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SCIENTIFIC INVESTIGATIONS

Insomnia severity predicts depression, anxiety, and posttraumatic stress disorder in veterans with spinal cord injury or disease: a cross-sectional observational study

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Study Objectives: To assess the association of insomnia symptoms and psychiatric symptoms in patients with spinal cord injury or disease (SCI/D).

Methods: In this cross-sectional observational study, veterans with SCI/D (n = 72; mean = 59.85 ± 10.4 years; 92% male) completed baseline measures, including the Insomnia Severity Index (ISI) during the baseline phase of a clinical trial on treatment of sleep disorders in veterans with SCI/D. Depression severity was measured by the Patient Health Questionnaire (PHQ-9; sleep items excluded), anxiety severity was measured by the Generalized Anxiety Disorder screener (GAD-7), and probable posttraumatic stress disorder (PTSD) was measured by the Primary Care PTSD screener. Blocked regression was used to evaluate the impact of insomnia symptoms (ISI) on mental health measures after accounting for demographics and level of spinal cord injury/disease.

Results: On average, participants scored in the mild range for depression (PHQ-9 = 7.4 ± 5.9) and anxiety severity (GAD-7 = 6.1 ± 6.1). In total, 36.1% (n = 26) screened positive for probable PTSD. ISI explained 19% of the variance in PHQ-9 and 20% of the variance in GAD-7 ($P < .001$) over and above demographics and SCI/D level of injury/disease. Odds of probable PTSD were increased 1.22-fold for each 1 unit increase in ISI ($P = .001$) after accounting for demographics and level of injury/disease.

Conclusions: In veterans with SCI/D, insomnia severity was linked to depression and anxiety symptom severity and risk of PTSD. Study results warrant further research to evaluate the impact of insomnia treatment on depression, anxiety, and PTSD in patients with SCI/D.

Clinical Trial Registration: Registry: ClinicalTrials.gov; Name: Treatment of Sleep-disordered Breathing in Patients With SCI; URL: https://clinicaltrials.gov/ct2/show/NCT02830074; Identifier: NCT02830074.

Keywords: spinal cord injury, spinal cord diseases, insomnia, depression, anxiety, posttraumatic stress disorder

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BRIEF SUMMARY

Current Knowledge/Study Rationale: Both sleep difficulties and mental health symptoms are prevalent in individuals with spinal cord injury or disease (SCI/D). This study examined the relationship between insomnia and mental health symptoms beyond known risk factors using common screening measures.

Study Impact: Insomnia symptoms are predictive of depression, anxiety, and probable PTSD in individuals with SCI/D. Utilization of a brief insomnia screening questionnaire as part of standard screening in clinical settings that serve patients with SCI/D may help identify individuals with both sleep and mental health concerns that warrant further evaluation and treatment.

INTRODUCTION

Over a quarter of a million Americans are living with a spinal cord injury or disease (SCI/D).[1] Sleep disturbance[2] and mental health symptoms[3] are more common in patients with SCI/D vs the population at large, with symptoms that may be more severe or complex compared with individuals without SCI/D.[2,4] Individuals with SCI/D who report difficulties with sleep also experience more depressed mood, fatigue, cognitive impairments, worse cardiovascular and metabolic outcomes, and lower quality of life.[5–7] Insomnia disorder, or chronic difficulty falling and/or staying asleep most nights resulting in daytime functional impairment,[8] commonly co-occurs with mental health difficulties such as depression, anxiety, and posttraumatic stress disorder (PTSD).[9] Data regarding the relationship between insomnia and mental health in individuals with SCI/D remain limited, despite the potential implications for functioning in patients with SCI/D.

Sleep and psychiatric difficulties are common in the SCI/D population, and untreated insomnia is a known risk for psychiatric

symptom relapse in the SCI/D population.[10] Insomnia symptoms are reported by over 50% of patients with spinal cord injuries,[11] and poor sleep quality is reported by 44–62% of patients with multiple sclerosis (MS), a spinal cord disease.[12] Both poor sleep quality and clinician-assessed insomnia disorder are associated with lower quality of life in MS,[13,14] while poor sleep quality is also associated with greater disability.[14] Approximately 30% of individuals with spinal cord injury meet diagnostic criteria for depression during acute rehabilitation, and 11–60% of community-dwelling individuals with spinal cord injury report elevated depression symptomatology on self-report measures.[15] One study assessing mental health in Australian individuals with spinal cord injuries found 37% report depression and 30% report anxiety and 8% report PTSD,[4] rates that are higher than population estimates for depression (28%), anxiety (27%), and PTSD (4%).[16,17] Individuals with MS also tend to have lower quality of life versus healthy controls, which is largely influenced by mood.[18] These data suggest that screening for and treating sleep and psychiatric problems may influence functional outcomes for individuals with SCI/D.

The majority of studies linking poor sleep with mood or anxiety symptoms in individuals with SCI/D rely on a retrospective questionnaire with a complex scoring rubric.[12,18] To our knowledge, no studies have examined insomnia severity per se as a potential indicator of mental health in SCI/D. Additionally, we are not aware of any research in the SCI/D population using screening questionnaires that are brief, easy to administer, and predictive of clinical diagnoses for both insomnia and mental health disorders, specifically depression, anxiety, and PTSD.

The objective of this study was to examine the relationship between insomnia and psychiatric symptoms in patients with SCI/D beyond known risk factors for poor mental health in SCI/D. We hypothesized that insomnia symptoms contribute to depression and anxiety symptom severity and increase the likelihood of screening positive for PTSD.

METHODS

All study procedures were approved by the Institutional Review Board at the Wayne State University and the John D Dingell Veterans Administration Medical Center (JDDVAMC). A waiver of consent was obtained for electronic-health record screening, and a waiver for documentation of consent was obtained for telephone screening. Written informed consent was obtained prior to initiation of any study assessments or interventions for all enrolled participants.

Participants

Administrative data were used to identify veterans receiving care at the study sites with an SCI/D-related diagnosis code (ie, G35-MS, S24.101A-Unspecified injury at T1 level of thoracic spinal code) and were at least 3 months postinjury or postdiagnosis. We identified 751 potentially eligible individuals and sent a brief letter describing the study with an opportunity to opt out of being contacted for telephone screening. A total of 673 individuals were contacted and completed the initial telephone screening. Of these, 73 individuals that met inclusion criteria (see below) provided written informed consent, and 72 individuals completed baseline assessments from 1/1/2017 to 3/31/2020 for a trial on positive airway pressure therapy for patients with sleep-disordered breathing (SDB). Inclusion criteria for enrollment into the study were adult patients with chronic SCI/D (> 3 months postinjury or diagnosis) and American Spinal Injury Association[19] classification A-D (ie, those with no evidence of a neurologic deficits based on American Spinal Injury Association classification were excluded). Additional exclusion criteria were receiving mechanical ventilation, current user of positive airway pressure device for SDB breathing with objective documentation of optimal adherence, a clinical contraindication that prevented positive airway pressure use, unstable medical or mental health that could affect sleep (eg, < 90 days postcerebrovascular accident, acute myocardial infarction, surgery/hospitalization, substance use disorder with < 90 days sobriety), and inability to engage in study procedures or provide self-consent for participation (eg, related to dementia).

Procedure

Participants were recruited from the JDDVAMC, the Ann Arbor VA (AAVA) and the Louis Stokes Cleveland Department of VA Medical Center (LSCDVAMC) as described above. Individuals who expressed interest in participation or did not opt out after receiving the recruitment letter were contacted and screened for eligibility by phone. Potentially eligible individuals completed informed consent procedures and an in-person baseline assessment evaluating inclusion/exclusion criteria, sleep, and mental health symptoms. All baseline assessments were conducted by a trained research staff member at the JDDVAMC sleep laboratory or at LSCDVAMC (for participants living in the Cleveland area who could not travel to the JDDVAMC; n = 3).

Measures

Demographic data (ie, age, sex, race/ethnicity, education, marital status, body mass index) and level of spinal cord injury (cervical vs thoracic and below) or spinal cord disease diagnosis were collected via interview and, when possible, confirmed with medical record review. SDB diagnosis and severity was assessed by collecting the apnea-hypopnea index (AHI) metric for each participant either from their electronic medical record (for participants that had already completed a clinical evaluation) or by baseline polysomnography (PSG) as part of the study (for participants that had not previously completed a clinical evaluation). Study PSGs were conducted and scored for standard polysomnographic parameters in line with the current American Academy of Sleep Medicine manual.[20] The AHI metric was calculated as the number of apneas and hypopneas per hour of sleep. Study PSG technicians were required to meet the American Academy of Sleep Medicine Interscorer reliability program accuracy standards,[20] and all PSG scoring was confirmed by a board-certified sleep specialist; all were blinded to participant questionnaire scores. AHI values from PSG are reported as part of participant characteristics (see **Table 1** and **Table S1**, **Table S2**, and **Table S3** in the supplemental material).

All self-report symptom outcome measures described below are commonly used as part of routine clinical screenings for insomnia, depression, anxiety, and PTSD.

Insomnia severity

The Insomnia Severity Index (ISI)[21,22] is a 7-item self-report measure of insomnia symptoms. Items are rated between 0 ("not at all") and 4 ("very much"). All items are summed to determine the ISI score (range: 0–28; 0–7 = no insomnia, 8–14 = subthreshold, 15–21 = moderate, and 22–28 = severe insomnia). A score of 8 demonstrates sensitivity of > 0.96 and specificity of > 0.78 in identifying insomnia across both community and clinical settings.[23]

Depression symptoms

The Patient Health Questionnaire (PHQ-9)[24] is a 9-item self-report measure that assesses for depression severity over the previous 2 weeks (sensitivity = 0.77–0.88, specificity = 0.88–0.94).[25] Items are rated between 0 ("not at all") and 3 ("nearly every day"). All items are summed to determine the PHQ-9 score (range: 0–27; 0–4 = no depression, 5–9 = mild, 10–14 = moderate, and 15–19 = moderate-severe, and 20–27 = severe depression).[24]

Anxiety symptoms

The Generalized Anxiety Disorder screener (GAD-7)[26] is a 7-item self-report measure of anxiety (sensitivity and specificity for GAD = 0.80).[25] Items are rated between 0 ("not at all") and 3 ("nearly every day"). All items are summed to determine the GAD-7 score (range: 0–27; 0–4 = no anxiety, 5–9 = mild, 10–14 moderate, and 15–19 = moderate-severe, and 20–27 = severe anxiety).[26]

Posttraumatic stress disorder

The Primary Care PTSD screener (PC-PTSD-5)[27] is a 5-item measure based on *Diagnostic and Statistical Manual of Mental Disorders*, fifth edition[8] criteria that assesses for PTSD. Items are rated as "Yes" or "No." All items are summed to determine the PC-PTSD-5 score (range: 0–5; score ≥ 3 is indicative of probable PTSD with sensitivity = 0.95 and specificity = 0.85).[27]

Statistical analyses

Descriptive statistics were calculated for participant characteristics and each study measure. Categorical variables were dummy coded for subsequent analyses with reference variables as follows: "male" (sex), "non-Hispanic white only" (race/ethnicity), "college educated or higher" (education), "married" (marital status), and "cervical" (level of injury/disease). Cases with missing data were omitted using listwise deletion.

Two separate nested regression models tested PHQ-9 or GAD-7 as the outcome variable. Possible covariates and the predictor variable (ISI score) were entered into 3 blocks. Block 1 included demographic covariates (age, sex, race/ethnicity, education, marital status, body mass index), Block 2 included level of injury (cervical vs thoracic and below plus spinal cord disease), and Block 3 included ISI total score. Sensitivity analyses were performed both with and without PHQ-9 item #3 ("Trouble

Table 1—Participant (n = 72) and measure characteristics.

Characteristic	Value
Age in years, mean ± SD	59.85 ± 10.43
Race/Ethnicity*	
White, n (%)	37 (51.39)
Black or African American, n (%)	34 (47.22)
Hispanic or Latino/a, n (%)	1 (1.39)
American Indian or Alaskan Native, n (%)	1 (1.39)
Asian American or Asian, n (%)	1 (1.39)
Sex	
Male, n (%)	66 (91.67)
Female, n (%)	6 (8.33)
Years of education, mean ± SD	13.90 ± 2.02
Marital status	
Married, n (%)	30 (41.67)
Divorced, n (%)	21 (29.17)
Separated, n (%)	6 (8.33)
Widowed, n (%)	3 (4.11)
Single/never married, n (%)	12 (16.67)
BMI, mean ± SD	27.92 ± 5.56
Spinal cord injury or disease (SCI/D)†	
Spinal cord injury (SCI), n (%)	38 (52.05)
Spinal cord disease (SCD), n (%)	37 (50.68)
Spinal cord injury level	
Level C or above SCI, n (%)	28 (38.89)
Apnea-hypopnea index (AHI), mean ± SD‡	29.33 (23.67)
AHI ≤ 5 events/h, n (%)	2 (3)
Mild (AHI > 5 events/h, AHI < 15 events/h), n (%)	23 (35)
Moderate (AHI ≥ 15 events/h, < 30 events/h), n (%)	17 (26)
Severe (AHI ≥ 30 events/h), n (%)	24 (36)
Measures	
PHQ-9 (excluding item #3), mean ± SD	6.20 ± 5.38
PHQ-9 (including item #3), mean ± SD	7.40 ± 5.94
GAD-7, mean ± SD	6.06 ± 6.07
PC-PTSD-5 ≥ 3, n (%)	26 (36.11)
ISI, mean ± SD	10.77 ± 6.59

*Participants were allowed to select multiple options for Race/Ethnicity. One participant selected both "White" and "Hispanic or Latino/a." †n = 3 had both SCI and SCD. ‡AHI is reported for n = 66 as 6 of the 72 participants declined PSG. BMI = body mass index, GAD-7 = Generalized Anxiety Disorder screener, 7-item, ISI = Insomnia Severity Index, PC-PTSD-5 = Primary Care PTSD screener, PHQ-9 = Patient Health Questionnaire, 9-item, SCI/D = spinal cord injury or disease, SD = standard deviation.

Table 2—Nested regression model of depression (PHQ-9; excluding sleep item #3) (n = 69).

Block	*F*	*df*	R^2	R^2 Change	*P*
1. Demographics	1.62	6, 62	0.136		.156
2. SCI Level	0.00	1, 61	0.142	0.006	.501
3. ISI	17.53	1, 60	0.336	0.194[a]	< .001

Block 1 demographics included age, sex, race, education, marital status, and BMI. Results for PHQ-9 including sleep item #3: [a]R^2 change = 0.233 P < .001. ISI = Insomnia Severity Index, PHQ-9 = Patient Health Questionnaire, 9-item, R^2 = coefficient of determination, SCI = spinal cord injury.

falling or staying asleep or sleeping too much") to examine the possible impact of overlapping sleep disturbance being captured by both the ISI and PHQ-9. A multiple logistic regression tested probable PTSD (PC-PTSD-5 ≥ 3) as the outcome variable, demographics (described above) and level of injury/disease as covariates, and ISI total score as the predictor variable. For all tests, an α level < 0.05 determined statistical significance. All analyses were conducted using STATA version 17 (StataCorp. 2021. Stata Statistical Software: Release 17. College Station, TX: StataCorp LLC.).

RESULTS

A total of 72 veterans with SCI/D participated in the baseline assessment and were included in these analyses, and the analyses had, at most, 3 missing observations (yielding n = 69). See **Table 1** for detailed participant and measure characteristics.

Rates of insomnia and psychiatric symptoms

On average, participants reported subthreshold insomnia (mean (M) = 11), as well as mild severity for both depression (M = 7) and anxiety (M = 6). A total of 56% of participants screened positive for insomnia (ISI score ≥ 10), 31% of participants screened positive for depression (PHQ-9 score ≥ 10), 28% of participants screened positive for at least mild anxiety (GAD-7 score ≥ 10), and 36% of participants screened positive for probable PTSD (PC-PTSD-5 score ≥ 3).

Insomnia and depression symptoms

See **Table 2** for results of the nested regression model of ISI predicting PHQ-9 excluding sleep item #3. Demographic variables (Block 1) did not explain significant variance in PHQ-9 (P = .156). Level of injury (Block 2) did not explain significant variance in PHQ-9 (P = .501) over and above Block 1. ISI explained an additional 19.40% of variance in PHQ-9 (P < .001) over and above Blocks 1 and 2. All variables in Blocks 1–3 were jointly associated with PHQ-9 (R^2 = 33.60%, adjusted R^2 = 0.248).

Similar results were observed for the PHQ-9 including sleep item #3 predicting ISI. Demographic variables (Block 1) did not explain significant variance in PHQ-9 (P = .080). Level of injury (Block 2) did not explain significant variance in PHQ-9 (P = .514) over and above Block 1. ISI explained an additional 23.31% of variance in PHQ-9 (P < .001) over and above Blocks 1 and 2. All variables in Blocks 1–3 were jointly associated with PHQ-9 (R^2 = 40.08%, adjusted R^2 = 0.321).

Insomnia and anxiety symptoms

See **Table 3** for results of the nested regression model of ISI predicting GAD-7. Demographic variables (Block 1) explained significant variance in GAD-7 (P = .021). Level of injury (Block 2) did not explain significant variance in GAD-7 (P = .115) over and above Block 1. ISI explained an additional 19.92% of variance in GAD-7 (P < .001) over and above Blocks 1 and 2. All variables in Blocks 1–3 were jointly associated with GAD-7 (R^2 = 43.89%, adjusted R^2 = 0.364).

Insomnia and PTSD risk

See **Table 4** for results of the logistic regression model of ISI predicting probable PTSD (PC-PTSD-5 ≥ 3). No demographic or level of injury variables were significantly associated with odds of probable PTSD. Odds of probable PTSD were increased 1.22 for each 1 unit increase in ISI (P = .001).

DISCUSSION

The purpose of our study was to examine the relationship between insomnia and psychiatric symptoms among veterans

Table 3—Nested regression model of anxiety (GAD-7) (n = 69).

Block	*F*	*df*	R^2	R^2 Change	*P*
1. Demographics	2.71	6, 62	0.208		.021
2. SCI Level	2.56	1, 61	0.240	0.032	.115
3. ISI	21.31	1, 60	0.439	0.199	< .001

Block 1 demographics included age, sex, race, education, marital status, and BMI. BMI = body mass index, GAD-7 = Generalized Anxiety Disorder screener, 7-item, ISI = Insomnia Severity Index, R^2 = coefficient of determination, SCI = spinal cord injury.

Table 4—Logistic regression model of probable PTSD (PC-PTSD-5 ≥ 3) (n = 69).

Variable	Odds Ratio	95% CI	*P*
Age	1.00	0.94, 1.06	.913
Sex (female vs male)	2.05	0.28, 15.26	.483
Years of education	1.07	0.79, 1.45	.649
Race (White vs Non-White)	1.11	0.32, 3.84	.864
BMI	0.91	0.81, 1.03	.143
Married	1.09	0.32, 3.73	.893
SCI/D Level	0.70	0.19, 2.61	.593
ISI	1.22	1.09, 1.36	.001

Goodness-of-Fit model statistics: Pseudo R^2 = 0.238, Log Likelihood χ^2 (8) = −33.973. BMI = body mass index, 95% CI = 95% confidence interval, ISI = Insomnia Severity Index, PC-PTSD-5 = Primary Care PTSD screener for DSM-5, SCI/D = spinal cord injury or disease.

with SCI/D, a population with elevated rates of sleep difficulties[2] and mental health disorders[3,28] that both negatively impact overall functioning and quality of life. The present study found an association between insomnia severity as a predictor of depression and anxiety severity over and above demographic and level of injury variables in veterans with SCI/D. These results also identified an increased likelihood of meeting criteria for PTSD for veterans with SCI/D who report elevated insomnia severity. Overall, our findings support the use of brief screening measures for insomnia for identifying a higher probability of depression, anxiety, and PTSD in individuals with SCI/D who report elevated insomnia symptoms.

Our data showed that one-third of veterans with SCI/D screened positive for PTSD, which is higher than previous research showing that 8% of individuals with spinal cord injury report PTSD.[4] This discrepancy may be due to differences in measures (eg, the 5-item PC-PTSD-5 in our study vs the 22 item Impact of Events Scale–Revised[4]) and study samples (eg, US military veterans with SCI/D in a Veterans Administration health care setting in our study vs Australian civilians with spinal cord injuries only[4]) between studies. Prevalence estimates of probable PTSD in military populations range from 5–41% depending on factors including active duty vs veteran status, branch,[29–31] and Veterans Administration health care utilization patterns.[31] PTSD screening in veteran populations and Veterans Administration settings may detect higher rates of probable PTSD.

Diagnosis of SDB was not a requirement for enrollment in the parent study. However, in the subset of participants for whom an AHI was available (n = 66), 88.9% had at least mild SDB (AHI ≥ 5 events/h) and 56.9% had moderate-severe SDB (AHI ≥ 15 events/h). SDB may occur in as many as 75% of patients with SCI/D;[32–34] thus, the high rate of SDB in our sample appears representative of SCI/D patients. As sleep-related breathing disorders may be missed or inadequately treated in SCI/D[33,35] and may masquerade as insomnia (eg, difficulty staying asleep), individuals with SCI/D presenting with sleep difficulties should be evaluated holistically to detect the full range of potential sleep and mental health disorders.[36] Future studies should simultaneously consider SDB and insomnia as potentially independent factors impacting mental health in patients with SCI/D.

Untreated sleep problems may worsen psychiatric symptoms,[10,37] and untreated mental health symptoms may develop into chronic conditions[28] that negatively impact rehabilitation[38] and quality of life.[18] Cognitive behavioral therapy for insomnia, the first-line treatment for insomnia,[39,40] improves not only sleep but also PTSD,[41] depression,[42] and response to antidepressant medication.[42] These additional effects may be due to intervention effects such as increased restfulness improving cognitive abilities or learning alternative and generalizable coping skills. To our knowledge, no prospective, randomized sleep-focused psychotherapy trials exist in individuals with SCI/D addressing insomnia as a modifiable risk factor for psychiatric symptoms. A depression psychotherapy intervention in individuals with MS improved depression and anxiety but did not resolve insomnia symptoms for individuals with MS,[43] and insomnia symptoms have been linked to depression relapse in other populations.[10] Modified cognitive behavior therapy protocols targeting sleep behaviors have shown promise for treating sleep, fatigue, and depression symptoms in individuals with traumatic brain injuries,[44] and alternative behavioral strategies (eg, countercontrol) have efficacy in older adults with limited mobility.[45] Sleep-focused interventions that incorporate SCI/D-related difficulties (ie, limited mobility, pain, and bladder management) may benefit sleep and psychiatric symptoms, as well as overall functioning. Additionally, some psychotropics, like Venlafaxine, have been shown to improve depression and spinal cord injury-related disability.[46] Although we are unaware of any trials examining PTSD-specific interventions in SCI/D, cognitive behavioral and mindfulness-based psychotherapies have been shown to reduce depression and anxiety symptoms in SCI/D.[43,47] Individuals with SCI/D who screen positive for insomnia and mental health symptoms should be encouraged to engage in relevant treatment, and patients with SCI/D with co-occurring insomnia and mental health conditions may require additional sleep-focused interventions. Research into the most advantageous sleep vs psychiatric treatment targets for improved functioning in SCI/D is warranted.

Study limitations

These cross-sectional data were collected during a baseline assessment for a study examining a sleep-disordered breathing and sleep quality intervention study in veterans with SCI/D. Thus, most patients in our study had SDB, making it impossible to know whether those without SDB might have a weaker relationship between insomnia and mental health symptoms. Also, these cross-sectional data cannot speak to causality of relationships between our variables of interest. Sleep disturbance is both a symptom that is elevated in association with several psychiatric diagnoses (ie, PTSD and depression)[8,48] and is predictive of later psychiatric symptom development[37] and relapse.[10] Additionally, veterans report higher rates of psychiatric symptoms than the general population.[49] Continued research assessing for temporal

precedence of sleep and psychiatric symptoms as well as implications for treatment is needed in the SCI/D population, and caution should be taken when generalizing these findings to a nonveteran SCI/D population

The data presented rely on self-reported sleep and mental health symptom and screening measures rather than a clinician-administered assessment to establish firmly that a patient meets diagnostic criteria for depression, anxiety, or PTSD. Although objective and prospective sleep data were collected as part of the parent study protocol, they are not presented here, as the aims of these analyses were to determine the association between screening questionnaires alone to reflect the type of information that might be gathered via standard triage procedures in a clinical setting. As limited data exist on the prevalence of sleep disorders such as insomnia in SCI/D, future studies should include measures in alignment with clinical practice guidelines to assess both prevalence of insomnia and other sleep disorders and the relationship between screening questionnaires and formal mental health diagnoses in individuals with SCI/D.

Despite these limitations, this study is the first to our knowledge to use insomnia severity to predict depression and anxiety symptom severity as well as the likelihood of probable PTSD in individuals with SCI/D in a relatively large group of veterans. The measures employed in this study are publicly available for clinical use and are straightforward to administer and score to identify symptoms that may benefit from further evaluation or treatment. Our results support the implementation of brief sleep and mental health screening questionnaires for patients with SCI/D endorsing sleep difficulties in addition to further medical evaluation of sleep symptoms.

CONCLUSIONS

In veterans with SCI/D, insomnia symptom severity was associated with depression and anxiety severity as well as higher likelihood of screening positive for PTSD. Endorsement of difficulty falling and staying asleep should prompt mental health screening in addition to medical screening for sleep disorders in patients with SCI/D. Additional research should evaluate whether insomnia interventions may benefit psychiatric symptoms and whether either sleep, depression, anxiety, or PTSD interventions impact functioning in patients with SCI/D.

ABBREVIATIONS

AHI, apnea-hypopnea index
GAD-7, Generalized Anxiety Disorder screener, 7-item
ISI, Insomnia Severity Index
MS, multiple sclerosis
PC-PTSD-5, Primary Care PTSD screener for DSM-5
PHQ-9, Patient Health Questionnaire, 9-item
PSG, polysomnography
PTSD, posttraumatic stress disorder
SCI/D, spinal cord injury or disease
SDB, sleep-disordered breathing

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