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Violent Behavior During Sleep: Prevalence, Comorbidity and Consequences

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Abstract

Background—Violent behaviors during sleep (VBS) are consequences of several sleep disorders but have received little attention in epidemiologic studies. This study aims to determine the prevalence of VBS in the general population and their comorbidity, familial links, course and treatment.

Methods—Random stratified sample of 19,961 participants, 15 years and older, from the general population of Finland, Germany, Italy, Portugal, Spain and the United Kingdom were interviewed by telephone using the Sleep-EVAL Expert System. They answered a questionnaire on VBS, their consequences and treatment. Parasomnias and sleep and mental disorders were also evaluated.

Results—VBS was reported by 1.7% (95% confidence interval: 1.5% to 1.8%) of the sample. VBS was higher in subjects younger than 35 years. During VBS episodes, 61.5% of VBS subjects reported vivid dreams and 24.6% hurt themselves or someone else. Only 12.3% of them consulted a physician for these behaviors. In 71.3% of cases, VBS were associated with other parasomnias (highest odds of VBS for sleepwalking and sleep terrors). Family history of VBS, sleepwalking and sleep terrors was reported more frequently in VBS than in non-VBS subjects with odds of 8.5, 2.2 and 3.0 respectively.

Conclusions—VBS are frequent in the general population and often associated with dream-enactment, sleepwalking and sleep terrors. High frequency of VBS, sleepwalking and sleep terrors in family of VBS subjects indicated that some families have a greater vulnerability to sleep disorders involving motor dyscontrol. Subjects who consulted a physician for these behaviors mostly received inappropriate or no support, indicating a lack of knowledge about VBS.

Keywords

Parasomnia; violent behaviors; epidemiology; sleepwalking; sleep terrors; Hypnagogic hallucinations; family history

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INTRODUCTION

Violent behaviors during sleep (VBS) refer to a broad range of behaviors ranging from simple dream enactment to complex behaviors that may have serious or even lethal consequences. The behaviors can be directed to oneself, other individuals or to objects. The common denominator is that the violent sleeper is unaware of his/her actions and has complete amnesia of the episode upon awakening. From 1900 to 2000, nearly 140 cases of VBS with forensic implications (homicides, non-fatal assaults and sexual misconducts) were described in the scientific literature (1).

VBS are not an essential feature of any sleep disorder. Violent behaviors may occur in both NREM (non-rapid eye movement) and REM sleep. In NREM sleep, VBS have been reported during sleepwalking, sleep terrors and confusional arousals (sleep drunkenness) and within the context of nocturnal seizures, namely frontal lobe and temporal lobe seizures. In REM sleep, VBS are associated with REM sleep behavior disorder (2).

VBS have received little attention from epidemiologists. The only epidemiological study on VBS reported a prevalence of 2.1% in the general population of the United Kingdom (3). In that survey, VBS were associated with various parasomnia symptoms such as sleep talking, hypnic jerks, hypnagogic hallucinations, sleepwalking and sleep terrors. However, the nature and consequences deserve more investigation in order to document medical and legal issues of these VBS in the general population.

Consequently, this study aims to document VBS in greater detail. More specifically, our objective was to characterize these behaviors, their familial links, course and treatment. The comorbidity with other parasomnias and consequences were also evaluated.

METHODS

Participants

The participants, aged between 15 years and 101 years, were interviewed between 1994 and 2000 with the broad objective to evaluate sleeping habits, sleep and psychiatric disorders (4). They came from seven different countries:

- United Kingdom: 4,972 participants aged 15 years and older interviewed in 1994;
- Germany: 4,115 participants aged 15 years and older interviewed in 1996;
- Italy: 3,970 subjects aged 15 years and older interviewed in 1997;
- Portugal: 1,857 subjects aged 18 years and older interviewed in 1998;
- Spain: 4,065 subjects aged 15 years and older interviewed in 1999 and
- Finland: 982 subjects aged 18 years and older interviewed in 2000.

Ethical and research committees approved the study conducted in each participant country. The total sample represented 19,961 participants. The subjects of the six European countries were representative of 210 million inhabitants. The overall participation rate was 80%, with the highest rate observed in Italy (89.4%) and the lowest in Germany (68.1%).

The samples for each country were all drawn in the same manner. First, the country (or targeted area) was divided into geographical areas, and number of inhabitants for each area was calculated using the latest census data. Those numbers were used to determine how many subjects needed to be interviewed for each area. Subsequently, telephone numbers were drawn using these calculations. Each time a telephone number was discarded (for example, because

it was a business number or no longer working), it was replaced by a telephone number from the same area.

During the first telephone contact, the Kish selection method (5) was used to select a household member. This method maintains the representation of the sample in terms of age and gender and avoids bias related to non-coverage error (6).

For subjects younger than 18 years, the verbal consent of one of the parents was obtained before interviewing the adolescent. Potential participants, identified by the Kish selection, who had insufficient fluency in the national language, a hearing or speech impairment, an illness precluding the feasibility of an interview, or who were currently hospitalized, were excluded from the study. Another member of the same household could not be interviewed in lieu of the selected participant under any circumstance.

Selected participants who refused to be interviewed were called again at least three weeks later and asked again to participate. If the individual refused again, the number was tabulated as a refusal and replaced with a new number from the same area.

In all countries, participation in the study was anonymous and no compensation was offered. Subjects who wanted more details about the study or who had specific questions were provided with the phone number of a sleep specialist in their country.

Instrument

The interviews were performed using the Sleep-EVAL Expert System (7,8). This software was specifically designed to conduct epidemiological studies in the general population. It managed technical aspects of the study (management of telephone numbers, Kish tables, performance of the interviewers) and drove the interviews. It selected the questions and displayed them one at a time on the computer screen. Lay interviewers read these questions to the participants and entered the answers in the Sleep-EVAL System.

Lay interviewers were mostly university students with little or no expertise in sleep medicine and psychiatry. They received 2 to 5 days of training that covered the study objectives, how to present the study to potential participants and how to use Sleep-EVAL. The training consisted mostly of role-playing that covered different situations likely to occur during telephone interviews. Each team of lay interviewers was monitored by at least two supervisors. The duties of the supervisors were to ensure that the interviewers administered the questionnaire as they were trained to, to answer the questions of the interviewers, and to randomly listen to the interviews in progress. Quality checks were also performed for about 10% of the completed interviews and rejected phone numbers.

The knowledge base of the Sleep-EVAL System was comprised of a standard questionnaire (7) and diagnostic guidelines covering the International Classification of Sleep Disorders (9) and the Diagnostic and Statistical Manual of Mental Disorders, fourth edition (10). The questionnaire consisted of sociodemographic information, sleep/wake schedule, sleeping habits, physical health queries and questions related to sleep and mental symptoms and diagnoses. All interviews began with general questions about demographic characteristics (marital status, education and occupation) followed by questions about sleeping habits (sleep/wake schedule, habits around bedtime, bedroom quality, etc.) and questions about sleep problems. Questions related to mental health appeared near the end of the interview. The questionnaire was built to begin with general topics and proceed to more private questions. Diagnostic and reasoning capabilities of the Sleep-EVAL System can be found elsewhere (8).

The duration of the interviews ranged from 20 to 333 minutes with an average of 40 minutes (s.d. ± 20 minutes). Interviews were completed over two or more sessions if the duration exceeded 60 minutes or per the request of the participants.

The questionnaire was translated from the English version to French, German, Italian, Portuguese, Spanish and Finnish. Each translation was verified by at least three translators whose native tongue was the targeted language. In all translations, the questionnaire was translated back to English, in order to verify that the questions retained the same meaning.

Variables

A section of the Sleep-EVAL questionnaire covered violent behaviors during sleep. The first question was “According to you, or your bed partner, do you have violent or injurious behaviors to yourself or your bed partner during your sleep? (For example, punching, kicking, leaping, running away from your bed while acting out your dreams).”

- a. A positive answer triggered a series of questions assessing the following:
 - Frequency (nightly, several nights per week, one night per week, 2–3 nights per month, once per month, unknown);
 - When the last episode occurred (within the last 24 hours, last week, last month, last year, more than one year ago).
- b. Subjects also answered a series of questions about
 - Age at the time of the first episode of violent behaviors;
 - Dream contents during an episode;
 - Period of the night when violent behaviors are more likely to occur;
 - Type of behaviors displayed during an episode;
 - Consequences of violent behaviors (type of injuries to self, bed partner or others);
 - Medical consultations and treatment for violent behaviors.

Participants in the United Kingdom and Germany answered a shorter version of this part of the questionnaire, covering only presence of injuries to oneself, bed partner or others (without description of the injuries) and if behaviors occurred during dream enactment.

- c. Family history of violent behaviors during sleep was investigated for all participants (with the exceptions of the United Kingdom and Germany).

Other variables explored were

- Sociodemographic determinants: age, gender, marital status, occupation.
- Parasomnia symptoms: sleepwalking, sleep terrors, nightmares, confusional arousals, sleep paralysis, hypnagogic (at sleep onset) and hypnopompic (upon awakening) hallucinations. Parasomnia symptoms were considered present when they were reported occurring at least once a month with the exception of nightmares, which had to occur at least twice month.
- Insomnia symptoms (difficulty initiating or maintaining sleep, non-restorative sleep), excessive daytime sleepiness, breathing pauses during sleep. These symptoms were present when they occurred at least 3 nights or days per week.
- Current consumption of psychotropic drugs (prescribed or not);

- Current consumption of alcohol, coffee, tobacco, level of stress, health quality, psychiatric disorders.

Analyses

A post-stratification (weighting procedure) was applied to correct for disparities in the geographical, age and gender distribution between the sample and each studied country. Results are based on weighted n values. Percentages for violent behaviors during sleep are given with 95% confidence intervals (95% C.I.). Bivariate analyses were performed using the chi-square test. Logistic regression was used to compute the odds ratios (OR) associated with VBS. Reported differences were significant at the .05 level or less.

RESULTS

Prevalence of violent behaviors during sleep

A total of 1.6% (n=313) (95% confidence interval: 1.4% to 1.7%) of the sample reported current violent behaviors during sleep (VBS). The prevalence was significantly lower in Spain (0.7%) compared with the United Kingdom (2.1%), Germany (1.8%), and Italy (1.8%). It was also significantly lower in Finland (0.9%) compared to the United Kingdom (Table 1).

As reported in Table 1, prevalence was comparable between men and women. In all countries the prevalence was comparable between men and women with the exception of the United Kingdom where more men than women reported VBS (2.6% vs. 1.7%; $p=.05$). As for age, the prevalence was higher among subjects 34 years or younger compared to those aged 35 years and older. This decrease with age was observed in all countries. Widowers were less likely to report VBS than other subjects, and shift/night workers reported VBS more frequently than daytime workers (Table 1).

Description of violent behaviors during sleep

Age of apparition—A total of 10.3% of subjects who reported VBS said these behaviors first occurred during their childhood (12 years old or younger); 5.6% said the VBS first occurred during adolescence (between 13 and 18 years old); 27.3% reported the first occurrence in adulthood (4.7% reported a first occurrence after 60 years old). However, many subjects (57.6%) could not remember how old they were when VBS first occurred.

Frequency—A total of 22.6% of subjects had VBS several nights per week, 8.3% reported VBS occurred one night per week, another 13.5% said it occurred several nights per month, and 55.6% said it occurred about one night per month.

Dream enacting behaviors—Data on dream enacting behaviors during VBS episodes were collected in Italy, Portugal, Spain, and Finland. Subjects reported that the most frequent dream enacting behaviors during an episode of VBS were talking (30.6%), kicking (28.1%), laughing (24.3%) and gesturing (23.5%). Only talking and laughing were more frequent in women.

Most VBS subjects (77.8%) reported they were having vivid dreams at the time when the violent behaviors occurred. Dreams were associated with being attacked by someone or an animal in 20% of cases; 40% reported they were attempting to protect a loved one from harm. Only 10% reported no dreaming associated with VBS.

Subjects reported that VBS occurred within 2 hours after they fell asleep in 33% of cases. Another 47% said VBS occurred mostly in the middle of the night (i.e., about 3–4 hours after sleep onset). The remaining (20%) reported that VBS occurred close to wake-up time.

Consequences

In all, 31.4% of VBS subjects (98 out of 313) reported having hurt themselves or someone else during an episode of VBS. The frequency of VBS was not associated with the frequency of injuries; individuals with less frequent episodes of VBS were as likely as those who had several episodes per week to hurt themselves or someone else.

Description of the injuries during VBS episodes and treatment were obtained from participants in Italy, Portugal, Spain and Finland. Most frequently reported injuries were bruises (42.9%), nose bleeding (25.5%), fractures (21.6%), abrasion (15.7%), pulled hair (23.5%), and head contusions (13.7%).

Surprisingly, only 5 VBS subjects talked with a physician about these behaviors and no action was taken (medication or complementary examination, e.g., polysomnographic recording).

Association with other parasomnia symptoms

Other parasomnia symptoms were frequent among VBS subjects: 72.8% reported at least one parasomnia symptom compared with 34.3% in non-VBS individuals ($p < .0001$). Hypnagogic hallucinations were the most frequent parasomnia symptom reported by VBS subjects (55.0%); they were also common in non-VBS individuals (24.6%) (Table 3). Highest odds were found for sleepwalking and sleep terrors: VBS subjects were nine times more likely to report one of them than non-VBS individuals.

At least one parasomnia symptom associated with REM sleep was reported by 68.4% of VBS subjects and 32.6% of the non-VBS subjects. As seen in Table 3, VBS subjects were eight times more likely than non-VBS individuals to report having at least two other types of REM parasomnias.

Family history of parasomnias

A family history of VBS, sleepwalking and sleep terrors was asked of participants in Italy, Portugal, Spain and Finland.

VBS among family members were higher among VBS subjects: 10.0% of them reported at least one other family member who had VBS. Among non-VBS subjects, 1.2% reported at least one other family member with VBS (OR: 9.3 (5.1–16.9); $p < .0001$). The father was the most frequently reported by both men and women.

Similarly, sleep terrors among family members were more frequent in VBS subjects (13.7%) than in non-VBS [3.6%; OR: 4.2 (2.6–7.0); $p < .0001$]. Sleepwalking among family members was also higher in VBS subjects (13.8%) than among non-VBS participants [7.4%; OR: 2.0 (1.2–3.3); $p < .0001$].

Factors associated with VBS

Table 3 presents independent factors associated with VBS calculated using a multivariate logistic regression model. Non-significant variables were occupation, level of stress, sleep satisfaction, difficulty initiating sleep, difficulty maintaining sleep, non-restorative sleep, smoking, daily alcohol intake, daily coffee intake, alcohol at bedtime, psychotropic medications, street drugs, anxiety disorders and hypnagogic hallucinations.

Factors significantly associated with VBS were age less than 35 years, male gender, breathing pauses in sleep, early morning awakening, daytime sleepiness, hypnagogic hallucinations, nightmares, sleep terrors, sleepwalking, sleep paralysis, mood disorders and physical illness. Living in Spain made it less likely that VBS would be reported.

DISCUSSION

This large-scale study conducted with 19,961 subjects from six European countries confirms that the prevalence of violent behaviors during sleep is substantial: 1.6% of the sample reported having them. This estimate is probably conservative since it can be expected that individuals living alone would generally be unaware of them. Others will be reluctant to report behaviors that can be viewed as shameful or that may have legal implications when someone else has been hurt.

The VBS resulted in harm or injuries to oneself or someone else in nearly a third of cases. However, the frequency of violent behaviors during sleep was unrelated to the presence of injuries to oneself or others during an episode. Obviously, the more frequent the violent behaviors, the higher the likelihood of harmful behaviors. However, as soon as the sleeper begins to move and become violent while asleep, he or she is at risk of hurting oneself or another person, since during an episode the sleeper is unaware of his or her actions, the immediate surroundings or any potential danger.

Another major finding in this study is the high rate (>60%) of vivid dream-enacting behaviors that regularly accompanied VBS, with the “disorders of arousal” (sleepwalking, sleep terrors) being especially implicated. It is now known that various “parasomnias” (i.e., sleep-related behavioral, autonomic nervous system and experiential disorders) can manifest with dream-enacting behaviors. These parasomnias include not only REM sleep behavior disorder (RBD; the prototypic dream-enacting disorder associated with disturbed REM sleep dreams and loss of the customary muscle paralysis of REM sleep), but also such diverse conditions as sleepwalking, sleep terrors, nocturnal seizures, and obstructive sleep apnea (11–13). Thus, dream-enacting behaviors can emerge from disturbed NREM sleep (sleepwalking, sleep terrors, nocturnal seizures), within REM sleep (RBD), during abnormal arousals from disturbed REM sleep (obstructive sleep apnea) or within the context of nocturnal frontal lobe and temporal lobe seizures.

It should be stressed, that this study was based on self-reports. Therefore, there were no PSG or EGG recordings. Although there are some questionnaires that can be used to identify possible cases with nocturnal seizures, these tools have been evaluated with clinical samples and administered by specialists. No such tool exists for general population.

The strong link of VBS with dream-enacting behaviors found in this epidemiologic study calls attention to the clinical need for physicians and nurses to not only become more aware of the high rate of VBS among their patients, but also to identify the underlying cause of the violent dream-enacting behaviors, so that specific, rational and effective treatment can be initiated. For example, to mistakenly treat obstructive sleep apnea presenting with dream-enactment as presumptive RBD with clonazepam (the standard treatment of RBD) would not only result in the lack of appropriate treatment of the obstructive sleep apnea (with progression of that disorder with its known serious adverse health risks), but also could result in benzodiazepine-aggravated worsening of the obstructive sleep apnea.

There is another and newly-recognized imperative for identifying the underlying disorder responsible for violent dream-enacting behaviors: it is now known that 65% of men ≥ 50 years old who originally had been diagnosed with idiopathic RBD will eventually (at a mean interval of 13 years) develop a Parkinsonian disorder. Therefore, to presumptively diagnose a patient with violent dream-enactment to have RBD without objective confirmation utilizing polysomnography in a sleep laboratory carries various medico-legal risks by misinforming the patient (and family) about the likelihood for developing Parkinsonism. Furthermore, without polysomnography, it is unknown to what extent young adults with presumed sleepwalking and

sleep terrors also have RBD, a mixed Parasomnia identified as the “Parasomnia Overlap Disorder”.

Several aspects of our results must be underlined:

1. From our results, it appeared that in a subgroup of cases the violent behaviors during sleep were part of other parasomnias such as sleepwalking, sleep terrors and confusional arousals. These three conditions are “arousal parasomnias” that typically emerge from deep (slow-wave) NREM sleep in the first third or half of the nocturnal sleep period, which corresponds with when during the night that violent behaviors often occurred, according to the subjects. REM sleep behavior disorder (RBD) is rare (less than 0.5% in this sample).
2. In about 40% of cases, the violent behaviors first appeared in adolescence or adulthood. The first clinical descriptions of patients with violent behaviors during sleep also reported an early onset of these behaviors (11).
3. Two thirds of VBS subjects reported at least one other parasomnia. These parasomnias were
 - A NREM parasomnia in 4.8% of VBS cases.
 - A REM parasomnia in 39.8% of VBS cases.
 - A combination of NREM and REM parasomnia in 26.7% of VBS cases.

This multiplicity of parasomnia symptoms indicates that a parasomnia spectrum exists in these VBS subjects. Further development in the classifications may take into account these results as an indication of a special category of parasomnia.

4. One of the surprising results was the significant number of subjects who reported multiple cases of VBS and other parasomnias among the members of their family. This aspect has been little investigated in the past, although strong familial clustering for sleepwalking and sleep terrors have previously been documented (14). For example, a notable family with parasomnias has been reported in which three adults had REM sleep behavior disorder, other parasomnias (sleepwalking, sleep terrors), narcolepsy and periodic limb movement disorder (15,16). This suggested that some families have a greater vulnerability to sleep disorders involving motor dyscontrol.
5. Interestingly, apart from a greater number of parasomnia symptoms, VBS subjects had sleep characteristics similar to other subjects: sleep-wake schedule and sleep duration were comparable; they were as satisfied as others with their sleep.
6. However, difficulty initiating sleep is a frequent symptom in VBS. This difficulty can be due to a fear of falling asleep from having an episode of VBS or sleep terrors or other parasomnias.
7. The significant association with breathing pauses during sleep in VBS subjects (including some with dream-enactment) suggests a link with obstructive sleep apnea. Longitudinal studies are needed to confirm this point.
8. Surprisingly, few subjects had consulted with a physician about their VBS. Those who did, mostly received no support or inappropriate advice. This clearly indicates a knowledge problem in both physicians and the general population about violent behaviors during sleep. For some individuals, violent behaviors during sleep are viewed as anecdotal facts that do not deserve medical attention. For others, VBS are viewed as shameful behaviors that must remain where they occurred: in the bedroom. It is not easy to report having VBS to a physician. Likewise, for the physician, it can

be hard to believe that the behaviors were unintentional; some suspicions about the meaning of these behaviors may affect the support and treatment of these subjects.

The strong link of VBS with dream-enacting behaviors found in this epidemiologic study calls attention to the clinical need for physicians and nurses to not only become more aware of the high rate of VBS among their patients, but also to identify the underlying cause of the violent dream-enacting behaviors so that specific, rational and effective treatment can be initiated. Screening questions for parasomnias that can be utilized by physicians and nurses have been published, and the role of a sleep disorders center in evaluating sleep violence has also been delineated (17–19). In the vast majority of reported cases, parasomnias can be controlled with safe and effective therapy.

Given the high rate of VBS found in this study, physicians and nurses can take the initiative with their patients by asking about VBS and other parasomnias during routine history-taking, and thereby encourage and facilitate the reporting of such problematic and hazardous behaviors. The prompt identification of VBS and other parasomnias can then lead to appropriate evaluation and effective therapeutic interventions. In contrast, undetected parasomnias, including VBS, can result in tragic consequences, including “parasomnia pseudo-suicide” and unintentional injury or death to a family member or roommate, with far-reaching consequences (20). Finally, the detection of VBS and other parasomnias can also lead to the identification (and control) of “Environmental Sleep Disorder” in the bed partner or roommate, whose sleep can be disturbed by the disordered sleep in a nearby person, including snoring, talking or shouting, limb and body movements, or vigorous and violent behaviors (21).

In summary, important medical and legal issues are pendant in VBS. We found a high rate of VBS justifying VBS routine questions in the clinical examination of subjects with sleep disorders; patients must be supported and encouraged to report such problematic and hazardous behaviors. The multiplication of legal cases about sleep violence underlines the issues on the real dangers of these behaviors and letting them go under-diagnosed. Prompt identification of these parasomnias will lead to appropriate and effective therapeutic actions.

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Table 1

Prevalence of violent behaviors during sleep by socio-demographic characteristics.

	N	%	95% C.I.
Total	19961	1.6	(1.4–1.7)
Country			
United Kingdom	4972	2.1	(1.7–2.5)
Germany	4115	1.8	(1.4–2.2)
Italy	3970	1.8	(1.4–2.2)
Portugal	1857	1.3	(0.8–1.8)
Spain	4065	0.7	(0.4–1.0)*
Finland	982	0.9	(0.3–1.6)
Age (yrs)			
<25	3554	2.7	(2.2–3.3)*
25–34	3732	2.1	(1.6–2.5)*
35–44	3294	1.4	(1.0–1.8)
45–54	3023	1.3	(0.9–1.7)
55–64	2680	0.9	(0.5–1.3)
65+	3677	0.8	(0.5–1.1)
Gender			
Female	10372	1.5	(1.2–1.7)
Male	9589	1.7	(1.4–1.9)
Marital status			
Single	5931	1.9	(1.6–2.3)
Married/common law	10949	1.5	(1.3–1.7)
Separated/divorced	1031	2.0	(1.2–2.9)
Widow	2038	0.7	(0.3–1.1)*
Occupation			
Daytime worker	8704	1.4	(1.2–1.7)
Shift/night worker	1527	2.8	(2.0–3.6)*
Unemployed	751	2.0	(1.0–3.1)
Not working	2888	2.1	(1.6–2.6)
Student	1811	1.6	(1.0–2.2)
Retired	4280	0.9	(0.6–1.2)

* p<.001

Table 2

Frequency of parasomnia symptoms in subjects with VBS

	No-VBS (n=19,648)	VBS (n=313)	Crude OR (95% C.I.)
Sleepwalking	1.1	9.9	9.6 (6.5–14.3)*
Sleep terrors	2.2	16.9	9.1 (6.7–12.4)*
Confusional arousals	3.7	17.3	5.5 (4.2–7.2)*
Nightmares	6.2	25.9	5.7 (4.1–6.8)*
Hypnagogic hallucinations	24.6	55.0	3.7 (3.0–4.7)*
Hypnopompic hallucinations	7.1	15.1	2.3 (1.7–3.2)*
Sleep paralysis	2.6	7.0	2.7 (1.8–4.3)*
Number of REM parasomnia ^a			
0	67.4	31.6	1.0
1	25.6	39.3	3.3 (2.5–4.3)*
2 or more	7.0	29.1	8.8 (6.6–11.8)*

^aREM parasomnia symptoms: nightmares, sleep paralysis, hypnagogic and hypnopompic hallucinations

* p<.001

Table 3

Factors associated with VBS in logistic regression model

	OR	95% C.I.	P=
Age groups			
<= 24	3.0	(1.9–4.7)	0.0001
25–34	2.4	(1.5–3.9)	0.0001
35–44	1.6	(1.0–2.6)	n.s.
45–54	1.5	(0.9–2.4)	n.s.
55–64	1.0	(0.6–1.8)	n.s.
>= 65	1.0		
Gender			
Female	1.0		
Male	1.6	(1.0–1.6)	0.0001
Country			
United Kingdom	1.0		
Germany	1.2	(0.9–1.7)	n.s.
Italy	1.5	(1.1–2.1)	0.02
Portugal	0.6	(0.3–0.9)	n.s.
Spain	0.6	(0.3–0.8)	0.046
Finland	0.6	(0.3–1.2)	n.s.
Breathing pauses during sleep ^a	1.8	(1.8–2.8)	0.008
Early morning awakening ^a	1.4	(1.0–1.9)	0.038
Excessive daytime sleepiness ^a	2.1	(1.6–2.8)	0.000
Hypnagogic hallucinations ^a	2.5	(1.9–3.2)	0.000
Nightmares ^a	2.0	(1.5–2.7)	0.000
Sleep paralysis ^a	2.0	(1.2–3.4)	0.008
Sleep terrors ^a	3.5	(2.4–5.2)	0.000
Sleepwalking ^a	3.8	(2.4–5.9)	0.000
Mood disorder ^a	1.8	(1.3–2.5)	0.001
Physical illness ^a	1.6	(1.1–2.2)	0.006

^aCategories of reference: Absence of the symptom

Non-significant variables were: occupation, level of stress, sleep satisfaction, difficulty initiating sleep, difficulty maintaining sleep, non-restorative sleep, smoking, daily alcohol intake, daily coffee intake, alcohol at bedtime, psychotropic medications, use of street drugs, anxiety disorders, hypnopompic hallucinations. Model calculated using all participants (N=19,961)