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Hidden scars: The impact of torture, traumatic brain injury, and PTSD on executive functions – a narrative review

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Key points of interest:

- Torture survivors often suffer from TBI, PTSD, cortical thinning, and executive dysfunction.
- Asylum interviews frequently disregard the neurological consequences of torture, complicating the asylum process.
- Executive dysfunction hampers survivors' ability to integrate into their new environment.

Abstract
Introduction: Victims of torture are often subjected to physical violence, which can result in traumatic brain injury (TBI) and PTSD. Executive functions encompass a complex set of higher cognitive abilities that include memory, inhibitory control, cognitive flexibility, planning, reasoning, and problem solving. This narrative review aimed to outline how torture affects executive functions, particularly in the context of TBI and PTSD. *Methods:* We searched the scientific literature using the databases of PubMed, PsycINFO and PsychArticles. The search included combinations of the terms: Torture, Executive Functions, Traumatic Brain Injury, Stress, PTSD, Refugee, Asylum Seeker, Memory, Planning, Motivation, as well as relevant Medical Subline Headings (MeSH). *Results:* Both TBI and PTSD have been associated with thinning of the cerebral cortex, hippocampus, and amygdala. Such changes lead to a broad spectrum of cognitive and emotional issues. Victims of torture, for example, might display a lack of coherence, initiative, motivation, and the inability to respond to changes in their environment. *Discussion:* In most countries, asylum-seeking is based on interviews in which individuals must provide a detailed and coherent narrative of the events that justify asylum. However, the neurological consequences of torture are rarely considered during asylum-seeking interviews, and a lack of details and coherence might be considered as a proxy for false statements. *Conclusions:* Knowledge of the effects of torture on executive functions is critical for the design and implementation of treatment strategies that increase the chances of recovery.

Keywords*:* Migration, Memory, Attention, Refugee, Asylum Seeker.

Introduction

Torture is a gross violation against human rights defined as any act by which severe pain or suffering, whether physical or mental, is intentionally inflicted on a person with the consent or acquiescence of a public official for such purposes of obtaining information, a confession, or punishing them for an act they have committed or are suspected of having committed (United Nations, 1984). Unfortunately, torture is common amongst asylum seekers, with some studies suggesting a prevalence as high as 80% (Tinghög et al., 2016).

Traumatic experiences like witnessing or experiencing violence, as in the case of torture, put a person at greater risk for a variety of psychological impairments and disability, among which posttraumatic stress disorder (PTSD) is the most common (Steel et al., 2009). PTSD is characterized by re-experiencing a traumatic event in the present, avoidance of traumatic reminders, and a sense of current threat (American Psychiatric Association, 2013; Cloitre, 2020). PTSD might develop after being threatened with death, serious injury, or sexual violence, and include recurrent, involuntary, and intrusive memories or dreams of the traumatic event, persistent avoidance of stimuli associated with the traumatic event, and negative alterations in cognitions and mood associated with it (American Psychiatric Association, 2013). Individuals who are exposed to assaultive trauma (sexual and non-sexual) are more likely to develop PTSD (Kessler et al., 2005). Since assaultive trauma is often used as a form of torture (Burnett & Peel, 2001; Pollanen, 2018) it is not surprising that the prevalence of PTSD among torture survivors is high (Abu Suhaiban et al., 2019).

Studies report that standard practices during torture include incarceration, blows with a blunt object such as whips or cables, crushing of the extremities, inflictions of burns by boiling liquid or cigarettes, cuts, electrical shocks, attempted drowning, asphyxiation, and gunshots (Clément et al., 2017). Blows to the head and asphyxiation can lead to traumatic brain injury (TBI), a condition that commonly results in physical, mental, and emotional disabling injuries (McPherson, 2019). Several reports suggest a considerably high prevalence of TBI in victims of torture, refugees, and asylum seekers. Studies carried out in Europe have reported that between 48-64% of these individuals suffered from blows to head that led to momentary loss of consciousness, chronic headaches, dizziness, balance problems, sleep issues, memory loss and concentration deficits (Doherty et al., 2016; Keatley et al., 2013; Moisander & Edston, 2003).

Cognitive and emotional deficiency in TBI

TBI is defined as an alteration in brain structure or function caused by an external force (Menon et al., 2010). The most common causes of TBI are physical assault, traffic accidents, sports injuries, and falls. The pathophysiology behind TBI involves shear injury of axons and disconnection of cortical and subcortical brain areas, hypoxia, and inflammation (Azouvi et al., 2017). A large body of evidence has proven that TBI is characterized by damage to, and significant loss of grey matter in one or several brain regions, including the frontal and temporal lobes, as well as subcortical structures such as the thalamus, hypothalamus, amygdala, hippocampus, midbrain, and locus coeruleus (Shetty et al., 2016). Because of their location, the hippocampal-amygdala complex and the ventromedial prefrontal cortex are particularly vulnerable to damage by blows to the head (Depue et al., 2014).

TBI can significantly negatively impact the quality of life and ability to work due to long-lasting cognitive, emotional, and behavioural changes. It has been reported that up to 60% of patients recover from mild TBI within six months, and given the right treatment, 85% of patients recover successfully between 1–3 years after injury. However, about 15% of patients experience more persistent emotional and cognitive complaints (Benedictus et al., 2010). Recovery might be attributed to the nature and severity of the injury (sport injury vs. blows to the head during physical assault, for example), and factors such as age and comorbidity. Unlike mild TBI, moderate and severe TBI are distinguished by long-lasting impairments in self-awareness, reasoning, language, and visuospatial processing. Only 36% of patients who have suffered severe TBI have been able to return to work and live an independent life (Jourdan et al., 2016). In extreme cases, patients have significant difficulties performing daily tasks such as driving, cooking, and handling money (Rabinowitz & Levin, 2014).

Executive functions are an umbrella term that encompasses higher cognitive abilities. It includes memory, inhibitory control, cognitive flexibility, planning, reasoning, and problem solving. These functions are necessary to set and achieve a goal, enabling understanding of complex and abstract concepts. TBI can lead to a rather broad spectrum of cognitive and emotional issues, amongst which executive dysfunction is one of the most common (Brenner, 2011). The ability to sustain attention for long periods of time is essential for goal-directed behaviour. The default mode network (DMN) is a brain network predominantly active during internally focused states, such as self-reflection, daydreaming, and recalling past experiences. It consists primarily of the medial prefrontal cortex, posterior cingulate cortex, praecuneus, and angular gyrus. The DMN becomes deactivated during externally demanding cognitive tasks and active attention to the external environment. Disruptions or alterations in DMN connectivity have been associated with difficulties in emotional regulation, executive functioning, and self-related processing (Menon, 2023).

Using a simple choice reaction time task, Bonelle and colleagues (2011) assessed 30 patients with TBI secondary to assault, traffic accidents, falls and sport injuries, and compared their performance against age-matched healthy controls. They found that impaired attention is common in patients with TBI, and that poor performance over time in tasks that require sustained attention and goal-directed behaviour is associated with abnormal patterns of activity in the DMN. Sustained attention during cognitively demanding tasks requires the regulation and deactivation of the DMN. Less activity in these areas is correlated to higher efficiency and thus, better performance. In other words, overactivity in the DMN implies a higher cognitive load, which eventually leads to mental fatigue. Further, mind wandering and increased internally focused attention have been coupled with higher activity in the praecuneus and posterior cingulate cortex. Patients with TBI not only fail to deactivate the DMN during tasks that require sustained attention but also show an abnormal pattern of recruitment in such areas, leading to decreased performance over time (Bonnelle et al., 2011).

Loss of conceptualisation and the ability to change strategies are common complaints in TBI patients. Several studies have reported a higher number of errors after moderate and severe TBI in tasks such as the Wisconsin Card Sorting Test (a test used to measure attention, perseverance, abstract thinking and set shifting in which patients are asked to sort different items according to arbitrary criteria and then change their arrangement according to new rules), (Ferland et al., 1998; Nelson, 1976; Rapoport et al., 2006). Speed of processing, mental flexibility and planning have also been previously studied in patients with TBI using the Tower of London test (a test used to detect deficits in planning in which patients must organise coloured beads on three vertical rods according to instructions using a restricted number of moves). Patients with TBI per-formed similarly on this task as healthy controls, but they took significantly longer to complete it (Azouvi et al., 2017; Pons-ford & Kinsella, 1992; Spikman et al., 2000). Longer times to complete the test imply poor planning and greater caution in making decisions. Further, recent studies have reported that pa-tients with TBI score poorly in tests of inhibition and cognitive interference, with a positive correlation between a number of errors and the severity of the injury (Cantin et al., 2007; Fortin et al., 2003). Finally, deficits in working memory have also been associated with altered activation patterns in the dorsolateral prefrontal cortex and Broca's area in patients with moderate and severe TBI (Perlstein et al., 2004). Executive functions are critical to regulating and adapting our behaviour concerning environmental conditions (Cristofori et al., 2019). However, little is known about the effects of torture on executive func-tions. Thus, the aim of this review was to outline how torture affects executive functions, memory formation and recollec-tion, particularly in the context of TBI and PTSD.

Methods

The present study is a narrative review aiming to identify and describe the effects of torture on executive functions, with particular attention to TBI and PTSD. Given the complexity and interdisciplinarity of the topic, a narrative rather than systematic review format was chosen, allowing a more integrative discussion and synthesis of findings across multiple fields (e.g., neuroscience, psychology, psychiatry, and medicine). The literature search strategy was broad yet intentionally flexible, combining systematic database searches with manual searches of relevant reference lists and consultation with experts in the field. Databases including PubMed, PsycInfo, and PsychArticles were searched using combinations of key terms and Medical Subject Headings (MeSH), such as "Torture," "Executive Functions," "Traumatic Brain Injury," "Stress," "PTSD," "Refugee," "Asylum Seeker," "Memory," "Planning," and "Motivation." Given the limited direct evidence explicitly linking torture and executive functions (for example, a PubMed search with these terms yielded only four articles in January 2025, two of which are included here), the review was intentionally broadened to include literature addressing cognitive and neural consequences of trauma, stress, and TBI, recognising their frequent co-occurrence in torture survivors. Articles were included based on their relevance to executive functioning, cognitive impairment, memory, and neural changes associated with torture, TBI, and PTSD. Articles focusing exclusively on physical health consequences unrelated to cognitive or executive functions (such as musculoskeletal or cardiovascular injuries) were excluded. The review incorporated peer-reviewed articles published in English and Swedish without any restrictions on publication date, ensuring that seminal studies and the latest evidence were considered. To further ensure comprehensive coverage and mitigate the risk of missing relevant literature, reference lists of the identified articles were manually reviewed, and additional pertinent literature was identified through expert consultation. Selection of articles was conducted collaboratively, involving discussions among the authors and clinicians within the research group specializing in the rehabilitation of torture survivors. This approach helped guarantee that significant, relevant research was neither overlooked nor intentionally excluded. In total, 32 studies were included in the results.

Results

The link between torture, TBI, PTSD, and executive dysfunction

Evidence of the effects of torture and TBI on cognitive functions is not particularly new. Already in the 70s and 80s, some reports were published describing anatomical and functional changes in the brain as a result of blows to the head in about 65% of torture survivors (Jensen et al., 1982; Thygesen et al., 1970). In addition to psychological testing and clinical interviews, over the last couple of decades, the diagnosis of cognitive and emotional deficits in torture survivors after TBI has also been possible by modern diagnostic imaging techniques. A significant body of evidence supports a cause-and-effect association between TBI and neurological and psychiatric illness. Inner-cranial wave physics and the presence of bone protuberances inside of the skull due to blows to the head have been shown to cause significant damage to the orbital and anterior temporal lobes (Depue et al., 2014; Perry et al., 2016). Torture has been associated with altered central executive network (CEN) and the DMN functioning. While the CEN exerts top-down executive control over emotional processing (Depue et al., 2014), the DMN translates emotional responses into appropriate behaviour (Liddell et al., 2022). Altered functioning between these networks in torture survivors at rest seems to be responsible for withdrawal and dissociative behaviour, problems with self-regulation, and difficulties in recognizing safety signals from the environment, all of which are also classical symptoms of PTSD (Teicher et al., 2016).

Brain connectivity and cognitive control during goal-directed behaviour are also compromised. Goal-directed behaviour requires active engagement, cognitive control, and the ability to inhibit interfering processing and actions. Liddel and colleagues (2024) examined neural networks and behavioural mechanisms during a response inhibition task in a group of 33 torture survivors with PTSD against 44 patients with similar PTSD severity symptoms but no torture exposure. The researchers found that torture survivors had weaker connections in brain networks responsible for attention, motor control, and cognitive inhibition compared to non-torture survivors. Specifically, they showed reduced connectivity between the posterior DMN (left precuneus), the auditory-motor network (right superior temporal gyrus), and the dorsomedial frontal and dorsal attention networks. Interestingly, despite these brain differences, torture survivors performed the task as well as the non-torture controls, suggesting that they may rely on alternative neural mechanisms to compensate. Additionally, weaker connectivity in the superior temporal gyrus and between the frontal and dorsal attention networks was linked to greater PTSD symptoms, specifically dysphoria (Liddell et al., 2024).

Measuring cognitive decline and executive dysfunction because of TBI in torture survivors is particularly difficult since, in most cases, no pre-injury data exists, and thus, performance on cognitive and executive tests cannot be compared and attributed to the injury. Since torture survivors who have suffered TBI vary greatly in age, health status, educational level, cultural background, and degree of injury, appropriate control groups are difficult to establish in scientific studies. Some studies rely on self-reports of mental health and cognitive ability. However, one of the hallmarks of moderate and severe TBI is that memory becomes impaired, and survivors lack self-awareness. Hence, individuals are known to under-report the number and severity of their symptoms (Jamora et al., 2012; Sbordone et al., 1998). Military personnel who suffered TBI because of torture or armed conflicts are one of the few groups that provide reliable data since pre-injury scores on both cognitive and executive function tests usually exist, and parameters such as age, educational level, cultural background, and health status are standardised amongst individuals. The Vietnam Head Injury Study was a multidisciplinary revaluation of more than 600 head-injured veterans from the Vietnam War and uninjured controls. Individuals were tested in the Army General Classification Test upon enrolment and up to 15 years after injury. The authors found that in penetrating brain injury, total brain volume loss strongly predicted performance in subtests composed of vocabulary knowledge, arithmetic word problems, object-function matching, and mental imagery construction of boxes. Perhaps not surprisingly, the more total brain volume loss, the worse individuals scored on such tests, even 15 years after injury. Poor performance was particularly coupled to lesions in the left temporal and occipital lobes. Interestingly, higher scores pre-injury were associated with a slower cognitive decline and a better recovery up to five years after injury (Grafman et al., 1988).

In a sample of 42 Vietnamese ex-political detainees who had been tortured in Vietnamese re-education camps and resettled in the United States, a detailed history of TBI was obtained through the Harvard Trauma Questionnaire. The questionnaire includes different types of events such as traffic accidents, accidental falls, physical assault, torture and combat-induced TBI. Further, depression and PTSD symptoms were determined by interviews and the Hopkins Symptom Checklist-25. Finally, cortical thickness and subcortical volume were assessed by magnetic resonance imaging. TBI was associated with cortical thinning in the frontal and temporal lobes, which in turn correlated with higher symptoms of depression. The authors argue that TBI plays a role in the development of psychiatric conditions (Mollica et al., 2009), which is in line with previous data associating lesions in the prefrontal and temporal cortex with depression, anxiety, and mood disorders (Arulsamy et al., 2018; Pope et al., 2019; Silverberg & Panenka, 2019; Vanderploeg et al., 2005). It is important to note that mood disorders such as anxiety, depression, and PTSD can arise because of TBI even in populations who had not experienced psychological trauma before the head injury. Similar cases of thinning of the cerebral cortex because of TBI have been reported in individuals involved in traffic and sport accidents (McKee et al., 2013). Torture can on its own lead to anxiety, depression, and PTSD. This means that in addition to playing a role in the development of mood disorders, TBI can significantly exacerbate cognitive decline and executive dysfunction in torture survivors (Doherty et al., 2016).

Traumatic events, even in the absence of TBI, have the potential to rewire brain circuitry, leading to long-term anatomical changes, which make recovery much more difficult. The prefrontal cortex and hippocampus are brain structures in direct contact with the amygdala and play an important role in behaviour (Depue et al., 2014). A study conducted in 21 combat veterans from the United States with mild TBI and comorbid PTSD from active duty, but no history of neurological disease prior deployment, showed that reductions in the size of the amygdala, leads to overprocessing of sensory input related to fear conditioning, which translates into anxiety and impulsive behaviour (Depue et al., 2014). Decreases in the size of the amygdala were also associated with higher scores in symptoms of PTSD. When compared to controls without TBI or PTSD, these individuals had lower scores on attention, perseverance, and self-control. It is worth noting that only individuals with mild TBI were included in the study. As such, a worsening of symptoms for cognitive and behavioural impairment is to be expected in those patients with moderate and severe TBI (Depue et al., 2014). In line with this, brain scans of torture survivors with PTSD have shown cortical thinning, reduced hippocampal volume, and hypometabolism in the caudate nucleus when compared to healthy controls (Liddell et al., 2022). Expressed in terms of functionality, this means memory loss, constant feelings of fear, and insecurity.

Elbert and colleagues (2011) examined how torture experiences alter brain responses to emotional stimuli, testing the hypothesis that repeated traumatic stress reorganises neural circuitry into a hyperresponsive "trauma network." The authors suggest that traumatic events create strong connections among sensory, emotional, and physiological responses, which merge into a generalised trauma memory without clear associations to time or place. Consequently, survivors may experience exaggerated emotional reactions, hyperarousal, and flashbacks even to non-specific emotional stimuli. They compared neural activity in 46 survivors of torture or severe organised violence diagnosed with PTSD to 41 healthy, ethnically matched controls. To test this, they employed rapid serial visual presentation, where participants rapidly viewed sequences of emotionally negative, neutral, and positive pictures while their neural activity was recorded using magnetoencephalography. They found significant differences in neural responses to emotional images between torture survivors with PTSD and healthy controls. For instance, torture survivors exhibited a rapid shift of neural activity from visual regions in the occipital cortex to limbic and fronto-temporal areas, including the amygdala, as early as 60–80 milliseconds after exposure to aversive images. On the other hand, controls maintained prolonged processing within visual sensory areas without notable early engagement of these emotional or frontal regions. In torture survivors, such an early activation of limbic and frontal regions reflects a "hyperresponsive trauma network" with a lower activation threshold and greater sensitivity to emotional cues, even when those cues are not explicitly related to their trauma. While controls showed stronger visual responses to neutral images, torture survivors showed stronger neural responses to aversive stimuli, demonstrating altered emotional prioritisation likely associated with chronic threat anticipation and vigilance (Elbert et al., 2011).

Higher levels of dissociative symptoms among torture survivors have been significantly linked to increased slow-wave activity (delta waves) in the left ventrolateral frontal cortex, a brain area associated with language processing and executive functions (Ray et al., 2006). This abnormal brain-wave activity suggests a functional disconnection between emotional processing and structured verbal memory retrieval, which aligns with the survivors' reported difficulties in verbally accessing traumatic memories. Interestingly, these dissociative effects remained significant even after controlling for PTSD severity, emphasising that dissociative experiences independently impact brain functioning beyond PTSD symptoms. Additionally, torture survivors displayed reduced activity in brain regions (right hemisphere) involved in inhibitory control, suggesting an imbalance in approach-withdrawal behaviour (Ray et al., 2006).

Likewise, patients with torture-related PTSD showed significantly reduced volume in the left hippocampus and overall grey matter with concomitant ventricular enlargement when compared to healthy controls, indicating potential neuronal loss or atrophy (Zandieh et al., 2016). These changes are coupled with moderate hypometabolism (reduced metabolic activity) primarily in the occipital lobe, caudate nucleus, and, to a lesser extent, the temporal lobe, posterior cingulate cortex, and frontal and parietal regions. These findings suggest disruption in areas important for cognitive control, visual processing, and emotional regulation (Zandieh et al., 2016).

This is in line with recent evidence suggesting that torture survivors exhibit altered neural responses in brain regions central to executive functions, especially those involved in cognitive control, threat evaluation, and reward processing (Liddell et al., 2021). Reduced ventral striatum activation in response to positive emotional stimuli (happy facial expressions) indicates impaired reward sensitivity and diminished motivational drive. This reduction is particularly pronounced among survivors with higher PTSD avoidance symptoms, suggesting specific deficits in the ability to initiate approach behaviours toward rewarding or positive experiences. Conversely, increased activation in the dorsomedial prefrontal cortex in response to threatening stimuli (fearful facial expressions) may indicate heightened cognitive effort in threat detection or conflict monitoring. Survivors show diminished hippocampal activation combined with stronger functional connectivity between the hippocampus and prefrontal and temporoparietal regions. Notably, this connectivity pattern is more pronounced among individuals exposed to higher cumulative trauma, potentially reflecting compensatory neural strategies to manage disrupted emotional regulation and memory processes (Liddell et al., 2021).

Scott and colleagues (2015) systematically reviewed neurocognitive deficits associated with PTSD, focusing on a large sample of 4,108 participants across 60 studies. The analysis included participants diagnosed with PTSD against groups of trauma-exposed participants without PTSD, and healthy, trauma-unexposed controls. Their findings indicate that PTSD is associated with neurocognitive deficits in verbal learning, memory, attention, and processing speed. Significant results were also seen in executive control, language, visual learning and visuospatial abilities. These findings are associated with dysfunction in the fronto-limbic network underlying the pathophysiology of PTSD. According to the researchers, neuropsychological functioning in attention, verbal memory, and speed of information processing is a key aspect in the clinical treatment of patients with PTSD (Scott et al., 2015). Likewise, Kanagaratnam and Asbjørnsen (2007) investigated 45 immigrants/refugees aged 18–55 who had been exposed to political violence and war. Among them, 22 individuals had a self-reported diagnosis of PTSD and 23 had no psychiatric diagnosis. The authors found impaired performance on tests of executive memory as well as problems in automatic processing in the war-exposed PTSD group. The more severe the posttraumatic symptoms, the more profound the impairment of executive memory. Problems in automatic processing can lead to compromised mental flexibility and negatively impact cognitive processing of traumatic memories (Kanagaratnam & Asbjørnsen, 2007).

Finally, exposure to traumatic events may produce lasting neural alterations in key brain regions involved in executive functioning, emotional regulation, and cognitive control, even in the absence of diagnosable PTSD. Trauma-exposed individuals without PTSD (survivors of combat, motor vehicle accidents, and intimate partner violence) exhibit altered activation patterns in executive and emotion-regulatory brain areas, including the right anterior insula, praecuneus, anterior cingulate cortex, and orbitofrontal cortex, when compared to trauma-naïve controls. Conversely, individuals diagnosed with PTSD display distinct neural changes characterized by increased limbic activation, particularly within the amygdala and parahippocampal cortex, relative to both trauma-exposed and trauma-naïve individuals. These findings highlight the importance of recognising trauma exposure itself as sufficient to disrupt brain networks associated with executive and emotional processing, underscoring the need to assess executive functioning deficits broadly among trauma survivors rather than exclusively among those who meet full PTSD criteria (Stark et al., 2015).

A summary of the effects of torture-induced TBI and PTSD on executive functions is shown in Table 1.

Remembering traumatic experiences

It is commonly but wrongly believed that stressful experiences are always better recalled. Prolonged exposure to stress profoundly affects the brain and memory functioning. Specifically, sustained elevation of cortisol leads to shrinkage of the hippocampus and associated impairments in declarative memory, the ability to recall facts and previously learned information. Even though individuals deliberately try, they often struggle to retrieve stored memories (O'Mara, 2018). Sleep deprivation is a commonly employed method of torture and interrogation. Chronic sleep deprivation leads to significant physiological disruptions across multiple bodily systems and can ultimately result in death if sustained over prolonged periods. Individuals experiencing long-term insomnia typically exhibit reduced hippocampal volumes and associated impairments in declarative memory. Numerous experimental studies conducted on diverse groups—including university students, psychiatric patients, and military personnel—have consistently shown that sleep deprivation impairs cognitive functions and memory performance, with severity increasing proportionally to the duration of sleep loss (O'Mara, 2018). Moreover, sleep-deprived college students are significantly more susceptible to falsely confessing to acts they did not commit (Frenda et al., 2016).

Morgan and colleagues (2004) studied 509 young (25 ± 5 years of age) military personnel in active duty enrolled in military survival school training in the United States. Military survival school is highly stressful, realistic and one of the most challenging experiences in the military. Individuals were interrogated after 48 hours of sleep and food deprivation.

Table 1. *The effects of torture-induced TBI and PTSD on the brain's structure and function.*

Condition	Brain changes	Effects on Executive Functions
TBI	Reduced brain volume (frontal, temporal lobes, hippocampus, amygdala); disrupted connectivity in brain networks (e.g., DMN).	Difficulty concentrating, memory loss, problems with planning, slow information processing, reduced mental flexibility, impaired inhibitory control.
PTSD	Increased activation in limbic areas (e.g., amygdala), reduced hippocampal volume, cortical thinning.	Difficulty managing emotions, heightened fear responses, poor attention, memory issues, impaired cognitive flexibility.
TBI + PTSD	Structural damage (cortical thinning, hippocampal atrophy, amygdala shrinkage), functional changes in DMN, Central Executive Network, and other critical brain regions.	Severe deficits in attention, memory retrieval, emotional regulation, planning, flexibility in thinking, motivation, and self-control. Increased dissociation and emotional hyper-reactivity.

TBI: Traumatic brain injury; PTSD: Post-traumatic stress disorder; DMN: Default mode network.

Their study revealed that only 66% of the soldiers were able to identify pictures of their interrogators 24 hours after being interrogated. The authors argue that memory formation during highly stressful and personally relevant situations is subject to significant error. The poor performance in facial recognition is attributed to the inverted U-shaped relationship between stress hormones and memory, where moderate stress levels improve memory. Still, both low and high levels might disrupt it. Secondly, it is known that sleep, particularly REM sleep, is necessary for forming memories. Perhaps the soldiers had performed better if given a longer time and appropriate recovery from training. Lastly, the effects of stress on neural circuits involved in face recognition cannot be discarded. It is not known how catecholamines and cortisol affect these circuits during short and intense periods of stress (Morgan Iii et al., 2004).

These findings are in line with previous studies that show that the gist of a story, but not the details about it, is more easily recalled after events with a high emotional component, such as armed robbery (Herlihy et al., 2002). Moreover, details are more susceptible to disruption and change upon recollection than the central elements of the story. Taken together, these findings indicate that moderate stress levels might improve attention and the formation of memories during an emotionally intense experience. However, the recollection of details about the experience might be compromised (Herlihy et al., 2002; Morgan Iii et al., 2004).

In a sample of 27 Kosovan Albanians and 16 Bosnians with refugee status in the United Kingdom, discrepancies were found between the accounts of traumatic events given on two different interviews separated by up to seven months (Herlihy et al., 2002). All the individuals in this study were permitted to remain in the United Kingdom under the United Nations High Commissioner for Refugees group, meaning they did not have to provide accounts of previous experiences to be granted asylum. The study was not associated with any clinical examination or migratory process. As such, the authors argue that it is difficult to see why the individuals investigated would provide false claims or exaggerate them on purpose. Since the discrepancies observed were about "peripheral details" (not central to the story), the authors suggest that there was no intent by the individuals to fabricate information. Interestingly, they found that individuals with PTSD became more inconsistent in their accounts the longer they waited between interviews (Herlihy et al., 2002).

This is consistent with previous studies showing that both the formation and recollection of memories can be influenced by emotions (McNally et al., 1994). It has been demonstrated that individuals with depression tend to focus on the negative aspects of previous events. Likewise, individuals suffering from anxiety will remember better and have a bias for situations they consider to be threatening (Herlihy & Turner, 2007). Finally, the recollection of events can also be influenced by the way questions are formed. Previous studies in asylum-seekers carried out by the United Nations demonstrate that inconsistency in the accounts given is highly dependent on the type and manner in which questions are asked (Herlihy et al., 2002).

Torture is characterized by hideous suffering and humiliation. A universal coping mechanism against it is dissociation, in which survivors actively and passively separate themselves from what is happening (Sarkar, 2009). Not surprisingly, dissociation during a traumatic experience leads to poor memory formation and recall. Time, ideas, and emotions are distorted and can easily lead to inconsistencies while accounting for these events. Saadi and colleagues (Saadi et al., 2021) randomly reviewed 200 medico-legal affidavits from asylum seekers in the United States collected between 1987 and 2017 and described the most common memory complaints reported in them. They found that memory gaps of the traumatic event, difficulty establishing a timeline of the traumatic experience, dissociation (as a coping strategy), and persistent memory loss interfering with daily activities were the most discussed by clinicians. Gaps in memory were particularly common because of physical and sexual trauma. Dissociation was reported in these individuals as the leading cause of memory gaps both during the traumatic experience and during the interview with the physicians while applying for asylum (Saadi et al., 2021). The authors underline the difficulty of individuals in answering questions related to threats to their children, for example, and how recalling such events triggered dissociative behaviour at several times during the interviews. Avoidance of memories about traumatic experiences is a common coping mechanism and a symptom category in the PTSD diagnosis. According to the affidavits, some individuals consistently avoided both listening to the threats to their family as well as talking about it since it made dealing with emotional pain much easier (Saadi et al., 2021). Lastly, the study highlights how traumatic events can lead to memory gaps and concentration deficits, affecting performance in daily activities. The individuals are described as easily distracted and forget what they are doing mid-chore. The more concentration the task required or the more stressful it was, the higher the probability that the individuals would be affected by their previous trauma (Saadi et al., 2021).

Discussion

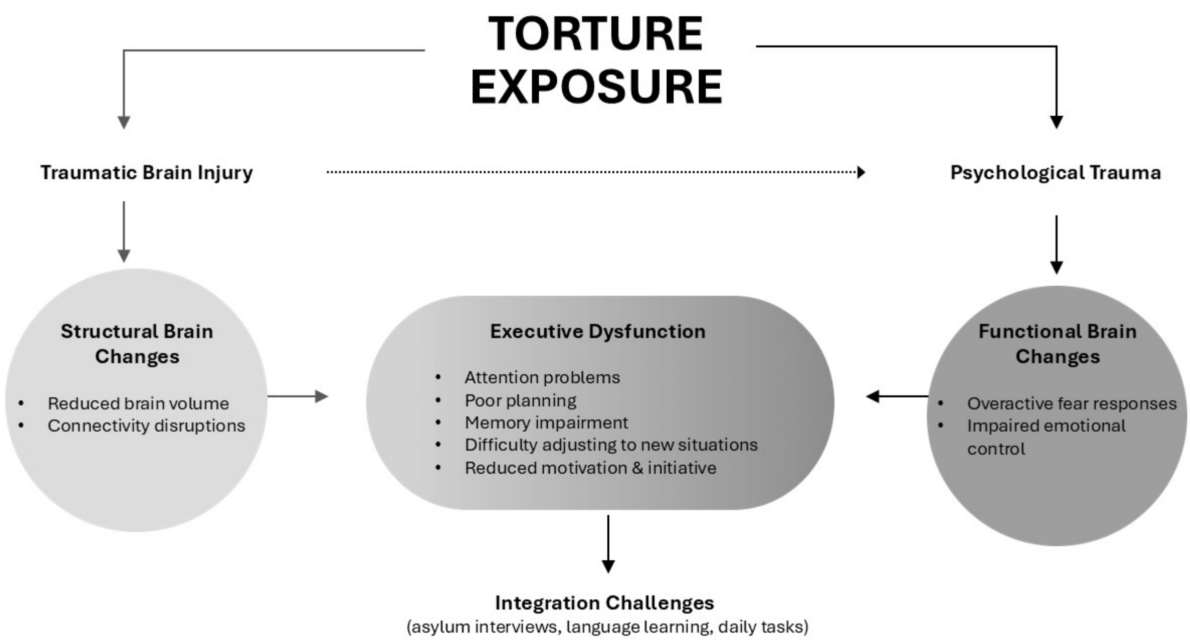
The asylum process and integration challenges for torture victims with executive dysfunction

In most European countries, the asylum-seeking process is based on oral interviews in which individuals must provide a detailed and coherent description of the events that made them leave their country of origin and apply for refugee status. Moreover, migration authorities often focus on the legal aspects of the asylum-seeking process and the neurological consequences of torture are rarely considered during such interviews (Aarts et al., 2019; van Willigen, 2008). Problems with memory formation and recollection in torture survivors might lead to reluctance in migration authorities to attach credibility to asylum seekers' narratives.

Executive dysfunction is one of the most problematic sequelae of TBI, with significant and negative consequences in daily activities, work performance, and social interactions even decades after injury. Following new rules and instructions proves difficult when individuals cannot change their behaviour in response to environmental clues. This leads to risk-taking or rule-breaking behaviour even in the face of negative consequences. Individuals do not necessarily choose to behave against norms and regulations, but they are unable to adapt to new information and internally process actions and responses (McDonald et al., 2002).

TBI and PTSD are difficult to treat and often lead to long-term effects. Recovering from trauma requires learning new strategies to deal with problems as well as acquiring new perspectives to look at oneself and the world. Successfully integrating in a new country after being granted asylum often requires learning a new language and social norms. (Abu Suhaiban et al., 2019). Further, neuroimaging research shows that social exclusion and emotional distress consistently activate regions associated with physical pain, especially the dorsal anterior cingulate cortex and anterior insula (Tchalova & Eisenberger, 2015). Experiences like social rejection or viewing pictures of lost loved ones activate these areas similarly to physical injuries. Pharmacological studies further support this overlap, with opioid-based painkillers alleviating emotional and social distress, underscoring a neurochemical link between social and physical pain systems (Tchalova & Eisenberger, 2015). This implies that traumatic social experiences such as rejection, exclusion, or severe emotional distress (all relevant to torture survivors) can directly and negatively affect brain regions involved in executive functions, emotional regulation, and cognitive control (Tchalova & Eisenberger, 2015). Therefore, a comprehensive approach is needed by migration authorities and healthcare professionals when meeting traumatised people. If learning a new language when suffering from PTSD or TBI proves difficult, the patient's entry into the labour market in their new country is delayed. Other expressions of executive dysfunction, such as difficulty taking initiative and multi-step planning, translate into problems getting to meetings on time, remembering what the meetings are about, and remembering afterwards what was discussed (Rabinowitz & Levin, 2014). Misunderstandings and conflicts can naturally occur between traumatised people and healthcare professionals, language teachers, work colleagues, and migration authorities. Not being able to perform can result in anxiety, and thus, everyday life easily becomes frustrating and confusing for these individuals. Unfortunately, the asylum process, as well as some efforts to integrate torture victims in their new countries, take little account of their needs and capabilities after the events that made them seek asylum (Figure 1).

Figure 1. *Structural and functional mechanisms behind the integration challenges in torture survivors with TBI and PTSD.*



Conclusions

A high percentage of asylum seekers are victims of torture. A growing body of evidence confirms both the prevalence and extent of the injuries commonly suffered by torture survivors. The traumatic nature of torture has the potential to rewire brain circuitry. A high percentage of torture survivors develop PTSD. In many cases, survivors are subject to physical violence, which also results in TBI. Both PTSD and TBI have been associated with thinning of the cerebral cortex as well as structures such as the hippocampus and the amygdala. PTSD and TBI have a negative effect on executive functions. Patients suffer from memory problems, have difficulty paying attention, lack initiative and motivation, and cannot appropriately adapt their strategies to deal with daily activities based on changes in their environment. Lack of coherence in their accounts of previous events is common. The hardships of settling abroad while applying for asylum and integrating into the host country might exacerbate the torture-induced executive dysfunction and make recovery more difficult. Thus, a better understanding of the effects of torture on executive functions is needed to accommodate the needs of torture survivors in their interaction with migration authorities, social insurance agencies, educational institutions, and healthcare providers.

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