

Sleep-Related Violence and Sexual Behavior in Sleep: A Systematic Review of Medical-Legal Case Reports

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Objective: To review systematically medical-legal cases of sleep-related violence (SRV) and sexual behavior in sleep (SBS).

Search Methods: We searched Pubmed and PsychINFO (from 1980 to 2012) with pre-specified terms. We also searched reference lists of relevant articles.

Selection Criteria: Case reports in which a sleep disorder was purported as the defense during a criminal trial and in which information about the forensic evaluation of the defendant was provided.

Data Extraction and Analysis: Information about legal issues, defendant and victim characteristics, circumstantial factors, and forensic evaluation was extracted from each case. A qualitative-comparative assessment of cases was performed.

Results: Eighteen cases (9 SRV and 9 SBS) were included. The charge was murder or attempted murder in all SRV cases, while 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. In most cases the criminal events occurred 1-2 hours after the defendant's sleep onset, and both proximity and other potential triggering factors were reported. The forensic evaluations widely differed from case to case.

Conclusion: SRV and SBS medical-legal cases did not show apparent differences, except for the severity of the charges and the victim characteristics. An international multidisciplinary consensus for the forensic evaluation of SRV and SBS should be developed as an urgent priority.

Keywords: sleep violence, sexsomnia, parasomnia, criminal law, forensic evaluation, sleepwalking defense

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Sleep-related violence (SRV) and sexual behavior in sleep (SBS) represent a challenging medical-legal issue when such behaviors are suspected or purported to have caused a criminal offense (e.g., assault, attempted murder, murder, sexual assault). Indeed, SRV and SBS can and do arise from the sleep period, without full consciousness, and therefore without responsibility for the offender.¹

SRV subsumes a wide spectrum of behaviors ranging from very simple or semi-purposeful behavioral manifestations to more complex, inappropriate acts that could be directed to oneself, to the bed partner, or to objects. Ohayon and Schenck found that violent or injurious behaviors during sleep (e.g., punching, kicking, leaping, and running away from the bed while acting out dreams) are reported by 1.6% of the general population.² SRV can occur during parasomnias (confusional arousals, sleepwalking, sleep terrors, REM behavior disorder [RBD], and parasomnia overlap disorder) or during nocturnal (i.e., sleep-related) seizures.^{1,3,4} SBS ranges from explicit sexual vocalizations/moaning/talking/shouting, genital bruising/(even violent) masturbation, to fondling another person, and complex sexual acts and agitated/assaultive sexual behaviors.⁵⁻⁹ Sleep related abnormal sexual behaviors, also called sexsomnia or sleepsex, are primarily classified as confusional arousals but have also

been less commonly associated with sleepwalking,¹⁰ although some authors suggest that they be classified as a distinct entity for its unique combination of specific motor and autonomic activation.⁷ Abnormal sexual behaviors during sleep are also reported in association with RBD,^{11,12} parasomnia overlap disorder,¹³ obstructive sleep apnea (OSA),^{6,8,12,14} and sleep-related seizures.⁸ Besides several scientific articles addressing forensic issues of SRV and SBS,^{4,8,15-25} two previous works have reviewed criminal cases implicating sleep disorders.^{26,27} However, both the above reviews present two limitations. First, they combined different types of reports (medical and legal) and sources (articles, books, media) without a systematic approach. Second, collecting cases from 1600²⁷ and 1791,²⁶ respectively, they hamper a diagnostic comparison of the reported cases. Modern sleep medicine research, indeed, developed only from the early part of the 20th century, and a formal classification of sleep disorders was not available until 1979, when the first "Diagnostic classification of sleep and arousal disorders" was published.²⁸

The present review focuses on medical-legal cases published since 1980 in which a sleep disorder was purported as defense during the criminal trial. Sleep experts' reports and testimonies were pivotal in these cases, whether they were appointed by the prosecution, by the defense, or by the court.

Table 1—Medical-legal key elements

Legal issues	<ul style="list-style-type: none"> • Charge • Defense • Verdict
Defendant characteristics	<ul style="list-style-type: none"> • Gender • Age • Occupation • Marital status • Criminal history • Clinical history • Family sleep history
Victim characteristics	<ul style="list-style-type: none"> • Gender • Age • Relationship with defendant
Circumstantial factors	<ul style="list-style-type: none"> • Proximity • Timing (interval between the defendant’s sleep onset and the event) • Current psycho-physical condition of defendant at the time of the event
Forensic evaluation	<ul style="list-style-type: none"> • Clinical examination (physical, neurologic, psychiatric) • PSG • Other evaluations (EEG, brain MRI, MSLT, brain CT, blood/urine tests, neuropsychological tests, scales, etc.) • Expert’s conclusion

PSG, polysomnography; EEG, electroencephalogram; MRI, magnetic resonance imaging; MSLT, multiple sleep latency test; CT, computerized tomography.

The research questions were:

- What were the legal issues of these cases?
- What were the defendant and the victim characteristics?
- What circumstantial factors were identified?
- What type of forensic evaluation was carried out?

Additionally, recommendations for a sleep expert evaluation are provided.

METHODS

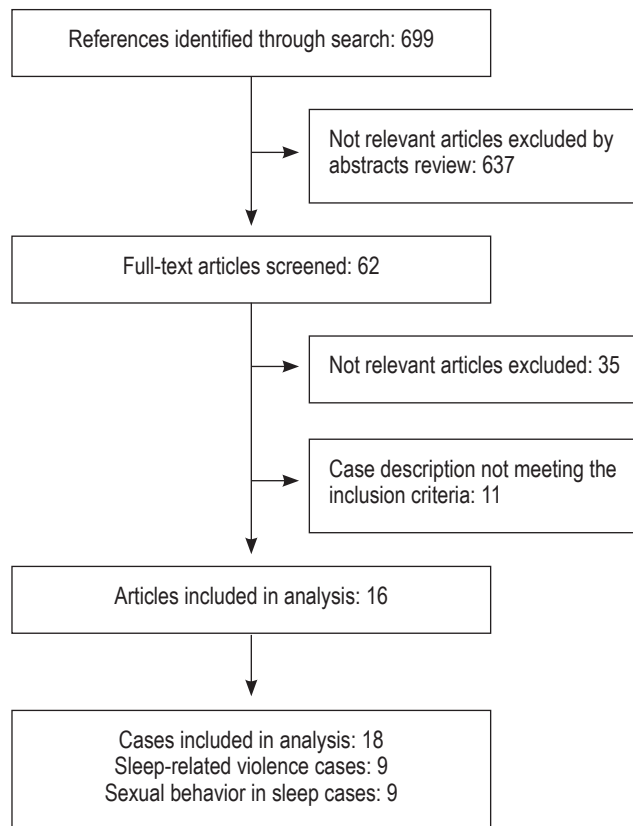
Inclusion Criteria

We included articles written in English published from 1980 to 2012 reporting cases in which a sleep disorder was purported as the defense during a criminal trial and in which information about the forensic evaluation of the defendant was provided.

Search Strategy and Study Selection

An electronic literature search of articles published from January 1980 through December 2012 was performed in Pubmed and PsychINFO databases. Two search strategies were used. The first included terms indexed in MeSH and Thesaurus vocabularies respectively: (crime OR criminal law OR insanity defense (defence)) AND (sleep OR parasomnia*). The second search was performed with the following free terms: “sleep violence” OR “violent behavio(u)r during sleep” OR “sleep-related violence” OR “sexsomnia” OR “sleep sex” OR “sleep-related abnormal sexual behavio(u)r” OR “sleepwalking defense (defence).”

Figure 1—The selection of studies included in the systematic review.



Two of the review authors screened titles and abstracts independently to identify potentially relevant articles. The reference lists of these articles were also screened for additional relevant sources. Two reviewers obtained and scrutinized the full texts of articles of interest. Disagreements were resolved by a third reviewer.

Data Extraction and Assessment

Three of the authors extracted from each case a set of medical-legal key elements (Table 1). A qualitative-comparative assessment of cases was performed.

RESULTS

We found 699 references; all abstracts were screened and 62 articles with potentially relevant material were examined in detail, leading to the final identification of 27 articles (26 in Pubmed and 1 in PsychINFO), containing a total of 35 medical-legal cases.

Sixteen of the above 27 articles, reporting a total of 18 cases (9 of SRV^{29,36} and 9 of SBS^{6,7,13,37-41}), met the inclusion criteria (Figure 1). The selected articles were published from 1985 to 2011 and included 9 single case reports,^{31-34,36-39,41} and 7 case series with at least 1 medical-legal case.^{6,7,13,29,30,35,40} Seven articles were published in psychiatry journals,^{6,7,29,30,34,35,38} 5 in legal medicine journals,^{33,36,37,39,41} 3 in sleep medicine journals,^{13,31,32} and 1 in a sexual medicine journal.⁴⁰ In cases fulfilling the

Table 2—Sleep-related violence cases

Authors	Description	Charge	Defense	Forensic evaluation and expert's conclusion	Verdict
Oswald and Evans, 1985	A 14-year-old schoolboy stabbed his 5-year-old female cousin with a bread knife after checking on her during the night.	Attempted murder	SW	Psychiatric evaluation, including family interviews; EEGs. Conclusion: SW.	Case deserted
Howard and D'Orbán, 1987 (case A)	A 17-year-old male trainee computer operator attacked his sleeping 18-year-old friend with a club and a knife. He was sleeping on the floor nearby the victim's bed.	Attempted murder with intent	NT	Psychiatric and neurological evaluation; fasting blood sugar; EEG. Conclusion: NT.	Acquittal
Howard and D'Orbán, 1987 (case B)	A 34-year-old salesman strangled his wife while dreaming of being chased by two armed Japanese soldiers. They were sleeping together in their bed.	Murder	NT	Psychiatric and neurological evaluation; psychological tests; EEG. Conclusion: NT.	Acquittal
Broughton et al., 1994	A 23-year-old recently unemployed man drove 23 km to the home of his wife's parents, where he beat and stabbed his mother-in-law, who died, and strangled his father-in-law, who survived.	First degree murder, and attempted murder	SW	Clinical assessment*; EEGs; brain CT; 2 PSGs. Conclusion: SW.	Acquittal
Nofzinger and Wettstein, 1995	A 37-year-old male laborer, possibly dreaming about deer hunting, shot and killed his wife (unclear if they were sleeping together).	First degree murder	OSA	Pulmonary examinations; video-PSG. Conclusion: severe OSA that could be associated with confusion and memory loss.	Conviction
Kayumov et al., 2000	26-year-old unemployed man was accused of first-degree murder of his girlfriend's 2-year-old daughter after he awoke to find her covered in blood and not breathing.	First degree murder	SW	Mental status examination; hypnotic interview; 2 video-PSGs Conclusion: parasomnia diagnosis not supported.	Conviction
Cartwright, 2004	A 42-year-old electrical engineer stabbed and killed his wife, leaving her body outside near the pool.	First degree murder	SW	Forensic workup as in the case reported by Broughton et al. plus 4 night PSGs (including a night with sound-induced arousals). Conclusion: SW followed by sleep terror.	Conviction
Poyares et al., 2005	A 26-year-old Hispanic, recently married man threw his son out of a 3rd floor window and then ran into the street.	Attempted murder	SW	Psychiatric evaluation; EEG; brain CT; video-PSG. Conclusion: SW.	Case dropped
Ebrahim and Fenwick, 2008	A 22-year-old man beat his father to death after going to sleep after a night of drinking.	Murder	SW	Mental and cognitive state assessment; neuropsychological tests; brain MRI; EEG; 5 night video-PSGs (including a night with verbal and tactile provocation, a night with alcohol challenge, and a PSG after 36h of sleep deprivation). Conclusion: confusional arousal into what was a SW episode.	Acquittal

*Clinical assessment included the following: psychiatric and neurological evaluation; sleep assessment (personal and family sleep/wake history, also from family members and from cell mates); psychological assessment and tests. SW, sleepwalking; EEG, electroencephalogram; NT, night terrors; CT, computerized tomography; PSG, polysomnography; OSA, obstructive sleep apnea; MRI, magnetic resonance imaging.

inclusion criteria but lacking data regarding the trial outcome, we directly contacted the authors. Each case was summarized in terms of the description of the event, the legal charge(s), the defense, the forensic evaluation, and the court verdict (**Table 2** and **Table 3**).

The remaining 11 articles, reporting a total of 18 cases, were excluded because it was not clear whether the sleep disorder was actually purported as the defense during the trial, or because information about the forensic evaluation was lacking. A description of excluded cases is reported in **Table S1** (supplemental material).

Sleep-Related Violence Cases (Table 2)

Legal Issues

All 9 SRV cases reported on a single criminal episode. The legal charge was “murder” in 5 cases (including case B reported by Howard and D'Orbán),^{30,32-34,36} “attempted murder” in 3 cases (with case A reported by Howard and D'Orbán),^{29,30,35} and “murder and attempted murder.”³¹

At trial, the defense was based on sleepwalking in 6 cases,^{29,31,33-36} on night terrors in 2 cases,³⁰ and on a confusional state related to arousals associated with OSA in 1 case.³²

Table 3—Sexual behavior in sleep cases

Authors	Description	Charge	Defense	Forensic evaluation and expert's conclusion	Verdict
Thomas, 1996	38-year-old male mechanic with a long-term partner was found drinking a beer while naked in a major urban thoroughfare.	Indecent exposure	SW	Psychiatric evaluation of the defendant and telephone interview of the partner. Conclusion: SW.	Acquittal
Borum and Appelbaum, 1996	31-year-old single man loudly knocked on door of communal bathroom while yelling; when the female occupant opened the door, he pushed and struggled with her, and his hand touched her breast.	Indecent assault/battery, assault with intent to rape	Not explicitly stated	Neurological evaluation. Conclusion: nocturnal complex partial seizure.	Acquittal
Schenck and Mahowald, 1998	26-year-old man, with partner, engaged in sexual behavior with his friend's 4-year-old daughter, who had crawled into bed with him during the night.	Sexual misconduct	SW	Interviews of defendant, his mother, his sister and his current partner. Conclusion: parasomnia.	Acquittal
Rosenfeld and Elhajjar, 1998	45-year-old married businessman fondled his 14-year-old daughter's female friend, who was sleeping downstairs in the living room of his house.	Sexual battery	SW	Neurologic and psychiatric evaluation. Conclusion: SW.	NR
Guilleminault et al., 2002	18-year-old single student placed his finger into the vagina of a young woman who was sleeping in the vicinity.	Sexual assault	SW	Clinical assessment*; 2 urine drug tests; EEG in regular and sleep-deprived conditions; video-PSG; MSLT. Conclusion: NREM parasomnia.	Acquittal
Shapiro et al., 2003 (case CJ)	35-year-old married man sexually touched his 9-year-old daughter, who had climbed into bed with her parents during the night.	Sexual touching	Not explicitly stated	Video-PSG study. Conclusion: parasomnic behavior.	Acquittal
Shapiro et al., 2003 (case AF)	32-year-old single unemployed man inserted a finger into the vagina of a 10-year-old girl with whom he was sharing a bed.	Sexual assault	Not explicitly stated	Video-PSG study. Conclusion: parasomnia.	Acquittal
Ebrahim, 2006	22-year-old single employed man rapidly penetrated a female friend orally, anally, and vaginally; they were sleeping in different rooms in the defendant's house after a party.	Three counts of rape	SW	Medical, psychiatric and neurological evaluations; Epworth Sleepiness Scale; 3 night PSGs (including a night with alcohol challenge). Conclusion: SW.	Acquittal
Cicolin et al., 2011	38-year-old divorced man repeatedly fondled the 8-year-old daughter of his current partner over a 6-month period.	Repeated sexual fondling	Sleepsex	Clinical assessment*; standard EEG; brain MRI; 5 night PSGs (4 under sleep restriction at 4 h/night). Conclusion: parasomnia overlap disorder (SW, sexual behavior during sleep, RBD).	Acquittal

*Clinical assessment included the following: (1) general medical evaluation with associated review of charts and test results obtained by private physicians during past years, including medication, drug, and alcohol intake; (2) sleep disorders evaluation by: scales (Sleep Disorders Questionnaire, Epworth Sleepiness Scale, Fatigue Scale); interviews of defendant, bed partners, and if possible other family members; clinical examination; (3) clinical neurological and psychiatric evaluation. *Clinical assessment included the following: general medical evaluation, sleep disorders evaluation (including interviews of defendant, bed partners, and if possible other family members), neurologic evaluation, and clinical psychiatric evaluation. SW, sleepwalking; EEG, electroencephalogram; PSG, polysomnography; MSLT, multiple sleep latency test; MRI, magnetic resonance imaging; RBD, REM behavior disorder.

The verdict was in favor of the defendant in 6 of 9 cases: 4 defendants were acquitted,^{30,31,36} while in 2 trials the charges were dropped.^{29,35} In 3 cases, the defendant was convicted.³²⁻³⁴

Defendant Characteristics

All 9 defendants were male, with a mean age 26.8 ± 9.3 years (range 14-42 years). Seven reports mentioned the defendant's occupation at the time of the event: 3 defendants were employed (including case B from Howard and D'Orbán),^{30,32,34} 2 were students (including case A from Howard and D'Orbán),^{29,30} and

2 were unemployed.^{31,33} In 6 cases, the defendants were married (including case B from Howard and D'Orbán)^{30-32,34,35} or had a partner.³³ Previous criminal history was mentioned in 6 cases: although defendants did not have convictions, a history of previous shoplifting,²⁹ episodes of theft at work,³¹ and abusive behaviors towards previous and current wives and children³² were reported.

An ongoing sleep disturbance was reported in 4 cases: sleepwalking,³⁵ sleep talking,²⁹ sleepwalking associated with sleep talking and enuresis,³¹ and night wandering episodes with a

long history of snoring,³⁶ respectively. Prior histories of parasomnias were reported in 4 cases.^{30,32,34} In 5 of 8 cases with an ongoing or past sleep disorder, sleep-related complex behaviors (including Howard and D'Orbán case B),^{29,31,34-36} were reported, along with 3 cases of sleep-related violent behaviors (with Howard and D'Orbán case B).^{29,30,34}

Consequences of a serious head injury three years previously (mild disability and moderate degree of residual posttraumatic personality change) were reported in 1 case (Howard and D'Orbán case B),³⁰ and a history of pathological gambling in another.³¹

Information about the defendant's family sleep history was reported in 4 of 9 cases and included isolated sleepwalking³⁶ or multiple parasomnias (sleepwalking, sleep talking, sleep terrors, bedwetting, and confusional arousals³¹ or bruxism³⁴). In 1 case, there was a negative family history for any sleep disorder.²⁹

Victim Characteristics

Of 10 victims, 6 were females. The victims were 7 adults and 3 minors, but their exact age was reported only in 3 cases (including Howard and D'Orbán case A).^{29,30,35} In only 1 case, the crime had 2 victims, the defendant's parents-in-law.³¹ The other victims' relations to the defendant included 1 son,³⁵ 1 father,³⁶ 3 wives (including Howard and D'Orbán case B),^{30,32,34} 1 daughter of a partner,³³ 1 cousin,²⁹ and 1 friend (Howard and D'Orbán case A).³⁰

Circumstantial Factors

In most of the cases, the defendant and the victim were sleeping under the same roof: in the same bed in 1 case (Howard and D'Orbán case B),³⁰ in the same room in 1 case (Howard and D'Orbán case A),³⁰ in different rooms in 3 cases,^{29,34,36} while in 3 other cases it was not specified whether they were sleeping in the same room or bed.^{32,33,35} In 1 case,³¹ the defendant was sleeping at home prior to the abrupt onset of sleepwalking and driving 23 kilometers to the victims' house.

The time span between the defendant's sleep onset and the criminal event was reported in 6 of 9 cases; in all the cases, the criminal event occurred within 1 to 2 hours after the defendant's sleep onset.^{30-32,34,36}

Details about the psycho-physical condition of the defendant at the time of the alleged event included: exposure to stress,^{29,31,34-36} sleep deprivation,^{31,35} unspecified³³ or excessive³⁶ alcohol intake, fatigue along with caffeine overuse (with Howard and D'Orbán case A),^{30,34} either alone or variably associated.

Forensic Evaluation

The forensic evaluation of the defendant included routine electroencephalogram (EEG) and a psychiatric and/or neurological assessment in 3 cases,^{29,30} and polysomnography (PSG)^{31,34} or video-PSG^{32,33,35,36} in 6 cases (the number of recorded nights ranged from 1 to 6). Provocative stimuli during the PSG were administered in 2 cases: "sound induced arousals" in 1 case,³⁴ and "verbal and tactile provocation," "alcohol challenge," and 36 hours of sleep deprivation (each provocation was administered on non-consecutive nights) in the other case.³⁶ Detailed PSG findings were described in all cases who underwent sleep-lab studies. All the defendants who underwent PSG study also

had additional clinical and/or instrumental evaluations (psychological/mental/cognitive assessments and tests; EEG; brain computerized tomography; brain magnetic resonance imaging, etc.). Seven of 9 defendants had a final diagnosis of parasomnia: sleepwalking in 3 cases,^{29,31,35} sleep terrors in 2 cases,³⁰ "confusional arousal into what was a sleepwalking episode" in 1 case,³⁶ and "sleepwalking followed by sleep terror" in 1 case.³⁴ The expert evaluation did not support the diagnosis of parasomnia in 1 case³³ and resulted in a diagnosis of severe OSA in another one.³²

Sexual Behavior in Sleep Cases (Table 3)

Legal Issues

The allegation regarded a single episode in all cases but one.¹³ Charges were: "sexual battery/assault" in 3 cases (including case AF reported by Shapiro et al.),^{6,7,40} "sexual touching/fondling" in 2 cases (including Shapiro et al. case CJ),^{7,13} "indecent exposure" in 1 case,³⁷ "indecent assault and battery with intent to rape" in 1 case,³⁸ "sexual misconduct" in 1 case,³⁹ and "three counts of rape" in 1 case.⁴¹

At trial, the defense was based on sleepwalking in 5 cases,^{6,37,39-41} and on "parasomnia including sleepsex" in 1 case.¹³ In 3 cases, the legal defense was not explicitly stated, but the authors reported that evidence of a parasomnia⁷ and of epileptic postictal aggression³⁸ were accepted in court.

In 7 of 9 cases, the verdict was reported and was in favor of the defendant. In 1 of the remaining 2 cases in which the trial outcome was unknown,⁶ we obtained information that the verdict was in favor of the defendant.

Defendant Characteristics

All 9 defendants were male, with a mean age of 31.7 ± 8.5 years (range 18-45 years). Five reports provided details on the occupations of the defendants at the time of the event: 3 were employed,^{37,40,41} 1 was a student,⁶ and 1 was unemployed (Shapiro et al. case AF).⁷ The marital status of the defendants was reported in all cases: 5 were married (including Shapiro et al. case CJ)^{7,40} or had a partner,^{13,37,39} and 4 were single (including Shapiro et al. case AF).^{6,7,38,41} Reference to a prior criminal history was provided in 4 cases: 2 defendants had no previous charges or convictions,^{39,40} a 38-year-old man had been arrested for burglary at the age of 18,³⁷ and 1 had a conviction for driving while intoxicated.³⁷

In 6 of 9 cases, the defendants had a long clinical history of either isolated persistent sleepwalking,³⁹ sleepwalking in association with other parasomnias,^{6,13,37,40} or snoring.⁴¹ Associated parasomnias consisted of sleep talking in 4 cases,^{6,13,37,40} (coupled in 1 case with sleep terrors and enuresis),⁶ and in 1 case sleep terrors and sleep behaviors "isomorphic with dream content."¹³ In 4 cases, parasomnias were characterized by complex behaviors,^{13,37,40,41} and in 2 cases included sexual elements.^{13,41} In 1 case the defendant had a history of nocturnal complex partial seizures, followed by periods of postictal wandering and confusion.³⁸

Clinical history was less suggestive in the remaining 2 cases, both reported by Shapiro et al.: AF had a history of sleep talking but exhibited sleepwalking on only one occasion; while in the case of CJ, the defendant's sleep history was based upon

his wife's recall, who reported that "there probably were times that he had spoken in his sleep (mumbling)."

Regarding past clinical features apart from sleep, a head injury at age 4 years and a gunshot wound to the head at age 22 years were reported in 1 case,³⁷ and a history of previous alcohol abuse was reported in 2 cases (including the case AF by Shapiro et al.).^{7,38}

Information about the defendant's family sleep history was reported in 4 of 9 cases and included sleepwalking in 2 cases,^{39,41} parasomnia not otherwise specified in 1 case (AF by Shapiro et al.),⁷ and sleepwalking plus sleep talking in the other one.¹³

Victim Characteristics

With the exception of the indecent exposure case, in which the defendant was seen by a male driver of an automobile to be drinking a beer while naked in a major thoroughfare,³⁷ in all cases the crime had a single female victim. The exact age of the victims was reported in 4 cases^{7,13,39} (7.7 ± 2.6 years, range 4-10 years), while in 2 cases the victims were only described as being "teenager."^{6,40}

The victim's relation to the defendant was reported in 5 cases: a daughter (case CJ by Shapiro et al.),⁷ a partner's daughter,¹³ a friend of defendant's daughter,⁴⁰ a friend,⁴¹ and a housemate, respectively.³⁸

Circumstantial Factors

In 4 cases, the defendant and the victim were sleeping in the same bed^{7,39} or in the same room,⁶ while in 4 cases they were sleeping in different rooms in the same home.^{13,38,40,41}

In the only 3 cases in which the interval between the time of sleep onset of the defendant and the time of the criminal event was reported, it was approximately 1-2 hours.³⁹⁻⁴¹ In 1 case the authors specified that "[the events] usually [occurred] during the first third of the night."¹³

Details about the psycho-physical condition of the defendant at the time of the event included exposure to stress,^{6,7,37,39} sleep deprivation (including Shapiro et al. case CJ),^{6,7,39} limited,^{6,37} unspecified,⁴¹ or excessive alcohol intake (including Shapiro et al. case AF),^{7,38,39} either alone or variably associated. In 1 case, the defendant also used marijuana (Shapiro et al. case AF).⁷

Forensic Evaluation

In 4 cases, the defendant underwent only a neurologic or psychiatric evaluation³⁷⁻⁴⁰ (in the case reported by Thomas,³⁷ neuropsychological assessment and PSG were not approved by the court due to limited funds). In 5 cases, PSG⁴¹ or video-PSG^{6,7,13} were performed for forensic purposes, and PSG findings were always provided in detail, apart from the case AF reported by Shapiro et al.⁷ In 3 cases, additional clinical evaluations were reported, including sleep questionnaires,⁴¹ multiple sleep latency test, urine drug screens, EEG, and brain magnetic resonance imaging.^{6,13}

In 2 cases, the number of PSG recordings was specified (3⁴¹ and 5¹³ nights, respectively), and provocative tests were performed: alcohol challenge (details not reported)⁴¹ and sleep restriction (4 hours of sleep on 4 consecutive nights),¹³ respectively.

The conclusions provided by the experts included sleepwalking in 3 cases^{37,40,41}; NREM parasomnia in 3 cases

(including the case AF by Shapiro et al.)^{6,7,39}; nocturnal complex partial seizure in 1 case³⁸; "parasomnic behaviour" in 1 case (case CJ by Shapiro et al.);⁷ and parasomnia overlap disorder (sleepwalking, SBS, RBD) in 1 case.¹³

DISCUSSION

From the 1980s, with the advent of formal video-PSG monitoring techniques and the first systematic classification of sleep disorders, the forensic dimension of sleep medicine entered a very new era. Since then, there has emerged a relevant scientific medical literature on this topic. Nevertheless, the sleep defense still "strikes the heart of the criminal law jurisprudence",⁵¹ which reflects the difficulty in evaluating the defendant's level of consciousness and the state of mind and volitional criminal intent. This requires a sleep expert opinion to provide objective and scientific elements supporting (or not) an underlying sleep disorder as the basis for the criminal behavior.

Our review has framed previously published medical-legal cases by means of a detailed analysis of legal issues, the defendant and victim characteristics, the circumstantial factors surrounding the crime, and the forensic evaluation. In order to have an official and international peer-reviewed foundation for establishing the presence of a sleep disorder, we included articles published since 1980, i.e., after the release of the first "Diagnostic classification of sleep and arousal disorders."²⁸ Cases sufficiently informative about the forensic evaluation (i.e., only half of those retrieved) were published from 1985 to 2011, mainly in journals in the psychiatric field, but also in the fields of legal medicine, sleep medicine, and sexual medicine, thus calling attention to the growing multidisciplinary interest to publish these cases. Unfortunately, the lack of completeness of the remaining published cases prevented an analysis about all the cases that came to trial.

All SRV reports encompassed major crimes (murder or attempted murder), while in SBS cases the criminal charges ranged from sexual touching to rape. In 1 case, the charge of "indecent exposure"³⁷ demonstrates that sleep disorders may result in criminal behavior, even when physical contact between a defendant and the victim is lacking.

In most of the cases, the sleep disorder supporting the sleep defense was sleepwalking, which indicates that the sleep defense generally corresponds to a "sleepwalking defense." The trial outcome was in favor of the defendant in all SBS and in two-thirds of SRV cases. However, we can not exclude a publication bias due to a possible greater interest engendered by an acquittal than by a conviction. In addition, some verdicts may be challenged on appeal, which could ultimately result in a different outcome for the defendant.

Almost all these legal cases concerned a single criminal episode, and had a single victim. In all cases, defendants were men of relatively young age; this was also found by Bonkalo in 20 cases of homicide collected from 1791 until 1969.²⁶ Beyond medical-legal cases, SRV with moderate to severe injuries is known to be frequently reported in males of relatively young age.⁵²⁻⁵⁶

Moreover, based on our results, in most cases defendants had no prior criminal record, were employed, had a partner, and did not demonstrate any antisocial trait. In the context

of otherwise unremarkable medical histories, the defendants' sleep history usually disclosed past or ongoing sleepwalking, frequently associated with other parasomnias and characterized by complex sleep behaviors. A family history, when investigated, revealed parasomnia in relatives in almost all cases.

Interestingly, differences between SRV and SBS cases were found in the victims' characteristics. Indeed, in most SRV cases the victim was an adult relative of the defendant, and of female gender in two-thirds of cases, while SBS victims were always females, and in most cases minors without a familial relationship with the defendant. Since it is known from the literature that in SBS cases, bed partners often experience physical injuries (ecchymoses, lacerations),⁸ our results suggest that the sexual offence is criminally reported only when the defendant is not known/not a relative or when the victim is a minor.

When reported, the time interval between the defendant's sleep onset and the crime was around 1-2 hours, consistent with the presence of a NREM parasomnia in most cases. In accordance with the published literature,²⁷ there was a close physical proximity between the defendant and the victim (sleeping in the same bed, sleeping the same room, sharing the same home) in almost all SRV cases and in all SBS cases.

Alcohol intake by the defendant on the night of the event was reported in 2 of 9 of SRV cases and in 6 of 9 of SBS cases. Despite alcohol intake being previously listed as a "precipitating factor" of confusional arousals, and a "risk factor" for sleepwalking,⁵⁷ the scientific evidence of alcohol-induced sleepwalking or confusional arousals as a defense to criminal behavior has been reviewed.^{58,59} The recently published International Classification of Sleep Disorders (ICSD-3)¹⁰ highlights the absence of a compelling relationship between alcohol use and a disorder of arousal, stating that, in the presence of alcohol intoxication, disorders of arousals should not be diagnosed. The above position complies with the current Diagnostic and Statistical Manual of Mental Disorders edition that has removed alcohol from the list of possible triggers for sleepwalking, adding also a section on the differential diagnosis of alcohol blackout.⁶⁰ These major shifts in opinion have important implications for those forensic cases in which unspecified or excessive amount of alcohol intake was reported.

A sustained or coincidental exposure to stressful condition was often reported, while sleep deprivation and caffeine overuse were pointed out less frequently. All the above mentioned conditions have been reported in literature as potential triggering factors for SRV in sleepwalking and sleep terrors,^{22,53} and a recent longitudinal survey of 100 sleepwalkers found that those with a history of SRV more frequently reported triggering factors.⁵⁶

The forensic evaluations differed from case to case for both SRV and SBS. A forensic evaluation restricted to neurological and/or psychiatric assessments, or at most an EEG, was carried out in the older cases, while all cases published after 1998 reported at least a PSG or video-PSG study for 1 to 6 nights, along with neuropsychological tests, brain computerized tomography, or magnetic resonance imaging in some cases. PSG at times was performed under sleep restriction or with sound/tactile provocation of arousals during the night. In two cases followed by the same author,^{36,41} a PSG alcohol challenge study was performed, with limited details provided, and without an

explicit rationale. In 1 case,³⁴ the Court ordered to replicate the same forensic workup performed in a previous case.³¹

Our review concludes that in most cases, the advice of a sleep expert is requested in cases of a suspected or purported sleepwalking-related felony.

A consensus about guidelines to follow in the forensic assessment of such cases is still lacking. Nevertheless, there is broad agreement that the sleep expert workup should include at least the following steps:

1. History of sleep disorders should be carefully investigated in relatives.^{6,21,35}
2. A complete description of the defendant's lifetime history of any motor behavior during sleep, preferably from both the defendant and possible witnesses (present and former bed partners/relatives/friends) should be obtained, and details about age at onset, the usual timing of the event during the sleep, the degree of amnesia, and both duration and frequency of episodes should be investigated.^{1,6,21,35,61}
3. Information about sleep/wake habits, drugs (prescribed or illicit), herbal products, and habitual caffeine and alcohol consumption/abuse should be collected.^{6,35,53}
4. Along with information about the event, circumstantial factors of both the person's life and the hours prior to the episode is essential: stressful events, sleep deprivation or excessive fatigue, and intake of alcohol and other substances should be investigated.^{6,35,61}
5. Complete physical, neurologic, and psychiatric evaluations along with administration of standardized questionnaires for sleep disorders should be carried out.^{4,15,20,35,62}
6. A video-PSG study to identify or rule out other sleep disorders associated with abnormal motor behaviors (RBD, nocturnal frontal lobe epilepsy) or possibly triggering sleepwalking (OSA, periodic limb movements) should be performed with standard polysomnographic monitoring⁶³ and with an extensive scalp EEG, electromyographic monitoring also of the arms, and time-synchronized audiovisual recording.^{4,15,20,21} To increase the possibility to capture an event, the documentation of nocturnal episodes with home video using a camera with infrared night vision function could be useful.^{4,6,62,64} Combining video and PSG monitoring at home may allow for longer recording periods and minimize bias from monitoring in a sleep laboratory setting. However, home video-PSG recording prevents the possibility of technician/physician intervention during and after a parasomnia episode. For these reasons, home video-PSG should be performed, when feasible, in conjunction with a sleep laboratory study.

It should be emphasized in the forensic context that irrespective of whether an event compatible with sleepwalking is recorded during PSG, this will not conclusively indicate that the defendant was or was not sleepwalking at time of the criminal event. Indeed, the only direct evidence of whether or not a criminal act occurred during a state of parasomnia comes from any eyewitness testimony and/or evidence obtained from the scene of the crime. Nevertheless, sleep experts have the duty to pursue as much as possible objective data to support or not

support a diagnosis of sleepwalking. Accordingly, they should first evaluate the conditions in which a sleepwalking episode may occur, namely a genetic predisposition in the presence of an increased pressure for slow wave sleep and factors favoring arousals or fragmenting sleep.⁴

From this perspective, the Montplaisir group's sleep-deprivation protocols⁶⁵ have been considered by some authors as a "promising novel approach to the forensic use of PSG in sleepwalking cases" for ruling out or greatly minimizing the probability that the accused is in fact a sleepwalker.⁶⁶ In predisposed individuals, 25-38 hours of sleep deprivation increases the number and the complexity of sleepwalking events recorded in the laboratory during sleep recovery, whereas similar sleep deprivation does not lead to sleep behaviors in subjects with no history of sleepwalking.^{65,67,68} In addition, several studies have disclosed neurophysiological abnormalities in sleepwalkers' slow wave sleep, even on nights without episodes, namely the absence of NREM sleep continuity, the overall decrease in slow wave activity during the first sleep cycles, and the increased cyclic alternating pattern rate.⁶⁹⁻⁷⁴ Further scientific evidence is needed to establish that these PSG findings are stable neurophysiological markers of sleepwalking. Therefore, at the present time, they may only provide indirect and circumstantial evidence in courtroom.

Cartwright and Guilleminault have recently reported that a PSG spectral analysis was used during a trial as a basis of an expert witness testimony.⁷⁵ The reliability of this analysis in a forensic setting has been seriously questioned on the grounds of the lack of sufficient sensitivity, specificity, and stability over the time.⁷⁶ In particular, according to some studies,⁷⁷⁻⁷⁹ arousals from deep sleep and hypersynchronous delta waves lack sufficient sensitivity and specificity to be used as diagnostic markers.¹⁰ In their rebuttal, Cartwright and Guilleminault claimed that several studies make "a low slow wave activity a strong candidate to be a manifestation of the genetic vulnerability to abnormal delta arousals and therefore likely to be a stable characteristic of sleep."⁸⁰

Finally, due to the complex nature of SRV and SBS, the opinion of a properly credentialed sleep expert^{81,82} and a multidisciplinary approach are highly recommended in forensic cases.^{16,20}

Forensic sleep medicine is at an embryonic stage. Our review points out that many medical-legal cases of SRV and SBS, reported in the form of small case series and case reports, do not provide essential information about a proper forensic evaluation. Cases sufficiently informative offer the conclusion that court trials for SRV and SBS involved relatively young and healthy adult males as the defendants, while victims were usually adult relatives in SRV cases and unrelated teenage or young girls in SBS cases. Although many sleep disorders could result in assaultive behaviors, in most cases sleepwalking was implicated, and the sleepwalking defense turned out to be generally successful. However, no common protocols for the forensic evaluation were utilized.

An international expert consensus among sleep experts, medical-legal experts, and psychiatrists for the forensic evaluation of SRV and SBS cases should be developed, which we consider to be an urgent priority. This report has provided a foundation for advocating such an international consensus.

Finally, enhancing the publication of accurate and comprehensive reports of medical-legal cases involving SRV and SBS would provide essential information for sleep medicine experts who participate in forensic evaluations, and a relatively homogeneous body of data for ongoing scientific research.

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SUPPLEMENTAL MATERIAL

Table S1—Excluded cases

Authors	Description	Charge	Defense	Forensic evaluation	Verdict
Buchanan, 1991	27-year-old single man walked up and down a communal balcony while naked, where he encountered a neighbor.	Indecent exposure	-	Unclear whether the relationship between crime and sleep disorder was a matter during the trial	Conviction
Fenwick, 1996 (case 1)	Young man crawling along a ledge entered the young neighbors' apartment. He crawled into bed with girl and her boyfriend and placed his hand against her genitals.	NR	SW	NR	Conviction
Fenwick, 1996 (case 2)	Young male airman repeatedly caressed the genitals of his male colleague with whom he was sharing a room, during the course of one night.	Sexual assault	SW	NR	Case dismissed
Fenwick, 1996 (case 3)	Young man entered a nearby room, which was inhabited by a young woman and her boyfriend. He reached into their bed and touched the woman's legs, genitals, and breasts.	NR	SW	NR	Case dropped
Shapiro et al., 2003 (case LD)	35-year-old married man sexually assaulted a 12-year-old girl.	Sexual assault	-	Unclear whether the relationship between crime and sleep disorder was a matter during the trial	Conviction
Mahowald et al., 2005	A 28-year-old commercial fisherman killed his 42-year-old girlfriend by stabbing and beating her while she was sleeping in their hotel room.	First degree murder	SW	NR	Conviction
Pressman, 2007 (R v. Catling)	Male defendant, after taking at least 6 tablets of zopiclone, stabbed his girlfriend 9 times and cut her throat after arguing with her.	NR	SW	NR	Eventually withdrew SW defense and pleaded guilty
Pressman, 2007 (Indiana v. McLain)	Male defendant assaulted police officers and resisted arrest. He was severely jetlagged and had consumed beer and marijuana.	NR	SW	NR	Conviction
Pressman, 2007 (US v. Clayton)	Male defendant hit victim in head with a hammer several times and chased victim down the street with hammer.	NR	SW	NR	Conviction
Pressman, 2007 (Ohio v. Hines)	Male defendant committed aggravated burglary and assault on elderly residents of home with rolling pin and knife; the defendant had fallen asleep after consuming 2-3 bottles of wine.	Aggravated burglary and assault	ST followed by SW	NR	Acquittal
Samuels et al., 2007	A man attacked his female friend with a bottle and video and grasped her by the throat.	Wounding with intent	NR	NR	Acquittal
Bornemann, 2008	After drinking alcohol, a 25-year-old man sexually touched a 12-year-old girl who was sleeping in the same house.	Sexual assault of a minor	Parasomnia	NR	NR
Mohanty, 2008	15-year-old boy sexually abused (including intercourse) his 13-year-old stepsister over a period of 4 years, transmitting to her genital warts and Chlamydia.	NR	SW	NR	Acquittal

Table S1 continues on the following page

Table S1 (continued)—Excluded cases

Authors	Description	Charge	Defense	Forensic evaluation	Verdict
Bordenave and Kelly, 2009	A married man shot his wife in the head, killing her.	Murder	SW and confusional arousals	NR	Acquittal on appeal
Beach and Soliman, 2010	Married man engaged in sexual contact with his stepdaughter, a minor.	Sexual battery and rape	SW	NR	Conviction
Ingravallo et al., 2010	A 28-year-old male industrial worker beat his wife on more than one occasion while they were sleeping together in bed.	Beatings	RBD in narcolepsy	NR	Acquittal
Wortzel et al., 2012	Man in his early 40's, who was sleeping naked, got out of bed and wandered down the hall where he was seen by his girlfriend's underage daughter.	Indecent exposure to a minor	-	Unclear whether the relationship between crime and sleep disorder was a matter during the trial	Conviction
Vlahos, 2012	A 26-year-old Kenyan college student attacked his wife with a hammer and then stabbed and strangled her to death.	Murder	Not possible SW defense due to the lack of expert evidence	NR	Conviction

NR, not reported; SW, sleepwalking; ST, sleep terrors; RBD, REM behavior disorder.