Original Article

Incidence and Pattern of Extremity Fractures seen in Accident and Emergency Department of a Nigerian Teaching Hospital

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Abstract

Background: Extremity fracture is an important component of musculoskeletal injury worldwide. The distributions of etiological factors and types of extremity fractures vary from and within subregions and have implications in preventive and treatment strategies. This study aimed at determining the incidence and pattern of extremity fractures seen in accident and emergency department (A and ED) of a teaching hospital in a developing country. **Patients and Methods:** This was a prospective study of all patients with extremity fractures seen in A and ED of Federal Teaching Hospital Abakaliki over 12 months between February 1, 2016 and January 31, 2017. **Results:** Extremity fractures necessitated visit in 251 patients with 306 fractures giving an incidence of 22.6/1000/year of A and ED attendances (39.2/1000 males and 9.2/1000 females), with age range of 2–90 years and a mean of 35.6 ± 16.7 years. Road traffic accident (RTA) (184, 73.3%), fall from height (23, 9.2%), and gunshot (13, 5.2%) were the three top causes of fractures, whereas tibia, femur, and humerus were three top bones involved. Of the 306 fractures, 270 (88%) involved the long bones, 193 (63.1%) were close, and 113 (36.9%) were open fractures. Forty-four (17.5%) of them were multiply injured patient and head injury in 32 (12.8%) the topmost associated injury. One hundred and ninety-four (77.3%) were admitted into surgical ward and 28 (11.2%) self-discharged against medical advice. **Conclusion:** Appropriate preventive mechanisms based on the observed pattern is needed; a policy response to curb the menace of RTAs may invariably reduce the incidence of extremity fractures. Treatment strategies entail appropriate facilities and skilled workforce to deal with fractures of varying degrees of severity and complexity observed.

Keywords: *Extremity, fracture, incidence Nigeria*

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Introduction

Fracture, a break in the structural continuity of bone, is an important musculoskeletal health concern worldwide. In published reports, the incidence of fractures varies and ranges from 3.21 to 22.8/1000 per annum in the general population.[1-3] Recently published report also indicated that extremity fractures constitute 82.1%–94.7% of all fractures by anatomical region distribution.[4-6] Garraway *et al*. reported the incidence of limb fracture of 15.69/1000 person-years in a developed country setting.[7]

Fractures of normal bones often results from high-energy impact or repetitive stress whereas for bones abnormally weakened by disease normal load or trivial injury is enough to cause a fracture.[8] The external causes of extremity fractures such as motor vehicular collisions, falls, sports injury, and assault are about the same globally. However, the distributions of these etiological factors vary between and within countries depending on prevailing demographic profile, socioeconomic, and environmental conditions. Some published reports indicate preponderance of falls as external causes of

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fractures among the pediatric and geriatric populations, and inhabitants of regions with a hilly terrain.[1,6,9] In some other reports, motor vehicular collision was the predominant external cause of fractures, especially in regions where road traffic injury is a neglected epidemic.[4-6,10-12]

The type and pattern of extremity fractures also vary with age and according to the mechanism and severity of injury, and involvement of surrounding tissues.[1,3] The type of extremity fractures as well as the demographic characteristics of the population involved has implications in treatment strategies and outcome. Detailed information on etiological factors and characteristics of extremity fractures in a setting can facilitate preventive and treatment strategies. However, there are very limited data on extremity fractures. The paucity of data and variation in distributions of type, etiology, and demographic features of extremity fractures from and within subregions underscores the importance of this study aimed at determining the incidence and pattern of extremity fractures seen in the accident and emergency department (A and ED) of a teaching hospital in a developing country.

Patients and Methods

This was a prospective study of all patients with extremity fractures seen in A and ED of Federal Teaching Hospital Abakaliki over 12 months between February 1, 2016, and January 31, 2017. The hospital came into existence in the year 2011 after a successful merger of the Ebonyi State University Teaching Hospital and Federal Medical Centre Abakaliki by the Federal Government of Nigeria. It is one of the major teaching hospitals in Southeast Nigeria that serves a population of about 10 million people and has the capacity to provide care for most trauma patients.

Each of the patients underwent clinical and radiological evaluations and definitive diagnosis of extremity fractures was made by consultant orthopedic surgeon. The demographic data of the patients (age, sex, and occupation), the etiology and type of fractures, bones involved, associated injuries, and the disposition of patient aftercare in the emergency room were collected in a pro forma.

The fractures were classified into open and closed fractures and the bones of the extremities involved into five types (long, irregular, flat, sesamoid, and short) of bones for the analysis. The appearance and morphological details of the fractures were observed and documented from X-ray examination. The fractures of the long bones were classified into diaphyseal and end segment fractures.[13] The long bone diaphyseal segment fractures were further subdivided into simple (spiral, transverse, oblique, and green stick) fractures, wedge (spiral, bending, and fragmented) fractures, and complex (spiral, segmental, and irregular) fractures.[13] A simple fracture is defined as one fracture line; cortical contact between fragments exceeds 90% after reduction. Wedge fracture is defined as three or more fragments; main fragment has contact after reduction. Complex fracture is defined as three or more fragments; main fragment has no contact after reduction.[13] The end segment fractures of long bones were classified as extraarticular, partial articular, and complete articular fractures, whereas fractures involving the other types of bones were simply classified as articular and extraarticular for the analysis. Extraarticular fracture is defined as no involvement of displaced fractures that extend into the articular surface. Partial articular fracture is defined as involvement of part of the articular component leaving the other part attached to the meta-diaphysis. Complete articular fracture is defined as involvement of articular surface with metaphyseal fracture that completely separates the articular component from the diaphysis.[13] Multiple bone fracture is defined as fractures in ≥2 bones at the same time. The fractures involving other types of bone (short, flat, irregular, and sesamoid) of the extremity were classified into extraarticular and articular fractures in this study. The patients were categorized according to their placement (after resuscitation and treatment in the emergency setting) into one of the following, admitted (directly or through the intensive care unit) into the ward as an inpatient, discharged from the emergency room to outpatient clinic, transferred/referred to other tertiary center, and self-discharge against medical advice.

Data were analyzed using the Statistical Package for the Social Sciences version 20 (SPSS Chicago, IL, USA) statistical software for graphs, frequency tables, and cross-tabulation. Chi-squared test was used for the statistical test of significance and $P < 0.05$ was considered statistically significant.

Results

Within the 12 months period, 11,119 patients (4944 males and 6175 females) were seen in the hospital A and ED and extremity fracture was the reason for visit in 251 (194 males and 57 females) of them with 306 fractures, giving an incidence of 22.6/1000 A and ED attendance (39.2/1000 males and 9.2/1000 females A and ED attendance), and a male-to-female ratio of 3.4:1. Patients with extremity fractures also constituted 7.8% of 3215 patients with surgical emergencies seen in A and ED within the period. The age of the patients ranged from 2 to 90 years, with a mean of 35.64 ± 16.7 years.

One hundred and seventy-four (69.3%) patients presented with lower-extremity fractures, 63 (25.1%) with upper-extremity fractures, and 14 (5.6%) had fractures in both lower and upper extremity. Fourteen (5.6%) of the patients had bilateral extremity fractures. Of these 14 patients, 7, 2, and 5 of them had lower, upper, and both extremity fractures, respectively. Fifty-eight (23.1%) of the patients had multiple bone fractures. Six (2.4%) of the patients had ipsilateral fractures of the femur and tibia (floating knee injury), whereas one (0.4%) had ipsilateral fracture of the humerus and radius and ulna (floating elbow injury). The pathological fracture was observed in 4 (1.6%) of the patients.

Road traffic accidents (RTAs) (184, 73.3%), all from height (23, 9.2%) and gunshot (13, 5.2%) were the three top etiology of extremity fracture as shown in Table 1. Of the 184 RTA-related fractures, 68 (37%) were occupants of two-wheeled motorcycles, 11 (6%) occupants of auto tricycle, and 64 (34.8%) were occupants of ≥4 wheeled motor vehicles that involved in collisions, whereas 41 (22.3%) were pedestrian involved in collisions. Of the 23 fell from height-related fractures, 18 (78.3%) fall from houses and building sites, and 5 (21.7%) fell from trees. RTAs were the predominant cause of fractures across all the age groups, the incidence of slips or falls-related fractures was more in the middle and elderly age group, and the young and middle-aged adult accounted for all the gunshot fractures as also shown in Figure 1. Road traffic accident accounted for 63.6% of fractures in children. Ten (71.4%) of these RTA related fractures in children were from pedestrian injuries. RTAs-related fractures also cut across all the bones involved with tibia-fibula and femur fractures the two tops in this category, whereas humerus was the predominant bone involved in gunshot and machete cut related fractures as shown in Figure 2. In Figure 3, RTA was the predominant etiology in each of the three top occupational groups (traders, students, and farmers) involved, and the incidences of fractures from fall from height and machete cut were the highest among students compared to other occupational groups.

Of the 306 fractures, 193 (63.1%) were close fractures, whereas 113 (36.9%) were open fractures. The

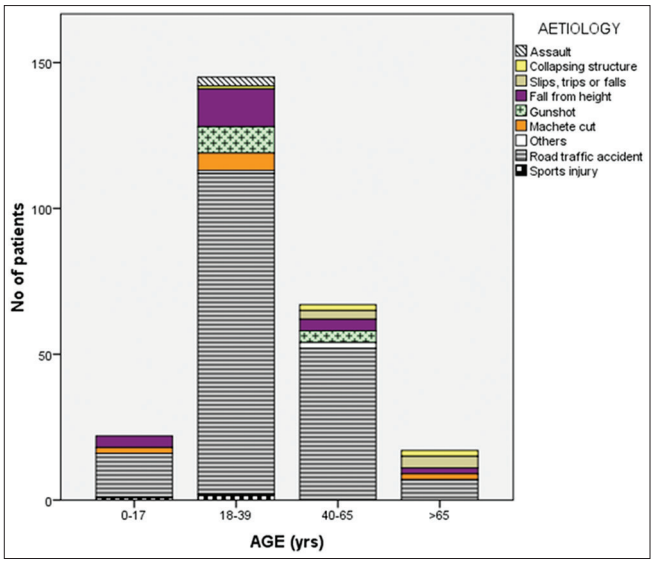


Figure 1: Etiology of extremity fractures by age group

Table 1: Type of extremity involved in fractures by demographic characteristic and etiology

Demographics/aetiology	Extremity				
	Upper (%)	Lower (%)	Upper and lower (%)	Total (%)	*P*
Age					
0-17	5 (22.7)	17 (77.3)	0 (0.0)	22 (8.8)	0.83
18-39	39 (26.9)	96 (66.2)	10 (6.9)	145 (57.8)	
40-65	15 (22.4)	49 (73.1)	3 (4.5)	67 (26.7)	
≥65	4 (23.5)	12 (70.6)	1 (5.9)	17 (6.8)	
Sex					
Male	50 (25.8)	133 (68.6)	11 (5.7)	194 (77.3)	0.89
Female	13 (22.8)	41 (71.9)	3 (5.3)	57 (22.7)	
Aetiology					
RTA	42 (22.8)	133 (72.3)	9 (4.9)	184 (73.3)	0.03
Fall from height	9 (39.1)	12 (52.2)	2 (8.7)	23 (9.2)	
Gunshot	3 (23.1)	8 (61.5)	2 (15.4)	13 (5.2)	
Machete cut	7 (70.0)	3 (30.0)	0 (0.0)	10 (4.0)	
Slips trips or falls	0 (0.0)	7 (100.0)	0 (0.0)	7 (2.8)	
Collapsing structure	0 (0.0)	5 (100)	0 (0.0)	5 (2.0)	
Assault	1 (33.3)	1 (33.3)	1 (3.33)	3 (1.2)	
Sports injury	0 (0.0)	3 (100.0)	0 (0.0)	3 (1.2)	
Others	2 (66.7)	1 (33.3)	0 (0.0)	3 (1.2)	

RTA: Road traffic accident

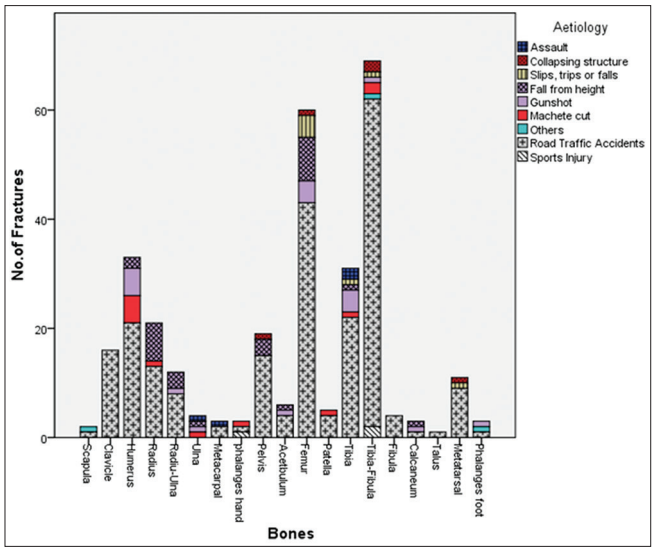


Figure 2: Distribution of extremity fractures by bone and etiology

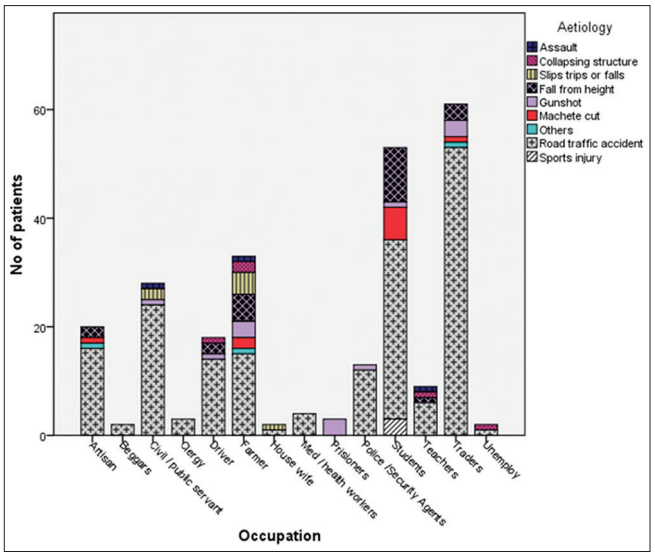
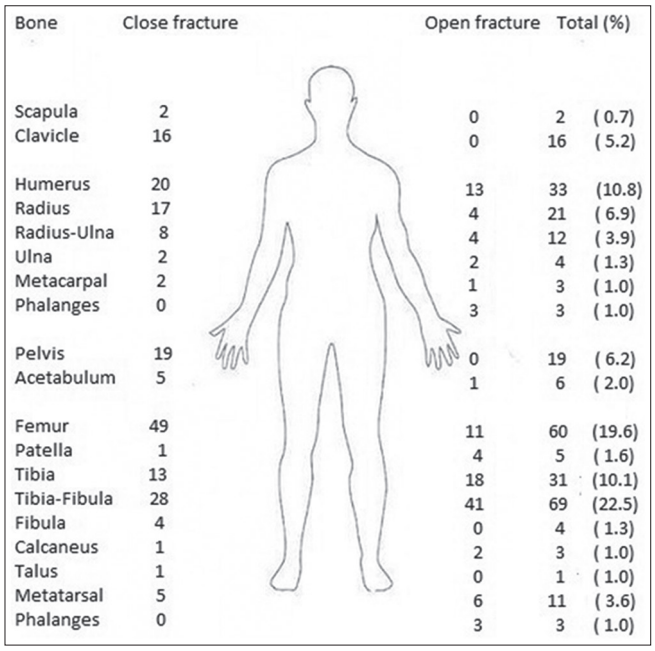


Figure 3: Extremity fractures by etiology and occupational distribution



Bone	Close fracture	Open fracture	Total (%)
Scapula	2	0	2 (0.7)
Clavicle	16	0	16 (5.2)
Humerus	20	13	33 (10.8)
Radius	17	4	21 (6.9)
Radius-Ulna	8	4	12 (3.9)
Ulna	2	2	4 (1.3)
Metacarpal	2	1	3 (1.0)
Phalanges	0	3	3 (1.0)
Pelvis	19	0	19 (6.2)
Acetabulum	5	1	6 (2.0)
Femur	49	11	60 (19.6)
Patella	1	4	5 (1.6)
Tibia	13	18	31 (10.1)
Tibia-Fibula	28	41	69 (22.5)
Fibula	4	0	4 (1.3)
Calcaneus	1	2	3 (1.0)
Talus	1	0	1 (1.0)
Metatarsal	5	6	11 (3.6)
Phalanges	0	3	3 (1.0)

Figure 4: Distribution of fractures by type and bone involvement

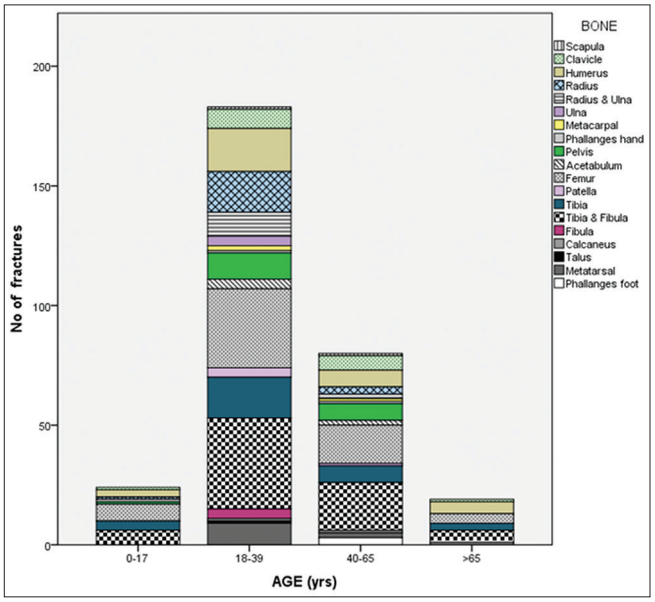


Figure 5: Extremity fracture by age and bone distribution

tibia (alone or with fibula), femur, and humerus were the three top bones involved in fractures; the femur was the most common bone involved in close fracture, whereas tibia-fibula fracture was the most common open fracture as shown in Figure 4. In the lower extremity, open fractures in the leg (tibia and fibula) outnumbered open fractures in the thigh (femur) by a ratio of 5:1, whereas in the upper-extremity open fractures in the arm (humerus) outnumbered open fractures in forearm (radius and ulna) by a ratio of 1.3:1. In Figure 5, tibia alone or with fibula involvement and the femur were the two top bones fractured among all the age groups; most of the radius and pelvis fractures occurred among the young- and middle-aged adults. Two hundred and seventy (88%) of the 306 fractures involved the long bones of the extremity. Of these 270 long bones fractures, 151 (55.9%) were localized in the diaphyseal segment, 119 (44.1%) were localized in the end segment, 28 (10.4%) were partial articular fractures, and 21 (6.9%) were articular fractures. The most common type of fracture based on the type of bone and localization of fracture on the bone is simple long bone diaphyseal segment fracture as shown in Table 2. In complex diaphyseal segment fracture, the incidence of open fracture is significantly ($P < 0.001$) higher than close fracture, as shown in Table 2.

Forty-four (17.5%) of these patients with extremity fractures were also multiply injured patients. Of the

Table 2: Distribution extremity fractures by type of fracture and bone

Type of bone and location of facture	Fracture		
	Close (%)	Open (%)	Total (%)
Long bone diaphyseal segment fracture			
Simple (spiral oblique transverse)*	56 (58.9)	39 (41.1)	95 (31.0)
Wedge (bending, fragmented)	19 (55.9)	15 (44.1)	34 (11.1)
Complex (segmental, irregular)	6 (27.3)	16 (72.7)	22 (7.2)
Long bone end segment fractures			
Extraarticular	49 (70.0)	21 (30.0)	70 (22.9)
Partial articular	23 (82.1)	5 (17.9)	28 (9.2)
Articular	11 (52.4)	10 (47.6)	21 (6.9)
Irregular bone (pelvis) fractures			
Extra articular	13 (100)	0 (0.0)	13 (4.2)
Articular	11 (91.7)	1 (8.3)	12 (3.9)
Flat bone (scapula) fractures			
Extraarticular	2 (100)	0 (0.0)	2 (0.7)
Sesamoid bone (patella) fracture			
Articular	1 (20.0)	4 (80.0)	5 (1.6)
Short bone fractures			
Extraarticular	1 (50.0)	1 (50.0)	2 (0.7)
Articular	1 (50.0)	1 (50.0)	2 (0.7)

*Green stick fractures inclusive. χ^2=37.67, df=11, P<0.001

Table 3: Associated injuries among the patients with extremity fractures

Associated injuries	Number of patients (%)
Head injury	32 (12.8)
Chest injury	7 (2.8)
Maxillofacial injury	5 (2.0)
Abdominal injury	3 (1.2)
Hip dislocation	3 (1.2)
Shoulder dislocation	3 (1.2)
Peripheral nerve injury	3 (1.2)
Spinal cord injury	2 (0.8)
Urethral injury	2 (0.8)
Bladder rupture	1 (0.4)
Elbow dislocation	1 (0.4)
Vascular injury	1 (0.4)
Traumatic amputation	1 (0.4)
Total	64 (25.5)

multiple injured category, RTA, fall from height, collapsing structure, machete cut were the causes of fractures in 35 (79.5%), 7 (15.9%), 1 (2.3%), and 1 (2.3%) of them, respectively. In Table 3, 64 (25.5%) of the patients had associated injuries involving soft tissues of the extremities and other body regions; head, chest and maxillofacial injuries were three top associated injuries observed.

Of the 251 patients with extremity fractures, 194 (77.3%) were admitted into surgical in-patient ward, 22 (8.8%) were treated and discharged from emergency room to outpatient clinic, 6 (2.4%) were transferred/referred to other tertiary centers, and 28 (11.2%) self-discharge against medical advice.

Discussion

Extremity fracture is not a rare component of surgical emergencies seen in the emergency room in this setting. The incidence of extremity fracture observed is higher than 15.98/1000 person-years reported by Garraway *et al*. in a developed country.[7] The reason for this difference in the rate of extremity fracture is not evident. The male gender bias in the incidence of extremity fractures observed in this study is similar to the findings reported by Janmohammadi *et al.* in Iran.[10] This also is not a surprise considering that previously published reports from similar settings indicated a higher risk of injuries in males compared to females from these common causes of extremity fractures observed.[14-16] The predominance of the young active segment of the population and its associated negative socioeconomic impact is by implication an additional burden to the morbidity of extremity fractures in this setting.

The preponderance of lower-extremity fractures in this study is similar to the findings reported by Chigblo *et al*.[6] in setting with a similar topmost cause of fractures (RTA) but differs from the predominance of upper-extremity fractures reported by Awashthi *et al*.[11] and Garraway *et al*.[7] in setting where fall was the topmost etiological factor for fractures. The natural tendency to extend the hand to break a fall perhaps explains the predominance of upper-extremity fractures where fall is the most important cause of fractures. The proportion of the patients that presented with floating knee injury is higher than 1.7% reported by Babalola *et al*. from Ilorin Nigeria.[5] The reason for this difference is not evident. However, the high incidence of multifocal extremity fractures observed indicates that very high-energy impact fracture is quite prevalent in our setting. The treatment and rehabilitation of patients with multifocal fractures can be quite challenging, especially in a low resource setting where more often than not the scarcity of skilled medical personnel and health workers as well as the lack of appropriate infrastructure and equipment in the hospitals is the norm. Thus, the importance of primary prevention that may reduce to barest minimum the incidence of extremity fractures, especially the multifocal ones in our setting cannot be overemphasized.

In this study, over 70% of the fractures were due to RTAs regarded as a neglected epidemic in developing countries.[17] This is quite different from the finding of low-energy injuries (slips trips and fall) reported by Chen *et al*.[1] as the most common injury mechanism in traumatic fractures in China. This also implies that a policy response aimed at curbing the menace of RTA may invariably result in a drastic reduction in the relatively high incidence of extremity fractures observed. In this series also, motorcycle injury was the most important etiological factor in RTA-related extremity fractures and this is no different from the findings in another published report from a developing country where RTA was also the leading cause of fractures.[18] Thus, interventions that enhance the safety of motorcycle riders, passengers, and pedestrians, as well as other vulnerable road users, should be taking into consideration in measures aimed at reducing RTA-related extremity fractures in this setting.

Previous published report indicates that the fracture of bones in the leg is predominately fracture of adults.[6] However, in this study, the rate of lower-extremity fractures in children was not different from the rates in older age groups and the preponderance of tibia and femur fractures among children observed is quite different from the predominance of radius and ulna reported by Chen *et al*. in China.[1] In this setting, RTA was the predominant cause of fracture in children, whereas in China slips trips and falls accounted for over 70% of fractures in children.[1] This variation in the distribution of etiological factors perhaps explains the differences in the distribution of bones involved in fractures in children.

The rate of open extremity fractures in this study is higher than 17.7% reported by Janmohammadi *et al*. from Iran.[10] The relatively higher rate of gunshot and machete cut fractures that more often than not results in the open fracture in this series than the one reported by Janmohammadi *et al*.[10] is a plausible explanation for the higher incidence of open fracture observed. In this study, open fractures of tibia outnumber that of the femur. This is similar to findings in previously published reports[19,20] and has been attributed to the subcutaneous nature of the tibia compared to femur that is well enveloped by muscles. However, it is rather a surprise in this study that open fractures of humerus outnumbered that of the radius and ulna in spite of the subcutaneous nature of the latter compared to the former. The reason for this is not evident and maybe elucidated by another study.

The most common bone (tibia) fractured in this study is similar to the findings reported Babalola *et al*. in a series that RTA also accounted for over 70% of fractures. The preponderance of fractures involving the long bones of the extremity as well the predominance of simple diaphyseal segment fracture in this study is similar to the finding reported by Odokuma *et al*.[21] However, the incidences of complex diaphyseal fractures that is significantly ($P < 0.001$) more likely an open one, and the distribution of extremity fractures by types of fractures and bones in this setting as shown in Table 2 entail a trauma care center well-armed with appropriate facilities and skilled manpower to deal with fractures of varying degree of severity and complexity.

In this study, extremity fractures presenting as a component of injury in a multiply injured patient was common, especially in among patients with RTA and fall from height-related fractures. Thus, the importance of thorough examination to rule out injuries in other body regions in patients with extremity fractures cannot be overemphasized.

Previous published report indicates that self-discharge against medical advice is common among trauma patients, especially the ones with fractures in the Nigerian setting.[14,16] Thus, the high rate of self-discharge against advice observed in this study is not surprising.

The strength of this study is in being a prospective one. Thus, the finding in this study can facilitate preventive and treatment strategies as well as form the basis for comparison in future studies in the subregion. The limitation of this study is in being a hospital-based one and may not be a representation of the entire population because patients with extremity fractures that did not present to the hospital A and ED were not captured in the study.

Conclusion

Extremity fracture is not rare among the patients seen in our A and ED. It occurs in RTA in over 70% of the cases and affects mainly the males and young age group with a preponderance of fractures in the lower extremity. Appropriate preventive mechanism based on the observed pattern is needed; a policy response to curb the menace of road traffic collisions may invariably reduce the incidence of extremity fractures. Treatment strategies entail appropriate equipment and facilities as well as skilled workforce to deal with fractures of varying degree of severity and complexity observed.

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Conflicts of interest

There are no conflicts of interest.

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