



EXAMINING THE RELATIONSHIP BETWEEN
POST-TRAUMATIC STRESS SYMPTOMS,
DEPRESSIVE SYMPTOMS, AND EMOTIONAL
REGULATION IN INDIVIDUALS WITH
TRAUMATIC BRAIN INJURY

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DECLARATION

I hereby declare that the project work entitled "Examining the Relationship between Post-Traumatic Stress Symptoms, Depressive Symptoms, and Emotional Regulation in Individuals with Traumatic Brain Injury" submitted to the Universiti Sains Malaysia (USM) and Universiti Pendidikan Sultan Idris (UPSI), is a record of an original workdone by me under the guidance of Dr. Mohd Faizal bin Mohd Zulkifly and this project work is submitted in the partial fulfillment of the requirements for the degree of Master of Psychology (Clinical). The results embodied in this thesis have not been submitted to any other University or Institute for the award of any degree or diploma.



Student's Signature

19 August 2025

Date

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ABSTRACT

Traumatic brain injury (TBI) is commonly associated with psychological challenges, including post-traumatic stress symptoms (PTSS), depressive symptoms, and emotional regulation difficulties. Despite the high prevalence of these issues, research on their co-occurrence and interrelationships in TBI populations is limited. This study aimed to examine the prevalence of PTSS, depressive symptoms, and emotional regulation difficulties among individuals with a history of TBI and to explore the relationships between these challenges. A sample of 150 individuals with TBI participated in this cross-sectional study. Participants completed self-report measures: the Post-Traumatic Stress Disorder Checklist (PCL), the Patient Health Questionnaire (PHQ-9), and the Emotion Regulation Questionnaire (ERQ). Statistical analyses, including descriptive statistics and correlation tests, were conducted to assess the prevalence and relationships between variables. The results indicated that 80.7% of participants met the clinical threshold for PTSS, with 43.3% exhibiting moderately severe depressive symptoms and 26.7% reporting moderate symptoms. Emotional regulation difficulties were prevalent, with 32.0% showing low cognitive reappraisal scores and 48.0% exhibiting medium levels of expressive suppression. A moderate positive correlation was found between cognitive reappraisal and PTSS (Spearman's $\rho = 0.253$, $p = 0.002$), while a strong positive correlation was observed between expressive suppression and PTSS (Spearman's $\rho = 0.532$, $p < 0.001$). Additionally, a strong positive correlation was found between PTSS and depressive symptoms (Spearman's $\rho = 0.728$, $p < 0.001$). These findings highlight the significant psychological challenges faced by individuals with TBI and underscore the role of emotional regulation in the co-occurrence of PTSS and depression. However, limitations such as the small sample size and reliance on self-report measures suggest that future research should explore larger, longitudinal studies to better understand the interrelationships between these psychological challenges in TBI populations.

Keywords: Traumatic brain injury, post-traumatic stress symptoms, depressive symptoms, emotional regulation, cognitive reappraisal, expressive suppression.

ABSTRAK

Kecederaan otak traumatik (TBI) sering dikaitkan dengan cabaran psikologi, termasuk simptom tekanan pasca-trauma (PTSS), simptom kemurungan, dan kesukaran dalam pengaturan emosi. Walaupun isu kesihatan mental ini sering berlaku, kajian mengenai keterlibatan dan hubungan antara kondisi-kondisi ini dalam populasi TBI adalah terhad. Kajian ini bertujuan untuk mengkaji prevalens PTSS, simptom kemurungan, dan kesukaran pengaturan emosi di kalangan individu dengan sejarah TBI serta meneroka hubungan antara cabaran-cabaran psikologi ini. Sampel seramai 150 individu dengan sejarah TBI telah mengambil bahagian dalam kajian rentas lintang ini. Peserta melengkapkan ujian sendiri: Senarai Semak Gangguan Stres Pasca-Trauma (PCL), Soal Selidik Kesihatan Pesakit (PHQ-9), dan Soal Selidik Pengaturan Emosi (ERQ). Analisis statistik, termasuk statistik deskriptif dan ujian korelasi, dijalankan untuk menilai prevalens dan hubungan antara pemboleh ubah. Hasil kajian menunjukkan bahawa 80.7% peserta memenuhi ambang klinikal untuk PTSS, dengan 43.3% menunjukkan simptom kemurungan yang sederhana hingga teruk, diikuti oleh 26.7% dengan simptom sederhana. Kesukaran pengaturan emosi adalah perkara biasa, dengan 32.0% menunjukkan skor reappraisal kognitif rendah dan 48.0% menunjukkan tahap penyekatan ekspresif sederhana. Korelasi positif sederhana ditemui antara reappraisal kognitif dan PTSS (Spearman's $\rho = 0.253$, $p = 0.002$), manakala korelasi positif kuat ditemui antara penyekatan ekspresif dan PTSS (Spearman's $\rho = 0.532$, $p < 0.001$). Selain itu, korelasi positif kuat juga dilihat antara PTSS dan simptom kemurungan (Spearman's $\rho = 0.728$, $p < 0.001$). Penemuan ini menekankan cabaran psikologi yang signifikan dihadapi oleh individu dengan TBI dan peranan pengaturan emosi dalam pertembungan PTSS dan kemurungan. Walau bagaimanapun, kekangan kajian ini, termasuk saiz sampel yang kecil dan bergantung kepada ujian sendiri, mencadangkan agar penyelidikan akan datang memberi tumpuan kepada kajian longitudinal yang lebih besar untuk lebih memahami hubungan antara cabaran-cabaran psikologi ini dalam populasi TBI.

Kata kunci: Kecederaan otak traumatik, simptom tekanan pasca-trauma, simptom kemurungan, pengaturan emosi, reappraisal kognitif, penyekatan ekspresif.

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LIST OF ABBREVIATIONS

ABI	Acquired Brain Injury
CBT	Cognitive-Behavioral Therapy
DSM-5	Diagnostic and Statistical Manual of Mental Disorders, 5th Edition
ERQ	Emotion Regulation Questionnaire
EFT	Emotion-Focused Therapy
GCS	Glasgow Coma Scale
MBCT	Mindfulness-Based Cognitive Therapy
MDD	Major Depressive Disorder
MRI	Magnetic Resonance Imaging
PCL	PTSD Checklist (for DSM-5)
PHQ-9	Patient Health Questionnaire-9
PTSD	Post-Traumatic Stress Disorder
PTSS	Post-Traumatic Stress Symptoms
SPSS	Statistical Package for the Social Sciences
TBI	Traumatic Brain Injury
TF-CBT	Trauma-Focused Cognitive-Behavioral Therapy

LIST OF SYMBOLS

α (Alpha)	Cronbach's alpha
df	Degrees of freedom.
p	Probability value (significance level).
ρ (rho)	Spearman's rank correlation coefficient
SD	Standard deviation.

CHAPTER 1

INTRODUCTION

1.0 Introduction

This chapter will discuss the background of the study, problem statement, the objectives of the study, research questions, research hypotheses, a conceptual framework, the definition for terms, and the significance of the study.

1.1 Background of Study

Traumatic brain injury (TBI) is a global public health challenge, affecting an estimated 69 million individuals annually (Babiloni et al., 2020; Maas et al., 2022). Often referred to as a "silent epidemic" due to its widespread but under-recognized impact, TBI results in both immediate and long-term consequences that affect not only the physical, cognitive but also the emotional and psychological health of individuals (Dewan et al., 2018). By 2030, TBI is projected to be one of the leading causes of injury-related fatalities and disabilities, burdening healthcare systems worldwide (Maas et al., 2022). According to the Centers for Disease Control and Prevention (CDC), TBI is defined as a disruption of brain function due to external mechanical forces such as a blow, bump, or jolt to the head, which may lead to temporary or permanent impairments (Keating & Cullen, 2020; Naumenko et al., 2023). The severity of TBI ranges from mild concussions to severe injuries that result in permanent cognitive, emotional, and physical impairments (Ayton et al., 2025; Howlett et al., 2021; Shuanglong et al., 2024).

In Malaysia, TBI is a leading cause of intensive care unit (ICU) admissions, primarily due to road traffic accidents (RTAs) (Teh et al., 2023). However, there is a lack of comprehensive national data on TBI, particularly regarding non-RTA causes such as falls, sports injuries, and abuse. Although the National Trauma Database Malaysia (NTrD), overseen by the Ministry of Health, has made efforts to document trauma cases, reports are infrequent and often outdated, with the latest data published in 2011. Given the high prevalence of RTAs, particularly among younger males in the 15–24 age group (Jamaluddin et al., 2011; Teh et al., 2023), it is crucial to address the long-term consequences of TBI in this high-risk demographic. Despite relatively high survival rates in trauma cases, there is

limited research on the psychological outcomes of TBI survivors, including post-traumatic stress symptoms (PTSS), depression, and emotional regulation difficulties (Arulsamy & Shaikh, 2020). This gap in research highlights the need for further investigation into how TBI affects the mental and emotional well-being of individuals, particularly those in vulnerable age groups.

TBI is widely associated with neuropsychiatric complications, including PTSS, depressive symptoms, and emotional regulation issues, all of which significantly affect recovery and quality of life (Santos et al., 2021; Torregrossa et al., 2023). PTSS, once thought to be uncommon following TBI, is increasingly recognized as a significant consequence of brain injuries, even in individuals who do not explicitly recall the traumatic event (Fisher et al., 2021; Iljazi et al., 2020). Research consistently shows that individuals with mild traumatic brain injury (mTBI) are at an increased risk of developing post-traumatic stress symptoms (PTSS) and post-traumatic stress disorder (PTSD) compared to those with other injuries or no TBI (Barak et al., 2025; Kallianezos et al., 2021; Shi et al., 2023; Shih et al., 2020; Van Der Vlegel et al., 2021). Meta-analyses and large cohort studies indicate that the prevalence of PTSD following mTBI in civilian populations ranges from approximately 12% to 16% within the first year post-injury (Han, 2014; Van Praag et al., 2019). Higher rates are observed in military populations, with some studies reporting up to 48%, and pooled estimates for all TBI cases around 27%, significantly higher than in non-TBI trauma groups (Loignon et al., 2019; Iljazi et al., 2020; Van Praag et al., 2019).

Symptoms such as hyperarousal, sleep disturbances, cognitive impairments, and fatigue are commonly observed in both post-traumatic stress disorder (PTSD) and post-concussion syndrome (PCS), conditions frequently seen

in individuals with TBI. These symptoms often overlap, contributing to significant functional impairments and worsening disability (Oyegbile et al., 2019; Santos et al., 2020; Stevens et al., 2021).

Post-traumatic stress symptoms (PTSS) and depressive symptoms are both commonly observed in individuals with traumatic brain injury (TBI), and together they significantly complicate the recovery process. These symptoms are often interrelated, with the presence of one exacerbating the severity of the other, leading to prolonged recovery trajectories (Iljazi et al., 2020; Mikolić et al., 2025; Simonovic et al., 2023). In addition to PTSS and depression, emotional dysregulation is another prevalent issue for TBI survivors, characterized by difficulties in managing emotional responses. This emotional dysregulation frequently co-occurs with both PTSS and depressive symptoms, further contributing to functional impairments and hindering rehabilitation efforts (Rezaei & Jafroudi, 2023; Sultana et al., 2023; Weis et al., 2021). Brain damage in areas such as the prefrontal cortex, amygdala, and ventromedial prefrontal cortex plays a key role in these impairments (Filippone et al., 2023). For example, lesions in the prefrontal cortex are associated with deficits in executive functions like planning, decision-making, and impulse control (José et al., 2020). Damage to the amygdala has been shown to significantly alter emotional responses, particularly fear processing, which can lead to increased emotional reactivity (Šimić et al., 2021). Furthermore, lesions in the ventromedial prefrontal cortex impact reward-based decision-making and risk evaluation, often leading to maladaptive behaviors (Bechara et al., 2000). These disruptions in key brain regions responsible for emotional and cognitive regulation highlight the complexity of recovery for TBI survivors.

1.2 Problem Statement

Traumatic brain injury (TBI) research in Malaysia has predominantly focused on its immediate physiological consequences, such as neuroinflammation and mitochondrial dysfunction (Arulsamy & Shaikh, 2020; Azim & Joseph, 2018; Sahel et al., 2019). However, the long-term psychological impacts of TBI, particularly Post-Traumatic Stress Symptoms (PTSS), depressive symptoms, and emotional dysregulation (ED), remain significantly underexplored in this context. While these psychological sequelae are increasingly recognized globally, their prevalence, interrelationships, and role in recovery are not well understood within the Malaysian population. This gap in understanding severely limits the development of rehabilitation strategies that address the psychological needs of TBI survivors, which are crucial for effective recovery (Iljazi et al., 2020; Loignon et al., 2020; Weis et al., 2021).

The need for further research is further underscored by the fact that PTSS, depression, and ED often co-occur, significantly influencing the rehabilitation outcomes of TBI survivors. These factors are not only interrelated but also act synergistically, exacerbating one another and complicating recovery (Bahraini et al., 2014; Choi et al., 2021; Looi et al., 2022). For instance, PTSS frequently intensifies depressive symptoms, while emotional dysregulation can impair coping mechanisms, leading to a vicious cycle that hinders rehabilitation (Iljazi et al., 2020; Vasterling et al., 2017; Weis et al., 2021). Despite the growing recognition of these interactions, anxiety—though prevalent in TBI survivors—is often seen as secondary in comparison to PTSS, depression, and ED, which have a more direct and profound impact on emotional and psychological well-being (Bryant et al.,

2010; Iljazi et al., 2020; Vasterling & Hall, 2018).

Furthermore, while significant research has been conducted on the psychological effects of severe TBI, less attention has been given to individuals with mild and moderate TBI, particularly in Malaysia. Existing studies predominantly examine severe cases, leaving a notable research gap in understanding how PTSS, depressive symptoms, and ED affect individuals with less severe injuries (Haagsma et al., 2015; Loignon et al., 2020; Looi et al., 2022). Loignon et al. (2020) highlight the strong link between PTSS and severe TBI, but similar studies for mild and moderate TBI remain scarce. The psychological recovery of individuals with mild and moderate TBI often involves nuanced factors such as depressive symptoms and emotional regulation difficulties, which are equally important but underexplored (Bryant et al., 2010; Looi et al., 2022; Weis et al., 2021).

This study seeks to fill these gaps by exploring the prevalence, interrelationships, and impact of PTSS, depressive symptoms, and emotional dysregulation in TBI survivors across all severity levels (mild, moderate, and severe) in Malaysia. By addressing these psychological factors, this research aims to provide empirical data that can inform more comprehensive rehabilitation protocols. Such protocols would not only address the physical aspects of recovery but also incorporate psychological strategies, which are crucial for the long-term well-being of TBI survivors (Carmichael et al., 2023; Loignon et al., 2020; Vasterling et al., 2017). In doing so, the study aims to contribute to the development of effective, holistic rehabilitation approaches for TBI survivors in Malaysia.

1.3 Objectives of the Study

General Objective:

- a. To examine the prevalence and interrelationships of post-traumatic stress symptoms, depressive symptoms, and emotional regulation difficulties among individuals with traumatic brain injury (TBI) in Malaysia.

Specific Objectives:

1. To determine the prevalence rates of post-traumatic stress symptoms, depressive symptoms, and emotional regulation difficulties in individuals with a history of TBI.
2. To examine the relationship between emotional regulation difficulties and the severity of post-traumatic stress symptoms among individuals with a history of TBI.
3. To identify the correlation between post-traumatic stress symptoms and depressive symptoms in individuals with a history of TBI.

Research Questions:

1. What is the prevalence of post-traumatic stress symptoms, depressive symptoms, and emotional regulation difficulties among individuals with a history of traumatic brain injury (TBI) in Malaysia?
2. What is the relationship between emotional regulation difficulties and the severity of post-traumatic stress symptoms in individuals with a history of TBI?
3. What is the correlation between post-traumatic stress symptoms and depressive symptoms in individuals with a history of TBI?

Hypotheses:

1. **H1:** Individuals with a history of traumatic brain injury (TBI) will exhibit significant prevalence rates of post-traumatic stress symptoms, depressive symptoms, and emotional regulation difficulties.
2. **H2:** Emotional regulation difficulties are positively correlated with the severity of post-traumatic stress symptoms in individuals with a history of TBI.
3. **H3:** Post-traumatic stress symptoms are positively correlated with depressive symptoms in individuals with a history of TBI.

1.4 Significance of Study

This study will contribute significantly to both the academic literature and clinical practice by filling an important gap in understanding the psychological outcomes of TBI in Malaysia. By investigating the prevalence and interrelationships of PTSS, depressive symptoms, and emotional regulation difficulties, the study will provide valuable insights into the long-term psychological effects of TBI, particularly in the Malaysian context where such research is limited. The findings will be crucial in enhancing rehabilitation protocols by providing evidence-based insights into the psychological challenges faced by TBI survivors, such as post-traumatic stress symptoms, depressive symptoms, and emotional regulation difficulties. By identifying the specific psychological needs of these individuals, rehabilitation programs can be tailored to integrate both physical and psychological interventions, promoting more holistic recovery. Additionally, the study will inform mental health policies by highlighting the importance of psychological support for TBI patients. The results could lead to the development of targeted mental health interventions, such as counseling or cognitive behavioral therapy,

designed to address the unique psychological outcomes of TBI. Furthermore, clinical practices, especially in rehabilitation centers, can be improved by incorporating psychological assessments into routine care to ensure that the mental health needs of TBI patients are identified and addressed early in the recovery process. The findings may also inspire further research into psychosocial interventions, potentially influencing broader health policy reforms that prioritize the integration of mental health care into physical rehabilitation for TBI survivors.

CHAPTER 2

LITERATURE REVIEW

2.0 Traumatic Brain Injury

Traumatic Brain Injury (TBI) is a major global public health issue, with millions of individuals affected annually worldwide. It occurs when an external force, such as a blow or jolt to the head, disrupts normal brain function, resulting in a wide range of cognitive, emotional, and psychological impairments. Common causes of TBI include motor vehicle accidents, falls, sports-related injuries, and interpersonal violence (Goldman et al., 2022; Norman et al., 2022).

TBI is typically classified as mild, moderate, or severe based on clinical assessments, including the Glasgow Coma Scale (GCS), the duration of loss of

consciousness, and post-traumatic amnesia (Malec et al., 2007). While mild TBI (mTBI), including concussions, represents the most common form, moderate and severe TBIs tend to have more pronounced long-term consequences, including significant neurological, psychological, and emotional dysfunction (Jeromin et al., 2015; Gravestijn et al., 2020).

Beyond the immediate physical effects, TBI is increasingly recognized for its long-term neuropsychological consequences, which can persist for months or even years after the initial injury. The severity and duration of these impairments depend on a range of factors, including injury severity, the brain regions affected, and individual recovery factors (Chen et al., 2023). Research highlights that TBI can disrupt emotional regulation, increase vulnerability to post-traumatic stress symptoms (PTSS), and elevate the risk of developing depressive symptoms, all of which significantly compromise an individual's quality of life and rehabilitation outcomes (Sahel et al., 2019; Rauchman et al., 2023).

As understanding of TBI continues to evolve, recent studies underscore the critical need to assess the psychiatric and emotional outcomes of TBI, particularly the prevalence of PTSS, depressive symptoms, and emotional regulation difficulties (Bahraini et al., 2014; Haagsma et al., 2015; Dehbozorgi et al., 2024; Pepping et al., 2024). These psychological consequences are often underdiagnosed and undertreated, despite their profound impact on the individual's emotional well-

being and rehabilitation process (Wilson et al., 2020; Kelly et al., 2023). Addressing these emotional and psychological outcomes is essential to improving recovery and quality of life for TBI survivors.

2.1 Post-Traumatic Stress Symptoms (PTSS) in TBI Patients

Post-traumatic stress symptoms (PTSS) frequently co-occur with traumatic brain injury (TBI), presenting significant challenges for clinical management and patient outcomes. Although trauma exposure is common in the general population, only a subset of individuals develops PTSS or post-traumatic stress disorder (PTSD) (Kilpatrick et al., 2013; Tortella-Feliu et al., 2019; Harnett et al., 2020). However, TBI significantly increases the likelihood of PTSS, especially in cases involving combat, motor vehicle accidents, or other high-impact injuries. Compared to individuals with non-TBI injuries, those with TBI exhibit a higher prevalence of PTSS, more severe symptoms, and prolonged recovery trajectories (Carlson et al., 2011; Van Praag et al., 2019; Iljazi et al., 2020).

The prevalence of PTSS among TBI patients varies according to population type and injury severity. In military personnel, where exposure to combat and

explosive blasts is common, mild TBI (mTBI) prevalence ranges from 4.4% to 23%, while PTSD rates range from 14% to 16% (Gates et al., 2012; Terrio et al., 2009; Rona et al., 2012). Notably, blast-related mTBI is associated with higher PTSD comorbidity rates compared to non-blast-related TBIs, suggesting that the injury mechanism plays a pivotal role in the development of subsequent symptoms (Lehavot et al., 2018).

In civilian populations, PTSS prevalence remains significant. Approximately 14% of individuals with TBI develop PTSD within the first year following the injury, while 7% continue to exhibit symptoms beyond one year (Scholten et al., 2016; Van Praag et al., 2019). Additionally, a study of 276 service members with mTBI found that preexisting PTSS significantly increased the risk of developing PTSD following injury (Manners et al., 2016). Similarly, in young athletes, preexisting psychological factors influence recovery from post-concussive symptoms, highlighting the importance of mental health prior to injury (Nelson et al., 2016; Trinh et al., 2019).

Several factors contribute to the likelihood of developing PTSS following TBI, including injury severity, pre-injury mental health conditions, sex differences, and the presence of early PTSS (Cnossen et al., 2017; Christiansen & Berke, 2020). A 2017 systematic review of 26 observational studies identified that female sex,

early PTSS, and memory of the traumatic event were all associated with a higher risk of PTSD (Cnossen et al., 2017). Furthermore, individuals with TBI often experience persistent cognitive and affective impairments, with symptom severity generally increasing as injury severity escalates (Bryant et al., 2010; Haagsma et al., 2015; Hoge et al., 2008; Kennedy et al., 2010).

The traditional view that severe TBI—characterized by posttraumatic amnesia (PTA) or loss of consciousness—precludes the development of PTSD due to a lack of traumatic memory has been challenged by recent findings. Evidence now suggests that individuals across all severities of TBI can develop PTSS, with proposed mechanisms including:

1. Neurobiological alterations affecting emotional processing (Bahraini et al., 2014).
2. Fear conditioning and heightened emotional responses due to brain changes (Kaplan et al., 2018).
3. Memory reconstruction post-PTA, where fragmented recollections of the traumatic event contribute to distress (Kaplan et al., 2018).

The comorbidity of TBI and PTSS is underpinned by overlapping neurobiological dysfunctions. TBI-related structural and functional changes in the amygdala, prefrontal cortex, and hippocampus—regions responsible for fear regulation and emotional memory—exacerbate PTSS symptoms (Vasterling & Hall, 2018; Petzold & Bunzeck, 2022).

- Amygdala hyperactivation increases fear responses, contributing to intrusive thoughts and hyperarousal (Vasterling et al., 2018).
- Prefrontal cortex impairments reduce the top-down regulation of fear responses, exacerbating emotional dysregulation (Roeckner et al., 2021).
- Hippocampal dysfunction disrupts contextual memory processing, leading to the generalization of fear responses beyond the initial trauma context (Vasterling et al., 2018).

Additionally, TBI patients with PTSS experience long-term neurocognitive impairments, particularly in episodic long-term memory and verbal memory, which further deteriorates functional and psychosocial outcomes (Couette et al., 2019; Petzold & Bunzeck, 2022).

The coexistence of TBI and PTSS complicates diagnosis and treatment, as overlapping symptoms (e.g., irritability, cognitive deficits, sleep disturbances) blur clinical distinctions (Bryant, 2011). Consequently, standard PTSD assessments may not fully capture PTSS in TBI patients, necessitating tailored diagnostic approaches that account for cognitive impairments and neurological factors (Dieter & Engel, 2019).

Effective management of TBI-related PTSS requires integrated therapeutic strategies that address both emotional dysregulation and cognitive dysfunction (Torregrossa et al., 2023). Given the shared neurobiological pathways, interventions targeting emotion regulation circuits—such as cognitive behavioral therapy (CBT), exposure therapy, and neurorehabilitation techniques—show promise as effective approaches for mitigating PTSS (Hinojosa et al., 2024).

In conclusion, PTSS is a prevalent and complex comorbidity in individuals with TBI, affecting both civilian and military populations. The bidirectional relationship between TBI and PTSS is shaped by various factors, including injury severity, pre-injury psychological factors, and neurobiological dysfunctions. The overlapping symptoms of TBI and PTSS present diagnostic and therapeutic challenges, underscoring the need for specialized assessment tools and integrated treatment approaches. Future research should focus on personalized therapeutic

interventions aimed at addressing the long-term cognitive and emotional impacts of PTSS in TBI patients.

2.2 Cognitive Dysfunction in Traumatic Brain Injury

Individuals with traumatic brain injury (TBI) frequently experience cognitive impairments, including difficulties with attention, memory, executive function, and processing speed. These impairments can complicate the presentation of post-traumatic stress symptoms (PTSS) by disrupting an individual's ability to process traumatic memories, regulate emotions, and engage in adaptive coping strategies (Dunbar et al., 2019; Uiterwijk et al., 2021).

The severity of cognitive impairments in TBI patients with PTSS is influenced by both the severity of the brain injury and the persistence of stress-related symptoms. For example, damage to the prefrontal cortex (PFC)—a brain region responsible for executive control and emotional regulation—can exacerbate difficulties in managing stress responses, leading to heightened emotional reactivity and maladaptive coping (Tsai et al., 2021; Zhang et al., 2022). Additionally, deficits in working memory and attentional control may make individuals more susceptible

to intrusive memories and rumination, which are core symptoms of PTSS (Jurick et al., 2021; Weis et al., 2022).

Research indicates that PTSS and cognitive deficits in TBI are bidirectionally linked: PTSS can further impair cognitive function, while cognitive dysfunction can hinder an individual's ability to process and recover from trauma (Dieter & Engel, 2019). The combined impact of TBI-related cognitive impairments and PTSS may also contribute to emotional dysregulation, as individuals struggle to regulate distressing emotions due to deficits in impulse control and cognitive flexibility (Manktelow et al., 2017; Taing et al., 2021).

Given these interactions, understanding the prevalence and severity of PTSS in TBI patients requires consideration of cognitive dysfunction and its role in emotional regulation difficulties. These factors may also contribute to the development of depressive symptoms, further complicating recovery and mental health outcomes (Bloom et al., 2017; Weis et al., 2022).

2.3 Emotional Dysregulation in Traumatic Brain Injury

Emotional dysregulation is a well-documented consequence of traumatic brain injury (TBI), playing a crucial role in the development and persistence of post-traumatic stress symptoms (PTSS) and depressive symptoms in affected individuals. Damage to key neurobiological structures involved in emotional regulation, including the amygdala, ventromedial prefrontal cortex (vmPFC), anterior cingulate cortex (ACC), and hippocampus, impairs the ability to regulate emotional responses effectively. This dysfunction leads to heightened emotional reactivity, impaired emotional modulation, and difficulties in interpreting and responding to emotional cues (Weis et al., 2022; Rezaei & Jafroudi, 2023; Santos et al., 2023). Importantly, these deficits overlap with symptom domains of PTSS and depressive disorders, suggesting a shared underlying mechanism that contributes to poor emotional control and increased psychological (De Munter et al., 2019; Joyal et al., 2019; Shorer et al., 2024).

TBI-induced damage to the prefrontal cortex (PFC) disrupts top-down regulatory control over the amygdala, resulting in exaggerated fear responses, increased emotional volatility, and impaired impulse regulation (Choi & Jang, 2021; Burbach et al., 2024). This dysfunction mirrors the neural alterations observed in individuals with PTSS, where hyperactivity of the amygdala and reduced inhibition from the PFC contribute to persistent hyperarousal, emotional numbing, and heightened stress sensitivity (Chiba et al., 2020; Alexander & Vasefi, 2021; Weis et al., 2022). Additionally, disruptions in the hippocampus, a structure

crucial for contextual memory processing and emotional regulation, may exacerbate intrusive memories and maladaptive fear responses, further reinforcing PTSS symptoms in individuals with TBI (Bae et al., 2019; Fisher et al., 2021; Navabi et al., 2024).

Psychologically, individuals with co-occurring TBI and PTSS frequently exhibit maladaptive emotional regulation strategies, such as emotional suppression, avoidance, and rumination, which not only sustain psychological distress but also contribute to the development of comorbid depressive symptoms (Wang et al., 2020; Howlett et al., 2021; Weis et al., 2021). Depressive symptoms in this population are characterized by persistent negative affect, loss of interest, social withdrawal, and cognitive impairments, which may be further exacerbated by underlying TBI-related deficits in executive function and working memory (Kaup et al., 2018; Li et al., 2021; Ryan et al., 2024). The interaction between PTSS, depressive symptoms, and emotional dysregulation creates a complex cycle in which difficulties in managing stress and negative emotions contribute to worsening mental health outcomes in individuals with TBI.

Understanding the role of emotional dysregulation in TBI-related PTSS and depressive symptoms is essential for developing effective interventions. Given that maladaptive emotional regulation strategies contribute to the maintenance of

psychological distress, targeted treatments should focus on enhancing emotional awareness, improving cognitive control over emotional responses, and fostering adaptive coping mechanisms (Weis et al., 2022). Evidence-based interventions that show promise in addressing emotional dysregulation in this population include Cognitive Behavioral Therapy (CBT), which helps individuals restructure maladaptive thoughts and develop effective emotional regulation strategies (Arfaoui et al., 2022; Saccaro et al., 2024; De Paul Savarimuthu et al., 2024). Mindfulness-Based Cognitive Therapy (MBCT) enhances self-awareness of emotional states, reducing reactivity and promoting adaptive stress management (Querstret et al., 2020; Brown et al., 2022; Gkintoni et al., 2025). Neurofeedback and Emotion Regulation Training aim to restore functional connectivity between the prefrontal cortex and limbic structures, improving emotional control and regulating arousal (Huang et al., 2021; Krylova et al., 2021; Li et al., 2025).

Given the high prevalence of emotional dysregulation in individuals with TBI, addressing PTSS and depressive symptoms through an integrated neuropsychological and psychotherapeutic approach is essential for improving functional recovery and long-term mental health outcomes. Future research should continue to explore the underlying neural mechanisms linking emotional dysregulation, PTSS, and depressive symptoms, with a focus on developing personalized, evidence-based interventions tailored to the unique challenges faced by individuals with TBI-related emotional dysfunction (Burbach et al., 2024).

2.4 Depressive Symptoms in Traumatic Brain Injury

Depressive symptoms are a common and debilitating comorbidity among individuals with traumatic brain injury (TBI), affecting approximately 13% of TBI patients, with a relative risk of 2.10 when compared to non-TBI controls (Dehbozorgi et al., 2024). Studies show significant heterogeneity in post-TBI depression, with 28% of participants self-reporting a depression diagnosis and 35% meeting DSM-5 criteria for major depressive disorder (Carmichael et al., 2023). Predictive models indicate that factors such as psychiatric history, injury severity, and pre-injury health are significant contributors to depression and PTSD in TBI survivors, though the models explain only a modest portion of the variance (Mikolić et al., 2025). Moreover, gender plays a critical role, as females are at a higher risk of developing post-TBI depression, with a relative risk of 1.4 compared to males (Sandhu et al., 2024).

Symptoms of depression in TBI patients can be subtle, often overlapping with cognitive deficits resulting from the injury, such as memory impairment, executive dysfunction, and attention deficits. This overlap complicates the accurate diagnosis of depression, as cognitive dysfunctions can mask emotional symptoms, leading to delays in appropriate intervention (Haarbauer-Krupa et al., 2021; Carmichael et al., 2023). Howlett et al. (2021) highlight the difficulty of diagnosing depression in TBI patients due to these cognitive impairments, which often mimic

depressive symptoms. Similarly, Maldonado & Sher (2023) emphasize that executive dysfunction in TBI can be misinterpreted as a sign of depression, complicating the diagnostic process. Chan et al. (2024) further stress that cognitive deficits in attention and memory are frequently mistaken for depressive symptoms, leading to treatment delays. Halalmeh et al. (2024) note that the interaction between cognitive impairments and emotional dysregulation in TBI patients makes it challenging to accurately distinguish between TBI-related symptoms and depression, contributing to both underdiagnosis and misdiagnosis. Traditional diagnostic tools, such as the DSM-5 criteria and self-report questionnaires (e.g., PHQ-9, HADS), often fail to address these complexities, as they are not tailored to the specific cognitive-emotional challenges of TBI patients (Von Steinbuechel et al., 2023).

Empirical research highlights the significant impact of depression on cognitive functioning in TBI patients. Deficits in working memory, cognitive flexibility, and processing speed are more pronounced in individuals with post-TBI depression compared to those without depressive symptoms (Keatley et al., 2022; Halalmeh et al., 2024). Moreover, depression can amplify emotional distress, further hindering recovery and contributing to greater disability (Howlett et al., 2021; Bradbury et al., 2021).

The prevalence of depressive symptoms remains high in the first year post-injury, with many TBI patients experiencing clinically significant depression. Studies indicate that depression risk is notably elevated during the initial months and up to a year post-TBI, particularly in patients with severe or frontal lobe injuries (Looi et al., 2022; Wang et al., 2021). For example, research from South Korea found that TBI patients are at significantly higher risk of developing depression compared to non-TBI individuals, with the risk during the first year being nearly 12 times higher (Choi et al., 2021). Given the persistent nature of depression and its bidirectional impact on other psychiatric conditions like anxiety (Wang et al., 2021), early identification and treatment are crucial. Specialized interventions that address both the emotional and cognitive aspects of post-TBI depression are essential for improving psychological well-being and optimizing recovery outcomes in these patients.

2.5 Emotional Regulation, Depressive Symptoms, and Post-Traumatic Stress Symptoms

Emotional regulation, which involves managing and modifying emotional responses, plays a crucial role in the development and persistence of both depressive symptoms and post-traumatic stress symptoms (PTSS) among individuals with