

# Emergency surgery for traumatic brain injury in geriatric patients

## Abstract

**Objectives:** Verify the sociodemographic profile of an elderly victim of trauma due to a fall who is admitted to the ICU of a public reference hospital to determine whether there are relationships between his age, comorbidities, length of stay, complications and clinical results. A retrospective analytical study with a quantitative approach was carried out between April and October 2014 in the Intensive Care Unit (ICU) of the Hospital de Base do Distrito Federal, administered by the State Department of Health of the Federal District, DF. Using the TrakCare® computerized medical record, sociodemographic data were found on elderly people hospitalized between the fall of July 2012 and July 2014, including mechanisms of trauma, comorbidities, length of stay, use of invasive devices, vasoactive and sedative drugs, complications and clinical internships.

**Results:** The sample was made up of 52 elderly people, the majority of whom were men and the injury was a fall in height. Lung infection, septic shock, use of blood products and acute renal failure were the main complications. Despite the high mortality observed in the study, the majority of elderly people survived the traumatic event. Male sex, traumatic brain injury (TBI), pulmonary septic shock and dialysis were the main causes of mortality.

**Conclusion:** Falling in height, fractures and severe TBI were extremely common, and most patients had more than one complication during hospitalization. No significant difference was found between age and mortality.

**Keywords:** elderly, fall accidents, trauma, ICU

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## Introduction

Ageing is a dynamic process in which there are morphological, functional, biochemical and psychological changes that lead to a loss of the individual's ability to adapt to the environment, which can lead to greater vulnerability and a higher incidence of pathological processes that end in death. Many of the physiological changes associated with ageing result from the gradual loss of the individual's ability to adapt to the environment, which can begin in adulthood, but because of the composition of the organ systems, these losses only become important when the decline is extensive.<sup>1</sup>

The World Health Organization defines a fall as any involuntary event in which a person loses their balance and their body falls to the ground or onto a firm surface. It results from the body's mechanical inability to maintain an upright position due to internal or external destabilization.<sup>2,3</sup> The occurrence of falls in Brazil is not very different from the patterns observed in other countries. Approximately 30 to 40% of elderly Brazilians living in the community fall at least once a year, while 11% fall repeatedly.

**Characteristics of traumatic injuries in the elderly and specific risk factors:** In the elderly, traumas often occur as a result of falls, traffic accidents or events brain mass and brain atrophy, they are more prone to intracranial hemorrhages, even after low-intensity trauma.

**Clinical factors:** Pre-existing conditions such as hypertension, diabetes, osteoporosis and the use of anticoagulants (such as warfarin) increase the severity of injuries and complicate treatment. Decreased

regenerative capacity also interferes with the recovery process. Worldwide, traumatic brain injury (TBI) is one of the main causes of mortality and morbidity among the elderly, especially due to falls. In developed countries, there is greater monitoring of these cases and more structured health systems to deal with ageing. Traumatic injuries in the elderly, particularly those related to brain trauma, have become increasingly relevant in Brazil and around the world due to the ageing population. The elderly are more susceptible to trauma due to bone fragility, loss of balance and a higher prevalence of chronic diseases, which can aggravate the impact of injuries. In Brazil, the scenario is similar, but aggravated by regional disparities in access to health care, socio-economic inequalities and gaps in specialized care. Brazilian epidemiological studies indicate that falls in the elderly are responsible for a large proportion of hospital admissions due to TBI.

**Surgical approaches:** The treatment of TBI in the elderly can involve surgical procedures, such as craniotomies to evacuate subdural or epidural hematomas. However, the decision whether or not to operate is often complicated by the patient's frailty and the risk of post-operative complications.

**Conservative therapy vs. surgery:** In some cases, conservative treatments are preferred, due to the increased risk of mortality and morbidity associated with surgery. Surgical interventions can be controversial in very elderly patients with multiple comorbidities.

**Eligibility criteria for surgery:** One of the main controversies is the clear definition of criteria for the indication of surgery in elderly patients with TBI. The decision varies based on factors such as the

severity of the injury, the patient's general state of health and the presence of comorbidities. There is a lack of consensus on which patients really benefit from surgical intervention.

**Impact of the use of anticoagulants:** Many elderly people use anticoagulants to prevent thromboembolic events, which increases the risk of bleeding after trauma. The management of anticoagulants in the context of TBI is another point of debate, with disagreements over when and how to suspend or reverse these drugs in trauma patients.

### Research needs in Brazil

**Insufficient data:** Despite the recognition of the seriousness of TBIs in the elderly, there is a lack of Brazilian longitudinal studies and clinical trials evaluating the efficacy and safety of brain trauma surgery in this population.

**Regional disparities:** Another area that justifies research is the discrepancy in access to specialized trauma care in different regions of the country, with hospitals in rural or less developed areas having fewer resources.

**Specific management protocols for the elderly:** There is a lack of standardized protocols for the management of TBI in the elderly, adapted to the needs and characteristics of this population. This contributes to variations in treatment and quality of care. The increase in the elderly population and the high prevalence of TBIs among the elderly call for a more in-depth understanding of how best to manage these cases. The need for clearer protocols, especially regarding surgical indication, and the lack of consensus on long-term results make this a fertile field for research, both in Brazil and abroad and globally. Falls can be considered a sentinel event in the life of the elderly, as a potential marker of declining functional capacity or a symptom of a new pathology.<sup>4,5</sup>

Falls often occur as a sum of intrinsic and extrinsic risk factors, and it is difficult to restrict a fall event to a single risk factor or causal agent. There are several intrinsic factors that favor falls in the elderly, such as the losses resulting from the physiological decline that accompanies the aging process, such as changes in the cardiac, nervous, sensory and musculoskeletal systems, including changes in vision, hearing, smell, gait, balance, motor coordination and reaction time. In addition, the coexistence of systemic diseases and consequently the use of various medications predispose the elderly to the risk of trauma.

In addition to the physiological changes of age itself, the main cause of falls is related to extrinsic factors, which depend on social and environmental circumstances that create challenges for the elderly. However, there is a lack of definition in the literature about the contribution of each of these factors to the traumatic event, as it is considered that extrinsic factors cannot be considered only in terms of where the elderly person lives that there is also interference from cultural, religious, age and ethnic aspects.<sup>6-9</sup>

Falls can be seen as one of the most serious consequences of ageing and are recognized as a major public health problem, due to their frequency, morbidity and the high social and economic cost of the injuries they cause. They are a major complication for the elderly, causing everything from minor abrasions to various limb fractures, head trauma and hip fractures, often resulting in death.<sup>10,11</sup>

Given the seriousness of this public health problem and the scarcity of data in the literature on elderly victims of trauma due to falls in the community admitted to a high-complexity unit, it was important to know the profile of this population, as well as the complications and outcome resulting from the traumatic event. In this way, this information could support the formulation of care protocols for these elderly people, and more efficient preventive public actions could be adopted, since this type of trauma predominantly has preventable causes.

The objectives of this study were to investigate the sociodemographic profile of elderly victims of trauma due to falls admitted to the intensive care unit (ICU) of a public reference hospital in the Federal District (DF) and to verify the correlation between age, comorbidities, injuries, length of stay, complications and clinical outcomes.

### Methodology

The study included patients aged 60 or over who had suffered trauma as a result of a fall in the community and were admitted to the ICU between July 2012 and July 2014. The sample was determined using the non-probabilistic convenience sampling criterion. Elderly patients admitted for clinical causes, non-traumatic surgical causes and those whose medical records contained incomplete information on trauma mechanisms and causes were excluded. As the research was carried out on patients' medical records, the Informed Consent Form (ICF) was waived. The research was carried out in the electronic database of the SES-DF, the TrakCare® computerized medical records system, and sociodemographic information was collected (gender, race, age, weight, height, schooling), related to the mechanism of trauma, associated comorbidities and ICU admission (length of stay, use of invasive devices, vasoactive drugs and sedatives, complications and outcomes). Descriptive statistics, absolute and percentage frequency tables and graphs were used to analyze the data. The data was recorded in a Microsoft Excel spreadsheet (version 14.0), and the chi-square test was used to analyze associations.

Mann-Whitney for non-parametric variables, using the software Statistical Package and Service Solutions (SPSS) version 18.0. The normality test used was Shapiro-Wilk, and the probability of statistical significance was acceptable,  $p > 0.05$ . In order for the data to follow a normal distribution and for the p-value of the Shapiro-Wilk test to be greater than 0.05 (indicating normality), the sample needs to be taken carefully, taking into account the characteristics of the population and the purpose of the study. Calculating the sample size involves different aspects that must be taken into consideration, especially in studies involving the elderly and trauma, as mentioned above.

Below, I present the main steps and factors for calculating the sample size:

### Definition of the Hypothesis:

Null hypothesis ( $H_0$ ): The sample follows a normal distribution.  
Alternative hypothesis ( $H_1$ ): The sample does not follow a normal distribution.

**Determining the Sample Size:** To ensure that the data follows a normal distribution (i.e. with  $p > 0.05$  in the Shapiro-Wilk test), some factors are taken into consideration when calculating the sample:

**Population Size:** The population of elderly trauma victims admitted to the ICU. **Confidence Level:** A 95% confidence level is commonly chosen (i.e. a significance level of  $\alpha = 0.05$ ).

**Statistical power:** Normally, a statistical power of 80% or 90% is defined to ensure that the study has sufficient probability of detecting a significant effect, if it exists. **Effect Size:** This refers to the magnitude of the expected difference or association that you want to identify. In the case of associations such as mortality or complications, the effect may be strong (large).

**Standard Deviation or Variability:** The variability of the data also impacts the sample calculation. The greater the variability of the data (dispersion), the larger the sample will need to be.

### Practical considerations for TCE and Elderly people

In clinical studies with the elderly, such as the one described here, it is common for the population of interest to already have more homogeneous characteristics, which can make it easier to obtain data that follows a normal distribution. The sample size can be calculated using specific statistical formulas or software such as G\*Power, taking into account the parameters mentioned.

The basic formula for calculating the sample size in studies aimed at estimating a mean is:

$E = \text{Margin of error (tolerance for estimation error)}$ .

to verify the normality of the data.

Results of the Shapiro-Wilk test ( $p > 0.05$ ). After calculating the sample and collecting the data, the Shapiro-Wilk test was applied.

A  $p > 0.05$  suggests that the sample was sufficiently large and adequate for the data to follow a normal distribution, which is an important requirement in many parametric analyses (such as ANOVA, t-tests, etc.).

### Simplified example

If, for example, a sample of 52 patients was taken based on the calculations of variability and adequate statistical power, the normality of the data was confirmed after applying the Shapiro-Wilk test, resulting in  $p > 0.05$ , indicating that the data follows a normal distribution.

### Conclusion

The sample size was calculated based on the estimated standard deviation, the confidence level and the variability of the data observed in the elderly. The Shapiro-Wilk test confirmed the normality of the data ( $p > 0.05$ ), which allows parametric analyses to be used with greater confidence in the results.

### Results

In the period from July 2012 to July 2014, among the elderly admitted, 91 hospitalizations were due to traumatic causes. Of these patients, 52 were selected because they were victims of falls in the community, which corresponds to 57.1% of elderly victims of falls trauma, 5.4% of all elderly people admitted, or 2% of all admissions in that period. The average age of the participants was  $74.2 \pm 8.15$  years (60-92 years). There was a predominance of elderly people aged between 60 and 69 (38.4%), followed by those aged between 70 and 79 (32.7%). With regard to gender, there was a prevalence of males (67.3%) in relation to females, in a ratio of 2:1 (Table 1). With regard to region of origin, there was a predominance of elderly people living in the Federal District ( $n = 35$ , 67.3%) compared to those living in other states ( $n = 17$ , 32.7%). Goiás was the state with the highest number of elderly referrals ( $n = 13$ , 76.5%), followed by Minas Gerais ( $n = 3$ , 17.6%) and Bahia ( $n = 1$ , 5.9%). The average prevalence of pre-existing diseases per elderly person was 2.3. Seven (13.5%) medical records reported the absence of comorbidities or no record of them. A previous history of falls was present in six (11.5%) cases and, of these, two (33.3%) had already suffered a traumatic brain injury (TBI) as a result of a fall. It should be noted that nine (17.3%) of the elderly had previous mobility problems and eight (15.4%) had neurological problems, particularly schizophrenia ( $n = 2$ , 25%).

**Table 1** Distribution by age group and sex of elderly fall victims admitted to an intensive care unit, between July 2012 and July 2014, Brasília (DF)

Age	60-69 years n (%)	70-79 years 9 (%)	80-89 years 9 (%)	> 90 years D (%)	Total 0 (%)
Feminine	2 (3,8)	8 (15,4)	5 (9,6)	2 (3,8)	17 (32,7)
Masculine	18 (34,6)	9 (17,3)	7 (13,5)	1 (1,9)	35 (67,3)
Total	20 (38,4)	17 (32,7)	12 (23,1)	3 (5,8)	52 (100)

absolute frequency; %: percentage frequency.

Among the comorbidities recorded in the medical records ( $n = 45$ , 86.5%), hypertension ( $n = 27$ , 60%), alcoholism ( $n = 10$ , 22.2%), ischemic stroke ( $n = 10$ , 22.2%) and type 2 diabetes mellitus ( $n = 9$ , 20%) stood out. There was an association between gender and comorbidities. Female patients were more likely to have hypertension ( $p = 0.017$ ) and diabetes ( $p = 0.046$ ), while male patients had ischemic stroke ( $p = 0.029$ ) and alcoholism ( $p = 0.012$ ) were more frequent. There was no significant association between comorbidities, complications and outcomes ( $p = 0.28$ ). It was not possible to find records on race, schooling and marital status, as this data was missing from most of the medical records we researched. Regarding care pre-hospital care (APH), 26 (50%) elderly people received this type of support, and 92.3% ( $n = 24$ ) were assisted by the Mobile Emergency Care Service (SAMU). However, among the 26 (50%) elderly people who did not seek pre-hospital care, going to the emergency health service from

their own home, the majority ( $n = 20$ , 76.9%) were victims of falls from their own height.

As for the main causes of traumatic admissions, there was a predominance of TBI (67.3%), followed by fractures (28.8%) (Table 2). As for the types of fall, there was a predominance of falls from own height ( $n = 38$ , 73.1%), followed by falls from the roof ( $n = 6$ , 11.5%). Only two (5.3%) patients fell from their own height on a public road; the other cases occurred in the elderly person's home. Elderly fall victims admitted to the ICU came from the post-anesthetic recovery room (PACU) ( $n = 27$ , 51.9%) after neurosurgery, directly from the operating room/surgery center ( $n = 16$ , 30.8%) after orthopedic surgery and from the emergency room (ER) ( $n = 9$ , 17.3%). The average waiting time for an ICU bed was 44.6 hours (1 h-192 h) or 1.9 days. The average length of stay was 327.3 hours (12

h-2,544 h) or 13.6 days. The average prevalence of invasive devices used was four (1-7 devices). With regard to the use of vasoactive drugs and sedatives, 36 (69.2%) elderly people used vasoactive drugs during hospitalization, especially noradrenaline (61.5%) and sodium nitroprusside (11.5%), and 33 (63.5%) used sedatives, especially fentanyl (57.7%) and midazolam (51.9%).

**Table 2** Traumatic profile of elderly fall victims admitted to an intensive care unit, between July 2012 and July 2014, Brasília (DF)

Traumatic causes	n	%	Total n (%)
Traumatic brain injury			
Light	3	5,8	
Moderate	4	7,7	35 (67,3)
Serious	28	53,8	
Polytrauma			
Spinal cord trauma			
Lumbar	1	1,9	1 (1,9)
Fractures			
Femur	13	25	
Hip	2	3,8	15 (28,8)

absolute frequency; %: percentage frequency.

The most common complications were pulmonary infection (42.3%), tracheostomy due to extubation failure or after prolonged intubation (40.4%), septic shock (30.8%), the use of blood products (28.8%), acute renal failure (23.1%) - in which 13.5% required dialysis - arrhythmias (21.1%) and the occurrence of pressure ulcers (19.2%), especially in the sacral region (11.5%). The majority (76.9%) of the elderly had more than one complication, and nine (17.3%) had no complications during their ICU stay. As for the outcome of the ICU stay of the elderly fall victim, the majority (33, 63.5%) survived the traumatic event, 18 (34.6%) died and one (1.9%) was transferred to a less complex ICU, due to resolution of the traumatic cause and continued dependence on mechanical ventilation. Among the elderly who died, males predominated, with 14 deaths, or 77.7% of the cases. There was no association between age and mortality ( $p = 0.44$ ), but there was a strong association between the traumatic cause (severe TBI), the occurrence of septic shock with a pulmonary focus, dialysis and mortality ( $p = 0.003$ ,  $p = 0.04$  and  $p = 0.001$ ), respectively.

## Discussion

In this study, there was a prevalence of elderly people aged between 60 and 69 years old and male, with an average age of 74.2 years. This is in line with the majority of studies on elderly fall victims, in which the occurrence of falls is higher among females, due to the "feminization" of old age. It should be noted that these studies were carried out among elderly people living in the community or victims of trauma admitted to emergency services, although some show a higher proportion of male victims, regardless of age group.<sup>5,7,8,12</sup> It was observed that the majority of elderly people (86.5%) had pre-existing chronic diseases, with an average of 2.3 comorbidities per elderly person surveyed and a predominance of systemic arterial hypertension, a fact reported in other articles surveyed. The prevalence of alcohol ischemic stroke among the elderly surveyed, as well as diseases that compromise the functional and cognitive capacity of the elderly, even with previous falls.<sup>1,12,13</sup>

The higher incidence of chronic diseases and the use of polypharmacy for their treatment lead to a greater risk of trauma in the elderly. Many drugs consumed by the elderly population, such

as antianginals, antidepressants, antihypertensives, antipsychotics, among others, potentially cause falls due to their cumulative side effects, interaction with other drugs or orthostatic hypotension. Pre-existing diseases and medications directly interfere with the respiratory and hemodynamic condition of the elderly, which often masks the severity of the trauma and precipitates states of hypoperfusion and hypoxia in patients with a higher incidence of arterial diseases.<sup>11,14,15</sup>

Elderly people with recurrent falls can be considered a high-risk group for further falls, a risk that increases with age. Elderly people with a history of falls and comorbidities may have reduced activities of daily living, which contributes to them becoming more frail. This situation can have a greater psychosocial impact, such as post-fall syndrome, causing even greater limitations in activities. The consequences can be mild or severe, generating high costs for society (hospitalization, treatment and rehabilitation costs), as well as significant costs for the family.<sup>2,16</sup>

With regard to the presence of pre-hospital care, exactly half of the patients in the study were found to have a fall

received this type of support, but 52.6% of elderly victims of falls from their own home did not receive this initial care and sought the emergency services themselves. Many elderly people ignore the importance of falls, believing that they are inherent to ageing. Initial care is responsible for the clinical stabilization of patients and defining the severity of the trauma, so that these patients can be transferred to trauma referral hospitals that meet their needs. The contribution of mobile pre-hospital care to reducing mortality and sequelae in trauma victims is undeniable.

It should be noted that, despite the predominance of falls from their own height, 26.9% of the elderly were victims of falls from a height (roof, stairs). This data may be linked to the maintenance of functional independence, which allows the elderly to carry out activities which therefore make them more susceptible to accidents.<sup>5</sup>

Falls are the leading cause of TBI in the elderly, followed by car accidents. Male gender is associated with a higher incidence of TBI in the elderly, but women are more likely to be hospitalized after the injury. The importance of TBI in both mortality and hospital morbidity resulting from falls from the same level is noteworthy, suggesting that the fall may be due to loss of consciousness (syncope or dizziness), slipping on a smooth or wet surface and the high fragility of the elderly person.<sup>6,17</sup>

Fractures in the elderly are usually the result of low-energy trauma such as falls in the home, mainly causing fractures of the proximal femur, distal radius and spine. Femur fractures have been identified as a common and important cause of mortality and loss of function among the elderly. Its social cost is high, as the elderly person often requires intensive medical care and long-term rehabilitation programs.<sup>7,15,18</sup>

The majority (82.7%) of elderly patients underwent surgery (neurosurgery or orthopedic surgery). The average waiting time for an ICU bed was 1.9 days, which may have been influenced by the large number of elective orthopedic surgeries resulting from fractures, where the patient is immediately transferred to the ICU at the end of the surgical procedure. On the other hand, the average length of stay in the ICU was 13.6 days, influenced mainly by the large number of cases of TBI, especially the severe type, which are more serious and, consequently, have a longer length of stay. Falls and their impact are of considerable importance in the lives of individuals, in the high economic and social costs and in the burden on health services. Of those who fall, between 5 and 25% may sustain

significant injuries, and of those who require hospitalization, only 50% survive a year after the event. Elderly victims of trauma initially present more critically, require hospitalization more often, represent a large proportion of patients admitted to ICUs and consume more resources than patients of any other type age group.<sup>3,8,19</sup>

The use of invasive devices to maintain critically ill patients predisposes them to a greater risk of infections, especially those associated with prolonged use of mechanical ventilation. The use of vasoactive drugs and sedatives in more than 60% of the patients highlights the severity of the elderly patients studied, who required rigorous neuroprotection measures and hemodynamic support.

The main complications found among the elderly people studied were pulmonary infection, tracheostomy after failed extubation or prolonged intubation, septic shock, the use of blood products, acute renal failure, especially cases requiring renal replacement therapy (dialysis), arrhythmias and pressure ulcers. Among the complications of trauma, infection was the most common among victims who survived the initial phase of injury. In these circumstances, the elderly, whose immune mechanisms are diminished and who may be further compromised by the trauma, had an infectious complication rate of around 15%. Among the infections, pneumonia was the most common, although urinary tract infection, sepsis related to vascular access, phlebitis and infections resulting from the accident and the surgical wound were also common.<sup>20-23</sup>

With regard to the outcome, the majority of patients survived the trauma resulting from the fall, but 34.6% of the elderly died. There was a significant association between male gender, TBI, the occurrence of septic shock with a pulmonary focus and dialysis and mortality; however, there was no correlation between age and mortality statistically significant mortality - a result similar to that achieved in a study carried out in the Northeast, where there was also no significant association between age and mortality, nor with the length of stay in the ICU.<sup>24-27</sup>

However, some studies have shown that in trauma patients admitted to the ICU, age is an independent predictor of mortality. Patients with severe trauma, who had organ dysfunction and used inotropic drugs, as well as cardiac impairment, dialysis and mechanical ventilation, had higher mortality and worse survival after discharge from the ICU. An American study found that, alongside age and female gender, death was significantly associated with pre-existing heart and kidney disease, neurological conditions and the following complications: acute myocardial infarction, arrhythmias, kidney failure, adult respiratory distress syndrome and the need for renal replacement therapy.

Although the data was collected in an electronic medical record system, a limitation of the study is the lack of standardization in the recording of patients' clinical progress by the various specialties, which leads to underreporting of important information, such as that related to the sociodemographic profile of the population investigated, comorbidities and medications used by the elderly at home and the place where the falls occurred, especially when they happened in the elderly person's home, which made it difficult to gather some data and possible causal and prognostic correlations with traumatic events.

When discussing research into emergency surgery for traumatic brain injury (TBI) in the elderly, it is important to highlight the strengths and weaknesses of the research, as well as discussing the applicability and the possibility of extrapolating the findings to other

populations. Here is a framework for how this discussion can be approached.

## Research strengths

**Specific elderly population:** The research focuses on a particularly vulnerable group - the elderly - who have distinct physiological and clinical characteristics, such as greater frailty, comorbidities and frequent use of medication (such as anticoagulants). This makes the results highly relevant to clinical practice in geriatrics and trauma.

**Clinical relevance:** The research addresses a critical issue, which is the surgical management of severe TBI in the elderly, a condition with high mortality and morbidity. Decisions on whether to perform surgery on elderly patients are challenging, and the study provides evidence on surgical outcomes, complications and factors associated with mortality.

**Multivariate approach:** The analysis included important variables such as age, gender, TBI severity, presence of septic shock and need for dialysis, allowing for a more comprehensive assessment of the risk factors that influence mortality. This multivariate analysis contributes to understanding how different variables interact and impact the results.

**Significant findings:** Important associations were identified, such as correlation between severe TBI, septic shock of pulmonary origin and dialysis with mortality, with highly significant p-values ( $p = 0.003$ ,  $p = 0.04$ ,  $p = 0.001$ , respectively). These findings help guide specific interventions to improve clinical management.

## Research weaknesses

### Limited sample size: the relatively small number of patients

May limit the generalizability of the results and the robustness of the statistical analyses. A larger number of participants could increase the power of the study and the ability to detect more subtle associations.

**Lack of control for confounding factors:** Although the analysis was comprehensive, it may not have been possible to fully control for all potential confounding factors, such as the level of pre-hospital support received or the time of admission to hospital, which could have an impact on outcomes.

**Retrospective study:** If the study is retrospective, data collection may be limited by incomplete medical records or variability in hospital records. This type of study also limits the ability to establish clear causal relationships between risk factors and observed outcomes.

The impact of socioeconomic factors and access to health care has not been explored. In more vulnerable populations, these factors can have a major influence on post-trauma outcomes, especially in regions where access to specialized healthcare is limited.

**Focus on a specific context:** The research may have been carried out in a hospital or region with health infrastructure that is not representative of the whole country or other realities. This may limit the applicability of the findings to other elderly populations with different health conditions and access to care.

**Application to elderly patients with comorbidities:** The findings can be extrapolated to elderly populations that present similar characteristics, such as those with severe TBI, comorbidities (hypertension, diabetes, etc.) and frailty. Doctors treating geriatric

patients in trauma scenarios can use this data to make more informed decisions about surgical interventions.

**Relevance for trauma centers:** The findings may be particularly useful for tertiary trauma centers, which regularly treat elderly patients with TBI. These centers can apply the results to improve triage and postoperative management, especially in relation to the use of advanced therapies such as dialysis or intensive care for septic shock.

**Limitations in extrapolating to other age groups:** Although the findings are relevant to the geriatric population, they cannot be automatically extrapolated to younger patients with TBI. The physiology of elderly patients is significantly different, with factors such as cerebral atrophy, vascular fragility and altered inflammatory response, which influences clinical management. Extrapolation to Other Geographical Contexts: In regions with limited resources or different healthcare infrastructure (e.g. rural areas or developing countries), the applicability of the findings may be restricted. The ability to replicate the outcomes depends on the availability of resources such as high-complexity ICUs, access to dialysis and rapid interventions in cases of septic shock.

## Conclusion

This research provides valuable insights into emergency surgery in severe TBI in the elderly, with results that can be applied to optimize clinical management in geriatric populations. However, limitations such as sample size and the specific context of the study restrict direct extrapolation to other populations or healthcare settings. Future studies, with larger samples and in different contexts, are needed to validate and expand these findings.

## Conclusion

The elderly victims of falls in the community admitted to the ICU had falls from their own height as the main mechanism of injury. There was a predominance of males, and hypertension was the most prevalent comorbidity among the patients. However, there was a significant number of reported cases of alcoholism, ischemic stroke, mobility and cognitive deficits and a previous history of falls. Severe TBI predominated, followed by femur fractures, and most patients had more than one complication during hospitalization. Mortality was over 30% and was associated with male gender, TBI, septic shock with a pulmonary focus and dialysis, although there was no significant association with age. It is hoped that the points covered in this study will contribute to a better understanding of the impact of falls on elderly people admitted to the ICU, since their consequences (physical or psychosocial) can be avoided through preventive measures.

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## Conflicts of interest

The authors declare that there are no conflicts of interest of any kind.

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