

## Mild Traumatic Brain Injury and Criminal Behavior

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**Abstract.** *Traumatic brain injury (TBI) is a major public health concern, affecting millions of people worldwide each year. The causes of TBI can be diverse and may include falls, motor vehicle accidents, sports-related injuries, assault, and military combat. Evidence from recent studies suggests that TBI is a risk factor for criminal behavior, although the strength of the association and the mechanisms involved may vary depending on the age of the person at the time of injury and other factors. TBI is associated with an increased risk of criminal behavior, possibly due to cognitive impairment, emotional dysregulation, and other factors. Further research is needed to fully understand the relationship between TBI and criminal behavior, and to develop effective interventions to reduce the prevalence of criminal behavior in individuals with TBI.*

**Key words:** traumatic brain injury, risk behavior, criminality

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### 1.Introduction

Traumatic brain injury (TBI) refers to brain damage caused by external forces, such as a blow or jolt to the head, a penetrating injury or other mechanisms that disrupt normal brain functioning. TBI is a major public health concern, affecting millions of people worldwide each year. TBI can range in severity from mild, such as a concussion, to severe, which may cause prolonged or permanent loss of consciousness and disability [1,2].

The effects of TBI can vary depending on the location and severity of the injury. Common symptoms may include headaches, dizziness, memory problems, fatigue, depression, anxiety, and irritability. More severe cases may result in long-term cognitive, emotional, and physical deficits, such as difficulty with attention and concentration, personality changes, paralysis, and seizures [3].

The causes of TBI can be diverse and may include falls, motor vehicle accidents, sports-related injuries, assault, and military combat. The incidence and prevalence of TBI are difficult to estimate, as many cases may go undiagnosed or unreported. However, studies have suggested that TBI is more common in males and in certain age groups, such as adolescents and young adults [1,4].

Effective management of TBI requires prompt diagnosis, early intervention, and comprehensive rehabilitation. Preventive measures such as wearing helmets, following safety guidelines, and avoiding risky behaviors can also help reduce the risk of TBI. Further research is needed to understand the long-term consequences of TBI and to develop better treatments and preventive strategies.

## **2. Traumatic brain injury and criminal behavior**

Evidence from recent studies suggests that TBI is a risk factor for criminal behavior, although the strength of the association and the mechanisms involved may vary depending on the age of the person at the time of injury and other factors. Several studies, including large-scale data linkage studies, have found that individuals who have experienced TBI are more likely to be involved in criminal activity, including violent and non-violent crimes, compared to those without TBI [4-12]. However, it is important to note that there are also many other factors that can increase the risk of criminal behavior, such as substance use, social disadvantage, and pre-existing behavioral issues.

The evidence on the relationship between TBI and crime in children and adolescents is unclear, with some studies suggesting that TBI before 12 years of age may be linked to earlier onset of criminality, while others suggested that the association may be mediated by factors such as substance use [7,11,12].

In adults, TBI appears to be a more consistent risk factor for criminal behavior, with some studies indicating that TBI is associated with an increased risk of any criminality, conduct disorder, and concomitant criminality and conduct disorder. It is worth noting that the measures used to assess TBI in these studies can vary widely, and some studies have not fully accounted for potential confounding factors such as familial and socioenvironmental influences. Nevertheless, the evidence suggested that TBI may be an independent risk factor for criminal behavior, possibly by impairing self-regulation and socialization skills, and that it may be a useful marker for identifying individuals at risk for criminal activity.

### **3. Studies in youth population**

Several studies have considered the relationship between neurological abnormalities and offending behavior, the prevalence of TBI among youth populations and its association with criminality. Schiltz *et al* found that violent prison inmates had significantly more brain abnormalities than non-violent prisoners or controls [13]. Witzel *et al* found that half of the patients in a secure mental health institution had signs of brain pathology compared with non-criminal controls [14]. In a meta-analysis of studies of TBI in juvenile offenders, nine studies were identified with approximately 30% reporting a history of TBI with a loss of consciousness (LOC). Juvenile offenders were substantially more likely to have a TBI compared with controls [15]. Studies of incarcerated young people showed that TBI was prevalent and linked to a greater risk of violence. Williams and colleagues found that 60% of incarcerated male young offenders reported a head injury with an LOC in 46% of the sample. Three or more TBIs were associated with greater violence [16]. In the UK, Chitsabesan *et al* reported that 82% of incarcerated adolescents reported a TBI, with those with moderate to severe TBI significantly more likely to have previously been in care and to be at current risk of deliberate self-harm and suicidality [17].

### **4. TBI severity and criminal behaviour**

The Glasgow Coma Scale (GCS) is a tool used to assess the severity of TBI. A GCS score of 13 or above (out of a maximum of 15) is considered mild, a score of 9-12 is considered moderate, and a score of 8 or below is considered severe. In addition to the GCS score, the severity of a historic TBI can also be gauged by the duration of post-traumatic amnesia or LOC. Mild TBI is considered to involve 0-30 minutes of LOC, with 30 minutes or more being indicative of moderate to severe TBI [18]. A very mild injury, typically referred to as a concussion, may involve some disorientation at the time of injury but no, or only brief LOC. While this type of injury rarely leads to permanent brain changes, more severe injuries are associated with a higher risk of chronic problems.

Moderate to severe TBI is associated with a range of long-term neurocognitive, behavioral, and psychiatric disturbances. These can include impairments in attention, memory, and executive functioning, as well as emotional and behavioral changes such as depression, anxiety, and irritability [19]. Individuals with moderate to severe TBI may also be at increased risk for developing post-traumatic stress disorder (PTSD) and other psychiatric conditions [20].

The long-term consequences of TBI can have a significant impact on an individual's quality of life, as well as on their ability to function in work and social

settings. It is therefore important to accurately assess the severity of a TBI in order to provide appropriate treatment and support to individuals with TBI.

**Table 1:** Summary of the main findings of studies on different populations and incidence of criminal behaviour in patients with TBI of difference severities.

Study	Population	Main Findings
[5]	Finnish males	TBI during childhood or adolescence associated with 4x increased risk of mental disorder with coexisting offending in adulthood. TBI before 12 years linked to earlier onset of criminality.
[6]	New Zealand birth cohort	TBI associated with increased likelihood of being arrested, but no longer significant after controlling for alcohol and drug dependence in those injured between ages 0-5 years.
[7]	Southwest England birth cohort	Mild TBI associated with increased risk of criminal behavior by age 17 years, but associations were confounded by substance use.
[10]	Swedish population	TBI associated with increased risk of violent crime, with adjusted odds ratios ranging from 2.0 to 3.3.
[11]	Young people with TBI in New Zealand	Pre-injury factors, especially pre-TBI offending, strongly linked to post-TBI arrests.
[12]	Ontarian adults attending emergency departments	TBI associated with increased risk of violent behavior

### 5.Executive dysfunction and criminal behavior

Executive dysfunction refers to impairments in the cognitive processes that are necessary for goal-directed behavior and decision-making. These impairments can be caused by a variety of factors, including TBI, stroke, and neurodegenerative diseases. Several studies have found an association between executive dysfunction and criminal behavior. Bathia et al found that executive dysfunction was a significant predictor of violent behavior in a sample of forensic psychiatric patients [21]. Similarly, a study by Meijers et al. found that individuals with a

history of criminal behavior had greater executive dysfunction than a control group [22]. Executive dysfunction can manifest in a variety of ways that may contribute to criminal behavior. For example, impairments in inhibition can lead to impulsive behavior, which may increase the risk of violent or antisocial behavior [21]. Deficits in planning and decision-making may lead to poor judgment and increased risk-taking behavior [23]. In addition to the direct effects of executive dysfunction on behavior, there may be indirect effects mediated by factors such as emotion dysregulation and social cognition. Executive dysfunction can lead to impairments in emotion regulation, which may contribute to aggression and other forms of antisocial behavior [24]. Social cognition deficits, such as impairments in theory of mind, may lead to misinterpretation of social cues and difficulty in navigating complex social situations, which may contribute to interpersonal conflicts and criminal behavior [25].

### **6. Brain areas associated with criminal behaviour**

Criminal behavior is a complex phenomenon that may be associated with various brain areas and neural circuits. One brain area that has been implicated in criminal behavior is the prefrontal cortex (PFC), which is involved in the regulation of executive functions such as impulse control, decision-making, and emotional regulation. Dysfunction of the PFC has been associated with various forms of criminal behavior, including violence, aggression, and impulsive behavior [25]. Studies have shown that individuals with reduced PFC activity or connectivity are more likely to engage in violent or antisocial behavior [26,27]. Another brain area that has been implicated in criminal behavior is the amygdala, which plays a key role in emotional processing and arousal. Dysfunction of the amygdala has been associated with increased aggression and violent behavior, particularly in individuals with a history of childhood maltreatment [28]. Studies have also shown that individuals with reduced amygdala volume are more likely to engage in criminal behavior [29]. The ventral striatum and the orbitofrontal cortex (OFC) have also been implicated in criminal behavior. These brain areas are involved in reward processing, impulse control, and decision-making. Dysfunction of these regions has been associated with increased risk-taking behavior, impulsivity, and poor decision-making, all of which may contribute to criminal behavior [29].

In addition to these brain areas, other neural circuits and structures have also been implicated in criminal behavior, such as the anterior cingulate cortex, the insula, and the mesolimbic dopaminergic system [29].

## Conclusions

The relationship between TBI and criminal behavior is complex, and additional research is needed to fully understand the underlying mechanisms. However, the evidence suggests that TBI may be a risk factor for criminal behavior, and that interventions aimed at preventing TBI and improving the outcomes of individuals with TBI may help reduce the prevalence of criminal behavior. Executive dysfunction is associated with an increased risk of criminal behavior, possibly due to impairments in inhibitory control, planning and decision-making, and other cognitive processes. The relationship between executive dysfunction and criminal behavior is complex and multifactorial, and additional research is needed to fully understand the underlying mechanisms. Interventions aimed at improving executive functioning and reducing the risk of criminal behavior may benefit individuals with executive dysfunction. Criminal behavior is a complex phenomenon that may be associated with dysfunction in various brain areas and neural circuits. The prefrontal cortex, amygdala, ventral striatum, and orbitofrontal cortex are among the brain areas that have been implicated in criminal behavior. Additional research is needed to fully understand the neural mechanisms underlying criminal behavior, and to develop effective interventions to reduce the risk of criminal behavior in individuals with neural dysfunction.

In conclusion, TBI is associated with an increased risk of criminal behavior, possibly due to cognitive impairment, emotional dysregulation, and other factors. Further research is needed to fully understand the relationship between TBI and criminal behavior, and to develop effective interventions to reduce the prevalence of criminal behavior in individuals with TBI.

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