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Original Research Article

To Determine Correlation Between Crime Scene and Pattern of Injuries in Deaths Due to Fall from Height

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Abstract

Mortality resulting from blunt trauma secondary to falls, as a consequence of an extended lifespan, is anticipated. The objective of this study was to investigate the association between the vertical distance of descent and the incidence, severity, and anatomical distribution of injuries in specific anatomical regions and organs. The cumulative incidence of cases during the designated research period amounted to 92 cases, constituting 5% of the overall autopsied cases observed throughout the study duration. This prospective study was conducted by examining the post-mortem examinations, inquests, psychological autopsy when deemed necessary, and subsequently reviewing the postmortem reports. In addition to these, a comprehensive examination of case reports, architectural blueprints, forensic photographs of the crime scene, investigative reports containing relevant historical information, and case diary files obtained from the police department were conducted.

Keywords: Injury pattern, Height of fall, Cause of death, Head trauma, Fatal falls.

Introduction

A fall from height, also known as a vertical descent, pertains to the act of descending from an elevated position to a lower level, typically involving structures such as ladders, stairs, rooftops, and similar architectural elements. The term "high fall injury" pertains to the physical harm incurred when an individual's body descends from a significant elevation and makes contact with the surface below [1, 2]. A contemporary characterization of a fall from an elevated position entails the act of

transitioning from an erect, seated, or supine posture, with the vertical displacement exceeding or equating to one metre. It has been noted that there is an increasing trend in fatalities resulting from falls from elevated surfaces. This phenomenon can be attributed to various factors, including lack of attentiveness, psychological disturbances, non-compliance with workplace safety guidelines, among others [3]. Individuals often engage in various occupational activities, such as painting, decoration, window cleaning, and high-rise construction, without adequate training or adherence to safety protocols, primarily driven by financial incentives [4]. Numerous variables contribute to the severity of injuries sustained in incidents involving falls from elevated surfaces. Several factors contribute to the occurrence of falls, including demographic characteristics such as age and sex, as well as physical parameters like the height and trajectory of the fall. Additionally, the presence of obstacles along the fall path, the amount of kinetic energy or force upon impact, the nature of the contact surface, and the potential intoxication of the individual are all relevant considerations in the analysis of falls [5-9]. In instances presented to the Department of Forensic Medicine and Toxicology of King George Hospital, Visakhapatnam, wherein autopsies are performed on individuals who have died as a result of falls from elevated surfaces, the absence of reliable eyewitness testimony, inadequate historical accounts provided by witnesses, the absence of closed-circuit television (CCTV) surveillance, insufficient preservation of the crime scene, the handling of the deceased without photographic documentation, incomplete crime scene sketches, and the limited understanding of forensic physics in scene reconstruction by certain investigating officers, as well as the absence of experienced setups for reconstruction, collectively pose challenges for the autopsy surgeon in determining the nature of the injuries sustained, unless they can be compared with the scene of the incident.

Examining the crime scene could potentially provide valuable insights to the forensic pathologist, aiding in the formulation of a more comprehensive understanding of the mechanisms underlying the inflicted injuries. This scholarly article endeavoured to examine the correlation between injury patterns and crime scenes. Therefore, within the scope of the current investigation on fatalities resulting from falls from elevated positions, establishing a correlation between the characteristics of the crime scene and the observed injury patterns assumes a heightened level of significance in determining the manner of death. Consequently, it is imperative to place a greater emphasis on this aspect of the analysis.

Methods

This study entails a prospective examination of fatal cases resulting from falls from elevated surfaces, which were subsequently brought to the mortuary of King George Hospital, affiliated with Andhra Medical College in Visakhapatnam. The primary objective of this investigation is to perform autopsies on these cases, with data collection spanning from November 2019 to December 2020. The aggregate number of cases observed throughout the designated research duration amounted to 92 cases, constituting 5% of the overall autopsied cases documented within the study period. This prospective study was conducted by examining the post-mortem examinations, inquests, psychological autopsy when deemed necessary, and subsequently reviewing the postmortem reports. In addition to these, a comprehensive examination was conducted, encompassing the analysis of case reports, architectural blueprints, forensic imagery, investigative reports containing relevant historical data, as well as case diary files obtained from the police department.

Data collected in these cases of fall from height were divided as per categories shown below:

- Personal Data: The Age, Sex, Occupation, Mental status (as per inquest and psychological autopsy), Marital status,
- Data Collected at the Crime Scene: Alleged manner of death, the Place of incident, If Safety precautions were followed, Surface at initiation point of fall, Protection wall/ grill at point of initiation of fall, Height of fall, Obstacles in the path of fall, Type of landing surface.
- Data Procured after Conducting autopsy: Injuries inflicted on the body, presenting part on contact to ground based on injuries, any suspicion of intoxication and Cause of death.
- Special efforts to visit crime scene and falling measurements are made.
- Toxicology results FSL and RFSL were reviewed in suspected cases.

Inclusion Criteria

During the period spanning from November 2019 to December 2020, the Department of Forensic Medicine and Toxicology at AMC, VSP received requests to perform autopsies and provide expert opinions on the cause of death for individuals who tragically lost their lives as a result of falls from elevated locations.

Exclusion Criteria

- Deaths which occurred due to falls from same level (such as fall on the roads while walking, fall due to sudden blackouts etc.,) were excluded.
- Deaths which occurred due to tumble over a staircase.
- Deaths due to fall from a moving Vehicle (bike, train, etc.,)
- Cases where fall from height is a secondary cause of death (Such as falls after sustaining electric shocks etc.,)

Results

The research cohort consisted of 92 autopsy cases over a period of 14 months as a result of incidents involving falls from elevated surfaces. After conducting a thorough analysis of inquests, post-mortem examination reports, and case diary files, the following observations have been delineated. The frequency distribution of all the variables examined in the study is presented in tables and graphs below.

Table 1: Age Distribution

Age Group	Number Of Cases
0 To 10 Yrs	5
11 To 20 Yrs	1
21 To 30 Yrs	24
31 To 40 Yrs	17
41 To 50 Yrs	21
51 To 60 Yrs	9
61 To 70 Yrs	13
71 To 80 Yrs	1
81 To 90 Yrs	1

Table 2: Gender Distribution

Gender	Number Of Cases
Male	80
Female	12
Total	92

Table 3: Distribution based on occupation

Occupation	Number Of Cases
AC Repair Mechanic	1
Mason	22
Dairy Farm Worker	1
Electrician	1
Fisherman	1
Gardener	1
Government Servant	3
Watchmen	4
House Wife	3
Lorry Cleaner	1
Naval Officer	1
Painter	5
Pentioneer	8
Plumber	4
Private Employee	12
Railway Employee	4
Student	14
Toddy Worker	2
Unemployed	1
Water Tanker Driver	2
Wood Cutter	1

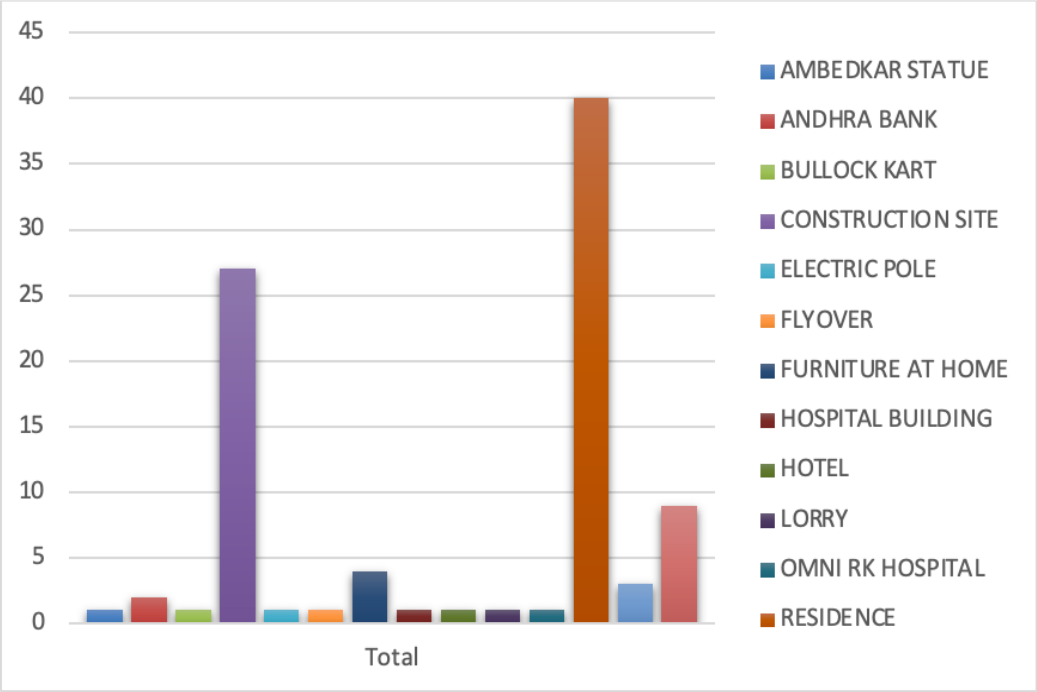

Figure 1: Distribution based on place of incident

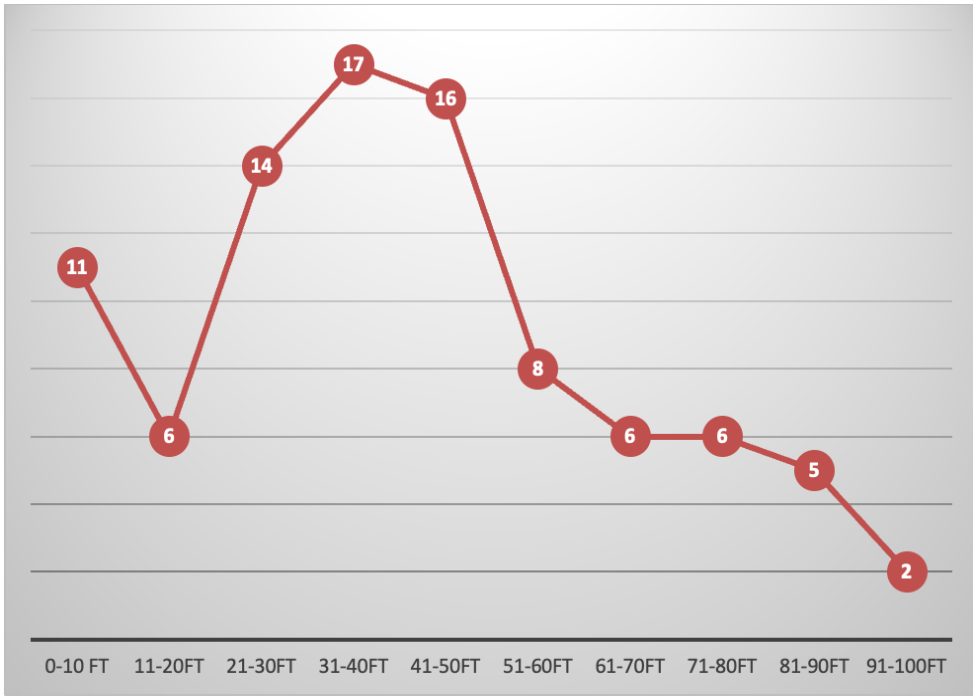

Figure 2: Distribution based on height of fall

Discussion

A fall is characterised as a traumatic incident experienced by an individual subsequent to descending to the ground from an elevated position, such as a ladder, scaffold, building, roof, or any other elevated work area. Falls are identified as the second most prevalent cause of unintentional injury fatalities globally [10, 11]. On a global scale, falls represent a significant public health concern. Approximately 684,000 fatal falls are reported annually, rendering it the second most prevalent cause of unintentional injury mortality, surpassed only by road traffic injuries [12]. While individuals of all demographics who experience falls are susceptible to potential harm, it is important to consider the influence of age, gender, and overall health on the nature and extent of injuries that may ultimately lead to mortality. Several variables contribute to the mortality and morbidity associated with falls, including patient age, fall height, etiology of the fall, characteristics of the ground surface upon which the patient fell, and specific anatomical regions affected [13]. The age of the individual, the height from which they fell, the cause of the fall, the type of ground they struck, the specific body part that was injured, and any resulting organ injuries are the primary determinants that influence the morbidity and mortality rates associated with falls from elevated surfaces [14].

In the current investigation, a substantial majority of participants, specifically 87%, were identified as male. This finding is consistent with previous scholarly research, thereby reinforcing its validity and reliability. Thirteen percent of the study cohort consisted of individuals assigned the female gender. Males exhibit a higher likelihood of encountering traumatic incidents and experiencing falls in comparison to females, primarily due to the increased levels of physical activity observed in boys during their early developmental stages. Furthermore, the prevalence of men engaging in physically demanding occupations surpasses that of women, further contributing to their heightened exposure to such incidents. The incidence of falls predominantly impacts the male population, exhibiting a notable disparity in the vulnerable age groups of both infants and the elderly. Globally, males consistently experience elevated mortality rates. Potential aetiologies for the observed disparity among males could

potentially encompass elevated prevalence of risk-taking behaviours and occupational hazards.

The cohort exhibiting the greatest incidence of falls in our research was the 21–30-year age group, accounting for 26% of the total cases. The observed disparity is distinct from previous research findings, where the highest prevalence was observed among individuals aged 0–4 years and 0–10 years. The elevated incidence of falls within these specific age cohorts can be attributed to the heightened physical activity levels exhibited by children, coupled with a deficiency in protective measures. In the present study, it was observed that a significant proportion of fatalities resulting from falls from elevated surfaces, amounting to 74%, occurred in individuals aged 45 years or younger. This finding suggests a higher incidence of traumatic incidents among individuals in their prime years of physical activity. Elderly individuals, particularly those aged 60 and above, experience a decline in their equilibrium function, leading to an increased susceptibility to falls.

According to our research findings, the occupation that exhibited the highest prevalence of impact was that of masons engaged in construction activities, accounting for approximately 24% of the affected population. Among the aforementioned 24% of fatalities, a significant proportion can be attributed to accidental occurrences. These unfortunate incidents have arisen primarily as a result of inadequate utilisation of essential protective equipment or failure to adhere to appropriate precautionary measures during occupational activities. Due to the rapid urbanisation of Visakhapatnam, a burgeoning metropolitan city, there has been a significant increase in the construction of residential apartments and office buildings. This surge in construction activity has consequently led to a substantial rise in the overall percentage of built structures within the city. The subsequent most prevalent demographic consisted of individuals within the age range of 5 to 26 years, identified as students, comprising 15% of the study cohort. This was closely followed by 13% of the cases involving private employees who were not engaged in occupational activities at elevated heights.

In our conducted study, it was observed that 43% of fatalities resulting from falls transpired within residential settings. This can be attributed to the fact that our study sample primarily consisted of individuals who identified as homemakers. It is worth noting that the prolonged COVID-19 lockdown measures necessitated individuals to spend a greater portion of their time within their respective residences, thereby potentially increasing the likelihood of falls occurring in such environments. The second most prevalent location reported was construction sites, accounting for 29% of the cases. In the study conducted, it was found that 10% of the reported cases resulted in fatalities as a result of falls from various tree species such as mango, tamarind, palm, neem, and others.

In general, the fatality rate is higher in cases of vertical descent from elevated locations as opposed to lower elevations [15]. The documented mortality rates associated with falls from heights of ≥12 metres (39 feet) and ≥18 metres (59 feet) were reported to be 50% and 100%, respectively [15]. In a case report presented by Lee BS et al [16], a remarkable survival following a precipitous descent of approximately 190 feet is documented. In a study conducted by Liu et al [16], it was observed that the mortality rate attributed to falls from a height greater than 6 metres (equivalent to 19.6 feet) was 22.7%. Similarly, Velmahos et al [17] reported a mortality rate of 9.6% for falls from a height exceeding 9 metres (equivalent to 29.5 feet). In the current investigation, the majority of fatalities were documented as a result of vertical descents from elevations ranging between 21 and 50 feet, with the highest incidence occurring at heights ranging from 31 to 40 feet. The distribution of cases based on the height of fall, arranged in descending order, is as follows:

According to the medical and academic data, 18% of cases occurred among individuals with a height ranging from 31 to 40 feet. Similarly, 17% of cases were reported among individuals with a height between 41 and 50 feet. Additionally, 16% of cases were observed in individuals with a height ranging from 21 to 30 feet. Furthermore, 12% of cases were documented among individuals with a height of 0 to 10 feet. Moreover, 9% of cases were reported among individuals with a height between 51 and 60 feet. Furthermore, 7% of cases were observed in individuals with a height ranging from 61 to 70 feet. Similarly, 7% of cases were documented among individuals with a height between 71 and 80 feet. Additionally, 5% of cases were reported among individuals with a height ranging from 81 to 90 feet. Lastly, 2% of cases were observed in individuals with a height between 91 and 100 feet.

Conclusion

The primary objective of this study was to establish a correlation between the characteristics of crime scenes and injury patterns in cases of fatal falls from elevated heights. Based on the conducted analysis, it can be deduced that there exist numerous deficiencies in the acquisition of data from the crime scene, whether by the investigating officer, the forensic team, or any other personnel visiting the site of the incident. Cases presenting comprehensive data have elucidated a lucid depiction of the criminal incident; however, certain instances have been marred by a paucity of evidence, thereby obfuscating the modality of demise. Hence, additional investigation involving the gathering of essential variables such as the spatial proximity of the individual to the structure, atmospheric air flow intensity, compilation of closed-circuit television recordings, and other pertinent data, can potentially provide novel perspectives on the nature and causation of bodily harm. This pursuit aligns with the fundamental goals of postmortem examinations, particularly in relation to discerning the manner of death. Several recommendations have been delineated in accordance with the findings of the present study.

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