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PREVALENCE AND OUTCOMES OF TRAUMATIC BRAIN INJURY AMONG CHILDREN IN SAUDI ARABIA: A SYSTEMATIC REVIEW

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Abstract

Background: Traumatic brain injury (TBI) is a major public health issue worldwide, with possibly long-term repercussions for children. Understanding the prevalence and management of TBI in Saudi Arabia can inform preventive strategies and improve healthcare delivery for this vulnerable population. **Objectives:** To assess the prevalence and management of TBI among children in Saudi Arabia. **Methods:** We did a comprehensive search of online databases including PubMed, MEDLINE, Web of Science, and Scopus. Two unbiased reviewers identified and retrieved data from relevant papers. **Results:** We included five studies with a total of 4159 participants and the majority were males (77.4%). The duration of PICU stay ranged from 1 day to 60 days. Two studies reported the prevalence of brain injury in Saudi children; 42% and 32.1%. Compared to patients with positive outcomes, those with poor outcomes had a considerably higher frequency of thrombocytopenia. Most cases showed good recovery, the mortality rates were similar (11.3% [11] and 14.9% [13]), and so was the associated neurological impairment. **Conclusion:** There is a heavy burden of dementia consecutive to CKD in the geriatric population. Better screening and treatment methods could be developed as a result of an improved understanding of causal factors, which could be facilitated by longitudinal research, brain imaging, and improved screening instruments.

Keywords: Traumatic brain injury (TBI), Children, Pediatrics, Saudi Arabia, Systematic review.

Introduction

TBI is a form of injury caused by a quick, forceful blow or jolt to the head [1]. This can happen for a variety of causes, including slips and falls, vehicle crashes, injuries from sports, and physical assault. TBI in children can have severe and long-term repercussions, including cognitive deficits, physical difficulties, and emotional disorders [2].

According to a study undertaken by the Saudi Pediatric Trauma Program, TBI is one of the top causes of morbidity and mortality among Saudi Arabian children [3]. The study discovered that the prevalence of TBI among youngsters in the country is disturbingly high, with a large

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percentage of cases need hospitalization and intensive treatment. The most prevalent causes of TBI in Saudi Arabian youth were motor vehicle accidents and falls, followed by sports-related injuries and physical maltreatment [4].

The management of TBI among children in Saudi Arabia poses a significant challenge due to various factors. Firstly, there is a lack of awareness and knowledge among healthcare professionals regarding the assessment and treatment of TBI in children [5]. This often leads to delays in diagnosis and inadequate management of the injury, resulting in poor outcomes for the patients. Additionally, there is a shortage of specialized pediatric neurosurgeons and rehabilitation services in the country, further complicating the management of TBI among children [3].

Furthermore, social and cultural factors in Saudi Arabia influence the frequency and treatment of TBI among children. Children from low-income households or rural areas may have restricted access to healthcare resources, causing delays in seeking treatment for TBI. Furthermore, cultural attitudes and practices may influence families' perceptions of TBI and their desire to seek medical attention for their children [6].

Increased awareness and education for healthcare professionals, as well as the development of training programs and guidelines, are needed to ensure effective treatment. Investment in specialized pediatric neurosurgery and rehabilitation services is also crucial, including the establishment of specialized centers and the training of more specialists. By improving access to high-quality healthcare services, better outcomes for children with TBI can be achieved [7]. TBI is a major public health concern with lifelong consequences for children. Limited data exists on the specific burden and management of TBI in Saudi children. This review will address this gap by synthesizing existing research and providing a comprehensive picture of pediatric TBI in the region. Children in Saudi Arabia are susceptible to TBI due to various factors. However, the lack of comprehensive data on its prevalence and management hinders effective prevention and treatment strategies. The primary aim of this study is to systematically review the current literature and assess the prevalence and outcomes of TBI among children in Saudi Arabia.

Study Objectives

- To identify and analyze existing studies on pediatric TBI in Saudi Arabia.
- To estimate the prevalence of TBI among children in the region.
- To evaluate the outcomes of pediatric TBI within the Saudi healthcare system.
- To identify any demographic characteristics associated with a higher risk of TBI in children.

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Methodology

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) criteria [8]. A thorough search was carried out across several electronic databases, including the PubMed database, MEDLINE, SCOPUS, and Web of Science. To select relevant studies, we used a combination of Medical Subject Headings (MeSH) and keywords. The search strategy will be created utilizing the following concepts.\:

- Population: Child/Children/Pediatric/Adolescent (exploded)
- Intervention: Traumatic Brain Injury/TBI/Head Injury
- Outcome: Prevalence/Epidemiology/Management/Treatment/Prognosis
- Location: Saudi Arabia

Boolean operators (AND, OR, NOT) were employed to combine these concepts and ensure a comprehensive search. We additionally carried out a manual search of reference lists from relevant papers to find other studies that had not been caught by the computerized database search.

Selection Criteria

Inclusion criteria:

- Studies investigating children (aged 0-18 years) diagnosed with TBI in Saudi Arabia.
- Studies published in English.
- The available full-text papers.

Exclusion criteria:

- Studies not including children (e.g., adults only).
- Studies not investigating TBI (e.g., other neurological conditions).
- Studies not conducted in Saudi Arabia.
- Reviews, editorials, letters, or case reports.
- Non-English language research (unless an English translation is available).

Study Selection and Data Extraction

To ensure precision, the search outcomes were validated with Rayyan (QCRI) [9]. Two reviewers independently assessed the titles and abstracts of identified papers using the predefined inclusion and exclusion criteria. Disagreements were resolved by discussion or consultation with a third reviewer. Full texts of possibly relevant studies have been obtained and reviewed for final inclusion. A consistent data extraction form was created to capture pertinent information from the studies that were included. Extracted data contained research characteristics (author, year of

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publication, study design), participant demographics (age, sex), clinical characteristics (GCS score, PICU stay duration), and reported outcomes (e.g., mortality, morbidity, functional recovery).

Data Synthesis and Analysis

The gathered data was aggregated and shown in tables or figures. We conducted a narrative synthesis based on the available data. The narrative synthesis detailed the results of the included investigations, highlighting major themes and patterns.

Risk of Bias

The evaluation evaluated potential causes of bias, such as publishing and selection bias, using the Joanna Briggs Institute (JBI) [10] critical assessment criteria for research reporting prevalence data. This tool consists of nine questions, with positive responses getting a score of one and negative, ambiguous, or irrelevant responses receiving a score of zero. Scores of less than 4, 5 to 7, and 8 or higher will be rated as poor, moderate, and high quality, accordingly. Researchers separately assessed the study quality, and any discrepancies were resolved through discussion. The study's limitations were noted, including those of the available literature and the search approach used.

Results

Search results

A thorough search turned up 492 study papers in total after 201 duplicates were eliminated. 221 papers were eliminated after the titles and abstracts of 291 studies were assessed. Out of the 70 reports that needed to be obtained, two items could not be found. Following a screening process that yielded 68 publications for full-text review, 31 were rejected due to incorrect study results, 28 due to incorrect population type, two papers were the editor's letters, and 2 were abstracts. This systematic review's five research papers met the eligibility criterion. **Figure 1** shows a summary of the process used to choose the study.

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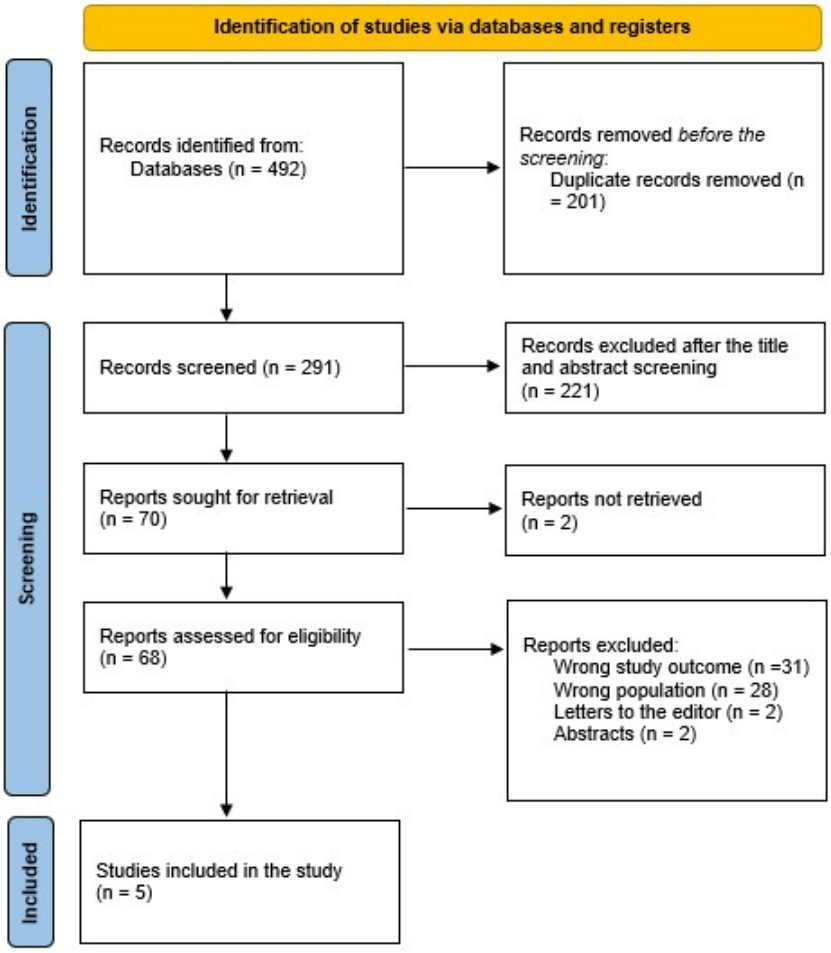

Figure (1) summarizes the study choice using a PRISMA diagram.

Sociodemographics of the comprised participants and studies

Table 1 shows the sociodemographic data from the research articles. Our data includes five trials with a total of 4159 individuals, 3218 of whom (77.4%) were male. One research was prospective [13], one was cross-sectional [14], and three were retrospective cohorts [11, 12, 15]. Four studies were carried out: one in Hofuf [13], one in Al-Hasaa [11], one in Buraidah [14], and two in Riyadh [12, 15]. The earliest research was done in 2007 [11], while the most recent one was done in 2024 [12].

Clinical outcomes

Table displays the clinical aspects (2). The length of time spent in the PICU varied from one day [13, 14] to sixty days [13]. According to two studies, 42% [14] and 32.1% [15] of Saudi youngsters had brain injuries. Three studies reported the predictors and outcomes of TBI in children. Low serum albumin, high liver enzymes, hypotension, mixed brain diseases, low GCS,

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higher grades of injury, length of PICU stay, and abnormal brain CT results all strongly predict the outcome following TBI [11-13]. Compared to patients with positive outcomes, those with poor outcomes had a considerably higher frequency of thrombocytopenia [13]. Most cases showed good recovery [11-13], the mortality rates were similar (11.3% [11] and 14.9% [13]), and so was the associated neurological impairment.

Table (1): the sociodemographic background of the participants.

Study	Study design	City	Participants	Mean age	Males (%)
Kamal et al., 2007 [11]	Retrospective cohort	Al-Hasaa	106	5.7	65 (61.3%)
Hazwani et al., 2024 [12]	Retrospective cohort	Riyadh	51	8.1 ± 4.1	36 (70.6%)
Kamal et al., 2011 [13]	Prospective cohort	Hofuf	74	4.7 ± 3.9	50 (67.5%)
Alomani et al., 2021 [14]	Cross-sectional	Buraidah	132	5	91 (68.9)
Alhabdan et al., 2013 [15]	Retrospective cohort	Riyadh	3796	8.6	2976 (78.4%)

Table (2): Clinical parameters and outcomes of the comprised research.

Study	PICU duration (days)	GCS	TBI prevalence (%)	Predictors of outcomes	Outcomes	JBI
Kamal et al., 2007 [11]	3.9	NM	NM	In this age range of children, low serum albumin, high liver enzymes,	Twelve children, ages 5.5 on average, passed away. Twelve kids	Moderate

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				hypotension, mixed brain diseases, low GCS, and brain CT results all strongly predict the outcome following TBI.	with a mean age of 5.3 years experienced neurological problems and survived. With an average age of 5.8 years, the 82 patients who survived had no neurological impairment.	
Hazwani et al., 2024 [12]	NM	8.3 ± 3.6	NM	Patients with diffuse axonal injury grades II and III showed notable improvement, and by the time a year passed, they had recovered very well despite showing substantial harm.	All diffuse axonal injury grades exhibited substantial enhancements in Pediatric Glasgow Outcome Scale-Extended (PGOSE) scores over time, indicating a high likelihood of recovery even in cases that were initially severe.	Moderate
Kamal et al., 2011 [13]	1 - 60	NM	NM	Patients with poor results had significantly greater	Eleven patients (14.9%) died, eleven patients	Moderate

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				rates of thrombocytopenia than those with excellent outcomes.	(14.9%) had severe neurological morbidity, nine patients (12.2%) had moderate disability, and forty-two patients (56.7%) made a full recovery.	
Alomani et al., 2021 [14]	1-7	NM	56 (42%)	NM	NM	High
Alhabdan et al., 2013 [15]	NM	8.6 ± 4.7	1219 (32.1%)	NM	NM	Moderate

***NM=Not-mentioned**

Discussion

The corpus of information governing the prognosis, prevalence, and outcomes of TBI in young patients has grown significantly in recent years. However, we found very limited literature on Saudi children. Two studies in this review reported the prevalence of brain injury in Saudi children; 42% [14] and 32.1% [15] and the majority of participants in this review were males (77.4%). This was higher than a population-based US poll involving both adults and children, 25% of participants who said they had suffered a head injury that caused them to lose consciousness within the previous year said they had not sought medical assistance [16]. **Thurman *et al.*** also found that the risk of injury is larger in males than in females: it is 2.2 times higher in men over the age of ten and 1.4 times higher in younger people [17].

This review also found that low serum albumin, high liver enzymes, hypotension, mixed brain diseases, low GCS, higher grades of injury, length of PICU stay, and abnormal brain CT results all strongly predict the outcome following TBI [11-13]. This data provided only crude

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information about these predictors and separate from each other. To fully and comprehensively interpret our findings, we need longitudinal studies with adequate follow-up periods and large sample sizes presenting these factors.

We also found that compared to patients with positive outcomes, those with poor outcomes had a considerably higher frequency of thrombocytopenia [13]. Most cases showed good recovery [11-13], the mortality rates were similar (11.3% [11] and 14.9% [13]), and so was the associated neurological impairment. **Goh *et al.*** reported that mild TBI recovery strategies are based on the observation that mild TBIs may resolve in weeks or days [18] following the injury with full recovery substantially by 3 months [19]. Numerous patients do not now obtain follow-up care even though they continue to have symptoms. Therefore, these patients may benefit from formal follow-up [20]. While a substantial deterioration in cognitive function in several areas was found among patients with severe TBI, underscoring the pressing necessity of concerted efforts to direct excellent rehabilitation for these youngsters [18].

Clinical implications and future research

There is a lack in the literature that discusses TBI among Saudi children. This field is open for epidemiological studies, prognostic investigations, and clear guidelines for management. Unfortunately, our systematic search did not yield any study that reported a clear management plan in the pediatric population.

In the current literature, there is a shortage of high-confidence data regarding prognosis that identifies risk factors for early symptom severity, persistent impairment, or delayed recovery. More investigation is required to enhance the identification of deliberate trauma in Saudi youth.

There is a dearth of strong, high-level evidence about management or treatment that can identify and direct particular individuals who can profit from recommendations for returning to activities outside the scope of routine care. To add comprehensible evidence for optimal procedures in the management of children with TBI, including therapies in the short- and long-term stages of recovery, more research employing RCTs is required.

Limitations

This review found few studies conducted in Saudi Arabia regarding TBI in children with small sample sizes. Because there are so few studies that fit the inclusion criteria, conclusions should be evaluated cautiously, particularly considering the design and participant constraints of the individual research. The number, age, severity, and type of participants in the included research varied, as did the outcome measures used. This variation affected the generalizability of the results and made it challenging to directly compare studies.

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Conclusion

TBI is a common condition among Saudi children, and a significant proportion of those affected experience catastrophic outcomes, such as disability or death. Therefore, in order to improve both their prevention and treatment, neurologists, other medical experts, and even the general public should give these injuries careful consideration.

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