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BRAIN INJURY STUDIES

A 12-month follow-up of long-term functional and clinical outcomes among adults with traumatic brain injury in Indonesia

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Abstract
Traumatic brain injury (TBI) remains a significant global and national health issues that leading to high rates of disability and mortality. Understanding long-term outcomes is pivotal for rehabilitation strategies and clinical management. In the context of nursing care, ongoing follow-up and assessment contribute in optimizing recovery. However, study focusing this clinical issue is limited particularly in Indonesia. Therefore, the study aims to evaluate the 12-month functional outcomes of patients with moderate and severe TBI using the Glasgow Outcome Scale Extended (GOSE), identify predictors of recovery and mortality, and draw attention to the nurse's role in the care continuum. In this study, a prospective cohort design was used to meet its objectives. The study initially enrolled 64 patients with moderate to severe TBI. Out of these, 46 patients were successfully contacted and participated. Data was collected on demographic characteristics, Glasgow Coma Scale (GCS) scores at admission, and GOSE scores at 12 months. Descriptive statistics and bivariate test were used for data analysis. The significance level was considered at 0.05 for hypothesis testing. The study documented that among the 46 patients, 18% died, while the others experienced varying levels of disability and recovery. Younger age and higher GCS scores at admission were significantly associated with better outcomes ($p < 0.05$), whereas sex was not ($p > 0.05$). Low initial GCS scores, older age, and delayed referrals were major factors contributing to mortality. Nurses were crucial in early clinical stabilization, educating patients and their families, and providing long-term follow-up care. Younger patients and those with higher GCS scores upon admission generally experienced better long-term functional outcomes. Nursing roles are vital in supporting recovery through acute management, rehabilitation coordination, and psychosocial support. This study underscores the necessity of nurse-led interventions to improve outcomes in TBI care.

Keywords: Glasgow Coma Scale, Glasgow Outcome Scale Extended, long-term outcomes, rehabilitation, traumatic brain injury

Introduction

Traumatic brain injury (TBI) is a major cause of death and disability altogether with significant impacts on individuals' quality of life, economic productivity, and healthcare systems (Xiong et al., 2019). The World Health Organization (WHO) reports that millions are hospitalized annually due to head injuries that many of whom suffer long-term consequences (Haarbauer-Krupa et al., 2021). TBI remains a critical public health issue worldwide, and Indonesia is no exception, given its large population and the increasing incidence trauma-related events (Nabila et al., 2024). TBI severity is categorized by using the Glasgow Coma Scale (GCS), with moderate (GCS 9–12) and severe (GCS ≤8) injuries often resulting in more complex clinical courses and poorer prognoses (Tsao, 2020). The incidence of moderate to severe TBI has been rising that reaching 182.7 cases per 100.000 population in 2019, with males being disproportionately affected (Huang et al., 2024). In Indonesia, the burden of TBI is also considerable (Rosyidi et al., 2021). According to a national injury surveillance system, head injuries due to traffic accidents account for approximately 20–25% of trauma-related emergency cases, with motorcycle collisions **(Figure 1)** being the primary cause (Faried et al., 2017). A study by the Indonesian Ministry of Health in 2020 reported that among trauma-related fatalities which TBI was involved in over 30% of cases (Chandra & Tobing, 2021). The standard care for patients with TBI involves a comprehensive, multidisciplinary approach that spans from acute management to long-term rehabilitation (Yan et al., 2024). Initially, the focus is on stabilizing the patient's

JHNS
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vital functions, preventing secondary brain injury, and managing intracranial pressure through medical and surgical interventions (Syzdykbayev et al., 2024).

Care for TBI in Indonesia typically involves initial emergency stabilization and neurosurgical intervention if needed, followed by limited access to comprehensive rehabilitation services due to regional disparities in healthcare infrastructure (Apriawan et al., 2025). This acute phase includes airway management, hemodynamic stabilization, and neurological monitoring, often in an intensive care setting (Messina et al., 2022). Following stabilization, the care transitions into a rehabilitation phase aimed at maximizing functional recovery and minimizing disability (Maas et al., 2022). This phase involves physical therapy, cognitive rehabilitation, and psychosocial support among patients with TBI (Davies et al., 2024). The GOSE provides a structured framework to assess recovery progress and guide ongoing care decisions of TBI survivors (Wilson et al., 2021). A study conducted in Indonesia found that factors influencing the Glasgow Outcome Scale (GOS) score included age, mechanism of injury, initial GCS score, treatment criteria, responder qualifications, and initial intervention, although it has limitations in generalizability (Indradmojo et al., 2020). Nurses play a fundamental role throughout this continuum of care that acting as the frontline caregivers and coordinators within the healthcare team (Shehade et al., 2023). Specialized knowledge, professional regulation, and sex-sensitive policies were crucial for positioning nursing in quality care improvement in Indonesia (e.g. brain injury care) (Trisyani & Windsor, 2019). However, nurses often serve as vital liaisons between the medical team, patients, and families to ensure continuity of care and adherence to rehabilitation plans at home. Nurses also bridge the gap between hospital care and community rehabilitation for ongoing support for patients with TBI (Smith et al., 2022).

Figure 1. Illustration of motorcycle accidents on the road (Documented by authors).

Despite the substantial impact of TBI in Indonesia, research on long-term outcomes remains limited (Rosyidi et al., 2019; Faried et al., 2017; Niryana et al., 2020). RSUP Dr. Hasan Sadikin Bandung Indonesia is one of the largest tertiary referral centers in the country that receiving a high volume of moderate and severe TBI cases annually. Approximately, 1.500 patients with TBI are admitted to the Hospital each year (Arifin et al., 2021). With comprehensive trauma care facilities and specialized neurosurgical services, the hospital is strategically positioned to contribute evidence on long-term recovery patterns in the Indonesian setting (Khan et al., 2021). Internationally, several studies have examined the long-term outcomes of TBI using standardized tools such as the GOSE that revealing that factors such as age, GCS at admission, and access to rehabilitation influence recovery (Downing et al., 2024; Mostert et al., 2022). However, many of these studies are conducted in high-resource settings (Tropeano et al., 2019; Koome et al., 2021; Alvarado-Dyer et al., 2023). In contrast, there is a gap in the literature concerning TBI outcomes in low- and middle-income countries like Indonesia, where differences in healthcare infrastructure, post-discharge rehabilitation access, and patient follow-up may influence recovery trajectories. Moreover, in countries with advanced healthcare systems, standard TBI care includes early neurocritical care, multidisciplinary rehabilitation, and long-term neuropsychological support (Maas et al., 2022). In Indonesia, these rehabilitation services are still evolving. The absence of national guidelines on post-TBI rehabilitation, limited access to follow-up care, and a lack of community-based support systems present challenges to optimal recovery (Nugraha et al., 2018). Government policies on TBI management primarily focus on acute care and trauma prevention, with limited emphasis on long-term rehabilitation and reintegration into society. In the context of long-term follow-up, nurses are key to monitoring functional recovery and facilitating community reintegration. Given these gaps, this study aims to evaluate the 12-month outcomes of moderate and severe TBI at a tertiary referral hospital using GOSE and identify factors associated with recovery. An available study only evaluated the outcomes for up to three months (Sutiono et al., 2018). Since employed the GOSE, the study offers a standardized and objective measure of patient progress over a substantial period of times. Furthermore, this study also seeks to highlight the vital role of nurses in supporting TBI patients throughout the continuum of care, from initial stabilization to long-term recovery. This research provided invaluable nursing perspective into the long-term functional outcomes of patients who have suffered moderate to severe TBI, a domain that has been relatively underexplored in Indonesia. The findings are expected to contribute to both local clinical nursing practices and global understandings of TBI recovery, applicable to Indonesia and other countries worldwide.

JHNS
Journal of Holistic Nursing Science
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Method

This study used a prospective cohort design to evaluate the long-term functional outcomes of patients with moderate and severe TBI using GOSE over a 12-month follow-up period. The design is ideal for this study because it allows researchers to follow patients over a defined period and capture the natural progression or long-term outcomes in real time (Capili & Anastasi, 2021). This approach provides robust, longitudinal data that reflect the dynamic recovery process and improve accurate assessment of functional status and clinical outcomes. Clinical outcomes included measures such as GCS at admission. These clinical indicators provided additional insights into the severity of injury and the immediate medical response, complementing the long-term functional assessment captured by GOSE. The study was conducted at RSUP Dr. Hasan Sadikin Bandung as a tertiary referral center in West Java Province, Indonesia. This hospital serves as a referral center for TBI due to its status as a national referral hospital with advanced neurosurgical services, neurocritical care units, and multidisciplinary teams experienced in managing complex trauma cases. It receives TBI patients from various district and regional hospitals across West Java and surrounding provin ces that making it a central hub for both acute management and long-term follow-up of moderate to severe TBI cases. Data collection took place from December 2022 to August 2023. The study population comprised patients with moderate (GCS 9–12) and severe (GCS ≤8) head injuries treated at the Hospital. Inclusion criteria included patients were those admitted between December 2021 and February 2022 that allowing a full 12-month interval before assessment, age ≥17 years, GCS score ≤12 at admission, ability to provide informed consent or have a family member consent on their behalf, and no prior diagnosis of severe psychiatric or neurological disorders. Patients were excluded if they had significant pre-existing comorbidities that could confound outcome interpretation, such as advanced malignancies, end-stage renal disease, uncontrolled diabetes mellitus with complications, chronic liver failure, or progressive neurodegenerative diseases like Alzheimer's or Parkinson's disease. Of the 117 patients initially eligible, 21 died during hospitalization due to complications related to severe TBI, such as intracranial hemorrhage, brain herniation, or systemic complications like sepsis or multi-organ failure. Additionally, 23 patients were uncontactable because their listed phone numbers were no longer active or due to difficulties reaching them at their listed home addresses. Nine patients declined to participate, citing reasons such as lack of interest, privacy concerns, or perceived participation burden. Ultimately, 64 patients met the eligibility criteria, and 46 completed the 12-month follow-up, which was conducted primarily via phone interviews **(Figure 2)**.

Data was collected through medical record reviews and structured follow-up interviews. Medical record data included sex, age, GCS score at admission, and initial diagnosis. Follow-up interviews were conducted between December 2022 and August 2023—12 months after initial injury, either in-person or via telephone, depending on patient accessibility and geographic location. The standardized GCS guided the interviews–Extended (GOSE) questionnaire, a widely used tool for assessing functional outcomes in patients with TBI. The GOSE categorizes patient outcomes into eight levels, ranging from death (score 1) to upper good recovery (score 8), and evaluates key domains such as independence in daily life, social and occupational functioning, and the presence of residu al symptoms. The structured interview format ensures consistency in data collection and facilitates reliable outcome comparison across patients. The follow-up interviews included core GOSE questions such as: can you manage everyday activities independently (e.g., cooking, bathing)? are you able to return to work, school, or previous activities? do you experience any physical or cognitive difficulties resulting from the injury? do you require assistance from others for daily tasks? have you resumed your normal social or recreational activities?. These interviews were conducted by two trained neurosurgical nurses who were blinded to the patient's original admission data to reduce interviewer bias. Being "blinded" means the nurses had no access to the patient's clinical information (e.g., GCS scores, diagnosis) prior to or during the interview p rocess, ensuring objective assessment. Before data collection, both nurses underwent formal training sessions on administering the GOSE questionnaire and conducting standardized interviews, including role-play exercises and practice interviews under supervision. The nurses served as research assistants, not principal investigators, and their primary role was to carry out follow-up assessments without involvement in the analysis or interpretation of results. Each follow-up session lasted approximately 20–30 minutes guided by a standardized GOSE questionnaire.

Two clinical instruments used are GCS score Glasgow Coma Scale (GCS) (Teasdale & Jennett,1974). The GCS score in three categories—eye opening (E), verbal response (V), and motor response (M)—with a total score ranging from 3 to 15. The lower the score, the more severe the impairment. The instrument is widely used in Indonesia healthcare services both in hospital or community clinic. Additional instruments utilized included GOSE (Wilson et al., 2021). The instrument categorizes outcomes into eight levels, including 1: Death; 2: Vegetative State; 3: Lower Severe Disability; 4: Upper Severe Disability; 5: Lower Moderate Disability; 6: Upper Moderate Disability; 7: Lower Good Recovery; and 8: Upper Good Recovery. The GOSE evaluates functional domains such as independence, return to work or school, and

JHNS
Journal of Holistic Nursing Science
E-ISSN: 2579-7751 P-ISSN: 2579-8472

cognitive-psychosocial functioning. Interpretation was based on structured interview questions, and outcomes were assigned according to the guideline (Wilson et al., 2021). The tools are routinely used at RSUP Dr. Hasan Sadikin, particularly in neurotrauma follow-up care, and have been validated and tested for reliability (Amirtharaj et al., 2022; McMillan et al., 2016).

The data analysis was conducted using IBM SPSS Statistics software version 26. Descriptive statistics were used to describe the sample characteristics, including frequencies and percentages for categorical variables, and means and standard deviations. This provided a clear picture of the sample's demographic and clinical characteristics. Bivariate analysis was then performed to explore the relationships between independent variables (age, sex, and GCS score) and the outcome variable (GOSE scores at 12 months). The Chi-square test or Fisher's exact test was used, depending on the data, to determine significant associations (Kim, 2017). These statistical methods helped identify relationships between the variables, informing clinical practice, rehabilitation strategies, and future research (Hess & Hess, 2017). The significance level was considered at 0.05 for hypothesis testing. The study received ethical approval from the Research Ethics Committee of RSUP Dr. Hasan Sadikin Bandung (Approval No: LB.02.01/X.6.5/459/2022). Participants or their families provided written informed consent that demonstrating their understanding of the study's purpose, risks, and benefits. This process respected participants' autonomy and dignity and protected them from potential harm (Varkey, 2021). Through the prioritization of ethical standards, the research enhanced trust, credibility, and validity of its findings.

Results

The study documented that among the 46 participants; the majority were male (80%). The most represented age group was 17–25 years (50%), followed by those aged 38–49 and 49–61 years (each 15%). Most participants had severe head injuries, and 29 patients (63%) had a GCS score of 12 at admission **(Table 1)**. Assessment using the GOSE revealed a spectrum of outcomes at 12 months post-injury: 8 patients (18%) died, 7 (15%) experienced upper severe disability, 7 (15%) experienced upper moderate disability, 13 (28%) demonstrated lower good recovery, and 11 (24%) achieved upper good recovery **(Table 2)**. Bivariate analysis indicated statistically significant associations between both age and initial GCS scores with GOSE outcomes at 12 months (p=0.014 and p=0.022, respectively). Patients in the younger age group (17–25 years) and those with higher GCS scores (GCS 12) tended to have better functional outcomes. In contrast, sex was not significantly associated with GOSE outcomes (p=0.236) **(Table 3)**. Notably, among the 8 patients who died, most were older (≥49 years) and had lower GCS scores (≤10) at admission. This suggests that age-related physiological vulnerability and initial injury severity were likely contributors to fatal outcomes in this cohort.

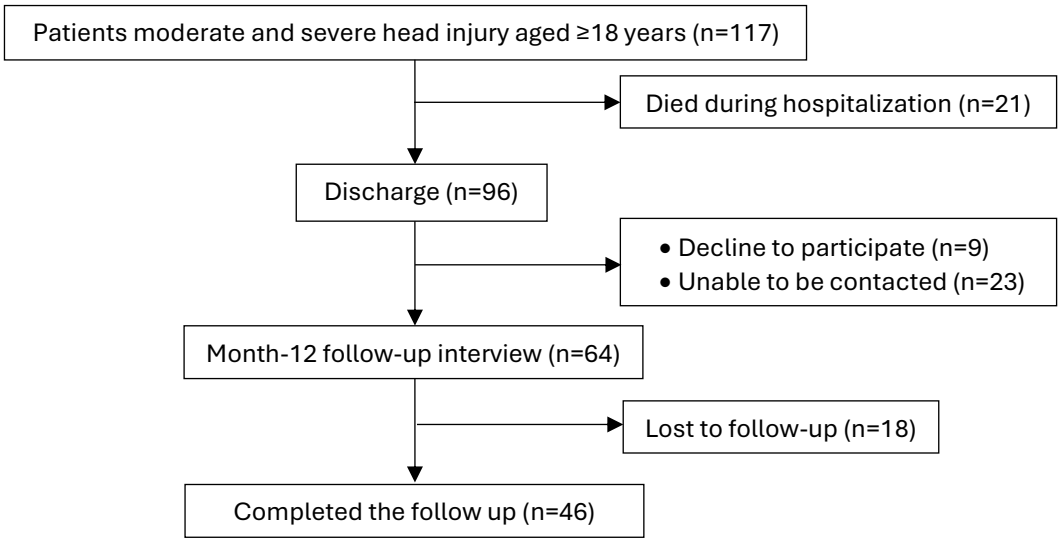

Figure 2. Flow chart of patient recruitment and follow-up.

Discussion

The finding indicates that most patients with moderate and severe head injuries at the Hospital were young males. This result is in agreement with global literature demonstrating that young adult males are more susceptible to head injuries (Kruk et al., 2018; Mollayeva et al., 2021). In Indonesia, traffic accidents remain a leading cause of TBI among young males

JHNS
Journal of Holistic Nursing Science
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who frequently ride motorcycles without adequate protective gear (Faried et al., 2017). Comparable trends have been reported internationally, such as in low- and middle-income countries where motorcycle accidents predominantly affect young males (Oyesanya et al., 2021). To prevent TBI among young males, nurses are at the forefront of both prevention and acute management. In terms of prevention, nurses can participate in public health campaigns to raise awareness about the risks of riding without helmets (Ranaei et al., 2021). They can educate patients and their families about safe driving practices and the severe consequences of TBI (Pappadis et al., 2023). Families, on the other hand, are indispensable partners in TBI care and prevention **(Figure 3)**. Their role begins with advocating for and enforcing safe practices within the household, such as insisting on helmet use. However, studies focusing on family's role in TBI prevention is limited or even underexplored in the literature.

Table 1. Characteristic of patients.

Characteristics	Frequency (n)	Percentage (%)
Gender		
Male	37	80%
Female	9	20%
GCS Score at Hospital Admission		
GCS 12	29	63%
GCS 11	15	33%
GCS 10	2	4%
Age		
17-25 years (adolescence)	23	50%
26-37 years (young adult)	4	9%
38-49 years (middle adult)	7	15%
49-61 years (older adult)	7	15%
61-73 years (pre-elderly)	5	11%

Table 2. The GOSE Score.

Glasglow Outcome Scale-Extended	Frequency (n)	Percentage (%)
Death	8	18%
Vegetative state	0	0%
Lower severe disability	0	0%
Upper severe disability	7	15%
Lower moderate disability	0	0%
Upper severe disability	7	15%
Lower good recovery	13	28%
Upper good recovery	11	24%

Table 3. Variables analysis of gender, GCS, and age with the GOSE.

Variables	*p*
Gender and GOSE	0.23
GCS and GOSE	0.02
Age and GOSE	0.01

The study also reveals that head injuries affect a wide age range, including pre-elderly patients (61-73 years). This finding mirrors international data showing that while younger individuals are more commonly affected, older adults are increasingly vulnerable to TBI due to falls and other mechanisms (Allen et al., 2023). Therefore, as primary caregiver, clinical nurses should close monitoring, assessment, and intervention to prevent further injury and promote optimal recovery (Ojo & Thiamwong, 2022). Nurses can educate patients and families on fall prevention strategies, such as removing tripping hazards, using assistive devices, and exercising regularly to improve balance and strength (Horta, 2024). In acute care settings, nurses closely monitor patients' neurological status, managing symptoms, and implementing evidence-based interventions to reduce intracranial pressure, promote oxygenation, and prevent complications. Outcome evaluation using the GOSE demonstrated variability in recovery levels 12 months post-injury,

JHNS
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with approximately 28% of patients achieving lower-level good recovery and 24% upper-level good recovery. This aligns with prior international studies indicating that severe TBI outcomes are heterogeneous that ranging from death and severe disability to substantial functional recovery (de Oliveira et al., 2017; Maas et al., 2022).

Initial GCS scores are key indicators of trauma severity and strongly predict mortality and long-term outcomes (Fitzgerald et al., 2020). The rehabilitation program at RSUP Dr. Hasan Sadikin likely contributed to recovery, although further investigation is required to delineate which specific rehabilitation components lead better outcomes. The hospital director and healthcare policymakers are essential in supporting rehabilitation programs like the one at RSUP Dr. Hasan Sadikin. They can develop policies and implement guidelines that promote evidence-based rehabilitation practices for high-quality care improvement. Furthermore, investing in rehabilitation infrastructure can help to reduce the severity of TBI in the future. Comparable research from rehabilitation centers in Europe and North America highlights the effectiveness of multidisciplinary rehabilitation approaches in maximizing recovery potential (Juengst et al., 2019; Rasmussen et al., 2019). The mortality rate (18%) and incidence of severe disability (15%) observed in this study underscore the ongoing challenges of managing severe head injury in healthcare systems worldwide. These challenges often include limited access to specialized neurosurgical care, a shortage of trained personnel (including neurosurgeons, intensivists, and rehabilitation therapists), inadequate pre-hospital care and prolonged transport times, and insufficient advanced diagnostic imaging (like CT or MRI). Furthermore, disparities in funding for TBI research and rehabilitation services, fragmented care pathways leading to loss of information or follow-up, and a lack of standardized, resource-stratified guidelines contribute to suboptimal outcomes. To effectively address these issues, a multi-pronged approach is essential includes investing in robust trauma systems that ensure rapid pre-hospital assessment and transport, increasing the availability of neurosurgical facilities and training skilled healthcare professionals, developing and implementing context-specific TBI management guidelines to local resources, promoting international collaborations for research.

The study presented a significant relationship between age and initial GCS score at admission with GOSE results at 12 months. This finding concurs with study reported that lower GOSE scores were evident across all age groups beyond the youngest cohort (15-24 years) two years post-TBI (Downing et al., 2024). Younger patients (17-25 years) in this study demonstrated better recovery outcomes, potentially due to higher neuroplasticity and fewer comorbid conditions—a pattern supported by international data (Corrigan & Hammond, 2013; Skaansar et al., 2020). The significant influence of initial GCS scores on functional outcomes is well-documented, with higher scores correlating to improved recovery trajectories (Butcher et al., 2022; Mohamed et al., 2022). However, sex was not significantly associated with GOSE outcomes in this study. Some studies suggest females recover better from TBI (Mollayeva et al., 2018; Mollayeva et al., 2021). However, any lack of a clear association in our findings could be due to limited sample size or other factors like age and injury severity. A more in-depth analysis controlling for these potential confounding factors, along with a larger sample size, would be necessary to draw more robust conclusions about the role of sex in TBI outcomes in this setting. It's also possible that the unique demographic or injury patterns within our specific Indonesian cohort might have influenced this finding, distinguishing it from studies conducted in different populations. This recent study also highlights the complexity of recovery and suggests that rehabilitation strategies should prioritize clinical characteristics like age and initial injury severity over demographic factors such as gender (Sveen et al., 2022). The contribution of nurses is crucial throughout the acute and rehabilitative phases of TBI care. They are fundamental in early assessments, monitoring neurological status, managing complications, and providing ongoing patient-centered care (de Oliveira et al., 2022). In the rehabilitation phase, nurses assist in functional recovery by supporting physical therapy, cognitive rehabilitation, and psychosocial interventions while also educating patients and their families (Sveen et al., 2022; Yu et al., 2015). International guidelines emphasized that nurse-led interventions improve adherence to rehabilitation protocols and

Figure 3. Illustration of accidents on the road (Documented by authors).

enhance long-term outcomes (Krupp et al., 2018). This underscores the need for specialized nursing education in TBI management for both acute care and long-term rehabilitation settings.

This study provides valuable insights into the importance of TBI follow-up care, but like all research, it has both strengths and limitations that should be considered when interpreting the findings. The same applies to this study, the missing data from 18 patients who were unreachable may have biased the findings. Also, age and sex distributions in this sample may not fully represent the broader TBI population. Overall, this study reinforces the significance of age and initial injury severity as predictors of long-term functional outcomes in moderate to severe TBI patients. Understanding these factors allows healthcare providers to develop specific treatments for maximizing recovery and healing. The variability in recovery highlights the potential benefits of personalized rehabilitation programs that incorporate neuroplasticity-enhancing therapies such as cognitive rehabilitation and physical therapy, especially for younger patients with higher regenerative capacity (Damkliang et al., 2015; Moksnes et al., 2023). Furthermore, optimizing rehabilitation requires a multidisciplinary approach in clinical setting (Vikane et al., 2017). The findings can guide clinicians in prognostication, enabling more and effective treatment plans that address both immediate and long-term patient needs. From a policy perspective, the evidence generated can inform the development of national guidelines for TBI management. Additionally, the study highlights gaps in current healthcare infrastructure, such as the availability of specialized rehabilitation centers and community-based support, which are essential for improving patient outcomes and quality of life. After a TBI, families become crucial caregivers to provide emotional and practical support (Lindlöf et al., 2024). They are often the primary source of information about the patient's pre-injury life which helps healthcare providers care plans. Family members also support rehabilitation by reinforcing therapy goals at home. In essence, nurses provide the professional medical expertise and nursing coordination, while families offer the consistent, intimate, and specific care support for holistic recovery at home.

Conclusion

This study highlighted that age and GCS score have prognostic value in determining long-term recovery potential among patients with TBI. The study also reinforces the critical role of timely and comprehensive rehabilitation interventions. Furthermore, early identification of patients at risk for poor outcomes is essential. Nurses serve as an essential role in monitoring neurological status, coordinating care, and facilitating recovery through patient and family education. The findings also underscore the necessity for age- and severity-specific rehabilitation strategies to support individualized patient recovery. Younger individuals and those presenting with higher GCS scores are more likely to benefit from proactive, intensive rehabilitation efforts. However, older patients or those with lower GCS scores may require specific interventions that consider age-related comorbidities and slower recovery trajectories. Government along with healthcare policy makers should integrate these insights into clinical practice by developing structured and multidisciplinary rehabilitation programs. Further research is needed to explore additional predictors of recovery, such as comorbidities, socioeconomic factors, and access to rehabilitation services. Investigating the mechanisms underlying age-related disparities in recovery could also inform the design of interventions.

Author's declaration

All authors contribute to the research process, manuscript writing and publication stages.

AI statement

Any generative text artificial intelligence was not used during manuscript preparation.

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Availability of data and materials

All data are available from the authors.

Competing interests

The authors declare that there are no conflicts of interest related to this study.

JHNS
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Authors' insight

Key points

- The study investigates outcomes for moderate and severe TBI that distinguishing itself from research that might lump all severities together.
- The 12-month follow-up period is a significant strength to provide insights into long-term recovery patterns rather than just immediate post-injury status.
- The use of the GOSE indicates a commitment to a globally recognized and comprehensive tool for assessing functional outcomes.

Emerging nursing avenues

- What unique challenges or contributing factors (e.g., healthcare infrastructure, socioeconomic disparities, referral pathways) might have influenced the observed long-term outcomes compared to similar studies in high-income countries?
- How did they correlate with the GOSE scores in differentiating between moderate and severe TBI patients over the 12-month follow-up?
- What specific interventions or rehabilitation strategies were implemented for the patients in this cohort during their follow-up period?

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