

Fall from Height- A Comprehensive Retrospective Study at Tertiary Care Teaching Hospital**Digvijay Vaghela¹, Dushyantkumar Barot², Nisarg Modi³, Tapan J.Mehta^{4*}, Parth Patel⁵**¹Associate Professor (HG), Department of Forensic Medicine & Toxicology, Smt NHL Municipal Medical College, Ahmedabad, Gujarat,²Professor & Head, Department of Forensic Medicine & Toxicology, Banas Medical College & Research Institute, Palanpur, Gujarat,³Associate Professor, Department of Forensic Medicine & Toxicology, Banas Medical College & Research Institute, Palanpur, Gujarat,⁴Professor (HG), Department of Forensic Medicine & Toxicology, Smt NHL Municipal Medical College, Ahmedabad, Gujarat.⁵Intern, C U Shah Medical College & Hospital, Surendranagar, Gujarat.

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Abstract

When a person loses consciousness while standing or walking, they may fall. The direction of the fall (forward, backward, or sideways) depends on various factors. When someone jumps or accidentally falls from a height, different factors influence the types and patterns of injuries they sustain. In this study, we examined autopsies conducted at the VSGH mortuary over a three-year period from 2011 to 2013. We performed 1111 autopsies in 2011, 1181 in 2012, and 1240 in 2013, and among these cases, 5.52% were due to falls from a height. We discovered that over 87% of these deaths were the result of accidental falls, either at the workplace or elsewhere from a height. Males (77.44%) outnumbered females (22.56%) in terms of deaths from falls. The age group of 21-40 years (42.56%) was the most affected, as this is a productive and young age range. Multiple factors influenced the severity of injuries, ranging from no visible external injuries to various external injuries such as contused lacerated wounds (34.35%) and internal injuries such as skull fractures (61.53%).

Key words: Fall from height, suicide, accident, autopsies.

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Introduction

Nowadays, high-rise buildings, both commercial and residential, are gaining popularity in urban areas. The drainage of our institute for autopsies mainly relies on urban areas. Due to limited land area, advancements in technology have enabled the construction of taller buildings. Falls from heights are the most common type of accidents in urban settings. [1] Builders, electricians, miners, and painters are particularly at risk for accidental falls. Faulty equipment, such as ladders and scaffold structures, as well as human factors like intoxication and inattention, contribute to these incidents. The actual height from which a person falls, the body's orientation upon impact, the surface the body lands on, and deceleration are all factors responsible for different patterns and types of injuries. [2,3]

In many cases, the most severe injuries occur at the site of the initial impact. The head is often the primary point of impact, followed by the trunk and buttocks. Leg impacts are less common.³ Head

injuries can manifest as fractures, intracranial hemorrhage, and brain injuries. Surprisingly, even a fall from a sitting stool (5ft/lb) can be enough force to fracture the skull, while in some cases, the skull may not fracture even with forces exceeding 90ft/lb. [4] Falls from heights can result in both direct cranio-cerebral injuries and indirect head injuries. [5] Brain injuries can range from contusions to severe lacerations, depending on the circumstances. Coup and countercoup injuries are also possible in falls from heights.

Cervical spines involvement is also quite common in form of fracture or dislocation as indirect violence by falling from height on buttocks or feet. [6] Fracture pelvis is common in buttock first impact. Multiple external injuries ranging from laceration to abrasion is common findings. Lungs, ribs and liver are mainly injured in fall from height. Abdominal structures most likely to be damaged in order of frequency- 1) liver, 2) spleen, 3) kidneys, 4)

intestines, 5) abdominal wall, 6) mesentery, 7) pancreas, 8) diaphragm. [7]

When someone falls from a height and lands on their feet, it may seem like there are no external injuries or only minimal ones. However, fractures of the foot bones, comminuted or oblique fractures of the tibia-fibula, femur, pelvis, vertebral column, and skull can occur. Lacerations to the liver and spleen are also common. In cases of primary head impact, comminuted or depressed skull fractures with brain lacerations are often found. The body can twist and turn in unpredictable ways during a fall, leading to a variety of injuries. The displaced air can act as a cushion, propelling the body away from the building upon impact, which explains why the point of impact may be some distance away from the building and not necessarily evidence of a push or jump.

Aim and objectives

The study aimed to provide a comprehensive understanding of the demographics, nature of injuries, and causes of death related to falling from a height.

Materials & Methods

This retrospective study was conducted at a tertiary teaching hospital in Ahmadabad, Gujarat. We analyzed the data of cases brought to the mortuary of VS Hospital in the Department of Forensic Medicine and Toxicology for medico-legal post-mortem examinations from January 2011 to December 2013 (a total of 3 years). In 2011, a total of 1,111 autopsies were performed, followed by 1,181 in 2012 and 1,240 in 2013. Out of these 3,532 autopsies, 195 cases were identified as fall from height cases, which included falls from beds or while standing to falls from tall buildings. We classified the cases based on age groups, gender, places of incidence, manner of death (whether brought dead or medically attended), type of injuries present, cause of death, and more. We determined the reasons for suicide or accidents through autopsy examinations and thorough investigations by the police. The data were analyzed and compared with findings from previous studies.

Results

Table 1: Deaths due to fatal fall from height in relation to the total AUTOPSY that had been received during the studied period

Year	Total no. of Case	No. of cases of fall	Percentage (%)
2011	1111	75	6.7
2012	1181	77	6.5
2013	1240	43	3.5
Total	3532	195	5.5

Total 195 deaths reported from fall from height representing 5.5% of 3532 total medico legal autopsies done during the Study period.

Table 2: Age and gender wise distribution of victims

Characteristics	Frequency (n-195)	Percentage (%)
Age (years)		
< 1	4	2.05
1-10	21	10.77
11-20	23	11.79
21-30	43	22.05
31-40	40	20.51
41-50	22	11.28
51-60	15	7.69
61-70	13	6.67
71-80	10	5.13
81-90	1	0.51
>90	3	1.54
Gender		
Male	151	77.44
Female	44	22.56

Maximum number of fall from height cases were seen in the age group of 21-30 years (22.05%) followed by 31-40 years (20.51%). Maximum cases of fall from height were observed in males which contributed to (77.44%) the total cases of fall from height.

Table 3: Cause and Manner of Death

Characteristics of death	Frequency (n-195)	Percentage (%)
Cause of death		
Multiple injuries	67	34.36
Head injury	61	31.28
Chest injury	27	13.85
Head and chest injury	21	10.77
Cervical spine and chest injury	14	7.18
Cervical spine injury	4	2.05
Thoracic and lumber spine injury	1	0.51
Manner of Death		
Accidental	171	87.69
Suicidal	24	12.31
Homicidal	0	0

The cause of death in maximum cases was attributed to multiple Injuries (34.36%) followed by head injury (31.28%). The most common manner of death was accidental in nature (87.69%) followed by suicidal (12.31%) and no case of homicide was reported.

Table 4: Variation of the types of External injury among the victims

Types of injury	Number of victim	Percentage
External injury		
CLW	67	34.36
SSW	61	31.28
Fracture	60	30.77
Contusion	47	24.10
Internal injury		
SAH	150	76.92
SDH	128	65.64
Skull fracture	120	61.54
Brain injury	78	40.0
Rib, Clavicle, Sternum fracture	65	33.33
Lung injury	56	28.72
Liver laceration	39	20.0
EDH	27	13.85
Spine fracture	18	9.23
Spleen laceration	15	7.69
Kidney laceration	8	4.1

SSW- Surgical stitched wound, CLW- Contused Lacerated wound, EDH- Extra dural haemorrhage, SDH- Sub dural haemorrhage, SAH- Sub-arachnoids haemorrhage.

The Most common type of External injury is contused lacerated wound (34.36%). The Most common type of internal injury is Sub-arachnoids haemorrhage (76.92%) which is followed by Sub dural haemorrhage (65.64%).

Discussion

Injury due to fall from height remain significant cause of morbidity and mortality in our day to day life. Fatalities occur when a person fall from greater than 2 stories or when the head of the victims hits a hard surface such as concrete these include falls from roof, windows, balconies. In this study, we have studied autopsies done at mortuary of VSGH during three years from 2011 to 2013. We have performed 1111 autopsies in year 2011, 1181 in 2012

and 1240 in 2013 and out of these, 5.52% died due to fall from height.

Deaths resulting from falls from heights are the second leading cause of fatal injuries and are unfortunately increasing. The majority of these cases involve males, accounting for 77.44% of the total. This finding aligns with other various studies. [8-13] One possible explanation for this gender disparity is that males often serve as the primary earners for their families and are more exposed to stress, strain, and occupational hazards, including working at heights. They may also exhibit a greater level of enthusiasm and involvement in such tasks compared to females.

We observed the highest number of fall from height cases in the age group of 21-30 years, accounting for 22.05% of the total cases, followed by the age group of 31-40 years at 20.51%. Our findings are consistent with the study conducted by Roopak SN et al. [9]. However, our study differs from the one

conducted by Venkatesh VT et al. [11]. This difference could be attributed to the fact that young individuals in these age groups are more susceptible to falls, possibly due to their high levels of stress and uncertain lifestyles.

The majority of fall from height cases, approximately 87%, were observed in the workplace, particularly among construction workers. This finding aligns with the studies conducted by Jagannatha SR et al. [8] and Roopak SN et al. [9]. Several factors could contribute to this trend, including a lack of education, poor working skills, and workers' qualities such as a careless attitude, misjudgment, and overconfidence when performing unfamiliar tasks. Additionally, the absence of proper safety measures may also contribute to these fatal injuries. Other predisposing factors for fatigue-related injuries include chronic work pressure, burnout, sleep deprivation, work-related depression from increased workloads, strenuous physical activities, and prolonged periods of working at heights, which can lead to overexertion.

In the majority of cases, the cause of death was attributed to multiple injuries, accounting for 34.36% of the cases, followed by head injury at 31.28% and chest injury at 13.85%. This finding is consistent with the study conducted by Guntheti BK et al. [13]. The head remains the most vulnerable organ to injury during a fall due to the positioning of these body parts and the unpredictable nature of body movements and twists during a fall. This could explain why head injuries and multiple injuries are the most common, followed by blunt chest injuries.

The most frequent manner of death was accidental (87.89%), followed by suicidal (12.31%), with no reported cases of homicide. This finding is consistent with the studies conducted by Roopak SN et al. [9] and Jagannatha SR et al. [10]. Differentiating a case of homicide in falls from height can be challenging unless there are transportation injuries or CCTV footage that may provide clues. The most common type of external injury in these cases was contused lacerated wounds (34.36%), followed by surgical sutured wounds (31.28%). This difference in injury types could be attributed to the higher percentage of hospitalized cases (77.44%) compared to cases brought in dead (22.56%).

The most common type of internal injury observed in this study is subarachnoid hemorrhage, which accounts for 76.92% of cases. This is followed by injuries such as subdural hemorrhage (65.64%), skull fracture (61.54%), and injuries to multiple organs including the brain, lungs, liver, spleen, kidneys, and spine. It has been noted that in these types of studies, the majority of cases involve falls onto hard surfaces such as cement, concrete, stone, hard soil, and marble, as opposed to soft surfaces like sand and mud. On a relatively yielding surface, the energy is

dissipated slowly, but on a relatively unyielding surface like hard soil or concrete, the deceleration time is shorter, resulting in greater forces exerted on the body.

Conclusion

The present retrospective study was conducted at a tertiary teaching VS hospital in Ahmadabad, Gujarat, in the Department of Forensic Medicine and Toxicology. The study focused on medico-legal post-mortem examinations from January 2011 to December 2013, with a total of 3532 autopsies performed. Among these, 195 cases were identified as fall from height cases. The key findings are as follows:

- Fall from height cases accounted for 5.5% of the total autopsies conducted.
- The majority of fall from height cases were accidental in nature (87.69%).
- Males (77.44%) outnumbered females (22.56%).
- The highest number of cases (42.56%) occurred in the 21-40 years age group.
- In 22.56% of cases, deaths occurred on the spot.
- The most common external injury observed in 34.36% of cases was contused lacerated wound.
- The most common internal injury, seen in 76.92% of cases, was subarachnoid hemorrhage.
- The common causes of death were multiple injuries (34.36%) followed by head injury (31.28%).

References

1. Gautam Biswas. Review of forensic medicine and toxicology including clinical and pathological aspects. 5th ed. Jaypee Brothers Medical Publishers: The Health Sciences Publisher; 2021; 318.
2. K. S. Narayan Reddy, O. P. Murty. The essentials of forensic medicine and toxicology. 34th ed. JAYPEE: The Health Sciences Publisher; 2017. p. 256.
3. V V Pillay. Textbook of forensic medicine and toxicology. 20th ed. Paras Medical Publisher; 2023. p. 205.
4. Modi's Medical Jurisprudence and toxicology. 23rd ed. Lexis Nexis Butterworths; 2005. p. 799.
5. J B Mukherjee's Forensic Medicine and Toxicology. 5th ed. Academic Publishers; 2018. p. 454.
6. J B Mukherjee's Forensic Medicine and Toxicology. 5th ed. Academic Publishers; 2018. p. 480.
7. Dr. Anil Aggrawal. Textbook of Forensic Medicine and Toxicology. 2nd ed. Avichal Publishing Company; 2021. p. 347.
8. Jagannatha SR, Venkatesha VT. Rise in Deaths Due to Fall from Height: A 3-Year

- Retrospective Study. Medico-Legal Update. 2019 Jul 1;19(2).113-6
9. Roopak SN, Jagannatha SR. "Deaths due to fall from height"-an autopsy study. Forensic Medicine & Toxicology. 2015 Jan;9(1):123-5
 10. Jagannatha SR, Kumar MV, Kumar TN, Ananda K, Venkatesha VT. Injuries due to fall from height-a retrospective study. Journal of Forensic Medicine and Toxicology. 2010;27(1):47-50.
 11. Venkatesh VT, Kumar MP, Jagannatha SR, Radhika RH, Pushpalatha K. Pattern of skeletal injuries in cases of falls from a height. Medicine, Science and the Law. 2007 Oct;47(4):330-4.
 12. C.R VM, Harish S, Chandra YP. The Study of Pattern of Injuries in Fatal Cases of fall from Height. AlAmeen J Med Sci.2012; 5(1): 45-52
 13. Guntheti BK, Singh UP. A Study of pattern of Injuries in fall from Height. Journal of Karnataka Medico legal society. 2016 Jan;25(1):26-34.