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The Impact of Suspected Sleep Apnea on Exposure, Relaxation, and Rescripting Therapy (ERRT): A Preliminary Examination

Katherine E Miller[1]*, Christopher C Cranston[2], Daniel V Simonet[3], Kristi E Pruiksma[4] and Joanne L Davis[5]

[1]National Center for PTSD, Dissemination and Training Division, VA Palo Alto Healthcare System, California, USA
[2]Department of Psychiatry & Behavioral Sciences, Division of Medical Psychology, Johns Hopkins University School of Medicine, Maryland, USA
[3]Department of Psychology, Montclair State University, New Jersey, USA
[4]Department of Psychiatry, University of Texas Health Science Center, Texas, USA
[5]Department of Psychology, The University of Tulsa, Oklahoma, USA

***Corresponding author:** Katherine E. Miller, NCPTSD D&T Division, VA Palo Alto Healthcare System, California, USA, Tel: 650-493-5000; **E-mail:** katherine.miller13@va.gov

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Abstract

Purpose: Trauma exposure is associated with nightmares, insomnia, and increased reports of obstructive sleep apnea (OSA), which may exacerbate trauma symptoms and interfere with treatment outcome. This study explored the impact of suspected OSA on treatment outcomes following Exposure, Relaxation, and Rescripting Therapy (ERRT) for chronic trauma-related nightmares.

Methods: Seventy trauma-exposed adults participated in a trial of ERRT. Self-reported OSA was assessed at baseline. Nightmare frequency and severity, sleep quality, insomnia severity, depression and posttraumatic stress symptoms were measured at baseline, and then one-week, three-months, and six-months following the end of treatment.

Results: Individuals with suspected OSA reported greater baseline symptom severity across all outcomes, except nightmare frequency, compared to their non-apnea counterparts. All participants reported significant reductions across symptoms following treatment, yet symptom levels in those with suspected OSA remained elevated compared to the non-apnea group. No significant group by time moderation emerged.

Conclusions: Trauma-related nightmares and associated symptoms are amenable to treatment, despite suspected OSA. Yet, individuals with OSA may continue to report clinically-significant symptoms, highlighting the potential need for an integrated therapy approach.

Keywords: Posttraumatic stress; Sleep apnea; Sleep quality; Nightmares

Introduction

Sleep disturbances are considered the hallmark of Post Traumatic Stress Disorder (PTSD) [1]. Symptoms of sleep disruption associated with PTSD include insomnia, Rapid Eye Movement (REM) sleep behavior disorder, and chronic nightmares, as well as other primary sleep disorders. A large proportion (50-90%) of individuals diagnosed with PTSD are suspected to have sleep-disordered breathing, such as Obstructive Sleep Apnea (OSA) [2,3]. OSA is characterized by repeated upper airway obstruction during sleep, leading to arousals and sleep fragmentation [4]. Left untreated, OSA increases the risk for cardiovascular conditions, obesity, and motor-vehicle accidents [5]. Additionally, OSA may worsen the course of trauma-related symptoms [6], and interfere with psychological treatment efforts. Recent studies examined the impact of OSA on symptom outcomes following evidence-based trauma-focused therapies, Prolonged Exposure [7] and Cognitive Processing Therapy [8]. Both studies found that PTSD symptom response at the end of treatment was significantly attenuated in those with OSA compared to those without OSA, despite receiving an adequate dose of treatment sessions.

Unfortunately, the relationship between OSA and nightmares is not well-understood. A greater number of apneic episodes has been associated with reduced recall of nightmares, perhaps due to suppression of rapid-eye movement (REM), the sleep stage most associated with nightmare occurrence [9]. In contrast, other studies found OSA to be associated with greater dream recall, particularly dreams with more emotional content [10]. Krakow et al. [3] propose a bi-directional relationship between sleep-disordered breathing and PTSD. Specifically, they suggest that sleep fragmentation arising from nighttime PTSD hyperarousal, often via nightmares and insomnia symptoms, can create vulnerability for upper airway

collapsibility; consequently, the sleep fragmentation from breathing obstruction can worsen PTSD symptoms. This theory needs to be validated; however, there is evidence to support that compliance with Continuous Positive Airway Pressure (CPAP) treatment for OSA has shown to reduce nightmare frequency among both idiopathic and trauma-related nightmare sufferers, and additional posttraumatic stress symptomatology in Veteran populations [11,12]. Several possibilities exist for why treatment of OSA may lead to PTSD symptom mitigation. One possibility is that reducing respiratory events may consequently reduce REM sleep fragmentation, allowing for additional emotional processing to occur at night [13].

Cognitive-behavioral therapy for nightmares (CBT-N) are available and have evidence for reducing nightmare frequency and severity, as well as improving depression and PTSD symptoms (average Cohen's *d*=0.56 for nightmare frequency [14]). Exposure, Relaxation, and Rescripting Therapy (ERRT) is one efficacious CBT-N that specifically targets trauma-related nightmares [15,16]. However, previous research on ERRT has yet to examine how sleep apnea may impact treatment outcome. Given the high rates of OSA among trauma-exposed populations and the previous reports of these conditions impairing treatment outcomes [7,8], the present study aims to add to the literature by 1) describing potential sleep apnea symptoms among a trauma-exposed community sample seeking treatment for nightmares; 2) assessing baseline differences on symptomatology between those with or without suspected sleep apnea; and 3) examining whether suspected sleep apnea moderates the effects of ERRT over time.

Materials and Methods

Participants

Men and women (*N*=70) were recruited from the community and completed treatment for trauma-related nightmares in a randomized control trial (RCT) comparing the efficacy of two treatment groups: (1) the full ERRT protocol, with nightmare exposure and rescripting (i.e., changing of nightmare content), versus (2) a dismantled version of ERRT, without the exposure and rescripting components [17]. Eligible participants were at least 18 years of age, experienced any Criterion A traumatic event [18] at least 3 months prior to initial evaluation, and reported at least one nightmare per week for the past month. Exclusion criteria included history of psychosis or mania, cognitive impairment, suicidal intent, and untreated substance use disorders.

Procedures

Refer to Pruiksma et al. [17] for a detailed description of the larger RCT. Briefly, interested individuals were screened for eligibility and those meeting initial inclusion criteria were scheduled for an in-person evaluation of exclusion criteria. If eligible following this evaluation, participants were randomized, *via* a random number generator, to one of the two treatment groups and scheduled for treatment. Participants received three sessions of treatment (full ERRT or ERRT without exposure). The full treatment protocol includes psychoeducation, relaxation techniques, sleep behavior modification, and written and oral exposure and rescripting techniques. Participants were assessed again one week, three- and six-months following the completion of treatment by assessors, who were blind to treatment group assignment. Procedures received institutional review board approval, and informed consent was obtained from all participants.

Measures

In order to assess suspected sleep apnea, eight items from the Sleep-50 Questionnaire [19] that form the 'sleep apnea' scale were totaled (range 8-32). This measure was included to provide a comprehensive screening of sleep disorders listed in the Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM-IV-TR [18]). Validation data indicates that a cut-score of 15 provides adequate sensitivity (0.85) and specificity (0.88) in predicting suspected sleep apnea. The Clinician Administered PTSD Scale (CAPS) was used to assess criteria for PTSD from the *DSM-IV-TR* [18-20]. This version separates queries for frequency and intensity on a 5-point scale (0-4). The Trauma-Related Nightmare Survey (TRNS) was developed for studies of ERRT and assessed nightmare frequency and severity throughout treatment and follow-up assessments [21]. The Beck Depression Inventory-II (BDI-II) assessed depression symptoms, with total scores ranging from 0-63 [22]. Scores of 20-28 suggest moderate levels of depression. The Pittsburgh Sleep Quality Index (PSQI) assessed qualities and problems associated with sleep during the past month [23]. Global sleep quality scores range from 0-21, with a cut score of 5. The Insomnia Severity Index (ISI) examined the degree of insomnia severity (range 0-28), with scores of 15-21 suggesting moderate insomnia [24].

Analytical strategy

The primary results of treatment outcome study [17] found significant reductions in all outcomes overall and no statistically significant differences between the treatment conditions. Therefore, participants from both groups were combined to improve power for the present analyses. Using the cut-off score suggested by Spoormaker et al. [19], suspected sleep apnea was dichotomized into not likely (<15 total score on SLEEP-50 items) and likely sleep apnea (≥ 15 total score on SLEEP-50 items). T-tests were used to examine whether baseline symptom level means were statistically different by suspected OSA group membership. Then intent-to-treat analyses were conducted using the MIXED procedure from the Statistical Package for Social Sciences (SPSS), Version 21 [25], to perform linear mixed models analysis of variance (ANOVA). The SPSS MIXED procedure uses maximum likelihood estimation, which accommodates missing data and eliminates the typical problem of list wise deletion. No statistically significant differences were observed on missing follow-up assessments between those with suspected OSA and those without suspected OSA. To examine

the effect of suspected sleep apnea on symptoms, statistical models with time, suspected OSA group membership, and group-by-time interactions were used.

Results

Participants were aged 18 to 73 years (*M*=42.53, *SD*=14.55), primarily female (71%) and European American (86%). Most were married (37%) or divorced (20%), and had some college education (75%). All participants reported at least one criterion A traumatic event [18], with an average of 6.26 (*SD*=3.42) potentially traumatic events in their lifetime. Sexual assault (16%), physical assault with a weapon (10%), and motor vehicle accidents (10%) were the most frequently reported worst traumatic events. See table 1 for additional demographic details.

Baseline symptoms and differences by suspected sleep apnea group membership

Prior to the start of treatment, participants reported an average of four nightmares in the past week (*SD*=2.81), moderate nightmare severity (*M*=4.03, *SD*=0.82), poor global sleep quality (*M*=13.35, *SD*=4.08), moderate levels of insomnia (*M*=15.96, *SD*=5.17), moderate levels of depression (*M*=23.83, *SD*=13.50), and moderate PTSD severity in the past week (*M*=48.14, *SD*=24.95), with 64.3% meeting PTSD criteria. Regarding suspected sleep apnea, the average total score on the SLEEP-50 sleep apnea items was 15.56 (*SD*=3.74), with 58.6% of participants meeting the threshold for a likely diagnosis of sleep apnea.

At baseline, participants with suspected sleep apnea reported significantly greater levels of nightmare severity ($t(49.54)=-2.30$, $p<.05$), PTSD severity ($t(68)=-4.26$, $p<.001$), global sleep impairment ($t(33.64)=-3.58$, $p=.001$), depression symptoms ($t(68)=-5.18$, $p<.001$), and insomnia symptoms ($t(68)=-5.77$, $p<.001$), compared to those in the non-apneic group. No significant difference emerged on number of nightmares in the past week.

Table 1: Demographics for sample and by suspected sleep apnea group membership

Demographic Variables	Full Sample (N=70)		Suspected OSA Group (n=41)		No Suspected OSA Group (n=29)	
	n or M	% or SD	n or M	% or SD	n or M	% or SD
Age	42.53	14.55	41.05	14.06	44.62	15.22
Gender						
Woman	50	71.40	26	63.40	24	82.80
Identified Race						
Caucasian	60	85.70	33	80.50	27	93.10
American Indian	7	10.00	5	12.20	2	6.90
African American	1	1.40	1	2.40	0	0.00
Asian	1	1.40	1	2.40	0	0.00
Unknown	1	1.40	1	2.40	0	0.00
Years of Education	14.86	2.79	14.53	2.43	15.31	3.22
Marital status						
Married	26	37.10	16	39.00	10	34.50
Divorced/Separated	14	20.00	8	19.50	6	20.70
Single	13	18.60	8	19.50	5	17.20
Living with partner	13	18.60	7	17.10	6	20.70
Widowed	4	5.70	2	4.90	2	6.90
Vocational Status						
Retired	9	12.90	5	12.20	4	13.80
Unemployed	19	27.10	13	13.70	6	20.70
Full Time	30	42.90	15	36.60	15	51.70
Part Time	6	8.60	3	7.30	3	10.30
Student	6	8.60	5	12.20	1	3.40
Receiving PTSD Treatment	20	28.57	16	39.02	4	13.79

Suspected sleep apnea effects on ERRT

Table 2 provides the means, standard deviations, and results from the linear mixed models analyses of treatment outcome variables. Statistically significant main effects for suspected sleep apnea group membership were observed for all outcomes, except nightmare frequency and severity. Specifically, participants with suspected sleep apnea reported greater symptom levels across domains, except the nightmare variables, compared to the non-suspected sleep apnea group. Additionally, statistically significant main effects for time were observed for all outcome variables, indicating a statistical improvement in all symptoms across time. No significant interactions between group and time were observed for any outcome, suggesting that treatment response over time was not impacted by suspected sleep apnea.

Given the potential influence of baseline PTSD symptom severity on post-treatment change, two supplementary growth curve models were conducted to test the robustness of findings. First, change in PTSD scores (baseline to 6-month post-assessment) using a first-order autoregressive structure with varying person intercepts and slopes were analyzed. Treating time and sleep apnea group membership as fixed factors, evidence remains for a marginal effect of treatment course, b=-4.11, $t(85)$=-1.76, p=.08, and main effect of sleep apnea, b=22.64, $t(68)$=4.21, p=.0001, but no interaction, b=-.98, $t(85)$=-.30, p=.76. Second, growth curves for all other outcomes with baseline PTSD as a covariate were conducted. In almost all cases, results replicate the mixed ANOVAs. One exception was global sleep quality which presents a significant suspected sleep apnea by time interaction, b=-1.56, $t(53)$=-2.64, p=.01 (Figure 1). Based upon the figure, this effect is driven by unique gains in sleep quality for the suspected sleep apnea group from 3-6 months post-treatment relative to no gains in the same time duration for the non-apnea group.

Discussion

There were three aims in this study. The first was to describe suspected sleep apnea symptoms among a sample of trauma-

Table 2: Means, Standard Deviations, and Intent-to-Treat Linear Mixed Models Analyses of Outcome Variables Across Time

Symptoms		Baseline			1-week			3-month			6-month				Group main effect	Time Main Effect
	Sleep Apnea	n	M	(SD)	n	M	(SD)	n	M	(SD)	n	M	(SD)	d	n	F	F
Nightmare Frequency															69	2.83	18.43***
	Yes	40	4.68	2.73	22	3.25	2.78	15	2.47	2.33	10	1.9	2.81	1			
	No	27	3.33	2.78	16	2.31	3.84	11	0.45	0.52	12	1.42	2.81	0.68			
Nightmare Severity															70	1.34	6.55**
	Yes	41	4.22	0.69	22	3.64	1.09	14	3.64	1.23	10	2.8	1.32	1.35			
	No	29	3.76	0.92	15	3.47	0.92	11	2.91	1.38	9	3.11	1.67	0.48			
PTSD Symptom Severity															70	13.91***	3.79*
	Yes	41	57.68	22.49	23	48.96	29.64	15	52.73	33.47	10	37.3	29.71	0.77			
	No	29	34.66	22.13	16	31.25	20.23	11	26.73	28.42	12	19.75	16.64	0.76			
Global Sleep Quality															63	5.85*	24.40***
	Yes	30	14.97	3.06	18	9.67	4.29	13	10.08	4.09	7	7.29	5.09	1.83			
	No	21	11.05	4.32	8	5.25	1.91	9	7.78	3.15	12	7.58	2.54	0.98			
Insomnia Severity															70	13.16**	26.79***
	Yes	41	18.44	4.23	22	12.82	6.29	15	13.6	7.33	10	8.2	5.77	2.02			
	No	29	12.45	4.31	16	6.56	4.41	10	9.7	5.5	11	6.64	5.68	1.15			
Depression Symptoms															70	26.54***	7.64***
	Yes	41	29.83	11.49	22	23.36	14.53	14	24.93	13.41	9	23.44	17.06	0.44			
	No	29	15.34	11.56	16	8.31	6.92	10	10	9.08	12	6.33	6.43	0.96			

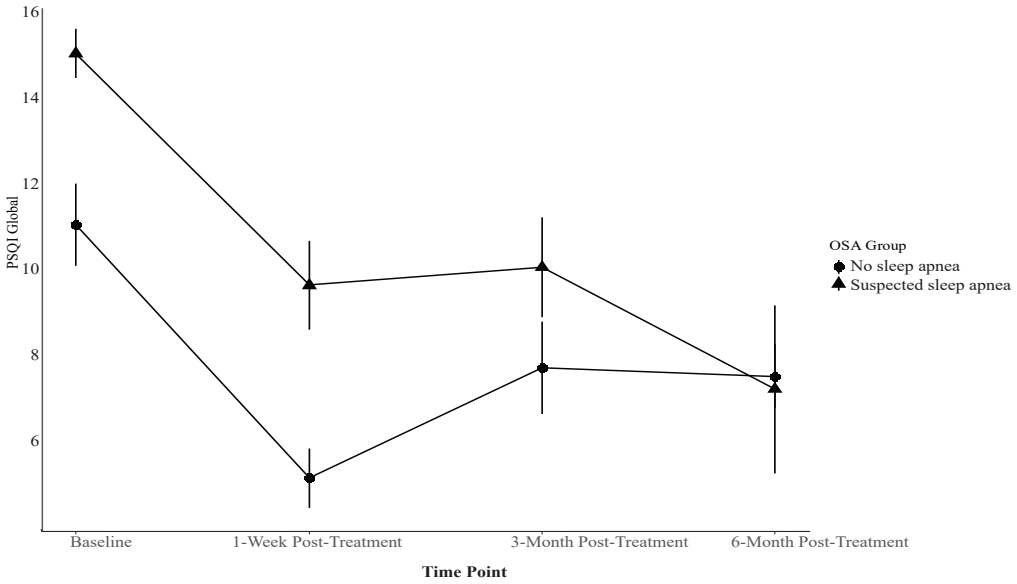

Figure 1: Effect of suspected sleep apnea classification and time on global sleep quality (PSQI Global) change following ERRT.

related nightmare sufferers. Approximately half of the sample met the threshold for a suspected diagnosis of sleep apnea. This result corroborates previous research indicating a high comorbidity between trauma symptoms, including nightmares, and sleep-breathing difficulties [3]. The second aim of the study was to assess baseline differences on symptomatology between those with or without suspected sleep apnea. Individuals reporting more symptoms of sleep apnea also reported greater levels of sleep disturbances and additional trauma symptoms, except for number of nightmares experienced in the past week. These results are consistent with previous research indicating that trauma-exposed individuals diagnosed with sleep apnea may experience greater symptomatology compared to their non-apneic equivalents [26]. The fact that the study targeted individuals with frequent nightmares may account for the lack of difference between groups on this variable.

Lastly, this study aimed to examine whether suspected sleep apnea moderated the effects of ERRT over time. Results from this preliminary examination found that ERRT was efficacious in reducing symptoms regardless of suspected sleep apnea symptoms. It is proposed that ERRT may work through decreasing both physiological and psychological-induced arousal, *via* the multimodal approach [16]. Psychological-induced arousal is a factor involved in both posttraumatic stress symptoms and sleep apnea. Previous studies of ERRT found that decreases in heart rate, skin conductance, and corrugator activity in response to nightmare imagery following treatment were related to symptom improvements [15]. Therefore, targeting hyperarousal activity may be an important focus for addressing the dysfunctional relationship between PTSD symptoms and the vulnerability of upper airway distress. Interestingly, after accounting for initial PTSD levels, a suspected sleep apnea by time interaction emerged.

Exploring the pattern suggests individuals with suspected apnea show greater gains in their sleep quality between 3-6 months following treatment completion, eventually matching non-apnea participants in terms of quality sleep. This finding corroborates the larger effect size for the apnea group. However, it is important to note that this interaction does not extend to other sleep functioning indicators (insomnia, nightmare frequency) implying the interaction is restricted to global sleep quality rather than domain-specific sleep problems.

Despite treatment benefits seen in the present study, individuals reporting more symptoms of sleep apnea also reported greater levels of sleep disturbances and additional trauma symptoms over time, except for number and severity nightmares in the last week. These results are consistent with previous research indicating trauma-exposed individuals diagnosed with sleep apnea experience greater symptomatology compared to their non-apneic equivalents, even with a course of evidence-based treatments [7,8]. While the benefits from a psychotherapeutic approach may start to attenuate the relationship between OSA and PTSD symptoms, this nightmare-focused intervention likely does not address the physiological changes that accompany breathing obstruction. Therefore, these data suggest that both conditions need to be addressed simultaneously.

Regarding the lack of a significant difference between groups on the nightmare variables, these results are consistent with the current state of the literature which is mixed on whether OSA may exacerbate or suppress nightmare prevalence [9,10]. There may be a few reasons for why nightmare frequency and severity decreased in both groups. First, ERRT is a treatment specifically targeting nightmares; therefore, it would be expected that individuals would receive the most benefit within

this domain. Additionally, previous work by Schredl and colleagues [27] found that oxygen desaturation was not related to nightmare frequency; rather, factors associated with daytime stress or the PTSD diagnosis may contribute more substantially to the nightmare experience in our sample. Overall, these results indicate that trauma-related sleep disturbances may be modifiable to treatment, as observed by a decrease in symptoms over time, even in the context of comorbid sleep apnea. Yet, some individuals would likely benefit from an integrated approach to address both the apnea symptoms and other trauma-related sleep disturbances.

While this study adds to the literature by examining the influence of suspected sleep apnea symptoms on treatment outcomes among individuals being treated for trauma-related nightmares, there are several limitations to consider. First, without an objective measure of sleep apnea (e.g., polysomnography) the actual rate of apnea within this sample is unknown. Studies show that trauma-exposed populations may be more likely to have sleep apnea [3]; therefore, the percentage of individuals with suspected apnea in this sample may be an under estimate. Additionally, the SLEEP-50 questionnaire is not specifically used to detect sleep apnea alone and several questions may require a bed-partner informing the sleeper about snoring, holding breath, and/or gasping in the night, which may be unknown to participants who sleep alone. Another limitation is that details of other psychotherapeutic treatment, medications, and possible CPAP therapy were not collected; therefore, outcome-influencing factors associated with additional treatment are unknown. Lastly, the small sample size and study attrition may reduce the accurate approximation of true parameters. Future research is needed to address these limitations and examine the potentially additive or sequential benefit to including CPAP therapy, for individuals with OSA, to this nightmare intervention.

Despite these limitations, this study contributes to a growing body of literature examining the influence of sleep apnea on the outcome of psychological treatment. Given the frequency of nightmares among trauma-exposed populations, it is imperative to better understand the influence of comorbid sleep conditions to increase personalized treatment plans. Improvement in assessment and the development of integrated interventions aimed to reduce nightmares and improve nighttime breathing may provide long-term improvements in overall quality of life for this population.

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