

PATTERN OF FATAL INJURY IN FALL FROM HEIGHT CASES- A MEDICOLEGAL STUDY

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Abstract

Introduction: In occupational settings, the most common type of fatal accident is fall from a height. The skull, brain, spinal cord and extremities are the most commonly injured systems. Falls from more than 20 feet have historically been triaged to trauma centers but even low-level falls can cause serious head injuries and death.

Objectives: The objective of this study was to find out the pattern of injuries and related medico-legal issues among the victims of fall from height.

Methods: This retrospective study was conducted among the victims of fall from height at Dhaka Medical College morgue during the period of January to December 2008. Various data were collected from inquest reports submitted by the investigating officers. Specific points regarding injuries were noted during autopsy examinations.

Results: A total 2714 autopsies were performed during the study period out of which 93(3.43%) were cases of fall from height. Among them 66(70.97%) were male and 27(29.03%) victims were female. Most of the victims 23(24.73%) were day labourer/ construction workers. Minimum level of height of fall was from 2nd floor 7(7.52%) and maximum number of victim have fallen from 5th to 10th floor 47(50.53%). Considering timing, highest incidents occurred during day time 57(61.29%). Ages of maximum victims were between 21-30 years 34(36.56%). All the victims had multiple abrasions and bruises in their body, followed by laceration 74(79.56%), fracture of skull 57(61.29%)

intra cranial haemorrhage 85(91.40%), injury to long bones of lower limbs 47(50.54%), injury to long bones of upper limbs 31(33.33%), injury to abdominal organs like liver, spleen, kidney 51(54.84%), fracture of pelvis 37(39.78%). In skull, linear fracture was the commonest one 48(51.61%), Temporal bone was the commonest bone to fracture 57(61.29%) and most of the victims 57(61.29%) had sub dural haemorrhage.

Conclusion: Death due to fall from height is an unforeseen and unfortunate occurrence. Installation of window guard, modification of physical environment, maintenance of safety as per building construction code, parental counseling to children can reduce this economical burden and protect vulnerable groups of people of our country from this type of incidents.

Key-words: Fall from height, injury pattern, medico-legal issue.

Introduction

In occupational settings, the most common type of fatal accident is fall from a height. Fall from height remain a significant cause of morbidity and mortality in day to day life. Factors determining serious and fatal injuries in a fall depends on distance of the fall, the characteristics of landing surface, orientation on falling, and whether the fall was direct or broken¹. Factors contributing to falls from heights include faulty equipment, such as ladders and scaffold structures, and human factors,

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such as intoxication and inattention during working. The skull, brain, spinal cord and extremities are the most commonly injured systems. Falls from 1 or 2 stories are more frequently nonfatal, but falls from more than 20 feet have historically been triaged to trauma centers. But even low-level falls can cause serious head injuries and death^{2,3}.

Materials and Methods

This retrospective study was conducted among the victims of fall from height at Dhaka Medical College morgue during the period of January to December 2008. Various data of the victim were collected from inquest reports submitted by the investigating officers. Specific points regarding injuries were noted during autopsy examinations. Later on the data were analyzed.

Results

A total 2714 autopsies were performed during the study period out of which 93(3.43%) were cases of fall from height. Among them 66(70.97%) were male and 27(29.03%) victims were female. Most of the victims were day labourer 23 (24.73%) (Table-I). Minimum level of height of fall was from 2nd floor 7(7.52%) and maximum victim have fallen from 5th to 10th floor 47(50.53%) (Table-II). Considering timing highest incidents occurred during day time 57(61.29%) and 36(38.71%) at night (Fig-1). Ages of maximum victims (36.56%) were between 21-30 years (Table-III).

All the victims had multiple abrasions and bruises in their body, followed by laceration 74(79.56%), fracture of skull 57(61.29%), intra cranial haemorrhage 85(91.40%), injury to long bones of lower limbs 47(50.54%), injury to long bones of upper limbs 31(33.33%), injury to abdominal organs like liver, spleen, kidney 51(54.84%), fracture of pelvis 37(39.78%) (Table-IV). In skull bones linear fracture is the commonest one 48(51.61%) (Table-V), Temporal bone was the commonest bone to fracture 57(61.29%) (Table-VI) and most of the victims 57(61.29%) (Fig-2) had sub dural haemorrhage.

Table-I: Types of victims by profession (n=93).

Types of victims	Total number	Percentage
Day labourer, construction workers	23	24.73
Student	14	15.05
Children	13	13.98
House wife	11	11.83
House maid	9	9.68
Intoxicated person	7	7.53
Geriatric person	5	5.38
Others	11	11.82
	93	100

Table-II: Level of floor as falling height (n=93).

Level of falling height	Total number	Percentage
2 nd floor	7	7.52
3 rd floor	9	9.68
4 th floor	13	13.98
5- 10 th floor	47	50.54
11-15 th floor	14	15.05
16 th floor and above	3	3.23
	93	100

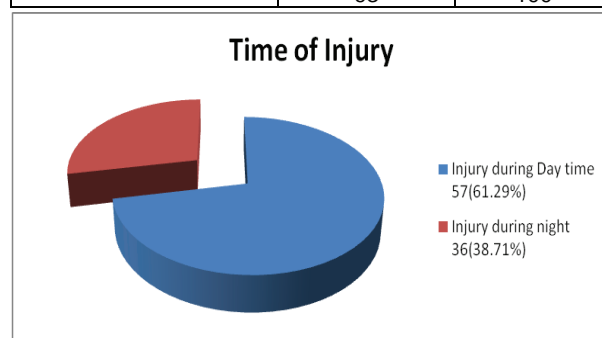


Fig-1: Time of injury of fatal fall from height victims (n=93).

Table-III: Age distribution of the victims (n=93).

Age limit of the victim	Total number	Percentage
<10 years	13	13.98
11-20 years	12	12.90
21- 30 years	34	36.56
31-40 years	21	22.58
41-50 years	8	8.60
>50 years	5	5.38
	93	100

Table-IV: Variation of the types of injury among the victims (n=93)*.

Types of injury	Number of victim	Percentage
Multiple abrasions	93	100
Bruise	93	100
Intracranial injury to brain	85	91.40
Laceration	74	79.57
Fracture of skull	57	61.29
Injury to abdominal organs	51	54.84
Fracture of bones of lower limbs	47	50.54
Fracture of pelvis	37	39.78
Fracture of bones of upper limbs	31	33.33
Injury to chest organs	29	31.18
Fracture of ribs	22	23.65
Fracture of vertebral column	17	18.28
Broken tooth	12	12.90

*Same victim had multiple types of injury

Table-V: Types of fracture of skull bones (n=93)*.

Types of fracture of skull bones	Number of victim	Percentage
Linear or fissured fracture	48	51.61
Depressed fracture	12	12.90
Perforating fracture	07	7.53
Gutter fracture	04	4.30
Ring fracture	21	22.58
Comminuted fracture	33	35.48
Pond fracture	02	2.15
Diastatic fracture	17	18.28
No fracture skull	36	38.71

*Same victim had multiple types of fracture.

Table-VI: Location of skull fracture in different cranial bones (n=93)*.

Names of skull bones involved	Number of victim	Percentage
Frontal bone	21	22.58
Occipital bone	07	7.52
Parietal bone	48	51.61
Temporal bone	57	61.29
Fracture anterior cranial fossa	16	17.20
Fracture middle cranial fossa	18	19.35
Fracture posterior cranial fossa	09	9.68
No fracture skull	36	38.70

*Same victim had multiple types of fracture.

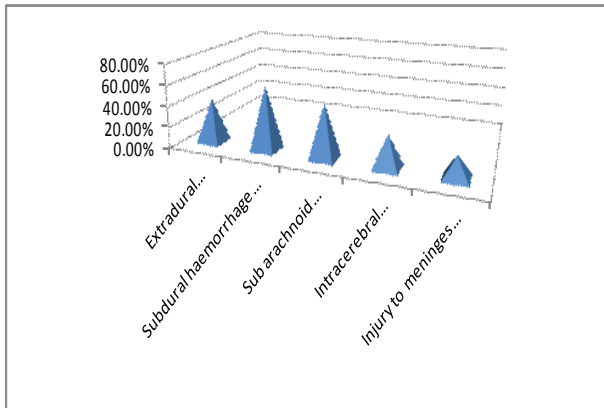


Fig-2: Frequency of different types of intra cranial haemorrhage (n=93)*.

*Same victim had multiple types of fracture.

Discussion

Injury due to fall from height remain a significant cause of morbidity and mortality in our day to day life. Fatalities occur primarily when a person fall from greater than 2 stories or when the head of the victim hits a hard surface, such as concrete. This includes falls from roofs, windows, and balconies^{1,2,3}. After motor vehicle-related injuries, falls of all kinds are the second leading cause of death from unintentional injury in the United States, accounting for more than 1,30,000 deaths during 1998 among persons of all ages, 126 of which were children 14 years and younger⁴.

In this study 66(70.97%) victims were male and 27(29.03%) were female. Most of the victims were day labourer / construction workers 23 (24.73%) followed by students 14(15.05%) and children 13(13.98%). Minimum level of height of fall was from 2nd floor 7(7.52%) and maximum victim have fallen from 5th to 10th floor 47(50.53%). Considering timing highest incidents occurred during day time 57(61.29%) and 36(38.71%) at night. Males are predominantly the earning members in our society context. Now days a number of high rise buildings are being constructed in Dhaka city, where building safety codes are not always properly followed. This indicates the significance of highest number of victims as construction workers. Students prefer roof top spaces for gossiping with friends or passing the leisure time. Falling from roof top is usually considered accidental in nature. But sometimes due to familial disharmony, failure in examination, emotional blackout after refusal by lovers, drug addiction also leads to suicidal cases. Homicidal cases are also not rare. Circumstantial evidences of some cases occurred during night indicates towards homicidal activities. Average height of Dhaka city residential buildings are between 5-10 stories, which refers to the maximum number of victims falling height. Previous studies have shown that falls from heights are a major problem in urban areas, especially for children living in multiple-story^{2,5}. In some urban areas, falls have represented up to 20% of the deaths of children from unintentional injury, as compared with an average of 1% to 4% nationally^{3,6}. These results coincide with this study. The falls from greater heights tend to cluster in the summer months, presumably because windows are more likely to be open and children are more likely to be playing on fire escapes, roofs, and balconies^{2,7,8}. Falls in the elderly tend to occur with activities of daily living. In England falls account for 29% of injury deaths among adults aged 65 and older. Older adults are five times more likely to be hospitalized due to falls than to injuries from other causes⁹. Host factors such as poor muscle tone, vision problems, medication use, and sedentary lifestyle are the biggest contributors to ground-level and stair falls, but environmental components such as poor lighting and no handrails may increase the frequency. Factors contributing to falls from heights include faulty equipment, such as ladders and scaffold structures, and human factors, such as intoxication and inattention.

In this study all the victims had multiple abrasion and bruise in their body, followed by laceration 74(79.56%), fracture of skull 57(61.29%), intra cranial haemorrhage 85(91.40%), injury to long bones of lower limbs 47(50.54%) and upper limbs 31(33.33%), injury to abdominal organs like liver, spleen, kidney 51(54.84%), fracture of pelvis 37(39.78%). This result coincides with previous studies done abroad which revealed that approximately one third of children who fall 1 or 2 stories sustained only minor injuries, such as contusions, abrasions, and lacerations¹⁰. Fractures of radius, ulna, and femur are the most common injuries^{11,12}. Rib, spine, pelvis and calcaneus fractures are much less common among children than among adults. Because children tend to use their arms to protect their heads and they have relatively flexible bones^{13,14}. Multiple fractures and craniocerebral trauma are common, especially those resulting from falls from greater heights^{12,14}. Abdominal and chest injuries are relatively uncommon in low height falls but they are more frequent in fatal falls from greater heights. The nature of the surface onto which the victim falls and the degree to which the fall is broken on the way down modify the pattern and severity of injuries. Children younger than 3 years are much less likely to have serious injuries than older children who fall the same distance because younger children have more fat and cartilage and less muscle mass than older children, they better dissipate the energy transferred by the fall¹⁵.

In this study among skull bones linear fracture was the commonest one 48(51.61%) and Temporal bone was the commonest bone to fracture 57(61.29%). In most cases of fall from height head strikes by forcible contact with broad resisting surface like the concrete ground resulting the linear fracture. The thinnest area in our skull is temporal bone(4mm), followed by frontal bone (6mm), parietal bone (10mm) and occipital bone (15 mm). A force of 400- 600 pound per square inch is required to fracture a skull covered by cushion of hair and scalp. However a fall from three foot height will produce impact energy of 35 foot pound, causing two linear fracture or mosaic fracture. This indicates the predominance of different fractures, where the victims of fall from height are thrown with great impact^{16,17}. This study have shown that most of the victims 57(61.29%)

had sub dural haemorrhage. Extra dural haemorrhages are more common in 20-40 years of age and occurred mostly due to Road Traffic Accident (RTA) or hit by other object¹⁸. Sub dural haemorrhages most commonly occur in old ages and children due to fall on ground by accidents, whereas subarachnoid haemorrhages are most common pattern on intra cranial haemorrhage in RTA. A number of strategies have been suggested to prevent children falling from heights. Parent counseling has been effective in preventing infant falls and other injuries and should be part of any prevention program^{15,19,20}. Considerable success has been reported with modification of the physical environment. Spacing of railings determines how well they function to prevent falls from balconies, decks, porches, and bleachers. Widely spaced rails are ineffective barriers because they permit a child's body to slip through. Virtually all children younger than 6 years can slip through a 6-in opening, and none older than 1 year can pass through a 4-in opening²¹. This information resulted in the adoption of the 4-in spacing by all 3 of the regional building code organizations in the United States²².

Conclusion

The majority of serious injuries causing death in fall from height cases are related to falls from windows and roof tops. Strategies designed to prevent these falls should have a substantial effect. Discouraging or prohibiting children from playing on fire escapes, roofs, and balconies, especially those that are not adequately fenced with vertical bars and encourage the use of ground-level safe play areas, such as public parks and playgrounds can reduce the number of incidents. At the same time modernization of physical environment and strict maintenance of safety procedure can protect the vulnerable personnel and reduce economical burden.

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