

# Sleep and Traumatic Brain Injury



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## KEYWORDS

• Traumatic brain injury • Insomnia • Excessive daytime sleepiness • Pleiosomnia • Histamine

## KEY POINTS

- Post-traumatic sleep–wake disturbances are frequent and often chronic complications after traumatic brain injury.
- The most prevalent sleep–wake disturbances are insomnia, excessive daytime sleepiness, and pleiosomnia (ie, increased sleep need).
- These disturbances are probably of multifactorial origin, but direct traumatic damage to key brain structures in sleep–wake regulation is likely to contribute.
- Diagnosis and treatment consist of standard approaches, but because of misperception of sleep–wake behavior in trauma patients, subjective testing alone may not always suffice.

Traumatic brain injury (TBI) occurs when an external force impacts the head and traumatically injures the brain. It is one of the most prevalent disorders affecting the brain. In the United States, about 1.7 million people sustain a TBI every year.<sup>1</sup> TBIs often produce long-term impairments that interfere with the return to normal life. In the previous 10 years, it has become evident that sleep–wake disturbances often complicate the course after TBI. In a meta-analysis comprising 21 studies, the authors found that about 50% of TBI patients suffer from sleep–wake disturbances.<sup>2</sup> This article provides a clinical guide on how to classify, diagnose, and treat post-traumatic sleep–wake disturbances.

## CLASSIFICATION

There is no official classification of post-traumatic sleep–wake disturbances. Based on current literature and the International Classification of Sleep Disorders, third edition (ICSD-3), the proposed classification as given in [Table 1](#) can be used for clinical purposes.<sup>3</sup> Other sleep–wake disorders such as narcolepsy, sleep apnea, and sleep-related

movement disorders have occasionally been reported after TBI, but because of the lack of stringent data, these were not included in [Table 1](#).

## POST-TRAUMATIC INSOMNIA

### *Definition*

A chronic insomnia disorder is characterized by difficulty initiating and/or maintaining sleep and associated daytime symptoms including fatigue, sleepiness, cognitive deficits, mood disturbance, irritability, behavioral problems, impaired social performance, proneness for errors or accidents, and/or concerns about sleep.<sup>3</sup> These problems occur at least 3 times per week, have been present for at least 3 months, and cannot be attributed to inadequate sleep opportunities or circumstances.<sup>3</sup> For post-traumatic insomnia, these problems must be in temporal relation to the TBI and not related to other causes.

### *Epidemiology*

Because of different assessments of insomnia after TBI, the reported prevalences differ markedly, with frequencies ranging from 5% to more

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**Table 1**  
**Best studied post-traumatic sleep–wake disturbances, their equivalent in the diagnostic international classification of sleep disorders, 3rd edition (ICSD-3), and a proposed definition for use in practice**

Diagnosis	Equivalent in ICSD-3	Definition
Post-traumatic insomnia	Chronic insomnia disorder: Insomnia caused by a medical condition	Difficulty initiating sleep or maintaining sleep with related daytime symptoms such as fatigue, sleepiness, cognitive or mood disorders, behavioral or social problems, occurring after TBI and not related to other causes
Post-traumatic excessive daytime sleepiness	Hypersomnia caused by a medical disorder	Daily excessive daytime sleepiness or daytime lapses into sleep, occurring after TBI and not related to other causes
Post-traumatic pleiosomnia	(not existing in the ICSD-3)	Increased sleep need of at least 2 h per 24 h compared with pre-TBI conditions, with or without sleepiness, occurring after TBI and not related to other causes
Post-traumatic circadian sleep–wake disorders	Circadian sleep–wake disorders not otherwise specified	Circadian rhythm sleep–wake disorders, occurring after TBI and not related to other causes.

than 70% in TBI patient.<sup>4</sup> There is some evidence that insomnia may occur more likely in patients with mild TBI than in those with severe traumata.<sup>5</sup> In addition, in a military sample, Bryan<sup>6</sup> found that repeated TBI's enhance the risk of developing insomnia. To make things even more complicated, there is some evidence that TBI patients tend to overestimate insomnia problems; subjective measures reveal higher figures than objective testings.<sup>7</sup>

### ***Etiology and Pathophysiology***

In most patients, post-traumatic insomnia is most likely of multifactorial origin. **Box 1** summarizes potential contributors to post-traumatic insomnia.<sup>8</sup>

### ***Diagnosis***

Insomnia should be primarily assessed by structured interviews and with questionnaires such as the Pittsburgh Sleep Quality Index (PSQI) or the Insomnia Severity Index (ISI).<sup>9</sup> In most countries, sleep laboratory examinations including actigraphy or polysomnography are not reimbursed for the diagnosis of insomnia. Nevertheless, given the assumption that insomnia patients might overestimate their insomnia symptoms, the diagnosis of post-traumatic insomnia based on interviews or questionnaires alone must be interpreted with some caution.

### ***Treatment***

There is only sparse evidence on how to treat post-traumatic insomnia. Good sleep hygiene

should be encouraged in all TBI patients, although this approach alone failed to produce significant improvements.<sup>10</sup> A more promising approach is probably cognitive–behavioral therapy, but solid scientific evidence from large-scale clinical trials is missing.<sup>11,12</sup> Regarding pharmacotherapy, benzodiazepine receptor agonists are effective to treat disrupted sleep, but these drugs should be used only during short periods (ie, up to 2 weeks).<sup>13</sup> In contrast to such recommendations, it has been observed that 1 out of 5 patients use hypnotics on average 9 years after TBI.<sup>14</sup>

### **Box 1** **Potential contributors to post-traumatic insomnia**

- Pain
- Analgesic pharmacotherapy
- Psychosocial factors
- Depression and anxiety
- Psycho-pharmacological treatment
- Neuroendocrine disturbances
- Medicolegal issues
- Post-traumatic epilepsy
- Anticonvulsive drugs
- Genetic predisposition
- Neuropsychological deficits
- Trauma-induced brain damage

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