

# A Review of Sleep-Related Violence

## The Demographics of Sleep Forensics Referrals to a Single Center



Michel A. Cramer Bornemann, MD; Carlos H. Schenck, MD; and Mark W. Mahowald, MD

This review of sleep-related violence reports the nature of the underlying sleep-suspected conditions encountered and helps establish the spectrum of sleep-related behaviors resulting in forensic consequences. This information may begin to bridge the gap between the differing medical and legal concepts of automatism (complex motor behaviors occurring in the absence of conscious awareness and therefore without culpability). Sleep medicine professionals are increasingly asked by legal professionals whether a sleep-related condition could have played a role in a forensic-related event. Inasmuch as sleep medicine is a relatively young field, there is scant information to address these questions. The three most prevalent criminal allegations of the 351 consecutive possible sleep forensic-related referrals to a single sleep medicine center over the past 11 years were sexual assault, homicide/manslaughter or attempted murder, and driving under the influence. The overwhelming possible sleep disorder implicated was sexsomnia, accounting for 41%, or 145 out of 351 cases. Of the 351 referrals, 111 were accepted following thorough case review. In general, cases not accepted were declined on the basis of little or no merit or contamination by alcohol intoxication. Of those cases accepted, the proposed initial claim that a sleep phenomenon was operant was supported in approximately 50%, which were mostly non-rapid eye movement disorders of arousal. No cases were felt to be due to rapid eye movement sleep behavior disorder. CHEST 2019; 155(5):1059-1066

**KEY WORDS:** crime; rapid eye movement sleep behavior disorder; sexsomnia; sleep forensics

This review of sleep-related violence (SRV) reports the nature of the underlying sleep-suspected conditions encountered and helps establish the spectrum of sleep-related behaviors resulting in forensic consequences. The generic term “parasomnia” broadly refers to abnormal complex behaviors or experiences and autonomic nervous system activity arising during sleep.<sup>1</sup> Parasomnias are the manifestation of a wide variety of

different underlying conditions that often masquerade as one another. The most common parasomnias are disorders of arousal (confusional arousals, sleepwalking, and sleep terrors) that arise from non-rapid eye movement (NREM) sleep behavior disorder sleep, sleep-related eating disorder (another form of NREM sleep parasomnia), and rapid eye movement (REM) sleep behavior disorder that arises from REM

**ABBREVIATIONS:** CPG = central pattern generator; NREM = non-rapid eye movement; PTSD = posttraumatic stress disorder; RBD = rapid eye movement sleep behavior disorder; REM = rapid eye movement; SBS = sexual behavior in sleep; SRV = sleep-related violence

**AFFILIATIONS:** From the Minnesota Regional Sleep Disorders Center (Drs Cramer Bornemann and Schenck); Hennepin County Medical Center (Drs Cramer Bornemann and Schenck), Minneapolis, MN; Sleep Forensics Associates (Dr Cramer Bornemann), Minneapolis/Saint Paul, MN; and Department of Psychiatry (Dr Schenck) and

Department of Neurology (Dr Mahowald [retired]), University of Minnesota Medical School, Minneapolis, MN.

**CORRESPONDENCE TO:** Michel A. Cramer Bornemann, MD, Minnesota Regional Sleep Disorders Center, Hennepin County Medical Center, 913 S 7th St, Green Level 8, Minneapolis, MN 55415; e-mail: [Michel9626@yahoo.com](mailto:Michel9626@yahoo.com)

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sleep. Nocturnal seizures that may be confused with confusional arousals and REM sleep behavior disorder (RBD) may arise from NREM or REM sleep. Sleep-related abnormal sexual behaviors, often associated with forensic issues, is often popularly referred to as “sexsomnia” or “sleep-sex.”<sup>2-4</sup>

State dissociation can occur because, contrary to popular opinion, sleep and wakefulness are not necessarily “whole brain” phenomena, are not mutually exclusive, and may occur simultaneously in the same brain, often with impressive clinical manifestations.<sup>5</sup> Furthermore, each of the three states of mammalian being (wakefulness, REM sleep, and NREM sleep) comprises numerous physiologic phenomena that usually occur in concert, resulting in full state declaration. The various state-determining physiologic variables may dissociate, however, and recombine, resulting in the simultaneous appearance of multiple states.<sup>6</sup> In humans, state dissociation is a plausible explanation for numerous clinical conditions, including narcolepsy, cataplexy, sleep paralysis, lucid dreaming, and disorders of NREM arousal (confusional arousals, sleepwalking, and sleep terrors), among others. Numerous physiologic measures have documented the simultaneous occurrence of wakefulness and sleep in humans in disorders of NREM arousal: surface EEG,<sup>7-9</sup> depth electrode EEG,<sup>10-12</sup> single-photon emission CT study<sup>13</sup> and transcranial magnetic stimulation,<sup>14</sup> and in lucid dreaming: EEG<sup>15</sup> and EEG/functional MRI.<sup>16</sup>

One important type of state dissociation experienced daily to some degree by all normal individuals is sleep inertia (also referred to as sleep drunkenness). Sleep inertia refers to the transition from sleep to wakefulness, which is not as instantaneous as it may appear or feel, but rather may be gradual, associated with periods of impaired performance and reduced vigilance averaging 1 h or longer. Sleep inertia has been well-documented by numerous physiologic measures, including EEG, evoked potential (visual, auditory, and somatosensory), cerebral blood flow and PET, and MRI studies.<sup>17</sup> This phenomenon appears to vary on an individual basis and may be potentiated by sleep deprivation or by the effects of medications.<sup>18</sup>

Complex movements and vocalizations occurring during various parasomnias (and other automatisms) may be explained by the interaction between “central pattern generators” and the phenomenon of state dissociation including sleep inertia. Central pattern generators (CPGs) are genetically determined functional neural

networks located in the brainstem, spinal cord, and possibly in the cortex that are linked to innate primal or overlearned behaviors, such as feeding, locomotion, and reproduction.<sup>19,20</sup> These networks can generate “fixed action patterns” in the absence of sensory feedback or timing cues from other extrinsic sources<sup>21</sup> and are active during fetal development; with maturation, they come under inhibitory neocortical control. Tassinari et al<sup>22</sup> have proposed that the similar phenotypic expression of different parasomnias (such as disorders of NREM arousal and RBD) and nocturnal seizures represents that the behaviors are generated by the same CPGs, but that the mechanism of release of the CPG behaviors varies among conditions. It is notable that CPGs reside proximate to many sleep/wake generating areas of the brainstem. CPGs have also been implicated in the appearance of complex motor activity during impending brain death and during syncopal spells.<sup>23,24</sup>

## Sleep Disorders and SRV

### *Disorders of Arousal*

The vast majority of cases of sleep-related behaviors with forensic implications are the manifestation of disorders of arousal. Disorders of arousal occur on a broad spectrum of increasing complexity ranging from confusional arousals through sleepwalking to sleep terrors. There is no evidence to support the erroneous concept that these are related to underlying psychiatric or psychological conditions,<sup>25-28</sup> although stress can trigger episodes in predisposed individuals.<sup>1</sup> The true prevalence of stress in such situations remains unknown. These simply represent a condition of state dissociation resulting from the simultaneous occurrence of wakefulness and NREM sleep: portions of the brain capable of generating very complex behaviors are awake, whereas other portions of the brain responsible for monitoring behavior and laying down memory of behaviors are asleep; this results in a brain capable of generating complex behaviors without conscious awareness.<sup>6,29,30</sup> Disorders of arousal are very common in the healthy population, particularly in children (up to 30%) and may persist into or even begin in adulthood. The lifetime prevalence of nocturnal wanderings in adults is 29%, with 3% to 4% of adults reporting such behaviors during the preceding year. Experiences normally associated with pain may not result in awakenings during disorders of arousal. This may represent how sleep can be an analgesic state.<sup>31</sup> Some cases of complex sleep-related behaviors may masquerade as erstwhile suicides.<sup>32</sup>

## *Sexsomnia and SRV*

Sexsomnia (sleep-sex) is formally designated as “Sleep Related Abnormal Sexual Behaviors” in the International Classification of Sleep Disorders 3rd edition,<sup>1</sup> where it is classified as a subtype of disorders of NREM arousal. Sexsomnia “often has major interpersonal, clinical and occasional criminal consequences.” The full range of sexuality is expressed with sexsomnia (at times with aggression and violence), including masturbation, sexual fondling, spontaneous orgasms, sexual intercourse/attempted intercourse, and sexual vocalizations/verbalizations (“sleepsexalking”). Sexsomnia may be chronic and recurrent. The first classification of sleep-related abnormal sexual behaviors and experiences was published in 2007,<sup>3</sup> with a subsequent update of the world literature published in 2015<sup>33</sup> followed by a published case series<sup>4</sup> and various case reports on sexsomnia.<sup>34-38</sup> The literature has identified the two most common clinical scenarios for sexsomnia because it is predominantly a young-adult male disorder that may emerge in the context of either a longstanding, complex history of NREM sleep parasomnias (eg, sleepwalking, sleep terrors), with sexsomnia being the latest NREM sleep parasomnia to emerge, or OSA, with the onset of sexsomnia emerging in tandem with snoring and other hallmark symptoms of OSA.<sup>36,39</sup> Forensic consequences often involve minors and may result in aggressive or violent sex with the bed partner leading to charges of sexual assault.

In a systematic review of published medico-legal cases of SRV and sexual behavior in sleep (SBS) involving case reports in which a sleep disorder was purported as the defense during a criminal trial and for which information about the forensic evaluation of the defendant was provided, 18 cases (9 with SRV; 9 with SBS) were identified.<sup>40</sup> The charge was murder or attempted murder in all SRV cases, whereas in SBS cases the charge ranged from sexual touching to rape. The defense was based on sleepwalking in 11 of 18 cases. The trial outcome was in favor of the defendant in 14 of 18 cases. Defendants were relatively young males in all cases. Victims were usually adult relatives of the defendants in SRV cases and unrelated young girls or adolescents in SBS cases. The forensic evaluations widely differed from case to case. The SRV and SBS medico-legal cases did not show apparent differences, except for the severity of the charges and the victim characteristics.

## *RBD and Sleep Violence*

RBD is a parasomnia involving dream-enacting behaviors during REM sleep with loss of the physiological skeletal muscle atonia of REM sleep.<sup>1</sup> The dream-enacting behaviors are often aggressive and can become violent, resulting in serious and life-threatening injuries to self and bed partner. The traditional RBD clinical profile involves middle-aged and older men with violent and injurious dream-enacting behaviors.<sup>41,42</sup> Documented injuries from RBD episodes include bruises; subdural hematomas; lacerations (including arteries, nerves, tendons); fractures (including high cervical fractures); dislocations, sprains, abrasions, rug burns; tooth chipping; and scalp injury from hair pulling.<sup>41-47</sup>

RBD carries major forensic implications, regarding both “parasomnia pseudo-suicide”<sup>32</sup> and unintentional assault/attempted murder/murder of the spouse or other bed partner.<sup>48</sup>

Parasomnia overlap disorder is a relatively uncommon condition characterized by the clinical and polysomnographic feature of both disorder of RBD and NREM arousal and thus carries potential forensic consequences throughout the sleep period.<sup>49-51</sup>

Trauma-associated sleep disorder is a novel parasomnia that has been proposed that incorporates elements of posttraumatic stress disorder (PTSD) and RBD in patients with emotionally traumatic experiences who engage in violent sleep-related behaviors with PTSD nightmares.<sup>52,53</sup> Although there is some loss of REM atonia (but below the usual threshold for bona fide RBD cases), trauma-associated sleep disorder appears to be a disorder of arousal from REM sleep with violent behaviors associated with PTSD nightmares.

## *OSA and SRV*

**OSA “Pseudo-RBD”:** Occasionally, OSA may present with complex sleep-related behaviors that perfectly mimic RBD<sup>54</sup>; however, polysomnographic study reveals OSA and normal REM sleep atonia.<sup>55</sup> Treatment with CPAP not only controlled the symptoms of OSA, but also controlled the complex and aggressive dream-enacting behaviors.

**OSA-Induced Complex and Violent Sleepwalking-Like Behaviors and Confusional Arousals:** In susceptible individuals, the sleep fragmentation and sleep deprivation associated with OSA may serve to result in behaviors identical to those in spontaneously

occurring disorders of NREM arousal that result in forensic issues.<sup>55-57</sup>

### **Sleep Deprivation and Cognitive Impairment:**

Insufficient sleep or chronic sleep deprivation results in deficits in daytime performance that is experienced universally and can result in significant social, financial, and human cost. The overall prevalence of sleep deprivation in the general population has been estimated at approximately 20%.<sup>58</sup> Not only has sleep deprivation been shown to produce cognitive impairment comparable to that induced by alcohol consumption at or above the legal limit, but motor vehicle accidents involving sleep-deprived drivers also have a fatality rate similar to alcohol-related accidents.<sup>59,60</sup> Given that sleep deprivation is a well-established preventable cause of human-error related accidents or mistakes, there are broad forensics implications for not only the individual, but for an employer as well.<sup>61</sup>

### **Compilation of Sleep Forensics Referrals to a Single Center Over 11 Years**

Referrals to sleep medicine from the criminal judicial system to consider involvement in criminal cases in a court of law as a medical expert witness have occurred with increasing regularity. Many of the first such early inquiries invoked psychiatric or psychological explanations. Such popularly held beliefs became substantially supplanted by neuroscientific constructs influenced by rapid advances in sleep medicine and sleep science and fostered by greater understanding of parasomnias. There is now overwhelming evidence that very complex behaviors potentially resulting in violent or criminal acts may arise from the sleep period, often without conscious awareness and therefore without culpability.<sup>62</sup>

**Spectrum of Presenting Legal Complaints:** Over the course of 11 years from August 1, 2006, through August 1, 2017, 351 consecutive medico-legal consults were requested at a single sleep medicine center in anticipation that a medical opinion eventually be entered into courtroom testimony. The majority of consults originated from inside the United States (335/351, approximately 95%). Professional-based sources (300/351, approximately 85%) included attorneys, law enforcement officials, medical examiners, forensic psychiatrists, and child protection agencies, whereas client-based sources (50/351, approximately 15%) primarily involved the defendant (or plaintiff) or, to a lesser degree, their direct family members.

There were 23 categories of legal complaints, with the top categories being murder, manslaughter, aggravated assault/battery, and sexual assault (Fig 1). The most common complaint was sexual assault, comprising approximately 41% (145/351) of all cases. Of the possible sleep-related condition subtypes implicated, the top four condition subtypes accounted for 97% of cases, ranging from parasomnias in about 57% (200/351), pharmaceutical effect in about 30% (107/351), sleep deprivation in about 5% (19/351), and OSA in about 4% (15/351) of cases.

### **Final Determination of Accepted Medico-legal Cases**

Of the 351 initial contacts, 110 were believed to be possibly sleep-related and were accepted to eventually render a medical opinion in a court of law as a retained sleep forensics medical expert. This reflects a low acceptance rate of case referrals of only 31%. The remaining 240 of the 351 initial contacts were not accepted for further investigative case review for three main reasons: (1) the behavior was clearly deemed to not represent a sleep-related condition and was best explained by another medical or psychiatric condition; (2) was contaminated by illicit drug use including cocaine or methamphetamines; or (3) was related to overt alcohol intoxication.

The three most prevalent criminal allegations of the accepted cases accounted for 77 (or approximately 70%) of these 110 cases, including sexual assault (52 cases), murder (18 cases), and driving under the influence (7 cases), for which the top 4 possible sleep-related condition subtypes (Table 1) remained parasomnias (77 cases), pharmaceutical adverse effects (18 cases), sleep deprivation (7 cases), and OSA (6 cases). Review of the 77 cases involving a possible parasomnia reveal that almost all of these were considered a NREM parasomnia subtype (74 cases), of which sleep-related abnormal sexual behavior (sexsomnia) was clearly most prevalent at 46 cases (62%). Though a REM-related condition was suspected in three cases, RBD was not supported in any case in the final determination. Seventeen of the 18 cases possibly involving pharmaceutical adverse effects involved zolpidem, with an isolated case involving zaleplon. Cases involving sleep deprivation were few but were associated with complex legal proceedings involving allegations of criminal negligence, vehicular homicide/manslaughter, and accidents involving commercial truck driver or train conductor error. Cases for which OSA was a consideration were also few, chiefly

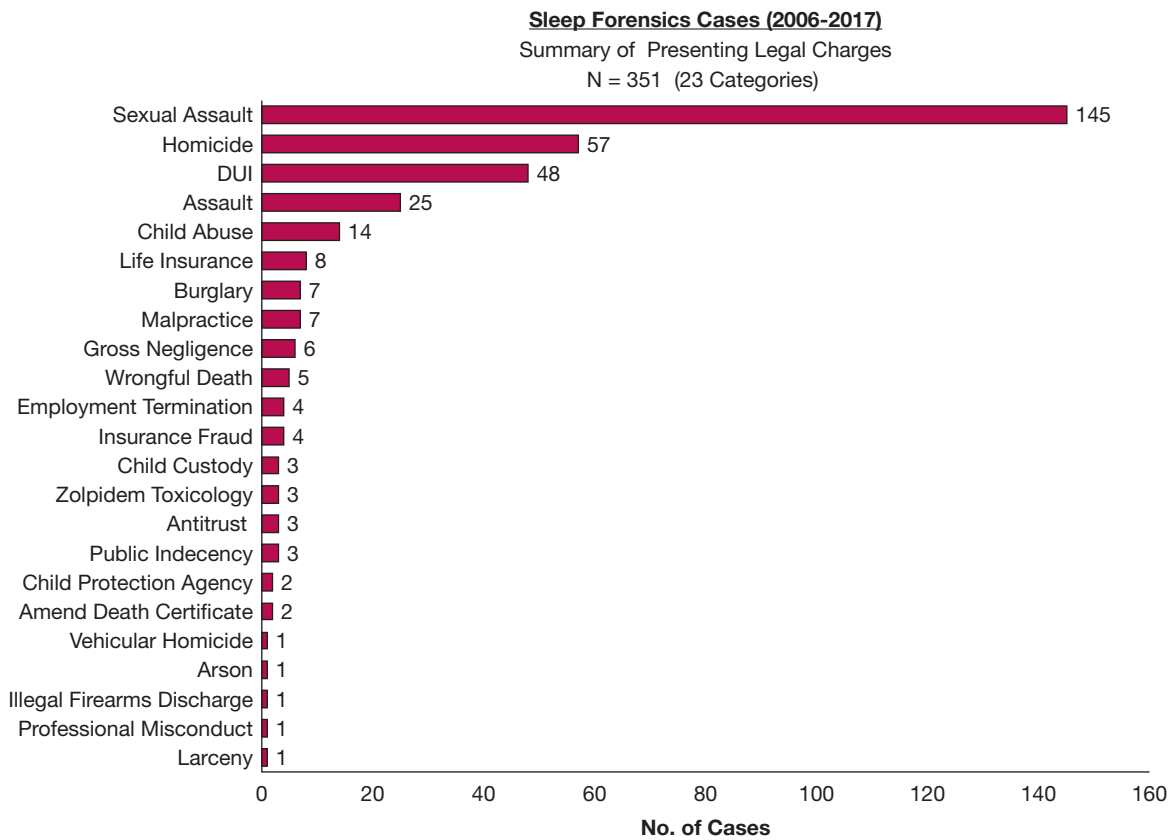


Figure 1 – Sleep forensics cases (2006–2017). DUI = driving under the influence.

solicited by state or federal prosecutors, and involved civil complaints related to medical malpractice, medical insurance fraud, and worker compensation insurance fraud.

There was great sex disparity concerning alleged perpetrators and victims in the final determination of accepted medico-legal cases. In general, perpetrators were largely male and victims tended to be female. Nowhere was sex disparity more apparent than in cases of SRV involving a possible parasomnia, especially those concerning sexsomnia. Of the 77 cases of possible parasomnia, males were cited as perpetrators in 69 cases (90%), whereas females accounted for 8 (10%). In these cases, females were cited as victims in 62 cases (81%), with males accounting for the remaining 15 cases (19%). Furthermore, it is striking to note that in the 46 cases of possible sexsomnia, males were cited as the perpetrator in all of the 46 cases (100%), with the victims almost always female (43 cases or 93%). All of the male perpetrators were between the ages of 18 and 55 years. Of the female victims, 40 (93%) were between the ages of 3 and 17 years, with the remaining between 18 and 55 years. Of the 3 male victims, 1 was between the ages of 3

and 17 years, with the remaining 2 cases between the ages of 18 and 55 years.

### Future Directions

SRV is associated with several sleep disorders that have broad implications. Sleep forensics is a growing investigative field most often associated with the “sleepwalking defense” in criminal allegations involving homicide or sexual misconduct. Experience from a single sleep medicine center over 11 years has revealed that the forensics implications of a sleep disorder or condition are much broader than first envisioned. Although medico-legal case referral involving homicide or assault were anticipated to be the most prevalent, the finding that allegations involving sexual assault were not only the most common of these but consistently the most regular type of referral was unexpected (Fig 1). Regardless of the source of referral, a high percentage of cases involving the legal argument related to a sleep disorder or condition could not be supported.

Published medical literature that has reported on the legal cases implicated sleep-related disorders provides a

**TABLE 1 ]** Subtypes of Sleep-Related Conditions in Accepted Cases as Retained by a Sleep Forensics Medical Expert

Subtype	No. Cases
Parasomnias	77
NREM	74
Sleep-related abnormal sexual behavior (sexsomnia)	46
Disorders of arousal	22
Parasomnia pseudo-suicide	5
Sleep driving	1
REM	3 <sup>a</sup>
Pharmaceutical toxicity	18
Zolpidem side effects	17
Zaleplon effects	1
Sleep deprivation	7
OSA	6
Insomnia	2
Total No. accepted cases	110

NREM = non-rapid eye movement; REM = rapid eye movement.  
<sup>a</sup>Though three of the accepted cases involved a possible REM-related phenomenon, none was determined to be consistent with RBD after final analysis.

foundation in sleep forensics investigations<sup>63-65</sup>; however, the ongoing collection of clinical and legal data on cases of suspected sleep-related violent behavior will further define the range of such behaviors, including their complexity and duration, and will serve to reduce the ill-founded skepticism surrounding these fascinating disorders.

A number of conditions for consideration are beyond the scope of this review, but could include alcohol-related blackouts,<sup>66-68</sup> pathological (or paradoxical) intoxication,<sup>69</sup> episodic dyscontrol syndrome,<sup>70-72</sup> epilepsy-related (nocturnal seizures,<sup>73</sup> ictal confusion,<sup>74,75</sup> postictal confusion,<sup>76</sup> postictal psychosis,<sup>77,78</sup> limbic psychotic trigger reaction<sup>79-81</sup>), sleep-related dissociative disorders,<sup>82</sup> compelling hypnagogic hallucinations as “repressed” memories of sexual child abuse,<sup>83</sup> hypnagogic hallucinations implicating innocent individuals in criminal behavior,<sup>84</sup> criminal behavior (shoplifting) occurring during a period of automatism induced by narcolepsy,<sup>85</sup> and malingerling.<sup>86</sup>

There likely exist a number of as-yet unidentified or poorly characterized conditions that mimic or masquerade as dissociated states of sleep and wakefulness. A number of case referrals appear to represent very protracted and extremely violent

dissociation-like events that would be most atypical for conventional wake/sleep dissociation. Refraining from “lumping” unusual or atypical cases into already identified conditions will encourage further investigation, leading to identification of new conditions or better characterization of previously poorly understood disorders presenting with very enigmatic behaviors.

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