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Original Article

## Psychopathologic correlates of adult sleepwalking

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## ABSTRACT

**Objectives:** Sleepwalking (SW) often has been associated with psychopathology, but the nature and magnitude of this relation remains unclear. The aim of our study was to investigate the presence of psychopathology in a large cohort of sleepwalkers and to determine if levels of psychopathology showed differential relations to specific characteristics of the disorder, including clinical history.

**Methods:** One-hundred and five sleepwalkers (39 men, 66 women; mean age, 32.4 ± 9.5 years) referred to our sleep disorders clinic for chronic SW underwent a comprehensive clinical investigation that included an overnight polysomnography (PSG) assessment in 90% of cases. All participants also completed a series of questionnaires, including the Beck Depression Inventory, Second Revision (BDI-II), the Beck Anxiety Inventory (BAI), and the Symptom Checklist 90-Revised (SCL-90-R).

**Results:** The proportion of sleepwalkers who scored above the minimal clinical threshold on the BDI-II, BAI, and SCL-90-R was 27%, 40%, and 28%, respectively. Only 15% of sleepwalkers showed moderate to severe symptoms on the BDI-II and 19% on the BAI. Taken as a whole, these profiles are similar to those observed in the general adult population. The presence of psychopathology in sleepwalkers was associated with a negative family history for SW, a higher frequency of nightmares, and with potentially injurious behaviors enacted during somnambulistic episodes.

**Conclusions:** A majority of adult sleepwalkers consulting for the disorder do not report clinically significant levels of depression or anxiety. Overall, sleepwalkers with and without psychopathology appear more similar than dissimilar.

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## 1. Introduction

Sleepwalking (SW), also known as somnambulism, is a nonrapid eye movement (NREM) sleep parasomnia involving behaviors of varying complexity usually initiated during arousals from slow-wave sleep (SWS) (deep sleep). Symptoms and manifestations of SW can be considered along a spectrum, but most episodes are typically characterized by misperception and relative unresponsiveness to external stimuli, mental confusion, perceived threat or agitation, and variable retrograde amnesia [1–3].

SW is common in childhood [4], but its prevalence decreases during adolescence [5,6] and reaches 2–4% in adulthood [4,7]. However, lifetime prevalence may be considerably higher (8.5%) in adult psychiatric populations [8]. Whereas the occurrence of SW in children is frequently viewed as a relatively benign event that will spontaneously resolve, the disorder often poses greater

problems in adults including social embarrassment and sleep-related injuries [9–14]. A strong genetic component for somnambulism has been documented in both children and adults [4,13,15,16], but the functional significance of these findings is not yet understood.

It is unclear as to why SW persists into adulthood in some adults but not others, and also why it may even develop de novo in adults. Although the pathophysiology of the disorder has been primarily explored through the study of various sleep parameters (for a review, see Ref. [17]), some research has focused on the psychopathologic profiles of sleepwalkers. Sleep laboratory investigations indicate that the overall sleep architecture and normal cycling of sleepwalkers across sleep stages is preserved. However, numerous studies converge in showing intrinsic abnormalities in the NREM sleep of sleepwalkers, indicative of an inability to sustain stable consolidated deep sleep [3,18–20]. By contrast, early psychoanalytically oriented authors viewed SW as a form of psychogenic dissociation resulting from unresolved mental conflicts [21,22], which could lead to the enactment of dream content including trauma-related dreaming [21,23,24]. The landmark work by Broughton [25] in 1968, which showed that SW was an NREM

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sleep parasomnia, attenuated the trauma and dream-enactment hypothesis but the idea that SW was nevertheless associated with psychopathology persisted. Consistent with this view, several subsequent studies reported the presence of severe and pervasive psychiatric disorders in adults presenting with SW or with a mixture of SW and sleep terrors (ST) [13,26,27].

Self-report epidemiologic investigations indicate that approximately 25% of adult sleepwalkers report a concurrent anxiety or mood disorder [7] and that SW is more frequent among individuals who consume psychotropic medications [28]. However, other studies indicate that a majority of adult sleepwalkers neither show elevated scores on questionnaire measures of psychopathology [29], nor meet criteria for psychiatric or personality disorders based on the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* [11,30]. Moreover, the successful treatment of patients' active psychiatric disorders usually do not impact SW frequency [11].

The methodology and main findings of studies that investigated the psychopathology in adult sleepwalkers are summarized in Table 1. As shown in Table 1, higher prevalence rates of psychopathology typically are reported in older studies of sleepwalkers than in more recent investigations. Several factors may account for this disparity. First, several early investigations [24,31,32] were conducted on military personnel, in whom SW could result in discharge and in whom sleep disorders may have developed in relation to trauma or combat-related experiences. Second, some early studies [13,33] relied on sleepwalkers recruited through media advertisements. In addition to diagnostic uncertainties, these individuals may differ from patients choosing to consult a health professional or those referred for clinical assessment by their treating physician. Third, studies reporting elevated levels of psychopathology typically relied on poorly defined criteria that focused more on clinical impressions, ill-defined personality dynamics, or vague character disorders [13,24,26]. Finally, few of the earlier studies included overnight polysomnography (PSG), which is essential to rule out the presence of other disorders with similar clinical presentations, including dissociative disorders, frontal lobe epilepsy, rapid eye movement sleep behavior disorder, and nocturnal panic attacks [17,34].

The main goal of our study was to help clarify the relationship between psychopathology and SW by focusing on the prevalence of depressive and anxious symptoms in a large cohort of carefully assessed sleepwalkers meeting the diagnostic criteria established by the *American Academy of Sleep Medicine International Classification of Sleep Disorders, Second Edition (ICSD-II)* [35]. We predicted that only a minority of sleepwalkers would show markedly elevated psychopathology. In addition, we investigated if sleepwalkers' levels of psychopathology showed differential relations to their clinical history, associated conditions, episode frequency and content.

## 2. Methods

### 2.1. Participants

Participants were obtained from a cohort of 162 patients (68 men, 94 women; mean age, 34.2 years [standard deviation, 12.0 years]) consecutively referred to the Sleep Disorders Clinic of the Hôpital du Sacré-Coeur by their treating physician between 2003 and 2012 for suspected SW. All patients underwent a comprehensive semistructured clinical interview and physical examination to determine specific sleep complaints and other psychiatric or physical symptoms. As part of our clinical investigation, over 90% of patients were prospectively evaluated with (1) at least one full night of continuous PSG in the sleep laboratory to screen for other sleep disorders; and (2) a 25-h sleep-deprivation

protocol, as this investigative tool has been shown to significantly increase actual behavioral episodes recorded in the laboratory during recovery sleep [3]. All patients were continuously videotaped during both sleep periods.

Subsequent to this clinical assessment, 28 patients were excluded from the study as they did not meet ICSD-II criteria for SW. These patients presented with atypical symptoms, other primary sleep disorders, or a questionable neurologic history. Twenty of these 28 patients (71%) showed evidence of significant psychopathology. Of the remaining 134 patients, 25 were excluded for not completing key questionnaires; three patients because they were younger than the age of 16 years; and one patient because he was undergoing legal procedures relative to his somnambulism. Thus our final sample was comprised of 105 participants including 39 men and 66 women. The clinical characteristics of the participants are presented in Table 2.

As shown in Table 2, seventeen of the 105 participants (16%) had an active psychiatric disorder already noted in their medical file at the time of their consultation. Ten participants had unipolar depression, four participants had anxiety disorders, two participants had schizoaffective disorder, and one participant had substance dependence; however, this clinical information must be interpreted with caution, as a psychiatric assessment was not systematically conducted for every patient prior to their referral to our sleep clinic and diagnostic criteria not always specified. Among the 17 patients with a psychiatric history noted in their file, two had adult-onset SW and only four reported a family history of SW.

Our study was conducted as part of a larger research project on the assessment and physiopathology of SW, which was approved by the hospital's ethics and scientific committee. Written informed consent was obtained from each participant.

### 2.2. Procedure

After their initial clinical interview, participants underwent two PSG assessments in the sleep laboratory. The first PSG was a whole-night sleep recording. Lights-off time was set between 10:00 pm and no later than 12:00 am, depending on each participant's habitual sleep schedule; wake time was between 6:00 and 8:00 am. Participants returned to the sleep laboratory in the evening for the sleep deprivation protocol and spent the remainder of the night under constant supervision. Recovery sleep was scheduled the next morning, 1 h after their previous wake time and after a total of 25 h of wakefulness (for details on the use of sleep deprivation in the assessment of SW, see Ref. [3]). Participants were instructed to refrain from taking naps and from consuming alcohol, caffeine, or other stimulating substances 1 day prior their visit and during all laboratory procedures. During their stay at the sleep laboratory, all participants completed several questionnaires assessing sleep habits, psychopathology, and various aspects of their somnambulism.

### 2.3. Materials

#### 2.3.1. PSG recordings

PSG recordings were conducted on a 32-channel Grass polygraph (sensitivity at 7\_V, bandpass at 0.3–100 Hz; Grass Instruments, Quincy, MA) and digitized at a sampling rate of 256 Hz. Electroencephalogram recordings and electrode placement were performed according the international 10–20 system with a linked-ear reference and included electrooculograms, submental electromyography, surface electromyography of the bilateral anterior tibialis, and an electrocardiogram. Respiration was monitored using an oronasal cannula and a thoracoabdominal plethysmograph, whereas oxygen saturation was recorded with a finger pulse oximeter. Twenty-second epochs of PSG were used to score sleep stages according to standard criteria.

**Table 1**  
Summary of methodology and principal findings from studies of psychopathology in adult sleepwalkers.

Authors	n	Sample	Clinical assessment	PSG	Sleep terrors	Adult onset	Family history	Measures of psychopathology	Control group	Main findings
Atay and Karacan [65]	22	Physician referrals	Clinical and neurologic examination interview with spouse or family	Yes 55% had abnormal EEG	100% Have concurrent parasomnia including ST	18%	33%	MMPI	None	41% had abnormal MMPI scores
Brion et al. [66]	21	Physician referrals	Presence of ambulation with persistence of sleep or impaired judgement	Yes	Unspecified	14%	52%	Psychiatric interview based on DSM-IV criteria; Hospital Anxiety and Depression Rating Scale	20 Normal controls	21% had an axis I disorder <sup>a</sup> ; SW scored higher on anxiety than controls
Crisp et al. [26]	12	Physician referrals	Clinical interview Diagnosis based on ASDC criteria	Yes	50%	Unspecified	Unspecified	Eysenck personality questionnaire, hostility questionnaire, Crown-Crisp experiential index	Instruments' normative data	Higher hostility and hysteria in SW; higher anxiety in ST
Guilleminault et al. [30]	50	Physician referrals	Clinical interview; medical examination; interview with spouse or family	Yes	Unspecified	Unspecified	Unspecified	Psychiatric interview	50 Normal controls	16% of the SW received a diagnosis of depressive or anxiety disorder
Hartman et al. [29]	22	Physician referrals	Clinical interview diagnosis based on DSM-III-R criteria for SW and PSG evidence of SW	Yes	55%	Median age of onset = 8 years old	Unspecified	DIS-Q (dissociation); Crown-Crisp experiential index	Normative data of the instruments	27% had a history of early trauma and scored higher than controls on anxiety, phobia, and depression; SW without trauma scored higher on anxiety with trends for depression and hysteria
Kales et al. [33]	11	Newspaper advertisement	Clinical and neurologic examination; interview with family	Yes	Unspecified	0%	Unspecified	Psychiatric interview, Rorschach, TAT, MMPI	None	82% had moderate to severe depressive symptoms; 45% had schizoid traits
Kales et al. [13]	29	Newspaper advertisement	Unspecified	No	55%	10%	Unspecified	Psychiatric interview MMPI, SCL-90	Recruited through advertisement	78% had a psychiatric diagnosis, mostly personality disorders MMPI: SW higher than controls on 3/8 clinical scales; SCL-90: SW higher on Hostility and Paranoid ideation
Llorente et al. [27]	6	Review in a sleep clinic of patient files with ST	Clinical interview	Yes	All	67% (ST)	50%	SCID-I (DSM-III-R); MCMI-II	None; normative data for MCMI-II	100% had a lifetime history of axis I disorder; All had pathologic personality traits based on MCMI-II

**Table 1** (continued)

Authors	n	Sample	Clinical assessment	PSG	Sleep terrors	Adult onset	Family history	Measures of psychopathology	Control group	Main findings
Lopez et al. [14]	100	Patients presenting at the sleep clinic	Clinical interview; diagnosis based on ICSD-II criteria	Yes	64%	17%	57%	BDI-II, State-Trait Anxiety Inventory (STAI), Short Form Health Survey	100 matched controls from the community	20% had depressive symptoms compared to 7% of controls; SW scored significantly higher on measure of anxiety and report poorer quality of life
Moldofsky et al. [9]	64	Physician referrals, most for sleep-related violence	Clinical interview Diagnosis based on ASDC criteria	Yes	Unspecified	20%	45%	Psychiatric interview based on DSM-III-R criteria; SCL-90	None	20% had a current axis I disorder; SCL-90 results unreported
Schenck et al. [11]	54	Mostly physician referrals	Clinical questionnaire; examination of medical history; neurologic examination	Yes	Mixed SW/ST sample	33%	Unspecified	Psychiatric interview using DSM-III checklist for axis I disorders; MMPI, BDI, SCL-90	36 RBD patients	35% had active axis I disorder 64% had abnormal MMPI profiles
Sours et al. [24]	14	Referred by military medical officers	Somnambulism defined as "an altered state of consciousness which begins during sleep"	Yes, results unreported	Unspecified	21%	7%	Psychiatric interview; MMPI, Rorschach	28 Enlisted men were administered the MMPI	100% had a psychiatric diagnosis (schizophrenic/schizoid or neurotic character disorders); MMPI: SW scored higher than controls on all but one of the clinical scales
Ugucioni et al. [67]	32	Referred by physicians	Clinical interview diagnostic based on ICSD-II criteria	Yes	Mixed SW/ST sample	Unspecified	Unspecified	Hospital Anxiety and Depression Rating Scale; Aggression Questionnaire	24 Patients with RBD	No significant difference between SW and RBD patients on depression, anxiety, or aggression scores

*Abbreviations:* ASDC, Association of Sleep Disorders Centers; BDI, Beck Depression Inventory; DSM, *Diagnostic and Statistical Manual of Mental Disorders*, Third Edition-revised; DIS-Q, the dissociation questionnaire; EEG, electroencephalogram; ICSD-II, *International Classification of Sleep Disorders*, Second Edition; MCMI, Millon clinical multiaxial inventory; MMPI, Minnesota multiphasic personality inventory; PSG, polysomnography; RBD, rapid eye movement sleep behavior disorder; SCID, structured clinical interview for DSM-III-R; SCL-90, Symptom Checklist 90-Revised; ST, sleep terrors; SW, sleepwalking; TAT, thematic apperception test.

<sup>a</sup> Axis I disorder refers to all clinical psychiatric disorders excluding personality disorders, which are coded on Axis II.

#### 2.4. Questionnaires

Participants completed a questionnaire battery that included the Beck Depression Inventory, Second Revision (BDI-II) [36], the Beck Anxiety Inventory (BAI) [37], and the Symptom Checklist 90-Revised (SCL-90-R) [38]. Because the SCL-90-R was added in the

course of the study, data were only obtained from the latter half of the participants. All three instruments have been extensively studied in a wide range of settings and populations and have consistently shown to possess excellent psychometric properties [39–43].

Summed scores for the BDI-II and the BAI were used in the analyses. Individual scores were considered clinically meaningful if

**Table 2**  
Sleepwalkers' general characteristics.

	Men (n = 39)	Women (n = 66)	Total sample (N = 105)
Age, y (SD)	31.5 (10.5)	32.9 (8.9)	32.4 (9.5)
Median episode frequency	2–3 episodes/wk	2–3 episodes/wk	2–3 episodes/wk
≥2 Episodes/wk	50%	62%	57.7%
Positive family history	49%	46%	48%
Childhood onset	82%	80%	81%
Injurious episodes	47%	51%	50%
Concomitant sleep terrors	53%	79%	69%
Active psychiatric diagnosis	8%	21%	16%
Psychoactive medication	10%	21%	17%

*Abbreviations:* SD, standard deviation; y, years; wk, week.

**Table 3**  
Sleep variables from sleepwalkers' overnight polysomnography.

Variable	Mean score	SD
Sleep latency, min	15.9	12.0
Total sleep time, min	430.3	48.6
Sleep efficiency	89.0	8.2
Stage 1, min (%)	36.1 (8.6)	18.0 (4.8)
Stage 2, min (%)	250.1 (58.0)	49.0 (8.7)
Stage 3, min (%)	43.8 (10.3)	30.4 (7.2)
Stage 4, min (%)	17.5 (4.1)	23.3 (5.5)
REM, min (%)	82.7 (18.9)	30.4 (5.8)
Number of arousals from slow-wave sleep	3.7	4.4

Abbreviations: min, minutes; REM, rapid eye movement sleep; SD, standard deviation.

they were above the minimal clinical thresholds defined in the instruments' manuals (i.e.,  $\geq 13$  for the BDI-II and  $\geq 7$  for the BAI). Established cutoff scores in the scoring manuals were similarly used to establish light, moderate, and severe levels of anxiety and depression. For the SCL-90-R, the global symptom index T scores were used in the analyses. The global symptom index represents the overall severity of reported symptomatology and has one of the best psychometric properties of the SCL-90-R scales. The T values were obtained using the gender-adjusted nonpatient norms of the manual pertaining to the instrument. The clinical threshold was defined as a T score of  $\geq 65$ .

Participants also completed an in-house questionnaire assessing various aspects of their SW, including nature and frequency of somnambulistic episodes, family history, suspected precipitating factors, history of injurious or violent somnambulism, and recall of sleep mentation associated with their episodes.

Descriptive statistics were used to present the overall sample characteristics and findings. Differences in men and women's mean scores on measures of psychopathology were compared using Student *t* tests. Pearson product moment correlation coefficients were used to assess the degree of intercorrelation among test scores. Tests for proportions were computed using the  $\chi^2$  test, or alternatively using the Fisher exact test if a cross-table contained more than one case with an expected value of less than 5.

### 3. Results

#### 3.1. Polysomnography

Standard sleep parameters from overnight baseline PSG recordings of the sleepwalkers are presented in Table 3. PSG data were available for 98 of the 105 participants; five participants refused to undergo overnight PSG assessment for professional or familial reasons and two participants missed their scheduled appointment, which could not be rescheduled. Consistent with previous findings, sleepwalkers had a normal mean sleep efficiency (ratio of total time spent asleep to the amount of time spent in bed) approaching 90% and showed normal sleep architecture and cycling among

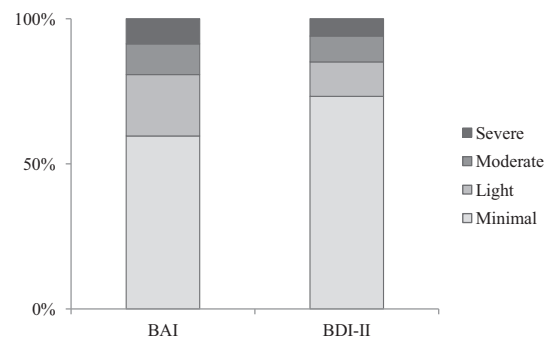
**Table 4**  
Mean scores on the psychopathologic scales for men and women sleepwalkers.

Measure	<i>n</i>	Men	Women	All	<i>P</i> value <sup>a,b</sup>
BDI-II	101	7.7 (8.2) <sup>a</sup>	10.7 (9.5)	9.6 (9.1)	.118
BAI	104	7.3 (7.6)	10.0 (9.8)	10.0 (9.1)	.157
SCL-90-GSI	65	0.57 (0.56)	0.72 (0.62)	0.66 (0.60)	.306
T score	65	58.3 (12.8)	58.5 (10.3)	58.4 (11.3)	.948

Abbreviations: BDI-II, Beck Depression Inventory II; BAI, Beck Anxiety Inventory; SCL-90-GSI, general symptom index from the Symptom Checklist 90-Revised.

<sup>a</sup> Numbers in parenthesis represent standard deviation.

<sup>b</sup> Differences in men and women's mean scores were compared using Student *t* test.



**Fig. 1.** Proportion of sleepwalkers within each symptoms severity class for the Beck Anxiety Inventory (BAI) and the Beck Depression Inventory (BDI-II).

sleep stages. The high number of arousals out of SWS in our sample is consistent with the well-established finding that somnambulism is characterized by an inability to sustain consolidated NREM sleep [17].

#### 3.2. Measures of psychopathology

Table 4 presents the results from the measures of psychopathology. Women tended to obtain higher scores than men, but the differences were not statistically significant. The three measures of psychopathology were moderately to highly intercorrelated. The correlation between the SCL-90-R and the BDI-II and BAI was  $r = .66$  and  $r = .79$ , respectively, though the BDI-II and the BAI showed a correlation ( $r = .66$ ;  $P < .01$  for all).

In the BDI-II, 12% of sleepwalkers obtained scores that were indicative of light symptoms of depression and 15% that were indicative of moderate to severe symptoms. For the BAI, 21% showed evidence of light symptoms of anxiety and 19% showed evidence of moderate to severe symptoms. Comparisons of scores on the BAI and the BDI revealed that 93% (25/27) of participants who obtained significant scores for depression also had elevated scores on the measure of anxiety; however, sleepwalkers who were anxious were not necessarily considered to be depressed. Of the 65 sleepwalkers who completed the SCL-90-R, 28% scored above the established clinical threshold of the instrument. These results indicated that a majority of our sleepwalkers did not report clinically significant levels of depression or anxiety. Fig. 1 further details the distribution of sleepwalkers' symptom severity on the BAI and BDI-II.

#### 3.3. Relationship between psychopathology and SW

The relationship between participants' levels of psychopathology and the clinical and phenomenological features of their SW was investigated. Three subgroups of sleepwalkers were created based on their highest score on either the BDI-II or BAI. The first subgroup was composed of 57 participants (23 men and 34 women), scoring in the minimal symptom range on either scale; the second subgroup included 17 participants (eight men and 10 women), scoring in the light range; and the third subgroup was composed of 25 participants (six men and 19 women), scoring in the moderate to severe range on either of the two scales. Five sleepwalkers were excluded from the analyses because they had not completed one of the two instruments. The light psychopathology and the moderate to severe psychopathology subgroups were each compared to the minimal or no psychopathology subgroup.

As shown in Table 5, sleepwalkers in the minimal or no psychopathology subgroup did not significantly differ from either the light or the moderate to severe subgroups on several variables,

**Table 5**  
Proportion of sleepwalkers reporting various clinical and phenomenological features of their sleepwalking as a function of psychopathology severity.

Variable	Severity of Psychopathology		
	Minimal (n = 57)%	Light (n = 18)%	Moderate-Severe (n = 25)%
Family history of SW/ST (mother or father)	57.4	47.1	33.3 <sup>a</sup>
SW onset during adulthood	24.6	5.6	20.0
SW episodes at least 2-3 times a week	46.4	33.3	44.0
Presence of sleep terrors	61.4	82.4	76.0
Frequent nightmares (over once per week)	7.0	22.2	32.0 <sup>*,a</sup>
Left house and walked outdoors	5.4	23.5 <sup>a</sup>	20.8 <sup>a</sup>
Walked on a balcony	10.9	41.2 <sup>*,a</sup>	37.5 <sup>*,a</sup>
Handled a knife or a gun	0	17.6 <sup>b</sup>	28.0 <sup>*,b</sup>
Injurious episode	42.9	58.8	60.0
Worried by their SW	53.6	77.8	72.0
Recalls mentation occurring during episodes	78.9	77.8	62.5
Believes sleep mentation triggers SW	69.8	76.9	31.6 <sup>*,a</sup>
SW increased by stressful events	74.1	76.5	91.7
SW increased by Sleep deprivation	29.6	41.2	45.8
Bad dreams increase SW	49.1	58.8	56.5
SW increased by alcohol intake	7.7	11.8	4.2
SW increased by caffeine intake	0	17.6 <sup>b</sup>	13.0 <sup>*,b</sup>
SW increased by pain or migraine	1.9	5.9	25.0 <sup>*,b</sup>

Note SW = sleepwalking; ST = sleep terror.

<sup>\*</sup> Statistically significant at  $p < .05$ .

<sup>\*\*</sup> Statistically significant at  $p < .01$ .

<sup>a</sup> Chi-square.

<sup>b</sup> Fisher exact test.

including the proportion of sleepwalkers with an adult onset, frequent episodes (i.e.,  $\geq 2$ /week), or concomitant ST. However, sleepwalkers with greater psychopathology were more likely to report having frequent nightmares or having engaged in potentially dangerous or injurious behaviors during their episodes; they also were less likely to present a family history for somnambulism, ST, or both.

When asked to rate a number of factors that could increase their SW frequency, no between group differences were found in the self-reported impact of stressful life events, sleep deprivation, or alcohol consumption. However, a greater proportion of sleepwalkers in both the light and the moderate to severe psychopathology subgroups reported that caffeine consumption increased their chances of having somnambulistic episodes. Experiencing pain or migraines was identified as an important precipitating factor only by sleepwalkers who reported the highest levels of psychopathology.

Finally, the groups did not significantly differ in the proportion of sleepwalkers who reported recall of sleep mentation associated with their somnambulistic episodes; however, sleepwalkers who reported more severe symptoms were less likely to believe that their episodes were actually triggered by sleep mentation.

We also examined if gender impacted the clinical and phenomenological presentation of the disorder, irrespective of psychopathology. Overall, the profiles of men and women were similar, though women were more likely than men to report comorbid ST.

#### 4. Discussion

Our investigation of psychopathology in a large cohort of patients meeting ICSD-II diagnostic criteria for SW revealed that 16% had a psychiatric diagnosis based on the *Diagnostic and Statistical Manual of Mental Disorders*, Fourth Edition, at the time of their referral and also that fewer than 20% of participants scored in the moderate to severe range of psychopathology on standardized measures of depression and anxiety. The mean BDI-II and BAI scores obtained from our sample of sleepwalkers were similar to those found to characterize college- and community-based samples [39,43,44]; the scores also were similar to those in patients presenting with other sleep disorders [45,46] and in medical outpatient populations [47–49]. Furthermore, our sleepwalkers'

scores on measures of psychopathology were considerably lower than those observed in psychiatric populations in which reported group means often were up to twice as high [41,47,50,51]. Although our results are in line with those from other studies [11,30], they contrast with studies characterizing sleepwalkers as presenting with pervasive personality and psychiatric disorders [13,24,26]. Several factors may account for this discrepancy.

One key variable to consider is sample composition, including how somnambulism is defined and the clinical history of the participants investigated. For instance, the study by Sours et al. [24] included patients who developed SW after acute trauma, likely worsening the overall clinical picture of the sample. SW also can develop in conjunction with the intake of psychoactive medication [52], or in relation to a primary sleep disorder such as obstructive sleep apnea [53]. Although the merits of grouping such cases along with those presenting with idiopathic SW is open to debate, we opted to exclude sleepwalkers presenting with atypical symptoms or in whom SW was secondary to a preexisting condition (i.e., other primary sleep disorders). Of the 28 patients excluded for not meeting ICSD-II diagnostic criteria, most presented with complex, atypical or overlapping sleep disorders in conjunction with intake of multiple psychoactive agents. Among the excluded participants, 71% (20/28) showed evidence of significant psychopathology. It is likely that the psychopathologic profile of patients presenting with a primary SW disorder differs from those with comorbid sleep disorders, with a complex psychiatric or neurologic history, or with intake of pharmacologic agents for underlying psychological conditions.

Similarly, patients presenting with suspected SW may in fact have other disorders (e.g., nocturnal frontal lobe epilepsy, rapid eye movement sleep behavior disorder), which also can cause complex behaviors during sleep and thus be confused with somnambulism [17]. For instance, Schenck et al. [34] described a number of cases of nocturnal dissociative disorders presenting as SW. Establishing a differential diagnosis typically requires an in-depth assessment including a full montage PSG investigation, which rarely is done in studies reporting strong associations between SW and elevated psychopathology [13,24].

The second objective of our study was to examine possible differences between sleepwalkers with and without considerable psychopathology. Participants who reported more severe levels of psychopathology were less likely to have a positive family history for SW, suggesting a smaller genetic influence for SW. However, our groups did not significantly differ in the proportion of sleepwalkers reporting a childhood history vs adult onset of somnambulism. This finding is in contrast with findings obtained in psychiatric settings which showed that 44% of sleepwalkers have an adult-onset of the disorder [8], a percentage considerably higher than the 15% found in a population-based study [4]. It is noteworthy that 16 (57%) of the 28 sleepwalkers initially excluded from our study did not report a childhood history of somnambulism. Taken together, these findings suggest that adult-onset SW may be more frequent in individuals presenting with a clear psychiatric history or with the presence of complex or comorbid sleep disorders.

Sleepwalkers who scored high on measures of psychopathology were more likely than those with lower scores to report somnambulistic behaviors placing them at risk for physical injury though they did not have a greater likelihood of actual injurious episodes. They also reported a higher frequency of nightmares, which is noteworthy given that nightmares are associated with a broad range of psychopathologies including mood and anxiety disorders [54,55].

Sleepwalkers with elevated psychopathology were more likely to report that pain or migraines increased their chances of experiencing somnambulistic episodes. Migraines have been previously associated with SW [56,57], but the nature of this relation remains unclear. Because pain is known to fragment sleep and to increase arousals from NREM sleep [58], it could act as a trigger for behavioral episodes just as the presentation of external stimuli during deep sleep can induce somnambulistic episodes in sleepwalkers [59]. That these two factors were most evident in sleepwalkers with elevated psychopathology might be attributable to the higher occurrence of migraine and chronic pain in these patients. Specifically, self-reported rates of migraine and chronic pain were considerably greater in the elevated psychopathology subgroup (56% and 44%, respectively) than in the other sleepwalkers (29% and 14%, respectively). The higher prevalence of chronic pain within the elevated psychopathology subgroup is not surprising, as both are known to be highly comorbid conditions [60].

Finally, a minority of sleepwalkers with signs of psychopathology indicated that caffeine consumption favored the occurrence of somnambulistic episodes. Largely based on descriptive reports [9,61], some authors [62] have suggested that caffeine may trigger SW in predisposed individuals. In relation to this finding, one epidemiologic study found that sleepwalkers were more likely to be heavy consumers of coffee when compared to individual without parasomnias, though the difference was only marginally significant [7]. Contrary to several precipitating or facilitating factors documented for somnambulism [52], caffeine intake actually reduces SWS [63], the sleep stage out of which most episodes arise. It may be that some sleepwalkers exhibit a paradoxical reaction to the effects of caffeine on sleep, similar to sleepwalkers' atypical reaction to sleep deprivation [3]. Alternatively, because sleepwalkers have recently been shown to have excessive daytime sleepiness [14,64], it is possible that they consume increased quantities of caffeine as a form of self-medication.

## 5. Conclusions

Our results indicate that a strong majority of carefully assessed and diagnosed sleepwalkers do not present with overt psychopathology. It should be noted that a history of aggressive or potentially injurious behavior during sleep was what lead almost all of

our participants to consult a medical specialist and to be referred to our sleep disorders clinic. By contrast, adult sleepwalkers who do not seek professional help for their somnambulism likely experience episodes that are more benign and less frequently accompanied by agitated or potentially dangerous behaviors. There is no reason to believe that relatively milder cases of somnambulism found in the general adult population would be characterized by greater levels of psychopathology. However, various mental health pathologies may be considerably more prevalent in patients presenting with atypical and complex parasomnias or without a clear family history of the disorder. More work is required to better delineate the pathophysiologic and psychopathologic profiles of these various subgroups of sleepwalkers.

Our study has several limitations. First, the assessment of the psychopathology in our participants was based on self-report questionnaires. Even though the instruments employed possess excellent psychometric properties, a thorough psychiatric evaluation conducted by an experienced mental health professional would have yielded a more comprehensive clinical picture. Second, questionnaire scores may have been augmented by items related to fatigue and disturbed sleep, which might in fact be more closely related to the sleep disorder itself rather than to psychopathology. Third, the clinical characterization of the participants' SW episodes was self-reported during intake interviews, and the inclusion of household members during the interview process may have yielded useful corroborating or supplemental information. Finally, because a control group was not included in the present study, the scores of our sleepwalkers on measures of psychopathology were thus compared to those from clinical populations and normative findings published in separate studies.

## Conflict of interest

The ICMJE Uniform Disclosure Form for Potential Conflicts of Interest associated with this article can be viewed by clicking on the following link: <http://dx.doi.org/10.1016/j.sleep.2013.05.023>.

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