



Original Article

Sleep, Cognition, and Criminality: Exploring the Complex Interplay between Sleep Disruptions and Forensic Implications

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Abstract

Sleep is very important in ensuring that there is an optimal cognitive and behavioral functioning. Sleep disorders and sleep deprivation have been known to hamper attention, decision-making and psychomotor performance, which are critical in controlled human behavior. According to neuroimaging research sleep deprivation causes extensive changes to the brain activity, which causes lapses in cognition and inefficiency in day-to-day functioning. Although the impact of complete sleep deprivation has been well researched, there is an indication that even partial or chronic sleep deprivation as frequently seen in real life situations can have considerable impact on cognitive functions. The severity of these effects can be moderated by such variables as age, gender, and genetic predisposition and can affect personal vulnerability to neurobehavioral impairments. Sleep cognitive impairments are not easy to recover, and they usually take a significant amount of time, which affects personal and social productivity. Within forensic and legal settings, sleep deprivation has been linked to actions that can lead to either unintended injuries or a law-breaking act as a result of poor control. This paper will conduct a review of physiology of sleep, the sleep disorders spectrum, neurobehavioral impacts of sleep disorders and a case study in relation to the behavioral implications and its possible forensic implications.

Keywords: Sleep disorders, cognitive impairment, brain alterations, unconscious criminal actions, sleep deprivation, neurocognitive performance, case studies.

Introduction

Importance of Sleep

Getting sleep is important, for health and has a bigger impact on different aspects of our well-being. (Bruce et al., 2017) It's also crucial for mental health, emotions and keeping our heart, brain and metabolism in shape. (Ramar et al., 2021) Having the amount and quality of sleep also helps lower the chances of accidents and injuries caused by feeling tired or worn out like workplace mishaps or car crashes. (Ramar et al., 2021; McNicholas, 2019; Czeisler et al., 2016) Not getting rest over a prolonged period can raise the risk of mortality and add to personal risks as well as the burden on society linked to various health issues such as heart disease, diabetes, being overweight and cancer. (Luyster et al., 2012)

New findings show that the optimum duration of sleep at night for those who usually don't get rest could bring about some health advantages. (Henst et al., 2019) Sleep deprivation or not sleeping enough in the run while having trouble, with the body clock or dealing with untreated sleep problems can not only physical health but also emotional well-being, mood swings and general safety of the person. (Pizinger et al., 2018) A persistent lack of sleep is connected to a chance of death. Worsens the challenges faced by individuals and society due, to different health issues, like heart disease, diabetes, obesity and cancer. New research suggests that sleeping each night can benefit the health of those who often don't get rest. (Watson et al., 2015)

Relationship between Sleep, Wakefulness, and Brain Performance Detail

Sleep is an essential part of overall wellness. It affects both mental and physical health.

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The detailed understanding of sleep as a basis for elucidating its relationship with health and sleep disorders requires accurate measurement of it. Waking and sleeping are marked by multiple variables at almost all systemic levels including gene expression which forms the most fundamental level, (O'Callaghan et al., 2018) Body and brain temperature, (Dijk & Landolt, 2019) and the release of neurotransmitters etc. (Zant et al., 2016) Sleep is widely thought to be very important, and to serve a specific function in memory consolidation. Although the exact mechanisms through which sleep acts on memory and neuroplasticity are still not clear, it is generally believed that the strengthening of specific synapses activated during wakefulness enhances memory consolidation during sleep. Conversely, weak synaptic connections become even weaker. (Okano et al., 2019; Walker & Stickgold, 2006; Gilestro et al., 2009; Witkowski et al., 2020; Lim & Dinges, 2010)

For more than one hundred years, researchers have been interested in the complex interactions between sleep and cognition. Several laboratory studies on well-rested healthy adults have shown that having better sleeping patterns leads to several improved cognitive abilities such as better learning capabilities and memories among others. The effects also extend beyond the lab since self-reported sleep data from college students' residential halls proved to be significantly connected with their grades. (Okano et al., 2019; Harrison & Horne, 2000; Wagner et al., 2004) Sleep patterns, in general, show a strong link with academic performance in the context of education. In this regard, lack of adequate sleep is associated with poor concentration and attention during class time. (Okano et al., 2019; Eliasson et al., 2009; Gaultney, 2010; Gilbert & Weaver, 2010; Gomes et al., 2011) Although few studies have reported null findings, the majority of research examining the effects of duration and quality of sleep on academic achievement has found that more extensive and better quality sleep is associated with improved grades and increased academic effort. (Okano et al., 2019; Johns et al., 1976)

Furthermore, inconsistent sleep patterns affect a student's academic performance academically. The concept of "social jet lag," characterized by irregularity in sleeping times or hours per day tends to appear as sleep debts on weekdays and extended sleeping hours on weekends. Sleep incoherence is most prevalent during late adolescence and early adulthood as they tend to stay up very late at night but have to wake up early most mornings. As it turns out, adolescents who have more variable sleeping schedules perform worse at school. (Okano et al., 2019; Lee et al., 2015; Díaz-Morales & Escibano, 2015; Raley et al., 2016; Haraszti et al., 2014) The grade of alertness, which can be characterized in terms such as sleepiness and tiredness can be measured through the use of validated scales for instance, the Epworth Sleepiness Scale and Karolinska Sleepiness Scale that measure perceived levels of alertness. (Dijk & Landolt, 2019; Åkerstedt et al., 2017; Johns, 1991) There is an understanding within sleep research literature that there may be a bidirectional relationship between the quality of wakefulness and sleep with each state being capable of influencing the other. Measuring the quality of wakefulness could involve monitoring vigilance maintenance and reaction to stimuli in simple repetitive test conditions such as psychomotor vigilance test (PVT). (Lee et al., 2015) Moreover, performance on tasks assessing more complex cognitive functions like working memory and executive function tests including required inputs to execute these tasks and those related to professional and social activities such as driving represent markers of the quality wakefulness. These comprehensive assessments give insight into the delicate interplay between sleep and wakefulness where a shift in one might affect the other equally well. (Dijk & Landolt, 2019; Groeger et al., 2014) Specifically, since the transition from sleep to wake is considered the ideal time for achieving optimal wake with PSG, the quality of wake is of interest when it occurs immediately after the transition to wake. The brain has to attain its full performance capabilities upon the transition to wake, requiring hours before it can reach these levels because of the phenomenon known as sleep inertia (ie, the continuation of some of the characteristics of sleep into the waking state; Sleep inertia has important implications in the operational domain, such as with pilots taking naps during long-haul flights, and it might occur more exacerbated following non-pharmacological treatments of sleep disturbances, such as sleep restriction, relative to treatments with medication, as well as following pharmacological interventions (Dijk & Landolt; Groeger et al., 2014; Balkin, 2002; Santhi et al., 2013; Boyle et al., 2012; Cohen et al., 2010)

Stages of Sleep

Sleep has subjective and objective dimensions. Subjectively, it leads to unconsciousness (falling asleep), dreams/nightmares, and how one feels about sleep when they wake up. Objectively, sleep means that the brain ceases movement while its arousal thresholds increase such that measured physiological changes occur. Common measurements in sleep research encompass electroencephalogram (EEG), electromyogram (EMG), electrooculogram (EOG), electrocardiogram (ECG), hormone levels, and respiratory parameters. A polysomnogram (PSG) is a record of these physical variables which enables quantification of the sleep state. (Dijk & Landolt, 2019; Frank & Heller, 2018)

At present, sleep is quantified primarily using sleep staging that relies on EEG, EMG and EOG signals. It consists of non-rapid eye movement (NREM) sleep and rapid eye movement (REM) sleep. N1-N3 stages constitute the NREM stage, with N3 being referred to as slow-wave sleep (SWS). The major parameters used in evaluating how well an individual sleeps include; how long it takes him/her to fall asleep, for each stage as indicated by its duration and the number of minutes it contributes to total sleep time towards these measures like wakefulness from onset of REM or any other recurrent arousals including turning over. Sleep continuity is also characterized by sleep efficiency (total sleep time/time in bed), wake after sleep onset, number of awakenings, EEG arousals and distribution of uninterrupted sleep bout durations. These parameters help us understand what happens during the consolidation of episodes while still waking up before each alertness episode. (Dijk & Landolt, 2019; Frank & Heller, 2018) Sleep occurs in five stages: wake, N1, N2, N3, and REM. The N1 to N3 stages are called non-rapid eye movement (NREM) sleep, with each stage leading to progressively deeper sleep. Around 75% of sleep is spent in the NREM stages, with the majority in N2. (Malik et al., 2018)

- Wake: Characterized by high-frequency beta waves on the EEG. (Malik et al., 2018)
- N1 (Light Sleep): The transition from wake to sleep, with the presence of theta waves. (Malik et al., 2018; Cj & Aw, 2019)

- N2 (Deeper Sleep): Characterized by sleep spindles and K-complexes on the EEG, which are important for memory consolidation. This stage comprises around 45% of total sleep time. (Malik et al., 2018; Cj & Aw, 2019; Shakankiry, 2011)
- N3 (Deepest Non-REM Sleep): Characterized by low-frequency delta waves. This is the deepest stage of sleep, and the body repairs and regenerates tissues during this time. It accounts for around 25% of total sleep time. (Malik et al., 2018; Cj & Aw, 2019)
- REM (Rapid Eye Movement): Associated with dreaming and characterized by brain activity similar to wakefulness. Muscles are atonic (paralyzed), except for the eyes and diaphragm. REM accounts for around 25% of total sleep time. (Malik et al., 2018; Cj & Aw, 2019)

Generally during a typical night's sleep there are about 4-5 progression stages: N1 → N2

→ N3 → N2 → REM, each lasting for 90- 110 minutes. As the night progresses, there is an increase in REM duration and a decrease in deep sleep (N3)(Malik et al., 2018; Cj & Aw, 2019; Shakankiry, 2011)

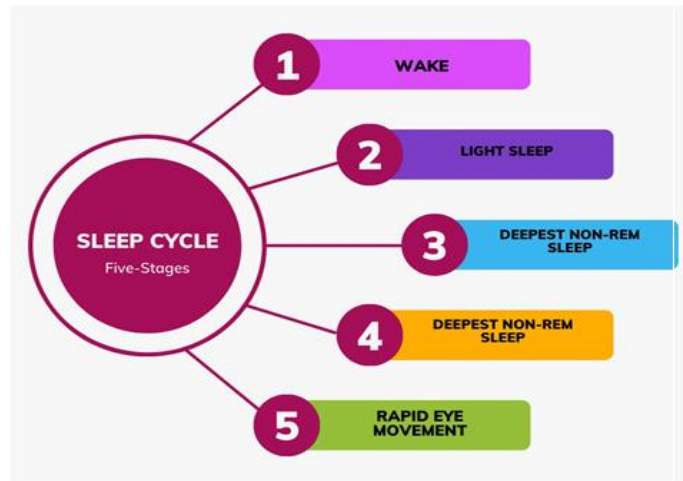


Fig-1: Stages of Sleep

Development of Sleep with respect to age

The duration spent in each sleep stage evolves as individuals age, often reflecting a decline in the overall biological necessity for sleep in individuals over time.

The connection between age and sleeping behavior is a strong one that varies with time. A newborn baby has its own way of sleeping, for instance, it can sleep for 16-18 hours each day. This sleep wake schedule is distributed over the whole day and night, with a remarkable 50% of all sleeps being REM sleep. Actually, in preterm infants the percentage of REM sleep may be even higher.

When children reach their second year there are changes in their sleep architecture. Sleep duration in toddlers typically consolidates to approximately 10 hours per day, during the night with one or two daytime naps. Furthermore, the proportion of REM sleep slows down to about 20-25% among the total time spent asleep. (Carskadon et al., 1993; Mercer et al., 1998; Schupp & Hanning, 2003)

Adulthood also sees some shifts where majority require six to eight hours of rest every night. The periods for rapid eye movement (REM) make up only around 15-20% of total sleep time (TST). However, as individuals enter their later years, sleep patterns undergo additional transformations. Although total amount of nocturnal rest remains relatively stable, the quality sometimes deteriorates notably in older adults who experience more fragmented sleep characterized by more frequent nocturnal awakenings along with wider periods awake throughout the sleeping period thus lowering sleep efficiency. Also normal aging related modifications are observed in old people's slumber structure which suggests rather a shift towards deep non-rapid-eye movement (NREM) slumbers rather than REM ones (Schupp & Hanning, 2003; Carskadon et al., 1993)

Table-1: Sleep Patterns according to different age groups.

Sr. No	Age Group	Sleep Duration	Sleep Patterns	References
1.	Newborns and Infants (Birth to 1 Year)	16-18 hours/day	Irregular sleep-wake patterns, sleep onset through REM, shorter sleep cycles	(Adair & Bauchner, 1993)
2.	Toddlers (1-3 years)	Around 11- 13 hours	Decreasing total sleep time	(Mercer et al., 1998)
Sr. No	Age Group	Sleep Duration	Sleep Patterns	References
3.	Children (3-9 years)	Around 11 hours	Develop circadian preferences (night owls/early risers), longer	(Mercer et al., 1998)

			REM latency, more N3	
4.	Adolescents (10-18 years)	9-10 hours	Reduced slow-wave sleep, increased N2, daytime sleepiness	(Carskadon et al., 1993)
5.	Adults (18+ years)	7-9 hours	Earlier sleep and wake times, reduced sleep consolidation	(Dijk et al., 2000)
6.	Older Adults (65+ years)	6-7 hours	Wake up earlier, sleep earlier than younger adults	(Dijk et al., 2000)
7.	Gender Differences	-	Men: more N1, nighttime awakenings, daytime sleepiness. Women: longer slow-wave sleep, more difficulty falling asleep. Increased daytime sleepiness during pregnancy/postpartum.	(Bach et al., 2000)

Physiology of sleep

Sleep physiology is a tangled process that involves several systems in the body. Sleep is regulated by homeostatic drive and circadian rhythm, with the waking promoting ascending arousal system and inhibitory cells of ventrolateral preoptic area (VLPO) triggering sleep onset. (Strecker et al., 2000). When it comes to measuring sleep, polysomnography (PSG) is considered as gold standard which records brain activity, eye movements, muscle tone as well as cardiorespiratory parameters. (Carley & Farabi, 2016) Each of these stages presents distinctive EEG patterns from alpha waves at drowsiness to delta waves during deep sleep. Apart from this, sleep has a significant impact on endocrine function. (Carley & Farabi, 2016) Prolactin levels increase at the initiation of sleep while growth hormone secretion strongly correlates with N3 sleep; cortisol follows a circadian pattern bottoming out early hours of slumber while thyroid stimulating hormone (TSH) is inhibited by stages of sleep especially during N3 sleep. (Gronfier & Brandenberger, 1998). These hormonal changes are important for metabolism since they may potentially affect glucose levels as well as insulin sensitivity in body leading to an increased secretion. (Carley & Farabi, 2016) Melatonin, growth hormone, and thyroid hormone secretion are all affected by sleep. They are all released and secreted at different times throughout the sleep-wake cycle and about sleep stages and circadian rhythms. Sleep restores endocrine function and these hormones are those that are most affected. For example, most glands release growth hormones at night, especially during slow-wave sleep. In light of the above, it can be said that endocrine function plays an imperative role in the process of sleep. (Kim et al., 2015)

Hypoventilation is noted in both NREM and REM sleep partly because of reduced muscle tone in the walls of the upper airway as well as of the rib cage. Sleep also inhibits many emergency respiratory protective mechanisms such as coughing reflexes and the hypoxic drive to breathe. Activity related to the respiratory system changes during sleep; it becomes more irregular during sleep, particularly while the patient is asleep and dreaming. (Lugaresi et al., 1978) There is general deactivation of the brain during NREM sleep and activation of the same during REM sleep but in the same manner as that of wakefulness and has a unique focus on the emotional and visual sections. (Somers et al., 1993). At the same time, the overnight urinary profile of patients reveals a decrease of electrolyte clearing ratio and an increase in urine concentration. These changes present many as contraction and dilation shifts in renal blood flow, filtration, and hormonal secretion. (Cianci et al., 1991) Blood flow to the brain and its metabolism similarly undergo alterations depending on the stage of the sleep. In particular, myocardial infarction risk has been found to be higher in the morning because the level of cardiovascular activity immediately starts to rise after waking up. The cardiovascular system of the passengers includes variations in blood pressure and heart rate mainly due to the action of the autonomous nervous system. (Floras et al., 1978) All these changes are most evident when a baby is going through K-complexes, arousals, and major body movements. Compared to wakefulness REM the sympathetic activity is enhanced. SNA exhibits a similarly variable profile, but it is reduced during N3 and increases momentarily after KCS. Though such physiological alterations are generally non-threatening to the health of most persons, they are potentially hazardous, especially to persons with heart ailments or other cardiovascular diseases. (Schupp & Hanning, 2003b)

Table-2: Physiology of various systems of the body during sleep.

Sr. No	Body System	Changes During Sleep	References
1.	Cardiovascular	• Fluctuations in blood pressure and heart rate • Brief increases with K-complexes, arousals, and body movements • Elevated risk of myocardial infarction upon awakening	(Cianci et al., 1991)
Sr. No	Body System	Changes During Sleep	References
2.	Autonomic Nervous System	• Decreased sympathetic activity in deep NREM sleep • Increased sympathetic activity during REM sleep	(Somers et al., 1993)
3.	Respiratory	• More erratic ventilation, especially in REM sleep • Hypoventilation in both NREM and REM sleep • Reduced pharyngeal muscle tone	(Lugaresi et al., 1978)

		• Increased upper airway resistance • Suppressed cough reflex • Diminished hypoxic ventilatory response	
4.	Cerebral Blood Flow	• Reduced overall in NREM sleep • Localized increases in limbic and visual areas during REM sleep	(Somers et al., 1993)
5.	Renal	• Decreased electrolyte excretion • More concentrated urine production • Changes in renal blood flow and glomerular filtration	(Cianci et al., 1991)
6.	Endocrine	• Growth hormone secretion peaks in early sleep (SWS) • Thyroid hormone secretion occurs in late evening • Melatonin secretion regulated by light-dark cycle	(Kim et al., 2015)

Role of Sleep Disorders in Criminal Conduct

Sleep comes in two different parts of brain activity - rapid eye movement (REM) sleep and non-rapid eye movement (NREM) sleep - which alternate with each other cyclically throughout the night, and each of these cycles lasts about 90 minutes. The subsets of para- somnias can include dream-related disorders, which arise from the REM or NREM stages or partial awakenings, and also daytime drowsiness. With sleep disorders of arousal, such as sleepwalking and nightmares that usually occur during the initial third of the night when NREM and deep sleep stages are dominant, these stages are more prominent. In contrast to REM parasomnias, which occur later in the night when REM sleep is more frequent, other parasomnias occur throughout the night. The dreamer usually is wide awake and therefore can remember all the details of the dream after having experienced REM parasomnia. (Carskadon et al., 1993) In contrast, people usually realize that something is wrong when they develop NREM parasomnia. They are not able to remember any dreams and do not recall their strange behaviour in the morning. The main fact is that the people who have NREM parasomnias are thought to be in a state of partial sleep and partial wakefulness and people with REM sleep behaviour disorder are regarded as being completely asleep and having vivid dream experiences. ("Principles and Practice of Sleep Medicine," 2011)

Table-3: List of common sleeping disorders responsible for criminal behavior.

Sr. No	Sleep Disorder	Description	Key Characteristics	References
1.	Disorders of Arousal	A spectrum ranging from confusional arousals (sleep drunkenness) to sleepwalking to sleep terrors. Represents an admixture of wakefulness and NREM sleep, allowing for complex behaviors without awareness or responsibility.	• May include somnambulistic homicide, filicide, attempted homicide, and suicide. • Often triggered by febrile illness, alcohol, sleep deprivation, and emotional stress. • More prevalent in adults than previously thought.	(Cartwright, 2004)
2.	REM Sleep Behavior Disorder (RBD)	Absence of REM sleep atonia, allowing the "acting out" of dreams, often with dramatic and violent or injurious behaviors.	• Violent behaviors misdiagnosed as seizures or psychiatric disorders. • Treated effectively with clonazepam. • May overlap with disorders of arousal	(Cartwright, 2004)
3.	NREM Parasomnias	Complex behaviors after sleep initiation, including partial awakenings, sleep terrors, somnambulism, sexsomnia, and automatisms.	• Sleep and wakefulness coexist during episodes. • Evaluation of criminal responsibility is a significant technical problem.	(Cartwright, 2004 C. Watson & Weiss, 2024)

Sr. No	Sleep Disorder	Description	Key Characteristics	References
4.	Somnambulism (Sleepwalking)	A series of complex behaviors resulting in large movements or walking during sleep.	• Occurs in 2-14% of children and 1.6-2.4% of adults. • Treatment involves benzodiazepines, antidepressants, or addressing underlying causes.	(Cartwright, 2004; Bonkalo, 1974)
5.	Sexsomnia	Sexual behaviors involving a sleeping person and an unwilling victim associated with NREM sleep. Classified	• Distinct from somnambulism due to involvement of sexual partners, arousal, autonomic activation, and	(Cartwright, 2004; Mahowald et al.,

		as a variant of somnambulism or confusional arousals.	dream mentation. - Behaviors range from exposure to pene- tration, including adult and child victims. - A medicolegal conundrum, with diffi- culty arguing lack of consciousness for complex behaviors.	1990)
6.	Sleep Terrors	Sudden awakening from NREM sleep with violent bodily activity and marked physiological activation.	- Tend to occur within the first three hours of sleep. - Associated with various internal and external factors like illness, stress, and sleep disorders.	(Cartwright, 2004)
7.	Hypersomno- le and Driving	Disorders of excessive sleepiness (hypersomnolence) may lead to criminal charges if a drowsy driver causes a motor vehicle accident re- sulting in injuries.	A conscious deci- sion to drive while aware of drowsiness leads to culpability if harm occurs.	(Cartwright, 2004; Pressman, 2011; Weiss & Del Busto, 2011; Schenck et al., 2007; Shapiro et al., 2003)

Sr. No	Sleep Disorder	Description	Key Characteristics	References
		A behaviour believed to be as a re- sult of the intake of short-acting hypnotic drugs such as zolpidem or Z-drugs.	- Applies to condi- tions like narcolepsy where the driver should have known the risks. - Since 2007 FDA warning, difficult to claim ignorance of the medications' effects. - Unlikely for driv- ers under the influence of these medications to evade responsibility for harm caused while driving.	
8.	Sleep Aponea	Sleep apnea is one of the severe health conditions that present them- selves as an abnormal lack of breath during sleep. If left unaddressed, it may result in loud snoring, sleep during the day or severe problems such as heart issue or hypertension.	This is a different con- dition from regular snoring. Primary snor- ing can result because of nose or throat prob- lems, sleep positions like sleeping on your back especially in case of adults and over- weight people, alcohol and other depressant use, and age. Both forms of snoring are triggered by the vibra- tion of tissues in the rear part of the throat. Sleep apnea patients usually have a tenden- cy to experience these two but for some rea- son people with this medical condition	(Nofzinger & Wettstein, 1995)

Sr. No	Sleep Disorder	Description	Key Characteristics	References
			Should not have bed partners.	
			- Snore much more loudly than those with regular snoring - Pause for over 10 seconds while they breathe - Take shallow breaths, gasp, or choke - Be restless during sleep	

The History of Sleepwalking Used As A Defense In Criminal Case

One of a series of major forensic issues concerning the diagnosis of true sleep disorders is determining whether aggressive acts were performed during the attack or in wakefulness. Establishing the credibility of some of the expert witnesses in

the question of sleep medicine is important since their testimonies greatly influence legal decisions. One of the most important goals is to exclude any conflict of interest with the examiner and exclude advocacy positions from the experts. In light of this, it is apparent that informing the public, as well as the juries, about sleep disorders and the behavioural consequences that come with them, remains a social necessity. Assisting in understanding the creation of legal norms to identify who is criminally liable where psychotic disorders and sleep violence are involved. However, due to the scarcity of research data on the prevalence and mechanism of sleep disorder violence, causality can hardly be determined. Solving each of these complex forensic issues requires work in concert between sleep specialists, attorneys, and scholars. Appropriate dispositions of such cases require incorporation of scientific findings in the legal systems and this can only be done through interdisciplinary collaboration. Further research is therefore necessary for enhancing the investigation of sleep disorder-associated criminal behaviour.

Table-4: Legal Cases Involving Sleep Disorders in Criminal Proceedings. *Reference: This table is compiled from case studies provided in the Sleep Forensic Database.*

Sr No.	Case Name	Year	Location	Outcome	Sleep Disorder	Description
1.	Fain v. Commonwealth	1879	Kentucky, USA	Convicted, reversed	Confusional Arousal	Shot porter while waking up. Reversed due to sleepwalking history.
2.	Bradley v. State	1925	Texas, USA	Acquitted	Confusional Arousal	Shot girlfriend while sleeping. Acquitted on appeal.

Sr No.	Case Name	Year	Location	Outcome	Sleep Disorder	Description
3.	Tibbs v. Commonwealth	1910	Kentucky, USA	Convicted	Sleepwalking	Beat and stabbed victim to death while waking. Convicted despite sleepwalking evidence.
4.	R. v. Boshears	1960	England	Acquitted	Confusional Arousal	American sergeant strangled girl after drinking. Acquitted based on automatism.
5.	State v. James Kirchner	2008	Oregon, USA	Acquitted	Sexsomnia	Touched child inappropriately while sleeping. Acquitted due to sleepwalking history.
6.	Alan Ball Case	2007	England	Acquitted	Sexsomnia	Kissed underage girl while asleep. Acquitted due to sleepwalking history.
7.	R. v. Cogden	1950	Australia	Acquitted	Sleep Terror	Killed daughter with axe during sleep terror. Acquitted.

Sr No.	Case Name	Year	Location	Outcome	Sleep Disorder	Description
8.	R. v. Griggs	1859	England	Acquitted	Sleep Terror	Threw baby out window while dreaming of fire.
9.	R. v. Ngang	1960	Not specified	Convicted, reversed	Sleep Terror	Stabbed man while dreaming of evil spirit.
10.	Ohio v. Hines	1993	Ohio, USA	Acquitted	Sleep Terror	Assaulted elderly resident during sleep terror.

Conclusion

One of a series of major forensic issues concerning the diagnosis of true sleep disorders is determining whether aggressive acts were performed during the attack or in wakefulness. Establishing the credibility of some of the expert witnesses in the question of sleep medicine is important since their testimonies greatly influence legal decisions. One of the most important goals is to exclude any conflict of interest with the examiner and exclude advocacy positions from the experts. In light of this, it is apparent that informing the public, as well as the juries, about sleep disorders and the behavioural consequences that come with them, remains a social necessity. Assisting in understanding the creation of legal norms to identify who is criminally liable where psychotic disorders and sleep violence are involved. However, due to the scarcity of research data on the prevalence and mechanism of sleep disorder violence, causality can hardly be determined.

Solving each of these complex forensic issues requires work in concert between sleep specialists, attorneys, and scholars. Appropriate dispositions of such cases require incorporation of scientific findings in the legal systems and this can only be done through interdisciplinary collaboration. Further research is therefore necessary for enhancing the investigation of sleep disorder-associated criminal behaviour.

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