A Survey Study of the Relationship Between Accident Types and Degree of Brain Injuries

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Abstract

Traumatic brain injury (TBI) is a complex and heterogeneous consequence of accidents, and its effects can last a lifetime. This study examines the relationship between accidents, vehicular, sports-related, falls, and brain injury outcome measures. We used a survey-based approach to analyze detailed data to reveal specific patterns revealed the types of brain injuries, severity, and consequences associated with each accident category described detailed demographic information, health history. By combination with specific accidents, the aim of this study was to give a general idea of how accidents are related to specific disorders of the brain. This study contributes to the growing body of knowledge needed to develop prevention strategies, refine diagnostic tools, and tailor treatment and rehabilitation to reduce TBI morbidity. Our findings showed a significant difference in injury systematically by accident type, supporting the need for a targeted approach to trauma care.

Keywords:

Traumatic brain injury, vehicular accidents, sports-related injury, falls.

Introduction

Traumatic brain injuries (TBIs) are considered as the primary causes of morbidity and mortality globally, often resulting in notable physical, cognitive, and emotional sequelae **(Ma et al., 2024; Miller et al., 2021a)**. The causes of TBI are multifaceted, with motor vehicle accidents, sports injuries, and falls being the main causes **(Bushnik et al., 2003; Lozano et al., 2015)**. Despite large studies of the immediate consequences of TBI and for duration, the relationship between accident characteristics and specific psychological injury patterns remains underexplored requires bridging this hole by investigating traumatic brain injury associated with accidents. Understanding these relationships is important for developing tailored strategies for stroke prevention, including prevention, detection, and rehabilitation. Perspectives from this discovery will provide healthcare vendors with the ability to tailor care based on accurate incidental injury models and maximize treatment and long-term outcomes for TBI patients.

Background

Traumatic brain injuries (TBIs) occur when external forces disrupt normal brain function, resulting in issues such as loss of consciousness, impaired memory, or impairment neurological functions **(Sloan and Snow, 2012)**. TBI characteristics are common depending on the type of accident and mechanism involved, different types of accidents cause injury patterns and severities **(Keating and Cullen, 2021; Meaney et al., 2014)**. For example, a high-speed automobile accident can cause diffuse axonal injury (DAI), where rapid decelerating forces spread and it cuts through brain tissue, affecting areas such as the frontal and temporal lobes **(Baker et al., 2022)**. By contrast, with older adults with a decrease in their strength especially the effects of general collapse contradict focal cuts may occur, where a specific part of the brain, such as the temporal lobe, is damaged or localized damage **(Lecky et al., 2021; Vaishya and Vaish, 2020).**

Such differences in injury patterns underscore the importance of tailoring clinical protocols to the specific circumstances of each accident. By identifying these differences, physicians can develop more accessible diagnoses, initiate more targeted therapies, and develop better rehabilitation strategies for outcomes be effective for patients with TBI This review aims to build on existing literature by examining the relationship between accidents and brain damage processes.

Research Questions and Objectives

The study is designed around the following research questions.

What are the major types of brain injuries associated with accidents?

How does brain injury differ in accidents?

How do demographic factors such as age and preexisting health conditions affect the relationship between accident characteristics and injury outcomes?

To address these questions, the study sets the following objectives.

To identify injuries associated with specific types of accidents, such as falls, collisions, and sports injuries.

Evaluate the severity and distribution of TBI in various accidents.

Develop evidence-based recommendations to increase the accuracy of diagnosis, preventive measures, and treatment based on specific injury cases and accidents.

Methodology

Study Design and Population

This study uses a cross-sectional, survey-based design, and focuses on individuals who sustained TBI as a result of an accident. Data were collected from patients in hospitals, trauma centers, and rehabilitation centers to obtain a comprehensive and representative sample. The inclusion criteria indicated that participants should:

Age 18 years or older, diagnosed with TBI after an accident, and able to give informed consent to participate in the study.

Individuals who sustained brain injuries due to non-accidental causes such as assault or infection were excluded to ensure that the sample was representative of only accident-related TBIs. This approach allowed us to pool multiple samples reflecting different ages, genders, and accident histories, providing rich data to examine how accidents impact brain injury patterns in the general population We anticipate that this study TBI will contribute to a better understanding of this and contribute to the development of targeted clinical programs that improve patient care across different populations and injuries.

Data Collection

Data were collected from ALSADR teaching Hospital, IRAQ/BASRAH, over a five-year period, 2015 to 2020. This database included a comprehensive analysis of each patient's traumatic brain injury (TBI) experience, including accident type, people demographic data (age, gender), and health history. Additional medical records were analyzed for specific injuries such as imaging results, clinical examinations, and symptom charts, and accidents were categorized as motor vehicle-related, sports-related, and fall-related events to facilitate analysis.

Inclusion criteria required participants to have a confirmed accidental TBI, as evidenced by survey responses and medical records. Cases that had missing or ambiguous accident data or injury characteristics were excluded to ensure data quality and accuracy. This comprehensive data collection provided rich datasets with multiple variables, enabling in-depth analysis of TBI related to injury patterns, demographics, and accident types

Statistical Analysis

Utilizing Graph Pad prism (version 9.0), statistical analyzes were conducted using descriptive and inferential methods to examine demographic and injury characteristics across accident groups The descriptive statistics summarized variables such as age, sex, and brain injury severity. Chi-square tests examined the relationship between accident characteristics and specific injury types, while logistic regression examined the effect of demographic factors on injury severity Confidence intervals and p-values were calculated for statistical purposes emphasizing the rationale of findings that support rigorous assessment of brain injury patterns in relation to accident types and demographic variables.

Results

Influence of age and health conditions on injury severity by accident types:

We collected data from 450 participants, the **(Figure 1)** disclosed how age and pre-existing health conditions influence injury severity throughout special varieties of accidents, vehicular, falls, and sports-related accidents. The severity influence is supplied on a zero to at least one scale, with better values indicating more injury severity.

Vehicular Accidents: Older individuals show the highest severity influence (0.5) among the age groups in vehicular accidents, suggesting that age may increase susceptibility to severe injuries in these types of accidents. Those with pre-existing health conditions also exhibit elevated severity, although lower than older individuals, with values around 0.4. Younger individuals and those without pre-existing conditions show a lower impact on injury severity, implying that they may have greater resilience in vehicular accidents.

Falls: Older adults show the highest severity influence across all accident types, reaching approximately 0.7, which indicates a significant impact of age on injury severity in falls.

Pre-existing conditions also lead to higher severity scores (around 0.5), emphasizing that both age and health conditions can exacerbate injury severity in fall-related accidents. Younger individuals and those without pre-existing conditions have moderately lower severity scores, which suggests they may be at a reduced risk for severe outcomes from falls.

Sports-Related Injuries: Both age groups (younger and older) and those with pre-existing conditions show lower severity influences in sports-related injuries compared to vehicular and fall-related injuries. Interestingly, the influence of age and health conditions on severity is relatively balanced, with no group exceeding a severity influence of 0.4. This suggests that sports-related injuries may be less influenced by age and pre-existing health conditions compared to other types of accidents. This is because sports injuries are often caused by severe external mechanical forces, such as a direct impact or sprinting, which are primarily physical in nature. Unlike chronic conditions or weaknesses that can pose a risk, or the severity of falls and other non-sports injuries have been exacerbated.

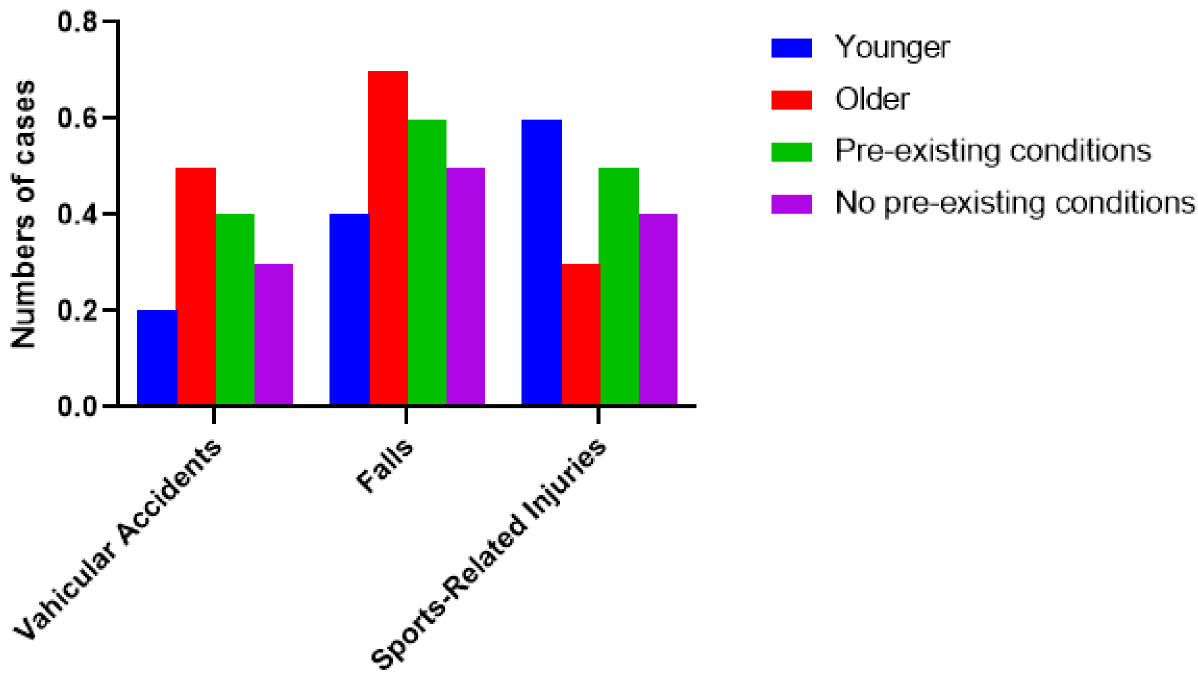

Figure 1: Influence of age and health conditions on injury severity by accident types

Distribution of brain injury pattern by accident types:

As illustrated in **(Figure 2)** the findings from this work reported reveal awesome patterns of brain accidents related to unique forms of injuries. *Vehicular injuries* had been predominantly related to diffuse axonal injuries, accounting for approximately 60% (300 out of 450 cases), likely due to fast deceleration forces impacting the brain throughout various axes. Focal contusions were observed in 22% of cases (100 cases), while concussions were relatively rare, comprising only 11% (50 cases) of the injuries in vehicular accidents.

Falls, focal contusions were highly prevalent in fall-related TBIs, with 77% (200 cases) of injuries in this category occurring among older adults. Diffuse axonal injuries and concussions were less common in fall-related cases, accounting for 19% (50 cases) and 12% (30 cases), respectively.

Sports-related accidents have been regularly observed to purpose concussions, with more youthful people demonstrating a better threat of sustaining repeated concussive accidents, representing 80% (400 cases) of injuries in this category. On the other hand, focal contusions and diffuse axonal injuries were relatively rare, comprising 6% (30 cases) and 4% (20 cases), respectively, indicating that sports-related TBIs are primarily characterized by mild, repetitive impacts rather than the high-energy trauma seen in vehicular accidents.

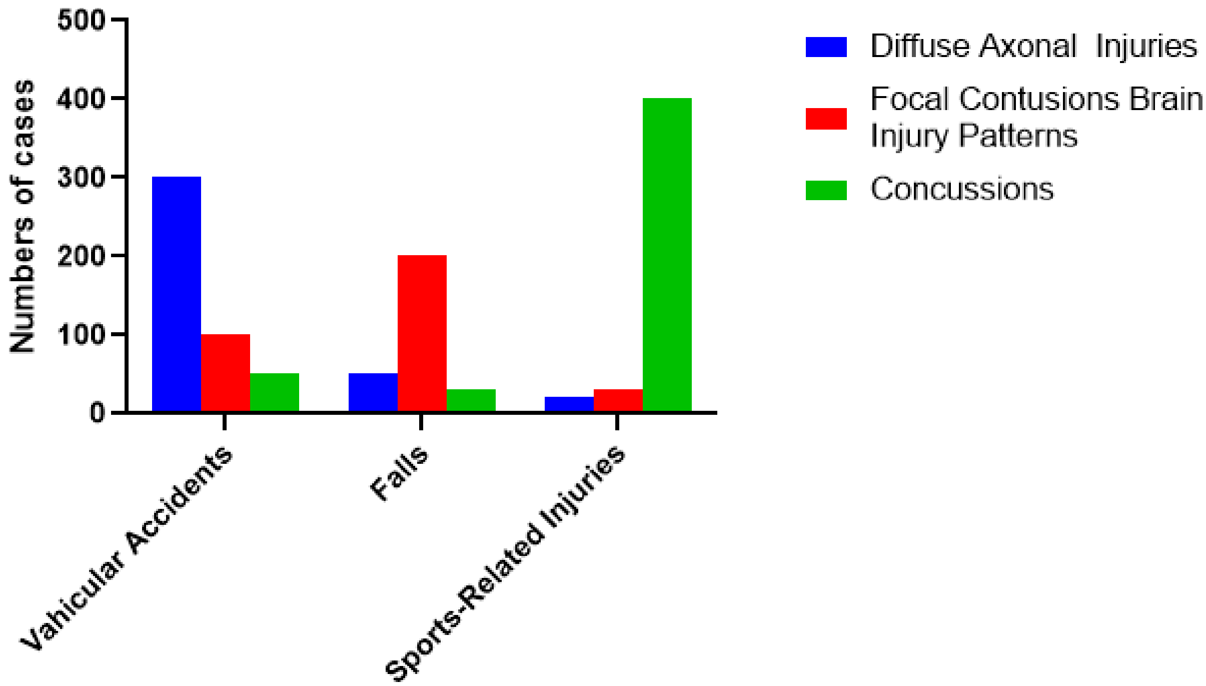

Figure 2: Distribution of brain injury pattern by accident types:

Discussion

The findings of this study highlight the importance of identifying the specific types of brain injury associated with specific types of accidents to improve the management of traumatic brain injury (TBI). By linking accident mechanisms to specific types of injuries, we can inform more effective methods of diagnosis and treatment. For example, the high prevalence of diffuse axillary injuries (DAIs) in automobile accidents suggests that rapid diagnostic imaging focused on identifying shear injuries may provide early diagnosis and intervention it has improved **(Su and Bell, 2016).** As the relationship between falls and central orbital atrophy in older adults and programs such as fall prevention, programs can reduce the incidence and severity of injuries in this vulnerable population in **(Skandsen et al., 2010).** The study findings are consistent with existing literature, supporting a model of individualized trauma care-based accidents and personal risks again

Diffuse axonal injuries were the most common brain injury pattern observed in vehicular accidents. This injury is often accompanied by rapid deceleration forces deficits that stretch and cut cerebral cortex in multiple axes, affect white matter pathways and impair cognitive and motor function **(Graham et al., 2020; Graham et al., 2021; Jolly et al., 2021)**. Other injuries included focal trauma and concussion, most likely caused by the brain hitting the skull during a high-speed impact **(Mavroudis et al., 2022; Vanaclocha et al.)**. Injuries were more severe in adults who were in their older age group, which was strong and an impact factor of 0.5 was. This is consistent with studies showing that older adults are more susceptible to severe TBI due to factors such as decreased brain flexibility and slower recovery times **(Laic et al., 2021; Ma et al., 2024).** In addition, pre-existing health conditions contributed to a significant increase in serious injuries (effect of 0.4), highlighting the combined risk factors for older people with co-morbidities on **(Miller et al., 2021a; Miller et al., 2021b).**

Focal contusions were the predominant injury in fall-related TBI, especially in older adults. This pattern is consistent with previous studies showing that falls in older people often have effects in the brain, especially in areas such as the frontal lobe or spinal cord **(Kelsey, 2022; Kumar and Husain, 2014; Kumar et al., 2013)**. Other injuries, including diffuse lacerations and concussions, were rare, suggesting that sometimes hard falls can lead to severe injury, although eccentric shortening remains complicated due to high impact forces **(Ommaya et al., 2002; Pöyry et al., 2013).** Severity of fall injury was greater among older adults, with a strong effect size of 0.7, and was further exacerbated by a pre-existing condition, which provided a stronger effect the severity increased at 0.6 **(Kelsey, 2022).** These findings are consistent with previous research showing that age and underlying health meet the conditions provided by fall-induced TBI risk and severity increase, mainly due to age-related factors such as decreased bone density and protection **(Faul and Coronado, 2015; Hartholt et al., 2011; Kelsey, 2022).**

Brain concussion are the most common sports-related injury, accounting for 80% of cases **(Conder and Conder, 2015)**. This finding is consistent with research on interactive games, which reports that younger individuals are particularly susceptible to repeated interference, often due to the cumulative effects of simple affect, and are usually produced instead of due to high-energy impacts **(McKee et al., 2024; Zuckerman et al., 2015)**. Focal contusions and diffuse axonal injuries were relatively rare in this group, reflecting injury mechanisms characteristic of sports activities compared to motor vehicle accidents and falls, those with high impact force or high rotational speed causing these injuries. Age having a greater effect on internal injuries is stronger on sport, and was 0.6 among younger individuals , who generally in competitive sport environments feel more exposed to physical contact **(Zuckerman et al., 2015)**. Pre-existing health conditions had a moderate effect on injury severity (effect of 0.5), although age was a significant factor. This finding is consistent with evidence that young athletes are at increased risk for repetitive concussions, which if not managed properly can have long-term psychological consequences **(Broglio et al., 2014; Brook et al., 2017; Zuckerman et al., 2015).**

These findings highlight the need for accident-specific age-related strategies for managing TBI. For vehicular injuries, improving diagnostic imaging systems for early detection of wide-arrow accidents may expedite the process and possibly improve outcomes. For adults who are older, particularly prone to falls, strong fall prevention programs should significantly reduce the incidence and severity of TBI. Follow-up of young athletes for symptom detection types that show concussion can also protect them from long-term neurological damage. These tailored strategies help implement a customized concussion care version that takes into account both accident characteristics and individual rights, including information from the latest research on TBI management it is consistent **(Volovici et al., 2019).**

Taken together, it provides valuable insight into how demographic data, fitness records, and accidents interact to shape TBI outcomes. By integrating these findings into clinical practice, healthcare agencies can optimize preventive and therapeutic strategies to reduce the burden of TBI and maximize patient outcomes materially in a combination of types.

Conclusion

This study provides a comprehensive review of the relationship between accidents and brain injuries and provides a clear case for targeted interventions in trauma care. By establishing injury models specific to motor vehicles, sports accidents, and fall accidents, this study enables health care providers to predict, and provide, specific types of brain injury based on accident data accurate diagnosis, effective treatment, and effective rehabilitation. The definitions hold, ultimately in TBI care enhance patient outcomes

Limitations

This study is limited by its reliance on self-reported data, which may have introduced recall bias. Furthermore, although the sample sizes vary, they may not be entirely representative of all demographic groups, especially the young age for some accidents. Future research should aim to obtain larger, more representative samples and consider how to examine the long-term effects of TBI in accidents.

Future Recommendations

Building on this study, future research should examine the biomechanical mechanisms involved in TBI associated with each accident. In addition, there is a need for long-term studies that track patient recovery and examine the long-term impact of TBI. Expanding the sample to include a broader age range and integrating advanced imaging modalities may further enhance our understanding of brain injury processes, and ultimately systems a groundbreaking evidence-based approach to managing and preventing TBI has emerged

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