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The Neuropsychological and Emotional Profile of Adults with Parasomnia: A Case Series

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Abstract: Although parasomnias are nocturnal phenomena occurring during sleep or during arousals from sleep, there is increasing evidence that they are associated with daytime dysfunction as well. However, systematic studies in this field are scarce. The aim of the current case series was to investigate the sleep–wake, neuropsychological and emotional profiles of patients with parasomnias. Thirty patients with parasomnia (13 NREM, 17 REM) and 30 healthy subjects matched for age, sex and educational status were included. All participants underwent comprehensive neuropsychological, cognitive and behavioral evaluation. We found that parasomnia patients scored higher in all neuropsychological, emotional, sleep–wake and quality of life scales compared to healthy subjects. The presence of a parasomnia was associated with major impact on daytime functioning across several domains with increased levels of fatigue (FSS > 4) in 56%, sleepiness (ESS > 10) in 47%, depressive symptoms (BDI > 20) in 17%, anxiety (PSWQ > 52) in 17%, anger expression out (STAXI A > 16) in 27% and anger expression in (STAXI B > 16) in 23%, as well as a reduced average quality of life score (RAND derived from SF-36). Sleep–wake disturbances were significantly correlated with QoL scores. In the intergroup analysis between REM/NREM, we found that the REM group had worse cognitive performance and lower levels of fatigue/energy compared to NREM patients. These findings suggest that parasomnia is associated with difficulties in several aspects of daytime functioning (cognitive, affective/emotional and physical) and, therefore, parasomnia diagnostic workup should not be limited only to nocturnal phenomena.

Keywords: parasomnias; NREM parasomnias; REM sleep behavior disorder; daytime symptoms; depression; anxiety; fatigue; sleepiness; quality of life

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1. Introduction

The term "Parasomnia" is derived from the Greek word "para", meaning alongside of, and the Latin word "somnus", meaning sleep. It is the consequence of dissociation between wakefulness, NREM or REM sleep, with behaviors characteristic of one state succeeding the other [1]. Parasomnias are classified according to the sleep state they predominantly occur in: (a) rapid eye movement (REM)-related parasomnias, (b) non-REM (NREM)-related parasomnias and (c) other parasomnias [2].

Parasomnias are nocturnal phenomena that encompass a broad spectrum of events including abnormal motor, behavioral and sensory experiences that might result in sleep

disturbance, sleep fragmentation and, sometimes, injuries. While there is significant evidence on the impact of parasomnias on sleep architecture [3,4], their impact on daytime functioning has not been sufficiently investigated. However, in the recent years, there is an increasing interest in the bi-directional relationship between daytime symptoms and nocturnal episodes in patients with parasomnias.

Patients with NREM parasomnia have shown increased levels of distress, emotional manifestations, fatigue and excessive daytime sleepiness compared to healthy subjects [3,5–7]. Similarly, patients with REM Sleep Behavior Disorder (RBD) showed increased deficits in cognitive domains such as memory, attention, executive functions and decision making compared to healthy subjects [8–11]. Vice versa, psychological distress and abnormalities in the sleep–wake cycle (sleep deprivation or sleep fragmentation) have been reported as trigger factors of parasomnia episodes [12].

The aim of the present case series was to assess the sleep–wake, neuropsychological and emotional profiles of patients with REM and NREM parasomnias and compare them with the profiles of age-, sex- and education-matched control subjects.

2. Participants and Methods

The protocol for this case series was approved by the local ethics committee at Eginition Hospital, National and Kapodistrian University of Athens, Medical School (protocol number 574/23 September 2019).

2.1. Participants

In this prospective case series, we recruited 30 subjects diagnosed with at least one parasomnia REM (Isolated RBD-iRBD) or NREM (sleepwalking, sleep terrors, confusional arousals) and 30 control subjects matched for age, sex and educational status. Inclusion criteria for the parasomnia group in the present case series were as follows: (1) age 18 to 80 years old; (2) no alcohol or drug abuse history; (3) no major mental health problems or any intake of psychotropic medication; (4) clinically reported or previously diagnosed parasomnia based on the International Classification of Sleep Disorders—Third Edition (ICSD-III) [1,2,13]. Patients with known neurological and psychiatric disease or any severe pulmonary disease, subjects with REM Sleep Behavior Disorder with motor symptoms suggestive of a phenoconversion, as well as patients with nocturnal phenotype suggestive of epileptic activity were excluded (i.e., only Isolated RBD patients were considered). Inclusion criteria for the control group were as follows: (1) no sleep disorder history; (2) no alcohol or drug abuse history; (3) no major mental health problems or any intake of psychotropic medication; (4) no clinical sleep disorders history or other sever pulmonary disease. Patients were recruited after the screening by a sleep expert neurologist (AB). The patients were recruited at Outpatient Clinics of Eginition Hospital and collaborative institutions (Evangelismos Hospital and Attikon Hospital). All participants provided written informed consent.

2.2. Polysomnography

All subjects in the study group underwent a single-night video recording polysomnography (vPSG), where polysomnographies are routinely performed, following the same recording protocols. vPSG included electroencephalogram (international 10–20 system), electrocardiogram, electro-oculogram, chin and limb electromyography (EMG), nasal airflow, two channels of breathing effort and oximetry. All recordings were reviewed and scored manually according to the most recent American Academy of Sleep Medicine (AASM) criteria [14].

2.3. Sleep–Wake Questionnaires, Neuropsychological and Emotional Evaluation

All participants completed sleep–wake questionnaires and underwent a neuropsychological and emotional assessment during the week following the polysomnography.

A detailed sleep interview in a standardized manner and the neuropsychological and emotional assessment were administered by an experienced sleep psychologist (MN).

The total scores and sub-scores of the following standardized questionnaires were used to assess sleep–wake, neuropsychological, emotional and quality of life and general health measures: Trail Making Test A and B (TMT) [15]; Three Words–Three Shapes memory test [16]; Beck Depression Inventory-II (BDI-II) [17]; Depression, Anxiety and Stress Scale (DASS) [18]; Penn State Worry Questionnaire (PSWQ) [19]; Barratt Impulsiveness Scale (BIS-11) [20]; Emotional Regulation Questionnaire (ERQ) [21]; State-Trait Anger Expression Inventory (STAXI) [22]; Epworth Sleepiness Scale (ESS) [23]; Fatigue Severity Scale (FSS) [24]; and reduced quality of life questionnaire (RAND SF-36) [25,26].

2.4. Statistical Analysis

Data were described using frequencies and percentages for categorical variables and mean values and standard deviation (SD) for continuous variables. To assess differences in demographic characteristics between patient and control groups, we applied *t*-tests for independent samples and chi-square tests. Due to the skewed distribution of the measured scales and sample size, the non-parametric Mann–Whitney U test was applied to investigate differences in measured scales between controls and study group subjects, as well as the subgroup analysis. Spearman correlation coefficient was calculated to assess the correlation between the parameters of neuropsychological, emotional and quality of life scales. To assess differences between REM and NREM patients, Mann–Whitney U test was used.

Two-tailed *p*-values are reported. A p-value ≤ 0.05 was considered statistically significant. Statistical analysis was performed using IBM SPSS software version 26 for analysis (SPSS Inc., 2003, Chicago, IL, USA).

3. Results

3.1. Main Demographic and Clinical Characteristics of Patients with Parasomnia and Control Subjects

The case series included 30 subjects with parasomnia in the study group (17 with REM and 13 with NREM parasomnia) and 30 control subjects.

In the parasomnia group, the mean age was 52.7 years (SD $\pm$ 20.5); 28 were male. All subjects reported having experienced parasomnia episodes for >5 years and had a mean of two episodes/month.

In the control group, the mean age was 53.3 years (SD $\pm$ 10.6); 27 were male. Demographic characteristics of both groups are presented in Table 1.

Table 1. Distribution of demographic and clinical characteristics of patients with parasomnia (N = 30) and healthy subjects (N = 30).

Demographic Characteristics	Descriptive Measure		*p*-Value
	Patients (N = 30)	Controls (N = 30)	
Sex (males: n, %)	28 (93.3)	27 (90.0)	0.640 [1]
Age (years: mean, SD)	52.7 (20.5)	53.3 (10.6)	0.875 [2]
Educational level (n, %)			
Lower	1 (3.3)	1 (3.3)	
Secondary	18 (60.0)	18 (60.0)	0.999 [1]
Tertiary	11 (36.7)	11 (36.7)	
Clinical characteristics of parasomnia patients (N = 30)			
Diagnosis (n, %)			
REM	17 (56.7)		
NREM	13 (43.3)		
Frequency of events/week (median, 25th–75th p)	2 (1–5)		
Duration (years: median, 25th–75th p)	5 (3.8–10)		

SD: Standard Deviation; [1] chi-square test; [2] *t*-test.

3.2. Polysomnographic Characteristics of Patients with Parasomnia

The results of the PSG and several objective sleep–wake parameters of parasomnia patients are shown in Table 2. Compared to age-standardized reference values [27], mean sleep efficiency (81 ± 9%) was reduced, and 36% of the patients had a sleep efficiency of less than 80%. Mean PLMS (periodic limb movements in sleep) index was 6.8/h, and 8% had an increased PLMS index ≥ 15/h. Mean Apnea–Hypopnea index was 6.2/h, and 16% had an increased AHI ≥ 5/h.

Table 2. Polysomnographic parameters in the parasomnia group.

PSG Parameters	Mean ± SD
Sleep efficiency (%) *	81 ± 9
REM sleep (% of total sleep)	14 ± 3
NREM 1 sleep (% of total sleep)	12 ± 5
NREM 2 sleep (% of total sleep)	56 ± 16
Slow wave sleep (% of total sleep)	18 ± 15
Wake after sleep onset (%) *	18 ± 13

PSG, polysomnography; SD, standard deviation; REM, rapid eye movement; NREM, non-REM; * relative to sleep period time.

3.3. Sleep–Wake, Neuropsychological and Emotional Profiles of the Patient and Control Groups

Patients had a higher error score in TMT-A, denoting impairment of visual attention and executive functioning and a lower success rate than controls in the Three Words–Three Shapes memory test (Table 3).

In the patient group, pathologically elevated scores on the scales revealed that increased levels of excessive daytime sleepiness (ESS > 10) and fatigue (FSS > 4) were reported by 47% (0% in the control group) and 56% (30% in the control group) of the subjects, respectively. Increased levels of depressive symptoms (BDI > 20), clinical anxiety (PSWQ > 52), anger expression out (STAXI A > 16) and anger expression in (STAXI B > 16) were found in 17% (0% in the control group), 17% (0% in the control group), 27% (0% in the control group) and 23% (0% in the control group), respectively.

As shown in Table 3, subjects with parasomnia had a higher median level of fatigue and excessive daytime sleepiness compared to controls. They also showed significantly higher median scores in BDI; in the depression, anxiety and stress subscales of the DASS; in the PSWQ; in anger in, anger out and anger control (STAXI); in the BIS-11 for attentional and motor impulsiveness but not for non-planning impulsiveness; and in expressive suppression (ERQ) versus the control group. Finally, subjects in the parasomnia group had lower cognitive reappraisal (ERQ) and reported a poorer quality of life as assessed by the summary values and subdomains of the RAND-SF-36 (Table 3).

In the intergroup analysis in Table 3, subjects with REM and NREM parasomnia had a higher median level in almost all scales compared to the control subjects. In the REM group, patients had a worse performance in the memory test (Three Words Three Shapes) and in the TMT-A test compared to the control subjects and NREM group. They also showed lower energy/fatigue and role limitations due to physical health compared to the controls subjects and NREM group, as well.

Table 3. Neuropsychological, emotional, sleep–wake and QoL assessment in REM parasomnia, in NREM parasomnia and in control subjects.

Scales	GROUP I Control Subjects (N = 30)	GROUP II NREM Patients (N = 13)	GROUP III REM Patients (N = 17)	GROUP IV ALL Parasomnia Patients (N = 30)	Intergroup Comparison			
	Median (25th–75th p)	Median (25th–75th p)	Median (25th–75th p)	Median (25th–75th p)	I vs. II (p Value)	I vs. III (p Value)	II vs. III (p Value)	I vs. IV (p Value)
Trail Making Test (TMT)								
TMT A < 78″	30 (18.8–50)	35 (27.5–40)	60 (55–75)	50 (31.5–71.3)	0.265	<0.001 *	<0.001*	0.001 *
TMT B < 4.5′	2 (1.5–2.5)	1 (1–2)	2 (2–3)	2 (1–3)	0.010 *	0.028 *	<0.001 *	0.970
Memory test								
Three Words–Three Shapes	6 (6–6)	6 (6–6)	5 (5–5.5)	5 (5–6)	0.905	<0.001 *	<0.001 *	<0.001 *
Beck's Depression Inventory (BDI)	2 (1–3)	8 (4.5–12.5)	9 (4–15)	8.5 (4.8–15)	<0.001 *	<0.001 *	0.600	<0.001 *
Depression, Anxiety and Stress Scale (DASS)								
Depression	3 (2–6.3)	8 (4.5–12.5)	6 (3–9.5)	6.5 (4–10)	0.003 *	0.069	0.153	0.004 *
Anxiety	3 (1–4.3)	8 (6–11.5)	7 (5–8)	7.5 (5–9.3)	<0.001 *	<0.001 *	0.113	<0.001 *
Stress	5 (2–7.3)	11 (7.5–16.5)	8 (6–11)	10 (6.8–16)	<0.001 *	0.007 *	0.105	<0.001 *
Barratt Impulsiveness Scale (BIS-11)								
Attentional impulsiveness	12 (11–14)	19 (17.5–19)	18 (15.5–19)	18 (17–19.3)	<0.001 *	<0.001 *	0.260	<0.001 *
Motor impulsiveness	14 (12–15)	23 (20–26)	25 (21–27.5)	24.5 (21–27)	<0.001 *	<0.001 *	0.207	<0.001 *
Non-planning impulsiveness	30 (27–32)	30 (28–31.5)	29 (27–30)	30 (27.8–31)	0.947	0.279	0.228	0.494
State-Trait Anger Expression Inventory (STAXI)								
Anger expression out	11 (9.8–12.3)	14 (10.5–18.5)	12 (11–16)	13 (11–16.5)	0.019 *	0.025 *	0.916	0.005 *
Anger expression in	10 (9.0–12.3)	14 (11–15)	14 (12–20)	14 (11.8–19)	<0.001 *	<0.001 *	0.461	<0.001 *
Anger control	26.5 (24–28)	12 (10–16.5)	15 (12–18.5)	14.5 (11–17)	<0.001 *	<0.001 *	0.077	<0.001 *
Anger expression index (total)	12 (9–15)	28 (25–30.8)	25 (24–26.5)	25 (31–35)	<0.001 *	<0.001 *	0.044 *	<0.001 *

Table 3. *Cont.*

Scales	GROUP I Control Subjects (N = 30)	GROUP II NREM Patients (N = 13)	GROUP III REM Patients (N = 17)	GROUP IV ALL Parasomnia Patients (N = 30)	Intergroup Comparison			
	Median (25th–75th p)	Median (25th–75th p)	Median (25th–75th p)	Median (25th–75th p)	I vs. II (p Value)	I vs. III (p Value)	II vs. III (p Value)	I vs. IV (p Value)
Emotion Regulation Questionnaire (ERQ)								
Cognitive reappraisal	29 (27–32)	20 (17–26.5)	19 (12–27.5)	19.5 (15–27)	<0.001 *	<0.001 *	0.357	<0.001 *
Expressive suppression	6 (4–7)	6 (4–11)	12 (8.5–18)	9 (6–16)	0.285	<0.001 *	0.019 *	<0.001 *
Penn State Worry Questionnaire (PSWQ)	19 (16–23)	38 (21.5–44.5)	36 (19.5–49.5)	37 (21–48)	<0.001 *	<0.001 *	0.983	<0.001 *
Fatigue Severity Scale (FSS)	3 (1–7)	21 (12.5–36.5)	21 (12–30)	5 (1–10)	<0.001 *	<0.001 *	0.867	<0.001 *
Epworth sleepiness scale (ESS)	2 (1–3)	8 (6–11)	11 (7.5–13)	10 (7–12)	<0.001 *	<0.001 *	0.085	<0.001 *
RAND-Health Survey Questionnaire (SF-36)								
Physical functioning	100 (100–100)	90 (60–90)	90 (77.5–90)	90 (71–90)	<0.001 *	<0.001 *	0.740	<0.001 *
Role limitations due to physical health	100 (100–100)	100 (78–100)	85 (50–100)	90 (74–100)	0.062	<0.001 *	0.132	<0.001 *
Role limitations due to emotional problems	100 (100–100)	80 (0–100)	70 (0–100)	70 (0–100)	<0.001 *	<0.001 *	0.342	<0.001 *
Energy/fatigue	80 (70–80)	70 (60–80)	60 (45–70)	60 (45–80)	0.018	<0.001 *	0.047 *	<0.001 *
Emotional well-being	88 (86–90)	75 (63–75)	65 (56–68)	68 (56–75)	<0.001 *	<0.001 *	0.009 *	<0.001 *
Social functioning	100 (100–100)	75 (69–87)	68 (50–75)	70 (66–86)	<0.001 *	<0.001 *	0.110	<0.001 *
Pain	100 (100–100)	65 (50–65)	65 (35–100)	65 (48–83)	<0.001 *	<0.001 *	0.766	<0.001 *
General health	100 (83.8–100)	50 (50–63)	80 (50–80)	80 (55–80)	<0.001 *	<0.001 *	0.133	<0.001 *

* statistically significant result at level of significance 5%.

3.4. Associations of Neuropsychological, Emotional, Sleep–Wake Scales and Subscales of Quality of Life in Patients with Parasomnia

Based on exploratory analysis, in the parasomnia group, the following parameters were significantly positively correlated: Three Words–Three Shapes and anger expression index (rho = 0.55); Beck's depression inventory and depression-DASS (rho = 0.66); Beck's depression inventory and Stress-DASS (rho = 0.53); Anxiety-DASS and anger expression out (rho = 0.41); and Stress-DASS with Fatigue Severity Scale (rho = 0.40). A statistically significant negative correlation was found between the following: Trail Making Test-A and Three Words–Three Shapes (rho = −0.40); non-planning impulsiveness and expressive suppression (rho = −0.48); anger expression in and cognitive reappraisal (rho = −0.48) (Supplementary Table S1).

It must be noted, however, that all the above-noted findings should be considered suggestive, due to the fact that they do not remain significant after correction for multiple comparisons.

Regarding quality of life, statistically significant positive correlations were found between Three Words–Three Shapes and QoL scores related to role limitations due to physical health (rho = 0.40), emotional well-being (rho = 0.42), social functioning (rho = 0.39) and general health (rho = 0.40). There were also statistically significant positive correlations between anxiety and QoL score related to social functioning (rho = 0.38); attentional impulsiveness and QoL score related to limitation to emotional problems (rho = 0.39); and anger expression index and emotional well-being (rho = 0.53). Statistically significant negative correlations were found between motor impulsiveness and emotional well-being (rho = −0.42); expressive suppression and energy/fatigue (rho = −0.48); and Epworth sleepiness scale and social functioning (rho= −0.55). Supplementary Table S2 shows the correlation coefficients between scales measuring neuropsychological performance and quality of health.

4. Discussion

In this case series, we investigated the neuropsychological and emotional profile of parasomnia patients. Our findings suggest that, apart from the obvious nocturnal disturbances, the presence of parasomnia is associated with daytime dysfunction as well. Subjects with parasomnia were more likely to report increased levels of excessive daytime sleepiness, fatigue, depressive symptoms and anxiety. In addition, their performance on cognitive tasks was found to be worse compared to the performance of matched control subjects. Finally, parasomnia patients report difficulties in expressing and regulating their anger, as well as a reduced quality of life.

The finding that subjects with parasomnias show increased levels of anxiety compared to control subjects, based on the mean values of the DASS and PSWQ, suggests that anxiety is associated with the presence of parasomnia [7]. Indeed, previous studies showed that daytime stress is a frequent trigger factor of nocturnal episodes in adults [5,6,28–30] and in children/adolescents [5]. An earlier observational study [28] also found that in 58% of patients with NREM parasomnia, stress was a clear predisposing/trigger factor for parasomnia events. Interestingly, within the parasomnia group, the subjects with NREM parasomnias manifest higher levels of anxiety compared to subjects with REM parasomnias.

Our case series confirmed that subjects with parasomnias report increased levels of depressive symptoms. Specifically on the Beck scale [17], which assesses depression, patients with parasomnia had significantly higher scores compared to control subjects. These results confirm a recent retrospective study [31] that showed an association between the presence of RBD and mood disturbances (such as apathy and depression) in Parkinson's disease (PD) patients. There is some evidence involving serotonergic pathways in the inter-relation between emotional fluctuations and the occurrence of parasomnias [31,32]. To further support this notion, patients with parasomnias in our case series study appear to display more daytime anger, greater anger expression as captured by the State-Trait Anger Expression Inventory and greater impulsive behavior compared to healthy subjects, as

shown by the Barratt Impulsiveness Scale. We found that patients with parasomnia express anger in, as well as anger out, through their daytime. Although there is no clear evidence that patients with parasomnia have more frequent violent dreams, it is an established fact that violent behavior against themselves or their bed partners is not unusual among patients with parasomnias, particularly among patients with RBD [33,34]. Indeed, in RBD patients, injuries during sleep occur to more than 75% of patients or bed partners, including ecchymoses, lacerations, bone fractures and subdural hematomas [35]. Our data suggest that anger and impulsiveness possibly leading to violent behavior might not be simply a dream-related emotion but might reflect behavioral traits during daytime as well.

Regarding cognitive assessment, while there were no significant differences between the NREM parasomnia group and the control group, we found that the performance of patients with REM parasomnia was worse, compared to control subjects, in the Trail Making Test and Three Words–Three Shapes scales, both tasks representing tools to assess sustained visual attention and short-term memory. A worse performance in those tests implies the presence of deficits in several cognitive areas, in particular in visual scanning and attention, working memory and task switching. Previous studies have suggested that cognitive impairment in RBD subjects might be related to fragmented sleep [8,36]; however, as shown via polysomnography in our REM parasomnia group, sleep efficiency was lower than expected but sleep fragmentation was not prominent, suggesting that the reported cognitive changes might imply chronic brain changes and not just the consequence of a disrupted sleep. Indeed, in RBD patients [8–10], poor cognitive performance appears to be related to brain pathology, in particular to fronto-limbic brain alterations [37].

Reduced cognitive performance could also be associated with the presence of daytime symptoms such as excessive daytime sleepiness and fatigue: almost half of our subjects with parasomnia reported increased daytime sleepiness (ESS > 10) or fatigue (FSS > 4), which confirms previous reports on disturbances of wakefulness in these patients [38,39]. Also, although impaired mood is a known factor that can impair cognitive performance, in this study, no correlation was observed between the relevant questionnaires. Excessive daytime sleepiness in parasomnia seems to be related with the presence of nocturnal disturbances [38,40]; however an interesting aspect worth investigating in the future might be the presence of abnormalities in the circadian rhythmicity of these patients.

Parasomnia patients reported also reduced quality of life (QoL) compared to control subjects. Also, several aspects of their reduced daytime functioning were related to specific domains of quality of life. In the RAND SF-36-item Health Survey, subjects with parasomnia reported less energy and worse mood and motivation for activities compared to control subjects. In the parasomnia group, the subjective complaint of poor somatic health was associated with poorer memory and higher anxiety scores, while levels of anger and anger regulation were correlated with emotional/mental well-being. The reduced QoL could be interpreted as a consequence of physical, mental and cognitive health issues but also as a possible tendency of subjects with parasomnias to have a negatively biased view of their self-esteem, interpersonal relationships and generally of the world and, therefore, of their QoL, due to their strange, disturbing and sometimes violent nocturnal episodes [41].

The intergroup comparison between NREM and REM patients showed that emotional distress is more frequent and more severe among subjects with NREM parasomnias compared to subjects with REM parasomnias. Specifically, subjects with NREM parasomnias manifest higher levels of anxiety and stress compared to subjects with REM parasomnias. This is in line with previous reports that anxiety and stress is a predisposing factor of NREM parasomnia [28]. Furthermore, the NREM parasomnias are associated with changes in limbic system areas, and, as we know from the literature, quite a few neuroimaging studies [42–44] based on functional magnetic resonance imaging (fMRI) analysis have shown that sleep deprivation increases activity within the 'network of fear', which includes the limbic system and the saliency area involved in neurocognitive control [45]. On the contrary, REM parasomnia patients had poor performance in the Trail Making Test com-

pared to NREM, which appears to be connected to brain pathology, especially changes in the cortical brain areas [37].

5. Conclusions

In these case series, we applied a comprehensive battery of tools to assess behavioral, neuropsychological, emotional and QoL aspects in subjects with NREM and REM parasomnias and in control subjects and compare the results between the patients. Our findings confirm that different aspects of daytime functioning, including cognitive, affective/emotional and physical functioning, as well as quality of life, are negatively affected in subjects with parasomnia. The limitations of the study included the small size of the participants' the frequency of parasomnia events in the cohort, which could influence the neuropsychological/emotional profile of the patients; as well as the different NREM parasomnia and REM parasomnia phenotypes. Also, regarding control subjects, the lack of polysomnography in the healthy group is one more limitation of this study.

The above findings need to be confirmed in larger cohorts and highlight the need for a different diagnostic approach in subjects with parasomnia that will extend beyond the nocturnal features and will include a multimodal daytime cognitive, neuropsychological and physical assessment as well.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/ctn7040035/s1, Table S1: Correlation coefficient matrix between neuropsychological, emotional and sleep-wake scales; Table S2: Correlation matrix between neuropsychological, emotional and sleep wake scales with quality of life

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Conflicts of Interest: The authors declare no conflict of interest.

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