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Firearm Injury Among Children and Adolescents in Nigerian Civilian Trauma Setting: Prevalence, Pattern, and Implications for Prevention

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Firearm injury in children and adolescents and the morbidity associated with it is an appreciable burden in resource-limited settings, though it is under-reported. This study aimed to determine its prevalence and pattern in Nigerian civilian trauma setting. We undertook a retrospective study of all the patients with firearm injury aged 19 years or under who visited the Emergency Department (ED) of two tertiary hospitals in Nigeria over a period of 15 years. Of the 46,734 children and adolescents seen in the ED, firearm injury was the reason for the visit in 56 of them, giving a prevalence of 1.2 per 1000 ED attendance (95% CI: 0.9-1.6). The male-to-female ratio was 1.8:1, and the mean age was 13.98 ± 5.6 years. The preponderance of firearm injury was in the rural areas, during the dry season, at home, and in the daytime. Armed robbery (20, 35.7%) and communal clash (7, 12.5%) were the two topmost incidents leading to gunshot wounds. Armed robbery-related gunshot occurred mostly on the roads and at nighttime and involved predominantly 15-19-year-olds. Lower extremity was the topmost anatomical region involved. The majority (67%) had no pre-hospital care; the mean and median injury-hospital arrival interval respectively was 352 hrs and 4.2 hrs. Wound infection was the topmost complication. The mean hospital length of stay was 22.6 days. One (1.8%) of the patients died on the third day of hospital admission. Educational campaigns for prevention intensified during the dry season should highlight the risk of firearm injury to this age group and emphasize the importance of proper supervision and guidance of vulnerable children and adolescents. Improving the rates of pre-hospital care and early presentation of victims to the hospital should be considered in tertiary injury prevention strategies.

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Abbreviations: ED, Emergency Department; ICRC, International Committee of the Red Cross; AIS, Abbreviated injury scale; ISS, Injury Severity Score; RTS, Revised Trauma Score; TRISS, Trauma Injury Severity Score; LOS, hospital length of stay.

Keywords: Firearm, gunshot, injury, children, adolescent, prevalence developing country

Authors Contributions: NIO: conceptualized and designed the study, involved in data collection, analysis and interpretation, drafted manuscript, read and approved the final manuscript. OAL: design of study, involved data collection and interpretation, involved in critical revision of the final manuscript, and read and approved the final manuscript.

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INTRODUCTION

Firearm injury is a cause of preventable morbidity and mortality in pediatric populations worldwide. A recently published report on global mortality from firearms indicates that 7220 children aged 10-14 years died from a firearm-related injury in 2016 [1]. Non-fatal firearm injuries in the pediatric population outnumber the fatal ones in a ratio that varies; on average, there are four non-fatal injuries for every death [2,3]. For every death, there are four survivors at risk of either short- or long-term morbidity. In the United States, a survey of childhood firearm injury from 2002 to 2014 indicates that an average of 1297 children die and 5790 are treated for gunshot wounds each year [3]. Firearm injury in children and adolescents in resource-limited settings is under-reported. However, previously published reports indicate that 6-20% of firearm injury seen in the emergency room of tertiary hospitals in Nigeria involved children and adolescents [4-6].

Globally, published reports indicate that interpersonal violence, armed robbery, domestic violence, legal intervention, communal clash, ceremonial gunfire, political violence, secret cult/gang clashes, hunting, suicide, and accidental discharge are some of the causes/incidents leading to gunshot among children and adolescents [3,4-9]. In most of these incidents leading to firearm injury, the victim could be either a target or hit by a stray bullet [10]. Although the causes/incidents leading to firearm injury among children and adolescents are about the same globally, its distribution varies from and within sub-regions. In the West African sub-region, a gunshot from interpersonal violence is a much more common scenario than suicidal gunshots, while in the US, the incidence of a homicidal gunshot is almost at par with suicidal ones, and a child shot by another individual playing with a gun is also a common scenario [3,4,11]. In Pakistan, children compared to other age groups are the most vulnerable to stray bullet-related firearm injuries [12]. Published reports indicate a relatively low prevalence of firearm injury in countries with a well-enforced firearm control act [13,14]. Most African countries have regulations that guide the acquisition and use of firearms. However, the illegal proliferation of guns (shotgun and military rifle) from insurgency, political violence, and in the aftermath of civil wars is a setback to these gun laws and policies [15,16]. Thus, the pediatric population in this setting is vulnerable to low- and high-velocity gunshot wounds.

Seasonal distribution of firearm injury also varies from countries: it is more prevalent in summer than in winter in Sialkot, Pakistan, while it occurred mainly during autumn in Egypt [17,18]. Also, a published report from New York City indicates that the seasonal incidence of firearm injury is higher during summer than in winter, and the rate of gunshot injury is significantly higher in the hotter days in summer [19].

Detailed information on etiological factors and circumstances of gunshot, temporal, spatial, and seasonal distributions, types, and outcome of children and adolescents firearm injury in a setting can facilitate preventive and treatment strategies. Overall, there is a paucity of data on child and adolescent firearm injury and almost non-existence of data in the West African sub-region. Thus, the dearth of data and the variations in the pattern of firearm injury in previously published reports necessitated this study. Therefore, this study aimed to determine the prevalence and pattern of children and adolescents firearm injury seen in two tertiary hospitals in Nigeria.

MATERIALS AND METHODS

We undertook a retrospective descriptive study of all the patients with firearm injury aged 19 years or under who presented at the emergency room of Alex Ekwueme Federal University Teaching Hospital Abakaliki Ebonyi State and National Orthopaedic Hospital Enugu over a period of 15 years (1st January 2005 to 31st December 2019). The former is one of the teaching hospitals in Nigeria and the latter one of the three regional Orthopaedic and trauma centers in Nigeria. The two centers are in South-East Nigeria and provide affordable health care services to the populations in South-East, and parts of South-South, and North-Central geopolitical zones of Nigeria. These centers accept and manage children and adolescents with firearm injury of varying degrees of severity and are not difficult to access from the rural areas.

The patient journal was the source of data. Information obtained from the patient journal includes demographic data (age and gender), etiology and causes/incidents leading to a gunshot, mode of a gunshot to the victim, locality (rural/urban) of gunshot, and scene of firearm injury (road, home, school, farm, market, and others), date and time of injury, and type of gun used. Data from the patient journal also include the type of injury and the anatomical region involved, the interval between injury and presentation to the hospital, pre-hospital care, co-morbidities, associated/additional injuries and trauma score parameters, treatment, length of hospital stay, outcome, and complications.

The patients were grouped into four age groups, 0-4, 5-9, 10-14, and 15-19 years, for the analysis. The setting of this study is of the tropical climate type with wet (May-October) and dry (November-April) seasons, a mean annual temperature in a range of 27^{o}C-34^{o}C, and high rainfall (May-September) that has a lowering effect on the temperature of the environment during the wet season [20]. Patients were classified into the wet and the dry group based on the seasonal incidence of the injury.

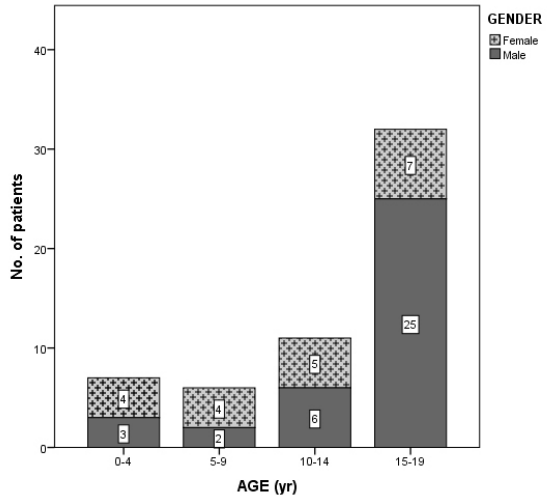

Figure 1. Firearm injury in children and adolescent by age and gender.

The gunshot wound was grouped into two, based on the presence (perforating) or absence (penetrating) of an exit wound. The International Committee of the Red Cross (ICRC) graded gunshot wounds based on the amount of tissue damaged and typed it according to structure injured [21]. Gunshot wound typed according to structure injured is the only component of ICRC classification used in this study. In the patient journal, patient/eyewitness description of the weapon, the type of wound and pellets observed in clinical and radiological assessments were the means of identifying the gun used. The gunshot was grouped into close range and distant range based on the estimated distance of the muzzle to the body of victims at the time of discharge (close range gunshot is within a distance of 60 cm and stipples the skin around the entrance wound) [22].

Firearm injury severity was according to Abbreviated injury scale (AIS), which graded each injury by body region according to its relative importance on a 6-point scale (a score of 1 indicates a minor injury and a score of 6 indicates maximal injury, currently untreatable) [23]. Injury Severity Score (ISS) is the sum of the square of highest AIS grade in each of the three most severely injured anatomic regions (ISS ranges 1-75, and a score > 15 is a severe injury) [24]. Systolic Blood Pressure, Respiratory Rate, and Glasgow Coma Scale are the parameters for calculating Revised Trauma Score (RTS) [24]. Trauma Injury Severity Score (TRISS) is the probability of survival from trauma based on the patient ISS, RTS, and age. TRISS ranges from 2.70-98.80% [24]. We entered the AIS, RTS parameters, and age of the patient into TRAUMA.ORG software calculator (https://www.srisangworn.go.th/home/triss/TRAUMA_ORG.htm) to compute the ISS and TRISS for each patient [25]. The patients were grouped into mild (1-8), moderate (9-15), and severe (≥16) injury based on the ISS.

In the setting of this study, pre-hospital care services for immediate care and prompt evacuation of victims of firearm injury with an ambulance from the scene to the trauma centers is almost non-existing [26]. To fill in the gap, some victims of firearm injury resort to the services of community health works, patent medicine dealers, health care personnel in private clinics, family relatives, and by-standers for care before presentation to the trauma centers, and all make it to the hospital with any available means of transportation [26]. Thus, a pre-hospital care in this setting is as any form of care (at the scene, en route, primary health facility, home and patent medicine stores) given to the patient before presentation to the trauma centre. The patients were grouped into two based on the presence (yes) and absence (no) of pre-hospital care.

Data were analyzed using IBM Statistical Package for Social Sciences, IBM SPSS Statistics version 20 (IBM Corp. Armonk, NY, USA) statistical software. We presented descriptive statistics in frequency tables and graphs and used Pearson Chi-squared test of association for the categorical data. The statistical significance was set at $p < 0.05$.

Data collection and usage in this study was following the principles of the Helsinki declaration. The Research Ethics Committee of National Orthopaedic Hospital Enugu Nigeria approved this study and waived the need for written informed consent in a retrospective study (IRB/Hec/no.S.316/iv, protocol no. 972).

RESULTS

A total of 46,734 children and adolescents visited the Emergency Department (ED) of the hospitals, and firearm injury was the reason for the visit in 56 of them, giving a prevalence of 1.2 per 1000 ED attendance (95% CI: 0.9-1.6). The male to female ratio was 1.8:1. The age ranged from 7 months to 19 years with a mean of 13.98 ± 5.6 years. The 15-19-year-old was the predominant age group (Table 1). In the 0-4 and 5-9-years age categories the females outnumbered the males by a ratio of 4:3 and 2:1 respectively whereas a reversal (male gender bias) was the case among 10-14 and 15-19 year age groups as shown in Figure 1. The variation in the age distribution of firearm injuries by gender was such that after the first 9 years of life, the incidence among the males doubled in the 10-14 years age group then octupled to a peak age incidence of 15-19 years whereas among the females there was a gradual increase in the incidence that nearly doubled at a peak age incidence of 15-19 as also shown in Figure 1.

Table 1 also shows 36 (64.3%) of the patients sus-

Table 1. Distribution of the patients by Age and Gender; Season, Locality, and Scene of Firearm Injuries.

Characteristics	Frequency (%)	95% Confidence Interval
Age (yr)		
0-4	7 (12.5)	4.4 - 26.8
5-9	6 (10.7)	2.7 - 19.6
10-14	11 (19.6)	9.8 - 32.2
15-19	32 (57.1)	42.8 - 67.9
Gender		
Female	20 (35.7)	23.2 - 49.1
Male	36 (64.3)	50.9 - 76.9
Season		
Dry	36 (64.3)	50.0 - 75.0
Wet	20 (35.7)	25.0 - 50.0
Locality		
Rural area	31 (55.4)	41.0 - 67.0
Urban area	25 (44.6)	33.0 - 59.0
Scene of injury		
Home	22 (39.3)	24.1 - 53.8
Road/Street	20 (35.70)	23.2 - 50.0
School	5 (8.9)	2.7 - 16.1
Restaurant	2 (3.6)	0.0 - 8.9
Market	2 (3.6)	0.0 - 9.8
Farm	2 (3.6)	0.0 - 9.8
Others	3 (5.4)	1.8 - 12.5

tained firearm injury in the dry season and 31 (55.4%) of firearm injuries occurred in the rural areas. The incidence of firearm injury was higher in the rural than the urban area in the dry season (71% vs 56%; $p < 0.25$). In Figure 2, the home was the most common scene of firearm injury among all the age categories in the first 14 years of childhood whereas the road/street was the topmost scene of injury among the 15-19 year olds. The majority (37, 66.1%) of the injuries occurred outdoors while 19 (33.9%) occurred indoors. In Table 2, handguns (31, 55.4%) were the most commonly used gun, and 38 (67.9%) of the victims were shot at a close range.

The majority (31, 55.4%) of the victims had intentional firearm injury while the injury in 25 (44.6%) was unintentional. There was no suicidal gunshot injury observed. In Table 2, the three top causes/incidents leading gunshot were armed robbery, communal clash, and law enforcement /security agents; gunshot targeted to the victim was the most common mode of gunshot observed. Of the seven law enforcement/security agent related gunshots, three were shot as suspects, three were struck by a bullet from gunshot intended for another target, and one was shot during a student riot. Of the five unsafe handlings of gun-related injuries, three were from accidental discharge of a gun that dropped from the hand of the victim to ground, one was a discharge of a wielded firearm, and the other one was a stray bullet from an unintentional

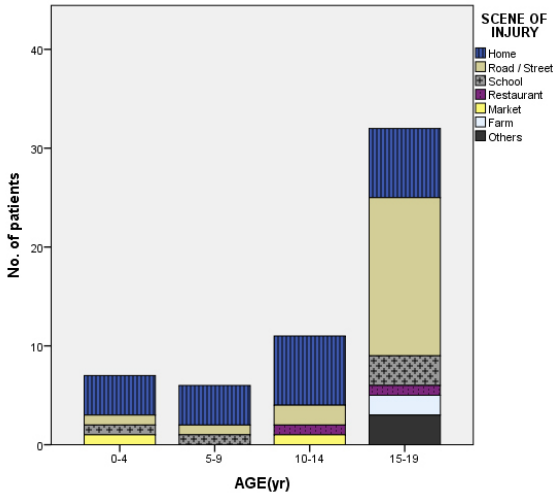

Figure 2. Distribution of firearm injury in children by age and scene of injury.

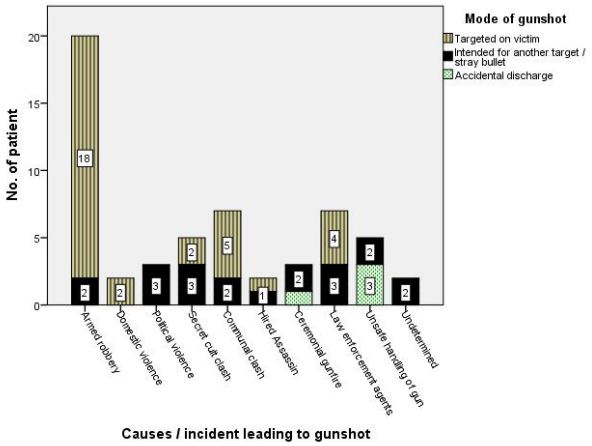

Figure 3. Firearm injury by mode of gunshot and causes/ incident leading to gunshot.

gunshot by a neighbor manipulating a loaded gun. The two domestic violence-related gunshot injuries involved two children shot by their father who also shot himself and died on the spot. The distribution of the mode of gunshot varies with the cause/incident leading to firearm injury, the incidence of gunshot targeted to the victim outnumbered that of a stray bullet in armed robbery, communal clash, and law enforcement agents related causes of gunshot, as shown in Figure 3. Domestic violence and unsafe handling of a gun were the two most important causes of firearm injury in 0-4 year age category whereas armed robbery related gunshot was topmost in all the age groups after the first 4 years of life (Figure 4). The rate of armed robbery-related gunshot was significantly higher in the urban than rural area (48% vs 25.8% $p<0.02$). All

Table 2. Distribution of the patients by Gunshot Characteristics.

Characteristics	Frequency (%)	95% Confidence Interval
Type of gun		
Handgun	31 (55.4)	44.6 - 71.4
Shotgun	15 (26.8)	15.2 - 42.0
Rifle	10 (17.9)	6.2 - 25.9
Range of gunshot		
Close	38 (67.9)	57.1 - 81.3
Distant	18 (32.1)	18.7 - 42.7
Causes/Incident leading to gunshot		
Armed robbery	20 (35.7)	22.3 - 48.2
Communal clash	7 (12.5)	2.7 - 23.2
Law enforcement/security agents	7 (12.5)	2.7 - 23.3
Secret cult clash	5 (8.9)	1.8 - 21.5
Unsafe handling of gun	5 (8.9)	2.7 - 17.9
Political violence	3 (5.4)	0.0 - 14.3
Ceremonial/celebratory gunfire	3 (5.4)	0.0 - 8.9
Domestic violence	2 (3.6)	0.0 - 10.7
Hired Assassin	2 (3.6)	0.0 - 8.9
Undetermined	2 (3.6)	0.0 - 8.9
Mode of gunshot		
Gunshot targeted on the victim	32 (57.1)	41.0 - 72.3
Gunshot intended for another target/stray bullet	20 (35.7)	25.0 - 51.8
Accidental discharge	4 (7.1)	1.8 - 14.3

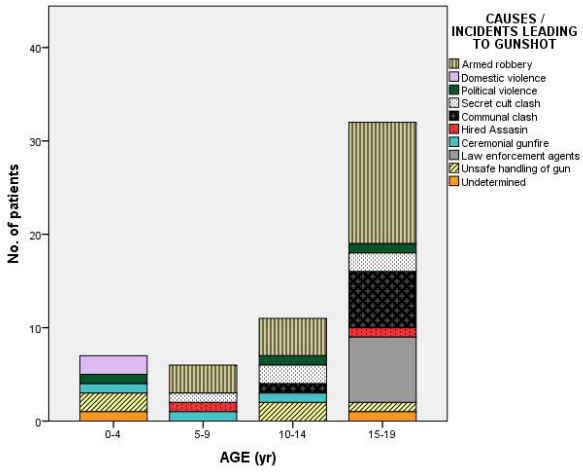

Figure 4. Distribution of causes leading to gunshot by age.

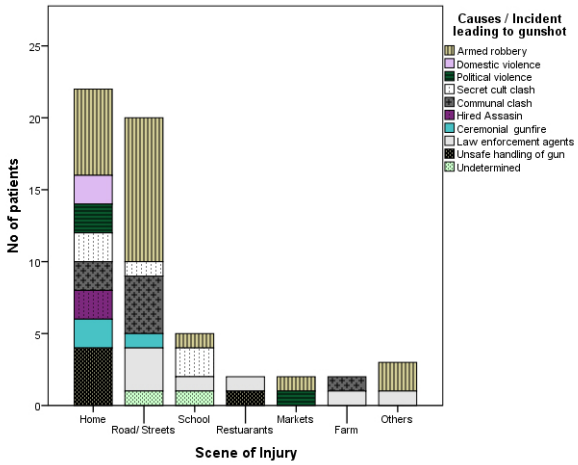

Figure 5. Firearm injury by causes/ incidents leading to gunshot by scene of injury.

the communal clash, ceremonial gunfire, and political violence-related firearm injury occurred in the rural areas, as also shown in Figure 4. The distribution of the causes/incident leading to gunshot also varies with the scene of injury, armed robbery, and unsafe handlings of guns were the two most important causes in the home; armed robbery and communal clash and law enforcement agents were the three top causes on the roads/street while secret cult clash was the most important cause in the school environment as shown in Figure 5.

Thirty-two (57.1%) of the victims sustained the injury in the daytime (6 am-11:59 am and 12 noon-5:59 pm) while in 24 (42.9%) injury occurred at nighttime (6 pm-11:59 pm and 12 am-5:59 am). Overall, the peak period incidence of firearm injury was 6 am-11:59 am. The peak period of incidence varies between scenes of injuries; it was 6 am-11:59 am at home, 6 pm-11:59 pm on the road and 12 noon-5:59 pm at school. The peak period incidence also varies with causes of gunshot; it was 6 pm-11:59 pm for armed robbery and secret-cult-related injuries, 12 noon- 5:59 pm in unsafe handling of gun and law enforcement agents gunshots and 6:00 am -11:59 am in the communal clash, political violence, and ceremonial

Table 3. Distributions of the Patients by Firearm Injury Characteristics.

Characteristics	Frequency (%)	95% Confidence Interval
Type of wound		
Penetrating (entry only)	43 (76.8)	60.7 - 88.4
Perforating (entry & exit)	13 (23.2)	11.6 - 39.3
Type of wound by the structure injured*		
Wound with soft tissue injury only	28 (50.0)	38.4 - 65.2
Wound with fracture only	20 (35.7)	23.2 - 50.9
Wounds with Vital structure injury:		
penetrating (dura) neurological injury	2 (3.6)	0.0 - 9.8
penetrating (pleural) chest injury	1 (1.8)	0.0 - 6.3
penetrating (peritoneum) abdominal injury	4 (7.1)	1.8 - 14.3
Wounds with fracture and vital structure injury	1 (1.8)	0.0 - 6.3
Injury Severity Score		
Mild (1-8)	27 (48.2)	37.5 - 60.7
Moderate (9-15)	16 (28.6)	17.0 - 36.6
Severe (≥16)	13 (23.2)	12.5 - 33.9

*ICRC- International Committee of Red Cross: classification of gunshot wound

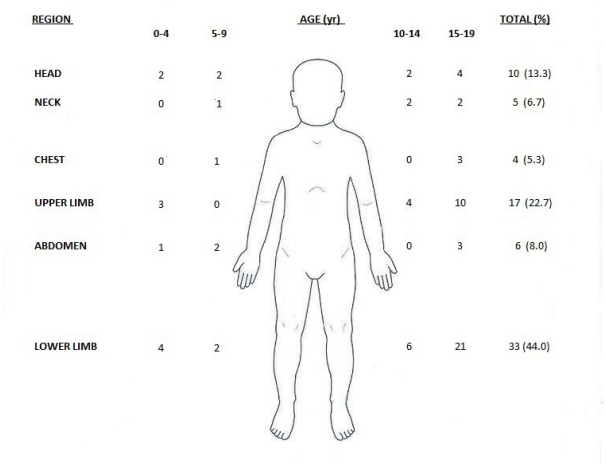

Figure 6. Firearm injury by anatomical region involved and age.

gunfire related gunshot injuries.

Figure 6 shows the lower limbs (44%), upper limbs (22.7%), and head (13.3%) were the three top anatomical regions involved in firearm injury. Ten (17.9%) of the victims had a gunshot injury in more than one body region, multiply injured. The majority (76.8%) of the victims sustained penetrating wound; wound with soft tissue injury only, and wounds with fracture were the two most common types based on the structure injured as shown in Table 3. There were 24 gunshot fractures in 21 patients; tibia/fibula (11, 45.8%) was the most common bone involved. Other sites of fractures were humerus (3, 12.5%), radius/ulna (2, 8.3%), femur (2, 8.3%), skull (2, 8.3%), mandible (1, 4.2%), clavicle (1, 4.2%), scapula (1, 4.2%), and cervical spine (1, 4.2%). Gunshot penetrating the peritoneal cavity was the most common type of wound with vital structure injury as shown in Table 3. Of the four penetrating abdominal injury, there were intestinal perforations involving the ileum/jejunum in two and the transverse colon in one of them. The ISS ranged from 4-17 with a mean of 8.96±5.21; and a median of 9. Table 3 shows the majority (27, 48.2%) of the victims sustained mild injury ISS 1-8. The mean and median injury to hospital arrival interval respectively was 352 hrs and 4.5 hrs. The injury to hospital arrival interval was later than 6 hrs in 26 (46.4%) of the victims. The majority (66.1%) of the victims had no pre-hospital care. The hospital length of stay (LOS) ranged from 1-149 days. The mean and median of LOS respectively was 22.61 and 16 days. Wound infection, anemia, and septic shock were the three most common complications as shown in Table 4. Six (10.7%) of the patients had long term physical complications.

Of the 56 patients, 12 (21.4%) were treated and discharged from the emergency room, 42 (75.0%) were admitted into the surgical ward for definitive care, 1 (1.8%) was transferred and 1 (1.8%) self-discharged against medical advice, and 1 (1.8%) died on third day of hospital admission. All the victims had a probability of survival (TRISS) ≥ 97%. The patient who died had a probability of survival (TRISS) of 98.4%, and the cause of death was overwhelming sepsis that complicated penetrating abdominal gunshot injury.

DISCUSSIONS

The result of this study indicates that despite an existing firearm control act, children and adolescents in our setting are vulnerable to the menace of firearm violence and its associated morbidity and mortality. The burden of firearm injury among the pediatric population in our environment is appreciable because there are eight other tertiary hospitals, in the same geopolitical zone, that also accept patients with gunshot injuries. The preponderance

Table 4. Complications of Firearm Injuries in Children and Adolescents (*N= 56).*

Complications	Frequency	(%)
Wound infection	18	32.1
Anemia	11	19.6
Septic shock	3	5.4
Peritonitis	2	3.6
Volkmann ischemic contracture*	1	1.8
Minor upper extremity amputation	1	1.8
Knee disarticulation	1	1.8
Ankle ankylosis	1	1.8
Sciatic nerve palsy	1	1.8
Malunited fracture	1	1.8
Chronic leg ulcer	1	1.8
Hemiparesis	1	1.8
Quadriplegia	1	1.8
Post-traumatic stress disorder	1	1.8

*Sequel to Compartment syndrome

of the male gender in this study is similar to the finding in other related published reports which attributed it to more aggressive and adventurous nature of males than females [5,8]. However, the reason for female gender bias in the first 9 years of life observed in this study is not evident. The increase in the incidence of firearm injuries among the males, after the first 9 years of life, suggests that the risky behaviors that make the male gender more vulnerable to firearm injury begin manifestation in the pre-adolescent phase of life. A published report indicates that risk-taking is common among adolescents and a part of growth to maturity [27]. Therefore, as a preventive measure, parents/guardians and teachers must be well-armed with skills to identify and deal with some of these risky behaviors that predispose children and adolescents (especially males) to firearm violence.

The preponderance of firearm injury in the dry (hot) season in this study is consistent with the higher prevalence of gunshot in summer than winter in New York City reported by Agarwal et al. [19]. In the setting of this study: the dry season is a season for most of the celebrations/ceremonies and a favorable period for most of the children and adolescent events/plays, a post-harvest period when cultivator farmers have spare time to engage in communal clashes, and a period that coincides with political campaigns and general elections [4]. A previously published report from a similar setting indicate that all these events that occur more often in dry season predisposes to incidents leading to gunshots and perhaps explains the preponderance of children and adolescent firearm injuries in the dry season [4].

The distribution of the type of gun used in this civilian setting is quite different from the 88% handgun and 12% shotgun/rifle reported by Powell et al. in Chicago [2]. These differences and the relatively higher incidence of shotgun/rifle in this series have been attributed to inefficient firearm control and proliferation of firearms in the aftermath of civil wars in the sub-region [14-16,28].

Armed robbery was the principal cause of gunshot in this series; it accounted for injuries in 35% of the victims compared to 6-11% in published reports from the US [8]. In this setting, armed robbery is common and driven by poverty, starvation, and youth restiveness occasioned by rising unemployment and gross economic inequality [29]. Thus, primary preventive strategies of firearm injury in this population entails measures aimed at eradicating armed robbery, which should include dealing with its predisposing factors. Furthermore, the preponderance of armed robbery related gunshots among victims 5 years of age and above, and on the roads/streets with a peak period incidence of 6 pm-11:59 pm observed calls for active education and supervision of children and adolescents as their natural quest for adventures on the roads/streets with peers begin to manifest. The need for reinforcement in security details in and around residential premises cannot be over-emphasized in this setting where armed robbery was also the most important cause of firearm violence in the homes. In this setting, land dispute in the background of tribal and clan differences is the most important reason behind communal clashes that accounted for over 12% of the firearm injuries observed [29]. It calls for early resolution of clan and tribal differences; mass education and orientation in the legal and political resolution of land disputes as an alternative to armed violence. In this series, a little more restraint from shooting suspects and rioters with a gun to demobilize them could have prevented over half of the law enforcement/security agent related gunshot injuries. The circumstances of a gunshot in domestic violence-related firearm injury observed underscores the importance of ascertaining regularly the mental health status of those licensed to own a gun. Most of the unsafe handling of gun-related injury occurred at home, and the peak period of incidence (12 noon-5:59 pm) coincided with the peak period of most of the children playing at home in this setting. It calls for active supervision of children at home during playtime and limiting their access to a gun as preventive measures.

The distribution of injuries in the body region is consistent with the findings reported by Powell et al. and Dowd et al. in the US [2,8]. However, the incidence of multiply injured victims is at variance from 37.6% reported by DiScala et al. in the US, and the reason is not evident [30].

The pre-hospital care of the patients at the scene of the injury and en route to the hospital, early presentation, and prompt appropriate emergency and definitive care in the hospital, and other measures to forestall complications are components of tertiary injury prevention. In this setting, there was no pre-hospital care for over 60% of

the victims, and the mean injury to hospital arrival interval observed is very different from the mean of 55 mins in Iran where there are pre-hospital emergency services that facilitate prompt transportation of gunshot victims to hospital [31]. A prolonged injury-hospital arrival interval is potentially related to delays in appropriate emergency interventions that have implications on the outcome of firearm injury. Thus, improving the rate of pre-hospital care and early presentation of victims to a hospital with a capacity for prompt and appropriate care should be given due consideration in the preventive strategies in resource-limited settings.

The wound infection rate (32.1%) observed is higher than the overall wound infection rate of 27.1% in a general population of firearm injury reported from a similar setting [4,32]. In this series, open fractures, perforating wounds, and anemia, identified as independent predictors of civilian gunshot wound infection in a published report, were quite common [26]. It perhaps explains the high wound infection rate observed.

The hospital LOS is directly related to morbidity and cost of treatment of firearm injuries. The mean and median length of stay in hospital in this study is much longer than 6.9 and 4.0 days reported by DiScala et al. in the US [30]. It suggests that the morbidity of firearm injury in children and adolescent is relatively higher in this setting. The reason for the differences in the LOS observed is not evident. However, a published report indicates that wound infection is pivotal to prolonged LOS and high morbidity rate in firearm injuries in a similar setting in a resource-limited country [4]. Thus, the relatively high wound infection rate observed perhaps explains the prolonged LOS. The mortality rate of 1.8% in this series is far from 9.7% reported by Dowd et al. in Kansas City, MO, US [8]. The reason for the relatively lower mortality rate observed is not evident.

The limitation of this study is in being a hospital-based one. The data may not represent the entire pediatric population with firearm injuries. Also, this study did not capture fatal and non-fatal firearm injuries not seen in the two hospitals. Despite this limitation, this study is the first of its kind in West African sub-region (to the best of our knowledge), and the findings can facilitate preventive strategies and serve as baseline data in a future study.

CONCLUSION

In our environment, firearm injury in children and adolescents involves predominantly the 15-19 year-olds, it occurs mainly from armed robbery and assault-related gunshots and is more prevalent in the dry season. The majority of the victims did not receive pre-hospital care, and injury to hospital arrival interval later than 6 hr was common. The considerable burden of firearm injury among the pediatric population in our setting despite an existing firearm control act calls for improvement in the efficient monitoring and enforcement of firearm regulations. Educational campaigns for prevention intensified during the dry season should highlight the risk of firearm injury to this age group as well as emphasize the importance of proper supervision and guidance of vulnerable children and adolescents. Besides, mass education and orientation in non-violent means of conflict resolution, and gainful employment and poverty eradication program that may reduce the high rate of armed robbery related gunshot injuries are explorable preventive measures. Improving the rates of pre-hospital care and early presentation of victims to the hospital should be considered in the tertiary injury prevention strategies.

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