operative planning. Second, it guides resource allocation and capacity building within trauma centres, particularly in resource-limited settings where advanced diagnostic and therapeutic options may be constrained [17]. Third, knowledge of injury patterns contributes to the development of targeted prevention strategies aimed at reducing high-risk exposures and mechanisms.

Despite the clinical and public health importance of multi-system injury patterns, data from sub-urban Nigerian settings remain sparse. Variations in environmental exposures, transportation systems, and healthcare access suggest that injury patterns observed in urban or high-income settings may not be directly applicable to sub-urban Nigerian populations. There is therefore a need for locally generated evidence to characterize the nature and distribution of paediatric trauma injuries in these contexts.

This study aimed to evaluate the pattern and distribution of multi-system injuries among paediatric trauma patients presenting to a sub-urban teaching hospital in the Niger-Delta region of Nigeria. By describing the anatomical regions involved and the frequency of multi-system injuries, this study seeks to provide evidence that may inform clinical practice, trauma system planning, and injury prevention strategies in similar resource-limited settings.

## Materials and Methods

### Study Design and Setting

This was a prospective observational study conducted at the Accident and Emergency Unit and the Surgical Outpatient Clinic of the Irrua Specialist Teaching Hospital, Irrua, a sub-urban tertiary healthcare facility located in the Niger-Delta region of Nigeria. The hospital serves as a major referral centre for surrounding urban and rural communities and provides emergency, surgical, and paediatric care.

### Study Population

The study population comprised all paediatric patients aged 18 years and below who presented with a history of trauma during the study period. Both direct presentations to the accident and emergency unit and trauma cases reviewed at the surgical outpatient clinic were included.

### Study Period

Data collection was conducted over a period of one year, from January 2025 to December 2025.

### Inclusion and Exclusion Criteria

All patients aged 18 years and below with a documented history of traumatic injury were eligible for inclusion. Patients with incomplete clinical records, those who sustained non-traumatic injuries, and those who were brought in dead were excluded from the study.

### Data Collection

Data were collected prospectively at the point of patient evaluation using a structured proforma. Information obtained included demographic variables (age and sex), mechanism of injury, anatomical regions involved, number of injured body systems, treatment modalities, and admission and discharge records.

### Definitions and Injury Classification

Trauma was defined as physical injury resulting from external mechanical forces. Injuries were categorized based on anatomical regions involved, including head and neck, chest, abdomen, extremities, skin, and perineum. Patients were classified as having single-system injuries when only one anatomical region was affected, and multi-system injuries when two or more anatomical regions were involved.

### Outcome Measures

The primary outcome measure was the pattern and distribution of injuries, with particular emphasis on the prevalence of multi-system injuries and the frequency of involvement of specific anatomical regions. Secondary measures included mechanisms of injury and age- and sex-related distributions.

### Statistical Analysis

Data were entered and analysed using the Statistical Package for Social Sciences (SPSS) version 25.0. Descriptive statistics were used to summarize demographic characteristics, mechanisms of injury, and injury patterns. Categorical variables such as Age group, Sex, causes of fall, etc., were expressed as frequencies and percentages. Results were presented in tables and figures as appropriate.

### Ethical Considerations

Ethical approval for the study was obtained from the Health Research Ethics Committee of Irrua Specialist Teaching Hospital (ISTH/HREC/2025/01/280). Informed consent was obtained from parents or legal guardians of all participants, and assent was obtained from older children where applicable. Patient confidentiality was maintained throughout the study by anonymizing all data and restricting access to study records.

## Results

A total of 139 paediatric trauma patients were recruited during the one-year study period. Of these, 101 were males (72.7%), and 38 were females (27.3%), resulting in a male-to-female ratio of 2.6:1. The incidence of trauma increased with age, peaking among adolescents aged 10-13 years, who accounted for 42.4% (n=59) of cases. This was followed by teenagers aged 14-18

years, with 30.2% (n=42). Infants and preschool-aged children together constituted less than 10% of cases. Adolescents and teenagers combined accounted for 72.6% of all paediatric trauma presentations (Table 1).

**Table 1:** Demographic distribution of paediatric trauma patients.

| Age group (years) | Number (n=139) | Percentage (%) |
|---|---|---|
| Infants (< 1 year) | 4 | 2.9 |
| Preschool (1–3) | 8 | 5.8 |
| School age (4–9) | 26 | 18.7 |
| Adolescents (10–13) | 59 | 42.4 |
| Teenagers (14–18) | 42 | 30.2 |
| **Sex** | | |
| Male | 101 | 72.7 |
| Female | 38 | 27.3 |

Road Traffic Accidents (RTAs) were the most common mechanism of injury, accounting for eighty-six cases (61.9%) (Figure 1). Falls from height constituted the second most frequent mechanism, with 22 cases (15.9%). Other mechanisms of injury occurred less frequently (Figure 1). Among RTA cases, motor vehicular accidents were the predominant subtype, accounting for fifty-eight cases (67.4%), followed by motor-pedestrian accidents and motorcycle–vehicular accidents, each contributing 12.8% of RTA cases. Motorcycle–motorcycle accidents accounted for the least proportion (7%) (Figure 2). Analysis of fall-from-height injuries revealed that falls from fruit trees were the most common cause, accounting for sixteen cases (72.7%). Other causes included falls from storey buildings (13.6%), falls from parents' hands or grip (9.1%), and falls from fences (4.6%) (Table 2).

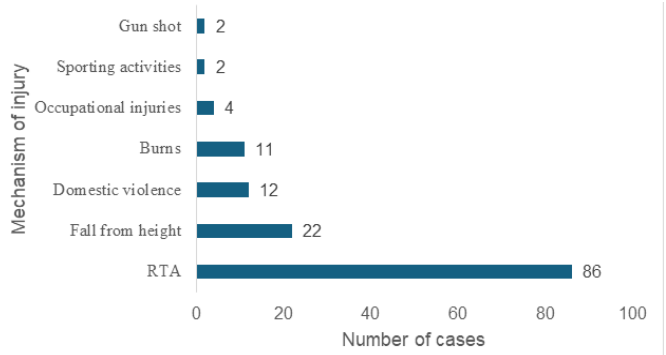



**Figure 1:** Mechanism of injury among paediatric trauma patients.

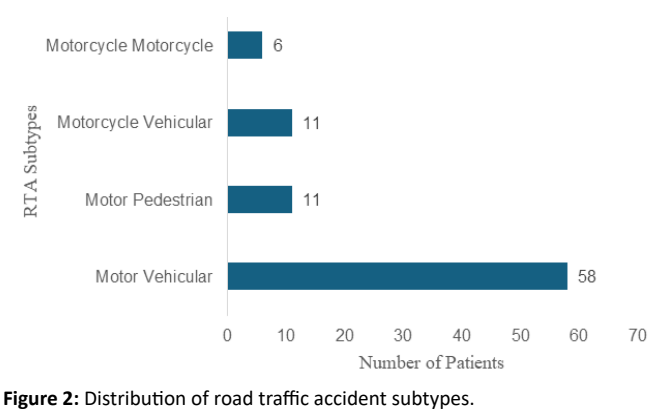



**Figure 2:** Distribution of road traffic accident subtypes.

**Table 2:** Causes of fall from height among paediatric trauma patients

| Causes of fall | Number (n=139) | Percentage (%) |
|---|---|---|
| Fruit trees | 16 | 72.7 |
| Storey buildings | 3 | 13.6 |
| Parent's hands/grip | 2 | 9.1 |
| Fences | 1 | 4.6 |

The majority of patients sustained multi-system injuries, with 111 cases (79.9%), while twenty-eight patients (20.1%) suffered injuries involving a single anatomical region (Figure 3). The abdomen was the most frequently injured anatomical region, involved in eighty-three cases, followed by the head and neck (61 cases), chest (44 cases), skin (41 cases), extremities (39 cases), and perineum (11 cases). Several patients sustained injuries to more than one anatomical region, resulting in overlapping distributions (Figure 4).

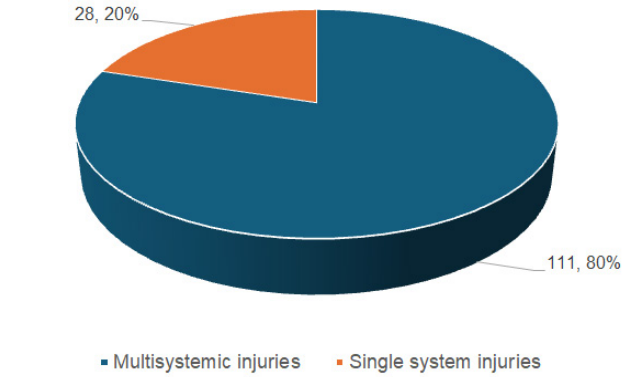



**Figure 3:** Distribution of single-system and multi-system injuries.

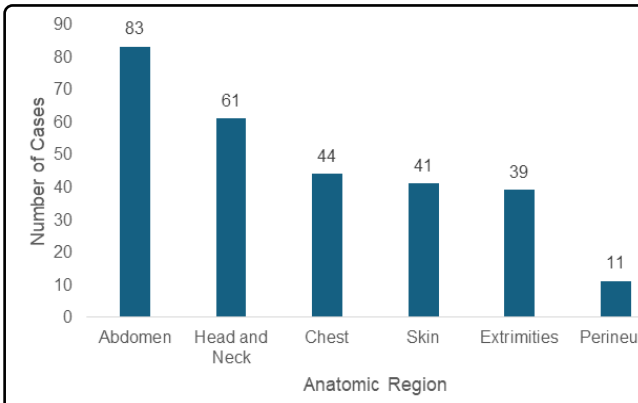



**Figure 4:** Anatomical regions involved in paediatric trauma.

## Discussion and Conclusion

This study evaluated the pattern and distribution of injuries among paediatric trauma patients in a sub-urban Nigerian teaching hospital, with emphasis on multi-system involvement. The predominance of multi-system injuries (79.9%) observed in this study highlights the severe nature of paediatric trauma presentations in this setting. In resource-limited environments where diagnostic and specialist services may be constrained, such patterns underscore the importance of structured trauma assessment and multidisciplinary management. Kiragu et al. emphasized the challenges of managing complex paediatric trauma in low-resource settings and the need for systematic trauma protocols to improve outcomes [5].

A male predominance (M:F=2.6:1) was observed, consistent with findings from Lagos and other African settings where boys were more frequently affected [2,14]. Similar trends have also been reported in Oman and Europe, suggesting that male vulnerability to trauma is not region-specific but may reflect behavioral and sociocultural factors [3,4]. Increased outdoor exposure, risk-taking behavior, and participation in physically demanding activities likely contribute to this pattern.

The highest incidence of trauma occurred among adolescents aged 10–13 years. This contrasts slightly with the findings of Onyemaechi et al. in Malawi, where younger children constituted a larger proportion of injuries [14], but aligns with reports indicating increased injury risk during early adolescence due to greater independence and environmental exposure (3,4). Developmental characteristics of this age group, including exploratory behavior and reduced supervision, may account for this trend.

Road Traffic Accidents (RTAs) were the leading mechanism of injury, accounting for 61.9% of cases. This finding is consistent with previous Nigerian studies that identified RTAs as the predominant cause of paediatric trauma [2,12,15]. Osifo et al. specifically reported high mortality associated with paediatric road traffic injuries in Nigeria [15], further emphasizing the public health significance of this mechanism. The predominance of motor vehicular crashes among RTA subtypes in this study reflects increasing motorization and persistent road safety challenges in sub-Saharan Africa [6]. In contrast, some studies from other regions have reported falls as the leading cause of paediatric injury (4), suggesting regional variation influenced by infrastructure, traffic systems, and supervision practices.

Falls from height constituted the second most common mechanism of injury, with fruit tree falls accounting for most of these cases. This pattern reflects the environmental context of sub-urban and semi-rural Nigerian communities. Similar environmental influences have been described in other African settings, where injury mechanisms are closely linked to local activities and living conditions [6,10].

A notable finding in this study was the predominance of abdominal injuries over head and neck injuries. While several large epidemiological studies have reported head injuries as the most common anatomical site in paediatric trauma [4,17], the pattern observed in this study may be explained by the high proportion of road traffic accidents and high-energy impacts. Akpınar reported that high-energy road traffic injuries were significantly associated with internal organ damage [16]. Additionally, limitations in early imaging access in low-resource settings may contribute to delayed identification and referral of severe abdominal trauma [5,13]. This finding reinforces the need for heightened clinical suspicion for intra-abdominal injury during initial assessment.

The high prevalence of multi-system injuries in this cohort aligns with the understanding that paediatric trauma often involves multiple anatomical regions due to physiological and biomechanical factors unique to children [7,9]. Lahoti emphasized that multiply injured children require coordinated orthopaedic and surgical management to reduce morbidity [9]. In low- and middle-income countries, strengthening trauma systems and implementing standardized primary and secondary survey protocols remain critical [5,13].

Overall, this study contributes locally relevant data to the growing body of literature on paediatric trauma patterns in sub-Saharan Africa. The findings highlight the ongoing burden of road traffic injuries and the complexity of multi-system trauma in children within resource-limited settings.

## Limitations

This study has several limitations that should be considered when interpreting the findings. First, as a hospital-based study conducted in a single sub-urban teaching hospital, the results may not be fully generalizable to other settings, particularly urban or rural communities with different environmental and healthcare characteristics. Second, the sample size was relatively small and limited to patients who presented to the hospital, potentially excluding cases of minor trauma managed at home or severe injuries resulting in pre-hospital mortality.

Third, although data were collected prospectively, the study relied primarily on clinical assessment and available investigations, which may have led to underestimation of certain injuries, particularly in the absence of advanced imaging modalities. Additionally, long-term outcomes such as functional disability and quality of life were not assessed, limiting conclusions regarding the full burden of paediatric trauma.

Despite these limitations, this study provides valuable insight into the pattern of paediatric trauma injuries in a sub-urban Nigerian setting and contributes to the limited body of evidence on multi-system injuries in children within resource-limited environments.

## Recommendations

Based on the findings of this study, several recommendations are proposed to reduce the burden of paediatric trauma and improve outcomes in similar sub-urban, resource-limited settings.

1. Strengthening Paediatric Trauma Assessment and Care

Healthcare facilities managing paediatric trauma should adopt structured trauma assessment protocols that emphasize early identification of multi-system injuries. Training of healthcare providers in paediatric advanced trauma life support principles is recommended to enhance prompt recognition and coordinated management of injuries involving multiple anatomical regions, particularly abdominal trauma.

2. Improvement of Trauma System Preparedness

Given the high prevalence of multi-system injuries, tertiary hospitals in sub-urban settings should strengthen multidisciplinary trauma care by improving access to diagnostic imaging, surgical expertise, and timely referral pathways. Establishment of dedicated paediatric trauma teams or protocols may improve clinical outcomes.

3. Road Traffic Injury Prevention

Road traffic accidents being the leading cause of paediatric trauma highlight the need for strengthened road safety measures. Enforcement of traffic regulations, promotion of child safety devices such as seat belts and child restraints, and public education on pedestrian safety should be prioritized, particularly in sub-urban communities.

4. Community and Parental Education

Community-based educational programmes aimed at parents, caregivers, and children should be implemented to increase awareness of injury risks and preventive strategies. Emphasis should be placed on supervision of children during outdoor activities and discouraging high-risk behaviours such as climbing fruit trees without appropriate safety measures.

5. Policy Development and Future Research

Policymakers should prioritize injury prevention as a public health issue by integrating paediatric trauma surveillance into existing health information systems. Further multicentre and population-based studies are recommended to better define injury patterns, risk factors, and long-term outcomes of paediatric trauma in Nigeria.

## Author Contributions

E.A. conceived the study, developed the protocol, wrote the manuscript, reviewed, and edited it. O.I.N. contributed to writing, data analysis, review and editing the manuscript. Both authors read and approved the final draft.

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## Conflict of Interest

The authors declared no conflict of interest

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None.

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