Dream recall frequency and nightmare frequency in patients with restless legs syndrome (RLS) or periodic limb movements disorder (PLMD)

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Summary. Dreaming in patients with sleep disorders, e.g., narcolepsy, insomnia, differs from dreaming in healthy controls. Dream research in patients with RLS/PLMD, however, is very scarce. Overall, 447 patients (263 women, 184 men) with RLS/PLMD and 208 healthy controls completed dream, sleep, and stress questionnaires during diagnostic procedures. The patient group did not show any differences regarding dream recall frequency but reported nightmares more often than healthy controls. This difference was no longer significant after controlling for daytime distress. This study indicates that patients with RLS or PLMD experience more nightmare than healthy persons – most likely due to the daytime burden associated with having this types of sleep disorders. Future research should study whether altered sleep physiology, e.g., vegetative and/or cognitive arousals, has a direct effect on the dreaming process.

Keywords: Restless legs syndrome, Periodic limb movement disorders, dream recall frequency, nightmare frequency, daytime distress

1. Introduction

Dreaming is defined as subjective experiences that occur during sleep and can, often partly, be recalled upon awakening (Schredl, 2018). As different sleep disorders are associated with altered sleep physiology (American Academy of Sleep Medicine, 2014), the question arose whether sleep disorders are also accompanied by changes in dreaming, e.g. altered dream recall frequency and/or altered dream content (Schredl, 2010). Three possible pathways seem plausible for possible links: (1) the pathophysiology of the sleep disorder directly affect the dreaming process, (2) the burden of having a sleep disorder is affecting waking life negatively, and dreams are affected because they reflect this negative waking life experiences, the so-called continuity hypothesis of dreaming (Schredl, 2003), and (3) a third variable might affect sleep and dreaming simultaneously.

An example for a possible direct effect of the sleep disorder on dreaming is narcolepsy as these patients report higher home dream recall frequency, more lucid dreams, and more bizarre dreams reflecting the overactive REM sleep systems underlying this disorder (Valli et al., 2020). Another example is the heightened home dream recall in patients with insomnia in comparison to controls (Schredl et al., 1998) which was explained by the heightened frequency of nocturnal awakenings. Interestingly, REM and NREM awakenings did not yield differences in dream recall between insomnia patients and healthy controls (Feige et al., 2018; Pérusse et al., 2016). In patients with depressive disorders which are often accompanied by disturbed sleep, the improvement of depressive symptoms during the day was directly correlated with a shift to more positive dream emotions in the course of the pharmacological treatment (Schredl et al., 2009) supporting the idea that improvement in waking symptomatology is reflected in dreams (even though a direct effect of depression on REM sleep (e.g., increased REM density) cannot be ruled out). Lastly, the findings that patients with insomnia experience more often nightmares (Schredl, 2009) and more negatively toned dreams (Feige et al., 2018; Pérusse et al., 2016; Schredl et al., 1998) than controls might point to the third pathway as stress play an important role in nightmare etiology (Levin & Nielsen, 2007) and insomnia etiology(Perlis et al., 2017). Overall, the three possible pathways do not exclude each other but may all contribute to the link between sleep disorder and altered dreaming.

The Restless legs syndrome (RLS), also called Willis-Ekbom disease, is characterized by a strong urge to move the limbs while resting, especially at bed time, often accompanied by uncomfortable sensations within the limbs, partially or totally relieved by movement, such as walking or stretching, at least as long as the activity continues (American Academy of Sleep Medicine, 2014). Most often, the legs are affected, but arms or even the whole body can show this symptomatology. The etiology is partly explained by genetic factors (often a positive family history is found) but the exact pathophysiological mechanisms are not fully understood, yet (Allen et al., 2022). Patients with RLS often report sleep problem, non-refreshing sleep, and a reduced quality of life (Allen et al., 2022). The prevalence of clinically significant RLS in the general population ranges between 4% to 7% (Harsanyi et al., 2022). Most RLS patients also show Periodic Limb movements during sleep (PLMS), but PLMS can

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Submitted for publication: September 2022
Accepted for publication: October 2022
DOI: 10.11588/ijodr.2022.2.90589

also occur independently from RLS, resulting – if clinically significant – in the diagnosis of a Period Limb Movement Disorder (PLMD); PLMS are repetitive, highly stereotyped limb, involuntary movements during sleep, often in the lower extremities (American Academy of Sleep Medicine, 2014). The exact prevalence of PLMD in the general population is not known, as this would require large-scaled polysomnographic studies (Harsanyi et al., 2022). Interestingly, dream studies in RLS are scarce.

Schredl (2001) found no differences in home dream recall frequency between 131 RLS patients and 762 controls; however, there was a significant negative association between dream recall frequency and PLMS index, supporting the idea that brief arousals may interfere with the dreaming process – a hypothesis formulated by Schredl et al. (1999) as patients with severe sleep apnea showed less bizarre dreams (not as elaborated) as patients with mild sleep apnea. A single-case report (Marin & Prado, 2013) described vivid RLS-related dreams (patient was running in his dreams to relieve the unpleasant leg sensations) even prior to the RLS diagnosis. However, in 190 dream reports of RLS patients 20% were related to walking and running, not significantly different from healthy controls (22.4%) (Schredl et al., 2012). On the other hand, dream emotions were more negative compared to healthy controls (Schredl et al., 2012). Two samples of patients with sleep disorders (also including RLS patients) nightmare frequency was elevated in comparison to controls (Goitom & Schredl, 2020; Schredl et al., 2012) which was interpreted as a heightened nightmare frequency in the RLS group as these patients did not differ from the sleep disorder group as a whole. To summarize, whereas alterations in dream recall and in disorder-related dream content have not yet been demonstrated, there might be more negatively toned dreams in patients with RLS.

The aim of this study was to compare dream recall frequency and nightmare frequency to a sample of healthy controls. Due to the burden associated with having RLS or PLMD (Allen et al., 2022), we expected higher nightmare frequencies in the patient group. We also tested whether the waking-life distress might explain the difference between patients and healthy controls, that is, the idea that burden due to the disorder is the main factor explaining the heightened nightmare frequency.

2. Method

2.1. Participants

In the present study, 447 patients (263 women, 184 men) with the diagnosis of a movement-related sleep disorder (restless legs syndrome (N = 318) and periodic limb movements during sleep (N = 129) and 208 healthy participants (136 women, 35 men) were included. The gender distribution was not significantly different ($\chi^2 = 2.6$, $p = .1099$. The patients had an average age of 51.26 ± 15.11 years (range: 12 – 91) and the healthy participants of 30.08 ± 12.03 years (range: 18 – 76). Age did differ significantly between the two groups ($t = 19.3$, $p < .0001$).

2.2. Measurements

2.2.1 Dream questions

Dream recall frequency in the last few months was measured with a seven-point scale: 0 = never, 1 = less than once a month, 2 = about once a month, 3 = two to three times a month, 4 = about once a week, 5 = several times a week, 6 = almost every morning (Schredl et al., 2014a). This item showed a high retest reliability of r = .83 (Schredl, 2004). For eliciting nightmare frequency an eight-point scale (0 = never, 1 = less than once a year, 2 = about once a year, 3 = about two to four times a year, 4 = about once a month, 5 = two to three times a month, 6 = about once per week, 7 = several times a week). This scale showed also a high retest reliability of r = .75 (Stumbrys et al., 2013).

2.2.2 Sleep questionnaires

The sleep questionnaire B (Görtelmeyer, 1986), short SFB-B questionnaire, contains 28 items which ask for sleep habits and subjective sleep parameters during the last two weeks. In the present analyses the 11 items about sleep quality (retest reliability after 4 weeks: r = .68), 8 items about their feeling of being refreshed in the morning (retest reliability after 4 weeks: r = .78) and one about nocturnal awakenings (retest reliability after 4 weeks: r = .61; Görtelmeyer, 1986) were included. These items were transformed – if necessary – to five-point scales and averaged. The item "How did you feel in the morning after awakening?" with the statement "well rested" included the following categories: 1 = never, 2 = rare, 3 = sometimes, 4 = often, 5 = very often and is an example item for measuring the feeling of being refreshed in the morning. The scale and item values vary between 1 and 5. Validity of the sleep quality item has been measured by comparing it to medical diagnosis which correlated highly r = -.63 (Görtelmeyer, 1986).

The Landecker Inventory for sleep disorders questionnaire (LISST) contains 75 items (Weeß et al., 2002); the following items respective indices were analyzed in the present study: nightmare frequency, problematic sleep-wake rhythm with 7 items, complaints of insomnia with 6 items, sleep quality which was coded as higher scores mean worse quality on 8 items, tiredness during the day with 5 items and complaints of parasomnia with 6 items. High reliability could be measured for sleep quality (Cronbach's alpha: 0.898) and tiredness (Cronbach's alpha: 0.830) (Weeß et al., 2002). The sleep quality item showed a high correlation (r = .74) with the sum score of the Pittsburg Sleep Quality Index (Buysse et al., 1989). An example which was part of the scale for sleep quality would be "During night, I get up because I cannot sleep anymore." All used items have been measured on a six-point scale (1 = never, 2 = rare, 3 = occasional, 4 = often, 5 = mostly, 6 = always). This was also the range of the nightmare "I have nightmares".

2.2.3 Stress questionnaire

The recreation-distress questionnaire EBF (Kallus, 1995) consists of 72 items which have been divided into 12 subtests consisting each of 6 items which all were rated on seven-point scales (0 = never, 1 = rarely, 2 = sometimes, 3 = several times, 4 = often, 5 = very often, 6 = always). Participants had to answer items like "In the last 3 days and nights, I have been aggressive." Of every subtest an average has been calculated and then averaged with the results of other subtests, seven subtests (42 items) were used to compute the distress index and five subtests measured recreation aspects. Internal consistency is for all subtests sufficient (r = .80 to r = .97; Hüppe, 1990). A 24-hour retest of a similar questionnaire showed correlations between r = .79

and r = .91 (Kallus, 1995).

2.3. Procedure

Patients were referred by physicians to our sleep center that is specialized for diagnosing and treating all sleep disorders except for sleep-related breathing disorders. All patients underwent a diagnostic interview and two nights of polysomnography with standard sleep measurements (EEG, horizontal and vertical eye movements, electrocardiogram and the submental electromyogram, leg movements and respiration measurements); these data served as basis for the diagnosis of a restless legs syndrome (RLS) and/or Periodic Limb Movements Disorder (PLMD) by a sleep specialist. As the questionnaires are part of the clinical routine, almost all patients completed the questionnaire, rare exceptions were language problems, i.e., patients were not so fluent in German in order to complete the questionnaire. The patients were diagnosed between January 2005 and June 2015. Only patients with the main diagnoses of Restless Legs Syndrome and/or Periodic Limb Movements were included in this analysis. Patients with a current mental disorder, e.g., depression, schizophrenia, were not included as in these cases the mental disorder would be the main diagnosis followed by additional – if present – sleep disorder diagnoses. The local ethics committee approved the retrospective analysis of the questionnaire data.

The healthy participants underwent the similar procedure (two nights of polysomnography), if a previously unknown sleep-disorder was detected, the participant was excluded.

Prior to the first sleep laboratory night, patients and participants were asked to complete the sleep, dream, and stress questionnaires.

Statistical analyses have been carried out with SAS 9.4 software package for Windows. Regressions have been used to analyze the effects of group, age, gender on dream recall frequency, nightmare frequency and other sleep questionnaire items. As the dream recall and nightmare frequency scales were ordinal, ordinal regressions were used for these variables. Moreover, Spearman Rank correlations were used to indicate the relationship between dream recall and nightmare frequency with other variables. The effect sizes for group differences (patients group vs. healthy controls) were computed according the formula given by Cohen (1988).

3. Results

In a first step, dream recall frequency and nightmare frequencies between the RLS group and PLMD group were compared using ordinal regression analyses in order to control for age and gender effects. None of the three variables showed a significant difference and, therefore, the RLS and PLMD groups were analyzed as one group. The distribution of dream recall frequency estimates for the two groups are depicted in Table 1. The percentage of high dream recall (recall of once a week or more often) was higher in the healthy controls (about 60%) compared to the patient group (about 40%). However, the difference in dream recall frequency was not statistical significant (see Table 3) after controlling for age and gender; that is, the difference shown in Table 1 is explained by the age difference between the samples. On the other hand, frequent nightmares (once a week or more often) were reported more often by the patients (about 12%) than by healthy controls (about 7%). The Spearman Rank correlation between dream recall frequency and nightmare frequency was significant: r = .477 ($p < .0001$, N = 611).

As reported above, there was no significant difference between RLS/PLMD patients and healthy controls regarding dream recall frequency (see Table 3). However, the patient group showed a higher nightmare frequency in both measures compared to healthy controls. Older age was related to lower dream recall frequency and nightmare frequency; whereas women tend to report higher dream recall and more nightmares (see Table 3). The two nightmare scales correlated with r = .750 ($p < .0001$, n = 591).

When distress (EBF index) was added to the regression analyses for nightmare frequency, patients with RLS/PLSM did not show a significantly higher nightmare frequency than healthy controls anymore (Standardized estimate = .0828, $\chi^2 = 2.4$, p =.1188) with significant effects of age (Standardized estimate = -.2128, $\chi^2 = 18.7$, p = <.0001), gender (Standardized estimate = .1428, $\chi^2 = 12.4$, p = .0004), and distress (Standardized estimate = .1947, $\chi^2 = 18.8$, $p < .0001$). The LISST nightmare frequency scale showed the similar pattern after adding the distress scale: group effect (Standardized estimate = .0791, $\chi^2 = 2.0$, p = .1532), gender (Standardized estimate = .1264, $\chi^2 = 8.9$, p = .0029) and distress (Standardized estimate = .2402, $\chi^2 = 25.9$,

Table 1. Distribution of dream recall frequency

	RLS/PLMD (N = 433)		Healthy Controls (N = 206)	
Category	Freq.	Percent	Freq.	Percent
Almost every morning	30	6.93%	15	9.28%
Several times a week	64	14.78%	56	27.18%
About once a week	70	16.17%	51	24.76%
About 2 to 3 times a month	79	18.24%	33	16.02%
About once a month	55	12.70%	23	11.17%
Less than once a month	67	15.47%	18	8.76%
Never	68	15.70%	10	4.85%

Table 2. Nightmare frequency distribution

	RLS/PLMD (N = 425)		Healthy Controls (N = 187)	
Category	Freq.	Percent	Freq.	Percent
Several times a week	28	6.59%	6	3.21%
About once a week	23	5.41%	7	3.74%
two or three times a month	42	9.88%	6	3.21%
About once a month	58	13.65%	26	13.90%
About two or four times a year	74	17.41%	56	29.95%
About once a year	42	9.88%	22	11.76%
Less than once a year	31	7.29%	13	6.95%
Never	127	29.88%	51	27.27%

Table 3. Dream recall frequency and nightmare frequency including ordinal regression analyses

	RLS/PLMD	Healthy Controls	Group effect				Age Effect			Gender Effect		
	M ± SD	M ± SD	SE	χ^2	p	Effect size	SE	χ^2	p	SE	χ^2	p
Dream recall frequency	2.76 ± 1.87 (N = 433)	3.58 ± 1.60 (N = 206)	-.0896	1.0	.3242	0.079	-.2646	30.8	<.0001	.1280	10.9	.0009
Nightmare frequency	2.62 ± 2.24 (N = 425)	2.37 ± 1.89 (N = 187)	.1736	13.7	.0003	0.295	-.2311	23.0	<.0001	.1375	11.8	.0006
Nightmare frequency item of LISST	2.23 ± 1.28 (N = 416)	1.82 ± 0.78 (N = 202)	.2020	16.1	<.0001	0.327	-.1336	7.2	.0074	.1153	7.8	.0052

SE = Standardized estimates

$p < .0001$). Age was only marginally significant (Standardized estimate = -.0935, $\chi^2 = 3.4$, $p = .0660$).

The results of the sleep and stress questionnaires are presented in Table 4. Overall, the patients with RLS/PLMD showed higher scores for distress, rhythm problems, complaints of insomnia, sleep quality, and tiredness during the day (large effect sizes). These patients also showed more parasomnia symptoms (medium effect size). The SF-B indices indicate also that the sleep quality and the feeling of being refreshed in the morning were reduced whereas they reported more awakenings during night (again with large effect sizes).

Mean PLMS index without arousals was 15.77 ± 7.04 (N = 413) in the patient group. This was not correlated with dream recall frequency ($r = -.013$, $p = .7864$, $N = 411$) but with nightmare frequency ($r = .103$, $p = .0392$, $N = 404$). As the PLMS-Index was also correlated with waking life distress ($r = .263$, $p < .0001$, $N = 410$), a partial correlation between nightmare frequency and the PLMS index was computed. That is, after controlling for the distress score, the correlation between the PLMS index and nightmare frequency was no longer significant ($r = .056$, $p = .2657$, $N = 392$).

4. Discussion

Overall, the findings indicate that patients with RLS or PLMD reported nightmares more often than healthy controls, whereas dream recall frequency did not differ. As this group difference was no longer present after controlling for daytime distress, the hypothesis that the burden due the sleep disorder might be responsible for the increased nightmare frequency was supported.

Prior to discussing the findings in detail, several methodological issues have to be taken into consideration. A clear advantage of this study is that the control sample underwent the exact same procedures (two night of polysomnography) than the patients and completed the questionnaires prior to the first lab night. In addition, we could exclude

Table 4. Means and standard deviations and parametric regressions for sleep and stress-related variables

		RLS/ PLMD	Healthy Controls	Group effect				Age Effect			Gender Effect		
		M ± SD	M ± SD	SE	t	p	Effect size	SE	t	p	SE	t	p
EBF	Recovery	2.11 ± 0.77 (N = 431)	3.48 ± 0.77 (N = 179)	-.6176	-16.4	<.0001	1.458	-.0206	0.6	.5855	.0092	0.3	.7714
	Distress	2.07 ± 0.77 (N = 431)	1.24 ± 0.67 (N = 179)	.5047	11.6	<.0001	1.031	-.1512	-3.5	.0006	.0074	0.2	.8346
LISST	Rhythm problems	22.65 ± 7.73 (N = 415)	16.56 ± 6.33 (N = 203)	.4521	10.0	<.0001	0.856	-.1548	-3.4	.0007	-.0885	-1.5	.1285
	Insomnia	16.44 ± 6.23 (N = 416)	11.50 ± 4.51 (N = 202)	.3908	8.6	<.0001	0.737	-.0219	-0.5	.6283	.0600	1.6	.1090
	Sleep Quality	30.06 ± 8.91 (N = 417)	14.85 ± 4.76 (N = 201)	.5474	15.7	<.0001	1.345	.2301	6.6	<.0001	.0628	2.2	.0293
	Tiredness	17.93 ± 5.49 (N = 415)	10.86 ± 3.59 (N = 201)	.6866	17.3	<.0001	1.482	-.2181	-5.5	<.0001	.0143	0.4	.6627
	Parasomnia	11.52 ± 4.96 (N = 418)	9.36 ± 2.62 (N = 203)	.2864	6.1	<.0001	0.522	-.0895	-1.9	.0575	.1288	3.2	.0010
SFB-B	Sleep Quality	2.73 ± 0.76 (N = 349)	4.15 ± 0.46 (N = 205)	-.6136	-17.8	<.0001	1.566	-.2014	-5.8	<.0001	-.0641	-2.2	.0252
	Feeling of being refreshed in the morning	2.39 ±0.82 (N = 349)	3.38 ± 0.74 (N = 205)	-.6657	-15.7	<.0001	1.382	.2584	6.1	<.0001	-.0260	-0.7	.4624
	Nocturnal Awakenings	3.90 ± 1.14 (N = 429)	2.27 ± 0.89 (N = 205)	.4668	12.2	<.0001	1.036	.2047	5.5	<.0001	.0396	1.3	.2112

EBF = Stress questionnaire, LISST, SFB-B = Sleep questionnaires, SE = Standardized estimates

any "healthy" persons with a relevant and hitherto undetected sleep-related breathing disorders and/or Periodic Limb Movements during sleep disorder. The findings that dream recall frequency and nightmare frequency declined with age in this sample also emphasize the validity of the findings as large population-based sample show a similar decline of these variables with age (Schredl et al., 2014b; Schredl & Göritz, 2019). Similar, the finding that women tend to recall their dreams more often and also report more often nightmares is in line with previous research summarized in two meta-analyses (Schredl & Reinhard, 2008, 2011). The two dream variables were measured retrospectively and there are pros and cons for this approach. On the one hand, keeping a log eliciting dream recall every morning can enhance dream recall drastically and, on the other hand, dream recall might be underestimated retrospectively due to memory (Aspy et al., 2015), so the "true value" is somewhere in-between. Some authors (e.g., Zadra & Donderi, 2000) argued that retrospective measures dramatically underestimate nightmare frequency but a more recent study (Zunker et al., 2015) was able to demonstrate that this underestimation was very small (effect size of d = 0.101). In the present study, comparing the patient group with the healthy control group, this methodological aspect should not affect the results. Due to retrospective nature of the study (long collection period), we did not have full medical records like somatic illnesses or medication of these patients. However, for the diagnostics within the sleep laboratory the patients did not take any sleep medication, RLS medication and/or psychotropic drugs. In addition, all patients did not suffer from a current mental disorder like major depression or schizophrenia, as these patients were not included – even if they had a RLS or PLMD disorder as a secondary diagnosis. However, it would be helpful if prospective studies include somatic comorbidities and medication intake to study possible effects on dream recall frequency or nightmare frequency.

The present study focused on the clinical data obtained by questionnaires, that is, assessing the subjectively experienced sleep problems, and did not include objectively measured sleep parameters like sleep efficiency, overall arousal index, arousals associated with periodic limb movements during sleep, REM sleep percentage and so on. In this study, the PLMS index was correlated with waking-life distress, that is, indicating the higher burden of a more severe sleep disorder, but for nightmare frequency there was no direct association between nightmare frequency and the PLMS index; it was mediated by daytime distress, pointing at the importance of subjective parameter if looking for factors that are associated with nightmare frequency. Interestingly, participants with frequent nightmares (once a week or more often) did differ significantly regarding subjective sleep quality (effect sizes around 1.00) from healthy controls but did not differ in parameters of the ambulatory carried out polysomnography, e.g., in nights 2 und 3 sleep efficiency was about 90% in both groups, the participants with nightmares and the controls (Paul et al., 2015). This finding and the present finding of no direct link between the PLMS index and nightmares suggest that objective sleep parameters might not explain differences in nightmare frequency in the RLS/PLMD groups. Nevertheless, it might be interesting to carry out more sophisticated physiological studies, for example, including parameters measuring the activity of the autonomic nerve system during sleep, especially REM sleep, like skin conductance or heartrate variability as these parameters were related to the occurrence of nightmares (Paul et al., 2019).

Home dream recall frequency did not differ between patients with RLS or PLMD and healthy controls – similar to the findings of Schredl (2001). In contrast to the previous study, we did not find a negative correlation between PLMS index and dream recall frequency. As the previous study (Schredl, 2001) suggested that arousals that are associated with PLMS might interfere with the dreaming process, it would be interesting to carry out REM and NREM awakening studies (not done so far in these patient groups) to study whether dream recall after these awakenings might be reduced.

The patient group showed marked differences (large effect sizes) in sleep quality, the feeling of being refreshed in the morning, tiredness during the day, and distress in general compared to the healthy control group – clearly reflecting the burden of having this type of sleep disorder (Allen et al., 2022). The difference in nightmare frequency was significant but of small to medium effect size; interestingly the difference was no longer significant if daytime distress was partialled out in the regression analysis. This might implicate that the negative dreams in these patient group reflect the consequences that RLS or PLMD has on their waking life (tiredness, not feeling refreshed etc.). A possible direct effect, the positive correlation of the PLMS index with nightmare frequency, is also related to the increased distress during the day (which is higher for higher PLMS indices). Although direct effects, e.g., a possible effect of vegetative arousals on dream emotions, could not be ruled out, the findings mainly support the so-called continuity hypothesis, that is, the sleep disorder negatively affects waking life and this negative effects, the disorder-related burden, affects dreams, that is, having more negatively toned dreams. The idea that sleep disorders might directly affect the limbic systems was formulated by BaHammam and Almeneessier (2019) who found a correlation between the apnea-hypopnea index during REM sleep and negative dreaming. It would be interesting to carry out sleep lab studies and awaken the patients (RLS and or REM-sleep related breathing disorders) after such arousals and compare these dreams with dreams from awakenings without arousals.

To summarize, this study indicates that patients with RLS or PLMD experience more nightmare than healthy persons – most likely due to the daytime burden associated with having this types of sleep disorders. Future research should take a closer look, e.g., with REM and NREM awakenings to elicit dream reports, in order to study whether altered sleep physiology, e.g., vegetative and/or cognitive arousal, has a direct effect on the dreaming process. From a clinical viewpoint, the findings suggest that asking RLS or PLMD patients about nightmares might be of value as nightmares are directly related to disorder-related daytime distress.

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