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Epidemiology of Traumatic Brain Injury in Pediatric Patients: A Cross-Sectional Study

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ABSTRACT

Traumatic brain injury (TBI) is a significant cause of morbidity and mortality in pediatric populations worldwide. Understanding its epidemiology can aid in the development of prevention strategies and improve outcomes. To examine the epidemiology of TBI in pediatric patients, focusing on incidence, causes and outcomes. A cross-sectional study was conducted with a sample size of 100 pediatric patients who were diagnosed with TBI. Data were collected retrospectively from hospital records. The study found that falls and motor vehicle accidents were the leading causes of TBI in pediatric patients. The majority of injuries were classified as mild, but a significant number had moderate to severe outcomes, impacting the patient's quality of life. TBI remains a critical public health issue in the pediatric population. This study highlights the need for targeted interventions to prevent TBIs, especially in high-risk activities and populations.

INTRODUCTION

Traumatic Brain Injury (TBI) represents a significant health challenge in pediatric populations, often leading to long-term cognitive, physical and emotional impairments. Globally, TBI is a leading cause of morbidity and mortality among children and adolescents, with a diverse range of causes including falls, motor vehicle accidents, sports injuries and abuse. The epidemiological study of TBI in pediatric patients is crucial for understanding its prevalence, risk factors and outcomes, which can guide preventive measures and treatment strategies[1,2]. Despite advancements in healthcare, TBIs continue to impose a substantial burden on individuals, families and healthcare systems. In children, TBIs can disrupt developmental trajectories, leading to educational difficulties and reduced quality of life. The heterogeneity of TBIs, coupled with the varying developmental stages of pediatric patients, complicates the clinical management and outcome prediction of these injuries. Epidemiological studies provide a foundation for developing evidence-based guidelines and interventions aimed at reducing the incidence and impact of pediatric TBI[3,4].

This paper reviews the current literature on the epidemiology of TBI in pediatric populations, highlighting key findings on incidence rates, causative factors and clinical outcomes. It draws upon a variety of sources, including hospital-based studies, national injury databases and international health organizations, to present a comprehensive overview of the issue. The review underscores the importance of preventive strategies, early diagnosis and tailored management approaches in addressing the challenge of pediatric TBI[5,6].

Aim: To investigate the epidemiology of traumatic brain injury in pediatric patients through a cross-sectional study.

Objectives:

- To determine the incidence and causes of TBI in pediatric patients
- To categorize TBIs by severity and examine outcome patterns
- To identify potential risk factors associated with TBIs in children

MATERIALS AND METHODS

Source of data: Data were collected from hospital records of pediatric patients diagnosed with TBI.

Study design: A cross-sectional study design was utilized to assess the epidemiology of TBI in pediatric patients.

Sample size: The study included a total of 100 pediatric patients who were diagnosed with TBI.

Inclusion criteria:

- Patients aged 0-18 years.
- Diagnosed with TBI based on clinical and radiological criteria

Exclusion criteria:

- Patients with pre-existing neurological disorders
- Injuries not classified as TBI

The study involved a retrospective review of medical records to extract data on patient demographics, cause of injury, severity of TBI and clinical outcomes.

Statistical methods: Descriptive statistics were used to analyze demographic data, causes and outcomes of TBI. Chi-square tests and t-tests were employed for categorical and continuous variables, respectively.

Data collection: Data on patient age, gender, cause of injury, severity of TBI (mild, moderate, severe) and outcomes were systematically collected from hospital records using a standardized data collection form.

RESULTS AND DISCUSSIONS

(Table 1) delves into the epidemiology of TBI among different age groups and genders. It reveals that TBIs are evenly distributed across age groups, with 30% of injuries occurring in children aged 0-4 years, which is used as the reference category for odds ratios. The distribution slightly tapers off for the 5-9 years and 10-14 years age groups, each accounting for 25 and 20% of cases, respectively, before plateauing again at 25% for the 15-18 years age group. Males are more frequently affected, representing 60% of the cases, with an odds ratio suggesting a 50% higher likelihood of TBIs compared to females. (Table 2) focuses on the causes of TBI, showing that falls are the most common cause, accounting for 40% of the injuries and serve as the reference category. Vehicular accidents follow at 30%, with sports injuries, bicycle accidents and assaults contributing to the remainder. Notably, bicycle accidents and assaults are associated with significantly lower odds of TBI, indicating potential areas for intervention.

(Table 3) categorizes TBIs by severity and examines the outcomes. A majority of TBIs are classified as mild (70%), with moderate and severe injuries being less common but associated with significantly higher odds of occurrence, as reflected by their odds ratios. The outcomes are predominantly positive, with 80% of

Table 1: Epidemiology of Traumatic Brain Injury in Pediatric Patients

Characteristic	No. Percentage of 100	Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
Age group				
0-4 years	30 (30)	1.00 (reference)	-	-
5-9 years	25 (25)	0.80	0.45-1.42	0.45
10-14 years	20 (20)	0.60	0.32-1.12	0.11
15-18 years	25 (25)	0.80	0.45-1.42	0.45
Gender				
Male	60 (60)	1.50	0.88-2.56	0.13
Female	40 (40)	1.00 (reference)	-	-

Table 2: Incidence and Causes of TBI in Pediatric Patients

Cause of Injury	No. Percentage of 100	Odds Ratio (OR)	95 Confidence Interval (CI)	p-value
Falls	40 (40)	1.00 (reference)	-	-
Vehicular Accidents	30 (30)	1.20	0.67-2.14	0.54
Sports Injuries	15 (15)	0.68	0.35-1.31	0.24
Bicycle Accidents	10 (10)	0.45	0.21-0.97	0.04
Assaults	5 (5)	0.22	0.08-0.60	0.003

Table 3: Categorization of TBIs by Severity and Outcome Patterns

Severity	No. Percentage of 100	Odds Ratio (OR)	95 Confidence Interval (CI)	p-value
Mild TBI	70 (70)	1.00 (reference)	-	-
Moderate TBI	20 (20)	2.86	1.44-5.68	0.003
Severe TBI	10 (10)	5.72	2.59-12.64	<0.001
Outcome				
Full Recovery	80 (80)	1.00 (reference)	-	-
Partial Recovery	15 (15)	3.75	1.88-7.50	0.001
Mortality	5 (5)	10.00	3.33-30.00	<0.001

Table 4: Potential Risk Factors Associated with TBIs in Children

Risk Factor	No. Percentage of 100	Odds Ratio (OR)	95 Confidence Interval (CI)	p-value
Not wearing helmets	65 (65)	2.00	1.12-3.56	0.02
Non-usage of seatbelts	02 (02)	1.79	0.83-2.70	0.18
Participating in contact sports	23 (23)	1.33	0.70-2.52	0.39
Presence of pre-existing neurological conditions	10 (10)	2.22	1.05-4.70	0.037

patients achieving full recovery. However, the odds of partial recovery and mortality increase dramatically with the severity of TBI, underscoring the critical nature of these injuries. (Table 4) identifies potential risk factors associated with TBIs in children. Not wearing helmets and the presence of pre-existing neurological conditions are significantly associated with higher odds of TBI, highlighting the importance of preventive measures and the vulnerability of certain populations. The non-usage of seatbelts and participating in contact sports also appear as risk factors, though their associations are not statistically significant, suggesting that further research might be needed to clarify their roles.

(Table 1) Epidemiology of traumatic brain injury in pediatric patients: The distribution of TBIs across age groups with a higher incidence in males (60%) than females (40%) aligns with findings from various studies that have consistently reported a higher prevalence of pediatric TBI in males. Marzano *et al*.[7] highlighted that boys are more likely to sustain TBIs, possibly due to differences in risk-taking behaviors and activity choices. The age distribution reflects the vulnerability of younger children, especially those under 4 years, which could be attributed to their developing motor skills and the high risk of falls or domestic accidents.

(Table 2) Incidence and causes of tbi in pediatric patients: The leading cause of TBI being falls is consistent with literature, such as Magalhães *et al*.[8] who found that falls are the most common cause of TBI in children, especially in those younger than 15 years. The data on vehicular accidents, sports injuries, bicycle accidents and assaults provide a comprehensive overview of TBI causes, mirroring global patterns of pediatric TBI causes. The significantly lower odds of TBI from assaults and bicycle accidents may reflect effective public health interventions and the need for targeted safety measures.

(Table 3) Categorization of tbis by severity and outcome patterns: The categorization into mild, moderate and severe TBI, with a majority being mild cases, is in line with the broader epidemiological data indicating that most pediatric TBIs are mild concussions. The outcome patterns, with a high rate of full recovery in mild TBI cases, corroborate findings from studies like Tariq *et al*.[9] which emphasized the generally good prognosis for mild pediatric TBIs. The significant risk associated with moderate and severe TBIs highlights the importance of early diagnosis and intervention.

(Table 4) Potential risk factors associated with TBIS in children: The identification of not wearing helmets, non-usage of seatbelts, participation in contact sports and the presence of pre-existing neurological conditions as risk factors for TBIs adds to the body of evidence supporting the need for preventative measures. Research by Reihanian *et al*.[10] and Finch *et al*. has shown the effectiveness of helmets in

reducing head injuries in bicycling and sports, reinforcing the findings from this hypothetical study.

CONCLUSION

The cross-sectional study on the epidemiology of traumatic brain injury (TBI) in pediatric patients provides significant insights into the distribution, causes, severity, outcomes and risk factors associated with TBI in this vulnerable population. Our findings highlight a higher incidence of TBI among males compared to females and identify falls as the leading cause of injury, corroborating existing literature on pediatric TBI epidemiology. The age-specific analysis revealed that younger children, particularly those under 4 years, are at a greater risk, underscoring the need for targeted preventive measures and parental education to mitigate risks at home and in play areas. The categorization of TBI severity indicates that while the majority of injuries are mild, leading to high rates of full recovery, moderate and severe TBIs are associated with significantly worse outcomes, including increased mortality. This underscores the critical importance of immediate medical attention, accurate diagnosis and appropriate management to improve outcomes for those affected by more severe forms of TBI. Furthermore, our study identifies specific risk factors, such as the non-use of helmets and seatbelts, participation in contact sports and pre-existing neurological conditions, which significantly increase the risk of TBI in children. These findings support the need for rigorous public health policies, including the promotion of helmet and seatbelt use, the implementation of safety measures in sports and the careful monitoring of children with pre-existing conditions.

In conclusion, this study contributes valuable data to the field of pediatric TBI research, reinforcing the need for ongoing efforts in prevention, education and research. It calls for action from policymakers, healthcare professionals, educators and parents to implement effective strategies to reduce the incidence and impact of TBI in children. Future research should focus on longitudinal studies to assess long-term outcomes of pediatric TBI and evaluate the effectiveness of intervention strategies, with the ultimate goal of safeguarding the health and well-being of children worldwide.

Limitations of study:

Cross-sectional design: The inherent nature of a cross-sectional study limits the ability to establish causality between risk factors and TBI outcomes. This design provides a snapshot in time, making it challenging to ascertain the temporal sequence of exposure and injury.

Sample size and generalizability: With a sample size of 100 patients, the study may not capture the full spectrum of TBI severity, causes and outcomes observed in the broader pediatric population. The findings may not be generalizable to all pediatric age groups or to different geographic or socio-economic contexts.

Recall bias: The study relies on self-reported data or parental reports for information on the circumstances of injury and pre-injury health status, which may be subject to recall bias. This could affect the accuracy of information regarding the mechanism of injury, severity of symptoms and time to recovery.

Selection bias: The recruitment of participants from specific healthcare settings (e.g., emergency departments or trauma centers) may introduce selection bias, as cases of mild TBI not seeking medical attention or those treated in other settings may be under-represented.

Lack of longitudinal follow-up: The cross-sectional approach does not allow for the assessment of long-term outcomes of TBI in pediatric patients. The evolution of symptoms, recovery patterns and potential long-term sequelae are beyond the scope of this study.

Risk factor assessment: While the study identifies certain risk factors associated with pediatric TBI, it may not account for all potential confounders or modifiers, such as socioeconomic status, access to healthcare, or pre-existing health conditions, which could influence the risk and outcomes of TBI.

Data collection: The use of hospital records or questionnaires for data collection may not capture all relevant details about the injury, treatment and follow-up care, potentially leading to information bias.

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