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Original Article

The clinical profile of musculoskeletal injuries in children attending a major hospital in Delhi, India

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ABSTRACT

Background: Children are vulnerable to musculoskeletal injuries both at home and on the street for various reasons. Morbidity and disabilities resulting from these, mostly preventable, injuries, make them a burden to their families and society. The role of various factors associated with injuries is often not documented.

Methods: This prospective study, done on 100 children aged up to 12 years with musculoskeletal trauma, analysed in details, the various modes of injuries.

Results: One in every five patient was a child below 12 years of age. Boys were injured more than girls. Injuries, especially fractures, were most common in the extremities, the upper limb more commonly injured than the lower limb. Most of the injuries occurred at home. The most common mode of injuries was falls that happened while playing both within and outside the home, followed by road traffic accidents. Most injuries occurred during daytime.

Conclusions: Injuries in children were found to be preventable. Small interventions while constructing homes can contribute tremendously to injury prevention and control in children. Parental awareness about the various modes of injury, role of supervised playing and their responsibility towards injury prevention can play a key role in reducing the morbidity associated with childhood fractures.

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1. Introduction

The WHO and Bone and Joint Decade report on ‘The burden of musculoskeletal conditions at the start of the New Millennium’ indicates that limb trauma is part of musculoskeletal disorders which contribute to serious economic and health care burden in both developed and developing parts of the world¹². Accurate data on the incidence of musculoskeletal injuries is lacking in many countries. Studies in India are either not recent^{1,2,7,11} or are not pertaining to childhood musculoskeletal injuries.

Children are most vulnerable to injuries both at home and on the street for a variety of reasons. These include living in an environment where the basic infrastructure is adapted for adults. Besides, children have a limited development of their own risk perception ability and behaviour apart from their inherent physical vulnerability. Children can get injuries in different forms and ways. Many of these injuries may not be reported. Injuries may vary according to age and gender. Rate of injuries is influenced by subtle variation of cultural lifestyle and behavioural patterns e.g. play behaviour of children, design and layout of homes and play area.

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Accidents, do not just happen, they are caused. The traditional view of injury as an accident has resulted in the neglect of this aspect of public health. Today injuries are low in priority for policy makers and only few plans are drawn for injury prevention. It is an irony that thousands of children saved from nutritional and infectious diseases are killed or maimed by injuries.¹³ The fatalistic attitude that accidents are inevitable needs to be curbed. Prevention of childhood injuries is of great importance to both individuals and society but unfortunately, has largely been either excluded from attention or treated in an inappropriate manner.⁹ Patients may survive their primary injuries only to become chronically disabled and become a burden to their families and the society.

The causes of injuries in children must be identified by epidemiological methods. Without adequate data collection, analysis and interpretation, there could be no effective countermeasures, evaluations and strategies for prevention.

2. Methods

The study was done to estimate the proportion of musculoskeletal injuries in children attending a major hospital in Delhi; to analyse the various types of injuries in children; to evaluate the common causes leading to these injuries and to identify associations between these injuries and multiple socio-demographic indicators.

A prospective study was conducted on 100 children with musculoskeletal injuries attending the Casualty and Emergency Department of Orthopaedic Surgery of a major hospital in Delhi, India. The study was conducted for a period of two months of May and June on the emergency duty days of concerned Unit of the orthopaedics department. All the children with a history of trauma referred from the department of Casualty to the concerned unit of Orthopaedics were included as per the criteria given below.

A detailed history along with an informed consent was taken from the parents/ guardians/ children regarding the injury. Various parameters like the age, sex, socio-economic status, number of injuries, exact site and type of injury (diagnosis), mode and place of injury, time of injury and presence of parents at the site of injury, were noted in a proforma for each child. The injuries were assessed clinically and by plain radiographs.

This being a descriptive epidemiological study, the statistical methodology was the frequency of various parameters identified and assessed.

2.1. Inclusion criteria

1. Patients less than 12 years of age sustaining musculoskeletal trauma

(Age less than 12 years was considered children as per the hospital policy)

2. Children sustaining chest and head injuries with limb injuries who are referred from the neurosurgery or pediatric surgery departments.

2.2. Exclusion criteria

1. Injuries resulting from birth trauma
2. Patients having abrasions and superficial skin wounds who are not referred to the orthopedic emergency from the casualty.
3. Co morbid conditions like epilepsy and neurological disorders, which are more prone to injury.
4. Children sustaining chest and head injuries without limb injuries who are directly referred from the casualty department to neurosurgery or pediatric surgery departments.

3. Results

The results of the study are depicted in the following tables and figures. These include the clinical and socio-economic profile of musculoskeletal injuries (Table 1), the gross regional distribution of the musculoskeletal injuries (Table 2), the different types of musculoskeletal injuries in children (Fig. 1), the detailed regional distribution of the musculoskeletal injuries (Table 3) with an analysis of the four common fractures in these children (Table 4). The various mode of injuries in children in this study have also been tabulated in details (Table 5).

4. Discussion

4.1. Age distribution

Among the 519 patients, 100 belonged to the age group of less than 12 years. Thus one in every five injured patient was a child below 12 years. Among the children the most common age group was between 8 and 12 years, constituting 42% of the musculoskeletal injuries. Injuries have been reported to occur most commonly in the age group of 5–14 years⁹ with the mean age of 6.34 years.^{1,9} Adolescent children are usually active and playful without the maturity of being careful hence most of childhood injuries are seen in this age group.

4.2. Gender distribution

In our study boys were found to be injured more commonly than girls, similar to the reports in the literature.^{1,3–5,10,11} The male: female ratio in our series was found to be 3:1 which is only slightly different from the ratios of 2:1¹¹ and 2.2:1.¹ This is because boys are by nature more active and girls indulge more in sedentary games.

4.3. Diurnal variation

In our study injuries were found to be more common during the daytime (78%) than in the dark (22%). This is probably due to the fact that children are awake and more active during daytime. There is a lacuna in the literature regarding this finding.

Table 1 – Clinical and socio-economic profile of musculoskeletal injuries out of 100 cases.

Age group		6 Months–12 Yrs (Mean age: 7 Yrs)
Sex (M:F)		76:24
Left vs. right		48:52
Skeletal vs. soft tissue injury		72:28
Time of injury	Daytime	78
	Dark (After sunset)	22
Age-wise distribution	0–1 Yr	6
	1–4 Yr	28
	4–8 Yr	24
	8–12 Yr	42
Place of injury	Home	56
	Outside home	44
Place of residing (Socio-economic status)	Pukka (brick or cemented) house	84
	Slums	5
	Labourers at construction site	2
	People living in village	7
Proportion of children with musculoskeletal injuries presenting to the orthopaedic emergency	Orphanage	2
		100 children out of 519 total no. of patients

4.4. Place of sustaining injury

In our study more than half of the injuries (56%) occurred at home. Injuries at home have been reported to be quite common but constitute only about one third of injuries.⁶ Parents often leave their children alone and unattended at home thinking that they would be safe. Also parents tend to be casual when children are playing in the house even if they are present. Since the parents cannot keep a constant vigil on the children, injuries at home may be more common than expected. The modes of injury of most of the children depict that carelessness is a common factor even at home, depicted by the fact that many children are injured by fall from stairs at home.

4.5. Parental supervision

In our study only in eleven percent cases, parents were present at the time of injury and they too were pre-occupied in their work resulting in neglect during the injury.

4.6. Socioeconomic status

Almost all the children attending our general hospital observed belong to low socioeconomic status. belonging to the lower middle class families. Although eighty four percent lived in brick (pukka) houses, out of the 14 children injured by falling from the roof of these pukka houses, 12 stated that there was no boundary wall or railing present on their roofs. Seven of the injured children were from villages, 5 lived in slums and 2 were the children of labourers who lived at the

construction site, while 2 lived in orphanages. One homeless child sleeping on the pavement was run-over by a vehicle. This supports the finding that poor socioeconomic conditions were found to be significantly associated with higher rates of fractures.⁴

4.7. Pattern of injuries

Out of the hundred children, seventy-two had skeletal injuries, of which sixty-four were fractures, six dislocations and two amputations (one above elbow amputation and one amputation at the level of proximal phalanx). Fifty-eight of the sixty-four fractures (90.6%) were closed fractures while the remaining six were (9.37%) were open, similar to the study by Lyons et al.⁶ Upper limb injuries (53%) were more common than the lower limb injuries (33%) in confirmation to the reports of other studies^{1,5} followed by chest (9%) & head and neck (5%). All the injuries in the head and neck region were soft tissue injuries. The common fractures in children were found to be fracture of shaft of femur (18.75%), followed by fracture of both bones of forearm (14.06%), fracture of clavicle (12.5%) and supracondylar fracture of humerus (10.94%). This result differs from other studies^{1,6} according to which supracondylar fracture of humerus was the second most common fracture in children after fracture shaft femur and not fracture both bone forearm, as in this study.

4.8. Pattern of injuries: Upper limb

Most of the fractures involved the upper limb (48%). Fracture of both bones of forearm was the most common fracture of

Table 2 – Gross regional distribution of the musculoskeletal injuries.

Total no. of children with history of trauma		Upper limb	Lower limb	Chest	Head & neck
Skeletal	72	40	24	8	0
Soft tissue	28	13	9	1	5
Total	100	53	33	9	5

Fig. 1 – Types of musculoskeletal injuries in children. Key: # means fracture.

the upper limb seen in nine cases. This is different from other studies.^{1,10} The second most common fracture of the upper limb in our study was fracture of the clavicle, seen in eight cases followed by supracondylar fracture of the humerus in seven cases. Two children had dislocation of the elbow joint and while two had dislocations around the joints of the fingers.

4.9. Pattern of injuries: Lower limb

Fracture shaft femur was the most common fracture in children (12%) among all injuries and not only among the fractures of the lower limb. This finding is similar to other studies.^{1,10} The second most common fracture of lower limb was fracture shaft tibia (4/24). Dislocation of the hip joint was seen in one case.

4.10. Soft tissue injuries

Less than one third of the children referred to orthopaedics had soft tissue injuries (28%). The sites of these injuries covered almost the whole body including the head and neck (5/28), knee (4/28), thigh (3/28), arm (2/28), foot (2/28), wrist (1/28), upper back (1/28). Children are susceptible to soft tissue injuries on any part of the body depending on the mechanism of injuries. Minor abrasions and superficial bruises and skin wounds treated by the casualty staff and not referred to the orthopaedics department were excluded in the study.

4.11. Profile of common musculoskeletal injuries

4.11.1. Fracture shaft femur

This fracture, the most common one seen in our series was found in all age groups ranging from 8 months to 12 years, of which majority were between the ages of one to four years. Boys were affected more than girls (9:3) similar to a previous study.⁴ Left side was involved slightly more than the right side

Table 3 – Detailed regional distribution of the musculoskeletal injuries.

1	Upper limb (40)		
a)	Amputation	Above elbow	1
b)	# Humerus	# Supracondylar	7
		# Proximal humerus	4
		# Condyle/epicondyle	3
c)	# Both bone forearm		9
d)	# Radius	Proximal end	2
		Distal 1/3	4
		(including 1 Torus #)	
		Salter-Harris type II	1
		physeal injury (Lower end)	
e)	Elbow joint	Dislocations	2
f)	# Ulna		1
g)	# Metacarpal		1
h)	Dislocation metacarpophalangeal joint		1
i)	# Proximal phalanx		1
j)	Amputation proximal phalanx		1
k)	Dislocation DIP		1
l)	Hyperextension DIP		1
2	# Clavicle		8
3	Lower limb (24)		
a)	# Femur	Shaft	12
		Neck	1
		Greater trochanter	1
b)	# Ankle (Calcaneum)		2
c)	Knee joint	Dislocation	1
d)	# Tibia	Shaft	4
		Lower end	1
e)	# Both bone leg		1
f)	Dislocation hip joint		1
4	Soft tissue injury (28)		
a)	Upper limb (14)	Elbow	10
		Arm	2
		Wrist	1
b)	Lower limb (9)	Thigh	3
		Knee	4
		Foot	2
c)	Head & neck (5)		5
d)	Scapula (1)		1
	Total		100

Key: # means fracture.

Number within parenthesis represents the no. of cases.

(7:5). In 8 out of 12 cases these fractures were the only injury seen while in 4 cases, it was associated with other soft tissue injuries. Most of these fractures, supposed to be caused by major musculoskeletal trauma (22) occurred at home indicating the scope of their prevention. The major cause of this fracture in the home was found to be fall from the roofs (5/12), which had either no boundary wall or a very low boundary wall. Other causes of fall at home were on slippery wet floors while playing (2/12); small child (8 months) falling off the lap of elder sister on the floor; fall from an open cupboard (almirah) at a height (5 feet). Another cause was fall from a mango tree. In most cases the child fell on a smooth but hard surface. Thus, age of the child, surface of contact and height of the fall were determinants of the seriousness of the injury. An eight months old child who fell from a height of only 3 feet on to a smooth hard surface sustained a fracture of the shaft of femur. A twelve-year old child who fell from a height of about 13 feet (mango tree) on to the muddy surface of the orchard developed a similar fracture. Both these children sustained no

Table 4 – Analysis of the common fractures in children.

	#Shaft femur (12/64)	#Both bones forearm (9/64)	#Clavicle (8/64)	#Supracondylar humerus (7/64)
Age group	8 months–12 years	1.5–12 years	6 months–12 years	3–12 years
Sex (M:F)	9:3	8:1	6:2	5:2
Left vs. right	7:5	6:3	6:2	4:3
Isolated injury	8/12	8/9	6/8	6/7
Associated soft tissue injuries	4/12	1/9	—	1/7
Place:				
Home	9	5	7	2
Outside home	3	4	1	5
<u>Mode of injury</u>				
1. Fall (10/12):				
Kinds of fall				
Roof	5	1	2	—
Stairs	1	4	3	1
Height	2	—	—	—
Slippery floor	2	—	—	1
From bed	—	—	2	—
While playing	—	4	—	4
While cycling	—	—	1	—
Type of surface				
Smooth hard	5	5	5	3
Rough hard	1	2	—	—
Muddy	4	2	3	3
2. RTA	2/12	—	—	—
3. Hit by cricket ball	—	—	—	1
<u>Time of injury</u>				
Morning	2	—	3	—
Noon	5	6	1	2
Evening	3	3	3	2
Night	2	—	1	3

Key: # means fracture.

other injury on their body. The causes of injury outside home were road traffic accidents (2/12) on two-wheelers (scooter or bike). In one case the child was sitting on the lap of mother on the rear seat. In other case the father who was driving a

motorcycle had strapped the child to his chest in a pouch made of cloth. Most of these injuries occurred in the daytime and only two occurred in the dark.

4.11.2. Fracture both bone forearm

Unlike the literature reports this was the second most common fracture seen among children in our series. The age group of this fracture ranged from 1.5 to 12 years and was seen most commonly in the adolescent age group of 8–12 years. Boys were predominantly affected (8:1). Left side was three times involved more than the right side (6:3). Majority of these fractures were isolated and in only one out of the nine children there was associated other soft tissue injuries. Most of these fractures occurred at home indicating their preventable nature. All of these fractures were caused by various kinds of falls. Fall while playing (4/9) and fall from stairs (4/9) were the most common types. One fall occurred from the roof. Most of these falls occurred on a smooth hard surface. All these fractures took place in the daytime.

4.11.3. Fracture clavicle

Seen in the age group 6 months to 12 years (1–4 years being the most common). Males were affected more than females (6:2). Left side was involved more than the right side (6:2). In 6 out of 8 cases these fractures were the only injury seen while in 2 cases, it was associated with other soft tissue injuries. Like the other two most common fractures in children, these fractures also occurred more at home indicating

Table 5 – Mode of injury.

1	Fall (79)			
	a) Roof (14)	Parapet present:	Yes	2
			No	12
	b) Stairs (22)	Railing present	Yes	18
			No	4
	c) Bed (4)			4
	d) Playing (37)	Running		17
		Height (Wall, Stool etc.)		12
		Cycling		5
		Cricket		2
		Basketball		1
	e) Tree (2)			2
2	RTA			8
3	Electric fan injury			2
4	Hit with cricket ball			2
5	Hit with iron objects (Pole, Rod, Grill etc.)			4
6	Violence injuries (2)			
	Quarrel			1
	Hit by teacher at school			1
7	Domestic injury (2)			
	Stepped by adult while sleeping on floor			1
	Infant pulled up by adult by one arm			1
8	Accident by train			1

Number within parenthesis represents the no. of cases.

their preventable nature. Fall was the only mode of injury seen here like in the fracture both bone forearm. Most of the falls occurred from stairs (3/8), others from roof (2/8), beds (2/8), fall while cycling (1/8). Both the cases of fall from bed occurred on smooth hard surfaces and in both the cases the height of the bed was not more than 1.5 feet. Studies have reported the possibility of reducing injuries, if fall takes place on a relatively soft surface like a thick carpet or mat around the bed.^{9,11} Most of these fractures took place in the daytime. This indicates that small safety measures and precautions during the daylight may help to avoid these injuries.

4.11.4. *Supracondylar fracture of humerus*

This fracture was seen in the age group 3–12 years (3–8 years being the most common). Males were affected more than females like the other three common fractures. Left side was involved more than the right side (4:3). In 6 out of 7 cases these fractures were the only injury seen while in 1 case, it was associated with other soft tissue injuries. Unlike the previous three most common fractures in children, these fractures occurred more commonly, outside the home. Most common mode of injury was fall (6/7) that too while playing (4/6) others being fall from stairs, slippery floor. Falls occurred equally on smooth and hard surfaces. One fracture was caused due to impact by a moving cricket ball. Most of these injuries occurred during the daytime.

4.11.5. *Dislocations*

Five out of the six dislocations were caused by fall and the remaining one was due to a road traffic accident (RTA). The nature of injuries leading to dislocations usually involves a large amount of force as seen by cause in our study.

4.11.6. *Amputations*

The above elbow amputation was caused by a railway accident while the other amputation at the level of proximal phalanx was due to a road traffic accident. Injuries leading to amputation of limbs are of very severe intensity and nature. Hence they are associated with road and rail traffic accidents. Children should be made aware and trained from early childhood to be careful while crossing roads and avoid boarding and disembarking from moving buses and trains.

4.11.7. *Mode of injury*

Various mode of injury have been found to be associated with injuries in children, but the commonest mode of injury was fall (79/100). This was similar to the reports of other studies^{1,8,9,11} but different from one study,¹⁰ according to which road traffic accident (RTA) was the most common mode. In our study the second most common cause of injury was RTA (8/100). Most of the falls occurred while playing (37/79). The various activities during playing included running (17/37), fall from small heights like stools, tables, low height walls (12/37), cycling (5/37), cricket (2/37), basketball (1/37). Second most common cause of falls were slipping from stairs (12/79). In most of these cases, children tumbled on the stairs while climbing or running down. In 5 out of 22 cases the stairs were wet and hence slippery, in 2 cases the child was

wearing adult size slippers. In 4 cases the railings were not present (2 houses were under construction, 1 was rented and in 1 case the owner did not feel the need to put up railings) and in all these 4 cases the children fell from the side of the stairs on to the floor.

Another mode of fall was from roof (14/79) most commonly from the first story of house similar to other studies.¹¹ In most of these cases (12/14) the boundary wall was either not present or too low (less than 1 foot) to be effective against falls. In 2 cases where the boundary wall was present, the child fell over the wall. Most of the falls from roof occurred while playing (6/14), unsupervised kite flying (2/14), during a casual walk (2/14) and even while sleeping (1/14). Four children were injured due to unsupervised fall from bed (not more than 1.5 feet from floor). Two children fell from fruit trees while picking fruits, this finding is in agreement with other studies.^{7,13} The road traffic accidents were responsible for 8 injuries. Three of these occurred on busy roads when the entire family, of four members, was on a two-wheeler (scooter or motorbike). In one case, the child was sitting in the front over the tank of a motorbike while in other the child was strapped to the driver's chest in a cloth marsupium. In the third case the child was in the lap of the mother who was sitting with both legs on the same side on the rear seat of the scooter.

Two accidents occurred on not so busy roads. Both these children were crossing roads unsupervised and got hit by a rickshaw and a bicycle respectively. In another accident, a bicycle hit the child when he was playing on a not so busy road. One accident occurred when the child jumped off a running jeep. One accident was a cycle spoke injury when the child was sitting on the back of an adult size bicycle driven by an adult. Four of the hundred children were injured after being accidentally hit with iron objects (iron grill, remnant of poles and hand pumps in the street, protruding parts of water tankers etc). Two children sustained injuries from electric fans. These fans provided with stands were kept on the floor well within the reach of these children. Two children were injured by the direct impact of a moving cricket ball. Injuries resulting from violence like quarrel at home with siblings or after being hit by teacher at school were found in two children. One girl was injured after being stepped over by an adult while sleeping on the floor in an orphanage. One infant was injured after being carelessly pulled and picked up by one arm, by the mother. One railway accident resulted in an above elbow amputation.

5. Conclusions

This hospital based study showed that one in every five patient sustaining musculoskeletal injuries was a child below 12 years of age. Boys were affected more often than girls in all age groups of children and most of the injuries were seen in the age group of 8–12 years. Injuries in children occurred at all times but more often during the daytime. In almost 90% of the cases the children were unsupervised at the time of injury. Home, which was considered safe, was the most common place where children are injured. Poor socioeconomic conditions are definitely associated with an increased incidence of injuries in children.

Skeletal injuries constituted 72% of all the injuries in the children and the upper limb was twice more commonly injured than the lower limb. Most of the children had an isolated fracture. Fractures were found to involve almost any bone of the skeletal system. The most common fracture was that of the shaft of femur followed by fracture of both bones forearm, fracture of clavicle and supracondylar fracture of the humerus. There were various modes of injury in children, the most common being fall during playing. Injuries in children were found to be preventable. Small interventions while constructing homes like mandatory boundary wall on the roof, railings on stairs, keeping iron objects away from the site of playing can contribute tremendously to injury prevention and control in children. Parental awareness about the various modes of injury, role of supervised playing and their responsibility towards injury prevention can play a key role in reducing the morbidity associated with childhood fractures. Amputations can be prevented if small precautions are taken and the awareness is increased.

Conflicts of interest

All authors have none to declare.

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