ORIGINAL ARTICLE

EPIDEMIOLOGY OF CHILDHOOD FRACTURES IN THE CITY OF KARACHI

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Background: The epidemiology of paediatric fractures is crucial for developing preventive strategies, but when it comes to developing countries, the urban scenario has rarely been studied in the context of childhood trauma. This study aims to identify the epidemiology of paediatric injuries occurring in the largest and most populated city of Pakistan, Karachi, so that a comparison to data from the developed world can be made, and appropriate precautionary measures can be devised. **Methods:** The data from 1,514 paediatric orthopaedic patients treated at the Accident and Emergency department of Jinnah Postgraduate Medical Centre, during the time frame ranging from January 2012 to January 2013 was studied. Survey forms were filled out by the residents on call. **Results:** The patients' ages ranged from 2 months to 17 years, with males outnumbering females. The mean age of presentation was 8.8±4.6years. The number of fractures was maximal among children aged 5–11 years, after which it decreased in adolescents. Fractures of the radius and ulna were most common (16.9%), followed by the distal radius (14.6%) and humours (12.0%). Patients aged 0–2 years most commonly presented with a fracture of the femoral shaft. Falls on the same plane were responsible for the most fractures (44.2%), followed by falls from a height (21.5%) and road traffic accidents (26.7%).Incidence of fractures peaked in the summer months (p=0.007). **Conclusion:** Adequate precautionary measures and preventive programs need to be inculcated through legislation and a community based effort. In a developing nation however, unless the issues of ignorance, illiteracy and poverty are tackled by the authorities, they will continue to be a major hindrance.

Keywords: Epidemiology, orthopaedic, Paediatric, Fractures, Pakistan, Karachi, Fracture

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INTRODUCTION

In the USA, injuries are the leading cause of death among children and young adults, as well as the leading cause of disability, regardless of sex, race/ethnicity, or socioeconomic status.[1] In 1990 the injury related death and disability-adjusted life years (DALY's) for children aged 0–14 years accounted for 49% of all Injury related DALY's, despite the fact that this age group accounts for only 30% of the population.[2] Injuries result in the death of over 875 000 children ≤18 years of age annually in the world, mostly in low- and middle-income countries (LMIC), where 13% of the total morbidity among children ≤15 years of age is accounted for by injuries.[3,4] When it comes to injury-related mortality for children and adolescents, Pakistan has an estimated mortality rate of 30+ per 100,000 people.[5] The National Health Survey of Pakistan 1990–1994, shows that for children aged 0–5 years, the incidence rate for non-fatal injuries is 49 per 1,000 children per year.[6] Fractures are a common and significant injury in childhood, but information about the pattern of fractures among children in developing countries is scarce. In Pakistan children aged <15 years make up about 43% of the population but there is limited data regarding how, when and why fractures occur. Due to overcrowding, the urban population has been shown to be at a higher risk of injury[7] and yet there have been few epidemiological studies on paediatric fractures occurring in the urban locale of a developing country. This study aims to identify the cause, pattern and outcome of fractures occurring in the paediatric population of an urban locale in Pakistan, in order to compare the results with those accumulated from previous studies in developed countries, so that appropriate intervention strategies and preventive measures can be formulated.

MATERIAL AND METHODS

This study was a data review conducted at Jinnah Postgraduate Medical Centre, Karachi. The total number of cases analysed in this study were 1514. The data was recorded by the on call residents in patient files. Ethical committee of the hospital approved the study protocol before initiation. Informed consent was obtained from all patients. Our survey included analysis of all injured children who presented at the orthopaedic unit of the Accident and Emergency Department for a period of 1 year starting from January 2012. The information recorded included the victim's age, gender, injury intent, nature of injury, place of injury, cause of injury, approximate time of

injury, mode of treatment, time of treatment and outcome. For the purpose of our study, the patients age was stratified into five groups, i.e., 0–1, 1–2, 3–4, 5–11 and 12–18.Children up to 1 year of age were classified as infants, ages 1–2 are toddlers, ages 3–4 come under pre-schoolers, ages 5–11 are the school going children and children aged 12 and onwards come under adolescents. The data was entered in SPSS 18 and analysed to obtain frequencies, percentages and means. A p value below 0.05 was considered significant. The Chi-square test was applied on categorical variables and Pearson's coefficient was calculated.

RESULTS

A total of 2016 patients aged between 2 months and 17 years reported to the Accident & Emergency department for an orthopaedic consult in the time period ranging from January 2012 to January 2013. Total number of patients with fractures was 1514 (75.2%), with males out numbering females by approx. 3:1 (73.4% Males). The mean age was 8.8±4.6 years. The most common fracture across all age groups was fracture of the forearm involving shafts of the radius and ulna (16.9%) followed by fracture of distal radius (14.6%) and humorous (12.0%) (Table-1). Forearm fracture also remained the most common fracture in both male and female patients. There was an increase in the overall number of fractures till age 12 years after which the number of fractures slightly decreased (from 43.9% in school going children to 33.4% for adolescents). Infants and toddlers presented with shaft of femur fractures more than other types while older children presented commonly with forearm fractures, this was found to be statistically significant (p=0.001) (Table-2). Fractures of the upper limb and clavicle were almost twice as common as lower limb and pelvic fractures (991 vs. 525). Table-1 shows the top 3 most common fractures in each age group. The most common cause of fracture across all age groups was fall from the same level followed by fall from a height and road traffic accident involving a two-wheeler. While fall from the same level also remained the most common cause in both sexes, second and third most common causes had little variation (Table-3).

After falls, vehicular accidents were the cause of trauma for 26.7% of the patients. The incidence for vehicular accidents, especially due to motorbikes shows a steep rise in the period of adolescence, and this is the age group in which vehicular accidents peak. None of the victims wore a helmet and most of them were driving the motorbike as opposed to being passengers.

The number of fractures which occurred in the morning, afternoon and evening were 513, 547 and 456 respectively. Highest number of fractures were recorded in the evening time and this was found to be statistically significant (p=0.000). The summer months (March–Sep) showed an increase in the number of fractures compared to the winter months (Oct–Feb), with peak number of fractures in months of June/July (Figure-1). A large number of fractures were occurring in summer vacations (June/July) for school going children (146) and adolescents (109), this was found to be statistically significant (p=0.000).

Table-1: Top 3 fractures in each age group.

Infants	Toddlers	Preschoolers	School goingchildren	Adolescent
Femur shaft	Femur Shaft	Forearm Radius/Ulna Shaft	Forearm Radius/Ulna Shaft	Forearm Radius/Ulna Shaft
Forearm Radius/Ulna Shaft	Clavicle	Humerus	Distil Radius	Radius
Humerus	Forearm Radius/Ulna Shaft	Distil Radius	Humerus	Tibia

Table-2: Distribution of upper and lower limb fractures across different age groups.

	Infants	Toddlers	Preschool Children	School going Children	Adolescent	Total
Combined Radius and Ulna Shaft	4 (0.27%)	17 (1.13%)	36 (2.39%)	117 (7.77%)	80 (5.31%)	254 (16.87%)
Distal Radius	1 (0.07%)	14 (0.93%)	31 (2.06%)	100 (6.64%)	74 (4.91%)	220 (14.61%)
Ulna	0	3 (0.2%)	7 (0.46%)	26 (1.73%)	11 (0.73%)	47 (3.12%)
Elbow, Olecranon	1 (0.07%)	1 (0.07%)	7 (0.46%)	30 (1.99%)	13 (0.86%)	52 (3.45%)
Humerus	2 (0.13%)	15 (1.00%)	35 (2.32%)	98 (6.51%)	31 (2.06%)	181 (12.02%)
Metacarpal	0	1 (0.07%)	7 (0.46%)	17 (1.13%)	36 (2.39%)	61 (4.05%)
Phalanges (hand)	0	2 (0.13%)	4 (0.27%)	19 (1.26%)	31 (2.06%)	56 (3.72%)
Wrist	0	0	1 (0.07%)	2 (0.13%)	7 (0.46%)	10 (0.66%)
Clavicle	1 (0.07%)	18 (1.20%)	19 (1.26%)	40 (2.66%)	19 (1.26%)	97 (6.44%)
Scapula	0	0	1 (0.07%)	3 (0.20%)	2 (0.13%)	6 (0.40%)
Neck of Femur	0	1 (0.07%)	3 (0.20%)	6 (0.40%)	7 (0.46%)	17 (1.13%)
Femur Shaft	6 (0.40%)	18 (1.20%)	29 (1.93%)	61 (4.05%)	37 (2.46%)	151 (10.03%)
Fibula	1 (0.07%)	0	1 (0.07%)	10 (0.66%)	14 (0.93%)	26 (1.73%)
Tibia	0	10 (0.66%)	18 (1.20%)	38 (2.52%)	40 (2.66%)	106 (7.04%)
Tibia and Fibula	1 (0.07%)	3 (0.20%)	10 (0.66%)	55 (3.65%)	35 (2.32%)	104 (6.91%)
Knee, Patella	0	1 (0.07%)	0	8 (0.53%)	10 (0.66%)	19 (1.26%)
Phalanges (foot)	0	0	0	6 (0.40%)	4 (0.27%)	10 (0.66%)
Tarsal	0	2 (0.13%)	1 (0.07%)	4 (0.27%)	4 (0.27%)	11 (0.73%)
Metatarsal	0	0	8 (0.53%)	13 (0.86%)	34 (2.26%)	55 (3.65%)
Ankle	0	0	0	2 (0.13%)	7 (0.46%)	9 (0.6%)
Pelvis	0	0	3 (0.2%)	3 (0.2%)	8 (0.53%)	14 (0.93%)

Table-3: Top 3 causes of fractures across all age groups.

Causes of fracture	Infants	Toddlers	Pre schoolers	School going Children	Adolescent
Fall-same level	10 (58.8%)	49 (46.2%)	107 (48.6%)	331 (49.8%)	172 (34.0%)
RTA-Pedestrian	3 (17.6%)	33 (31.1%)	56 (25.5%)	150 (22.6%)	105 (20.8%)
Fall- height	2 (11.8%)	9 (8.5%)	23 (10.5%)	78 (11.7%)	85 (16.8%)

Table-4: Causes of fractures across age groups

	RTA			Fall		Gun shot	Assault		Occupational	Sports	Other
	Pedestrian	2 Wheeler	4 Wheeler	Same Level	Height		Blunt	Penetrating			
Infants	3 (0.2%)	1 (0.07%)	0	10 (0.66%)	2 (0.13%)	0	1 (0.07%)	0	0	0	0
Toddlers	9 (0.59%)	9 (0.59%)	2 (0.13%)	49 (3.24%)	33 (2.18%)	2 (0.13%)	0	0	1 (0.07%)	0	1 (0.07%)
Preschool Children	23 (1.52%)	22 (1.45%)	2 (0.13%)	107 (7.07%)	56 (3.70%)	1 (0.07%)	2 (0.13%)	1 (0.07%)	1 (0.07%)	1 (0.07%)	4 (0.26%)
Schoolgoing Children	78 (5.15%)	57 (3.76%)	8 (0.53%)	331 (21.86%)	150 (9.91%)	12 (0.79%)	5 (0.33%)	1 (0.07%)	6 (0.40%)	4 (0.26%)	13 (0.86%)
Adolescent	72 (4.76%)	105 (6.94%)	14 (0.92%)	172 (11.36%)	85 (5.61%)	8 (0.53%)	12 (0.79%)	1 (0.07%)	12 (0.79%)	5 (0.33%)	20 (1.32%)
Total	185 (12.22%)	194 (12.81%)	26 (1.72%)	669 (44.19%)	326 (21.53%)	23 (1.52%)	20 (1.32%)	3 (0.20%)	20 (1.32%)	10 (0.66%)	38 (2.51%)

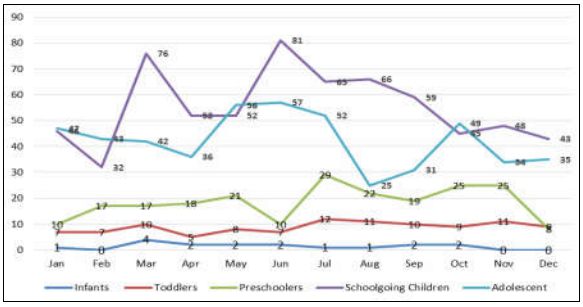

Figure-1: Monthly Pattern of fractures among paediatric population

DISCUSSION

The various stages of childhood are characterized by different stages of physical, cognitive and social development, which may explain the varying pattern of injuries across paediatric age groups.[8] In the light of epidemiological studies in the developed world, distinctive injury patterns have emerged amongst paediatric age groups.[9]

In accordance with previous studies, our data showed a male preponderance amongst paediatric fracture patients[1012], presumably due to their higher level of activity and risk taking behaviour[13], as demonstrated in a previous study in Tasmania. However, in our country this may represent the cultural issue of 'son preference'[14], resulting in males being given greater independence and importance, therefore male patients are brought to the hospital for treatment while females may be neglected or treated at home. Fractures for males peaked at ages 5 and 12, whereas for females the peak age was 5. This is in contrast to other studies where the peak age for females is close to puberty. The overall boy-to-girl ratio was 3:1, which rose to a maximum of 5.1:1 in the adolescents.[11]

Common fracture sites varied with age, revealing that fractures of the upper limb occurred more often than the lower limb.[10–12] Amongst all age groups, Fractures of the forearm, distal radius and humerus predominated, which has been seen in previous studies from Sweden[10] and Hong Kong[11]. However, in our case, an exception occurred in children up to age 3, as fractures of the shaft of femur were found to be the most common in these children. This was found to be statistically significant (p<0.001) and certainly warrants attention as femur fractures have been reported to be highly suggestive of non-accidental trauma in 30–60% of young children.[15] In children younger than 1 year of age, these fractures are thought to be uncommon , so their occurrence is linked to child abuse.[16] Another possibility could be vitamin D insufficiency, but sub optimal levels of vitamin D in a child should not discourage a diagnosis of possible child abuse.[17] For cases like these, it is imperative that the physician follows a careful screening procedure with a thorough history, physical examination, and other investigations, where indicated, to rule out the possibility of intentional injury.

Falls on the same plane were found to be the most common cause of a fracture amongst all age groups consistent with a study from Sweden.[12] This finding also corroborates the results obtained from a study recently done in the Pakistani provinces of Sindh and Baluchistan, which demonstrated that about 51% of injuries in children were attributed to falls.[18] Vehicular accidents where the child was riding, or a passenger on a motorcycle were a common cause of trauma in adolescents comprising 20.8% of the total causes for that age group.

The incidence of fractures increased with age and the highest number of fractures were seen in school going children (ages 5–11 years), after which there was a downward trend as children entered the period of adolescence. Most notably there was a decline in the fractures sustained due to fall on the

same plane and from a height. This concurs with epidemiological data obtained previously which shows that the incidence of paediatric fractures increases with age and peaks around an age coinciding with the pubertal growth spurt[10,12], after which a decline can be seen. The decline in trauma due to falls could be due to well-developed motor skills in adolescents as well as the demonstration of cautious and responsible behaviour.

The occurrence of fractures was increased in the evening. This finding is in accordance with a study from France[19] which also demonstrated that childhood fractures peaked in the afternoon. In our study, seasonal variation also was profoundly marked and was found to be statistically significant. Paediatric fracture cases peaked in the summer months (March–September), especially for children of ages 5 and onwards, the highest being in June/July. Similar trends have been demonstrated previously[10–12,] where occurrence rates for paediatric fractures have peaked in the summer months. This can be attributed to the fact that children are on vacation from school during these months and therefore have longer playing times, which increases the likelihood of them getting injured, especially if they play on the streets, which is quite common here.

Although the incidence of injury from fire arms was quite low, coming to 1.5% of the total causes, it still merits attention. These injuries were mainly sustained by children aged 5–17, with the greater number of cases amongst ages 5–11. In the USA approximately 3000 children and adolescents die as a result of firearm related homicides, suicides, and unintentional injuries annually.[20] However, a recent study in Karachi revealed that victims aged 1–20 comprised 17% of all firearm injuries, and that robbery, bystanders and accidental gunshots contributed 40%, 19% and 10% respectively to the causes.[21] It can be conjectured that the escalation in Poverty, gang wars and terrorism are the reason why innocent children fall victim to firearm injury.

Occupational injuries were the cause of trauma in a small number of cases, the majority being adolescents. In a developing country such as ours, the underlying cause for child labour is mostly poverty. Evening schools and centres which provided skill-based education and health facilities for working children were found to bring an improvement[22], so it stands to reason that an increase in the number of institutes like these as well as stringent laws related to child labour will bring about a positive change.

Since falls have been established as the major causative factor resulting in paediatric trauma, preventive strategies should be aimed at reducing these, both at home and outside. For younger children, prevention measures could include use of stair gates, window guards and reduced/supervised use of infant walkers. Despite falls from windows being a rare event in our study, we recommend legislation to install grills on windows and balconies in multi-storey buildings. Doors with self–closing hinges can reduce injuries due to slamming doors. In a developing country, when parents go to work, they usually leave their younger children at home, supervised by their elder siblings. The provision of day care centres at work may reduce the rate of trauma encountered when the toddlers are not properly monitored by their siblings at home. It has been suggested that adequate supervision by a caregiver is a vital factor in the prevention of home based injuries in children. Ideal supervision was delineated as the situation in which the caregiver is within sight and reach of the child. It was defined as being based on a triad of "attention, proximity and continuity"[23], to reduce the incidence of childhood injuries at home.

Older children spend more time outside of the home, and so we need to shift to child-centred strategies for injury prevention. Once again, closely monitoring them will while they play is vital to their safety but the upgrading and maintenance of playground equipment is imperative too. It has been shown that using rubber surfacing in playground equipment and making sure that the ground surrounding playground equipment is a soft and yielding one will ensure a reduction in injuries.[24]

In our study, trauma due to Road traffic accidents predominantly involved adolescents, specifically trauma while riding motorbikes, whereas other age groups sustained trauma mainly as pedestrians. Pedestrian injuries were slightly higher than injuries to vehicle occupants. Vehicular accidents are a major cause of childhood death, hospitalization, and disability worldwide.[25] Ineffective traffic police and a lenient parental attitude results in a lot of children being confident enough to ride motorbikes raucously, resulting in trauma. Promoting the use of safety helmets using legislation, showed a substantial decrease in injury to cyclists.[26] This suggests that safety helmets are a valuable aide in reducing injury. We also advocate the construction of sidewalks and tunnels to guarantee a safe passage for pedestrians, away from mainstream traffic, reducing the likelihood of them getting injured. Campaigns to educate children about traffic rules and violations should also be instated.

A multi-disciplinary approach is needed to reduce childhood trauma. Campaigns aimed at educating the public, designing and implementing safety strategies and bringing about legislative changes can produce a change. Participation at a community level as well as nationally is required for

the effectiveness of any accident prevention programs. Most notably though, children's needs are often overlooked in a developing nation and these need to be prioritized by the government, along with efforts to reduce obstacles such as illiteracy and poverty. As our study involved one center only, so our interpretation of the results only applies to this study population. Studies on a larger scale are needed for better understanding of the causes of childhood trauma which can help in implementing policies for its prevention.

AUTHOR'S CONTRIBUTION

KM and SS: conceived the study, KM: oversaw the conduct of the study as principal investigator. SS helped design the study, participated in its conduct and coordination, AA performed the statistical analysis and wrote the results. MMA and MH: participated in study design, conduct and data collection. MH: provided his expertise as an orthopedic surgeon. All authors were involved in drafting the manuscript and read and approved the final version.

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