Examining Insomnia During Intensive Treatment for Veterans with Posttraumatic Stress Disorder: Does it Improve and Does it Predict Treatment Outcomes?

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Abstract

Previous research has demonstrated that sleep disturbances show little improvement with evidence-based psychotherapy for posttraumatic stress disorder (PTSD); however, sleep improvements are associated with PTSD treatment outcomes. The goal of the current study was to evaluate changes in self-reported insomnia symptoms and the association between insomnia symptoms and treatment

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outcome during a 3-week intensive treatment program (ITP) for veterans with PTSD that integrated cognitive processing therapy (CPT), mindfulness, yoga, and other ancillary services. As part of standard clinical procedures, veterans (N = 165) completed self-report assessments of insomnia symptoms at pre- and posttreatment as well as self-report assessments of PTSD and depression symptoms approximately every other day during treatment. Most veterans reported at least moderate difficulties with insomnia at both pretreatment (83.0%–95.1%) and posttreatment (69.1–71.3%). Statistically significant reductions in self-reported insomnia severity occurred from pretreatment to posttreatment; however, the effect size was small, d = 0.33. Longitudinal mixed-effects models showed a significant interactive effect of Changes in Insomnia x Time in predicting PTSD and depression symptoms, indicating that patients with more improvements in insomnia had more positive treatment outcomes. These findings suggest that many veterans continued to struggle with sleep disruption after a 3-week ITP, and successful efforts to improve sleep could lead to better PTSD treatment outcomes. Further research is needed to establish how adjunctive sleep interventions can be used to maximize both sleep and PTSD outcomes.

Sleep disturbance is rated as one of the most pressing concerns among veterans with posttraumatic stress disorder (PTSD; Rosen, Adler, & Tiet, 2013) and has been independently associated with higher suicide risk (Ribeiro et al., 2012) and poorer physical health (Clum, Nishith, & Resick, 2001). However, evidence suggests that sleep disturbance is refractory to front-line evidence-based psychotherapies for PTSD and that sleep symptoms persist even with significant PTSD symptom improvement (e.g., Belleville, Guay, & Marchand, 2009; Galovski, Monson, Bruce, & Resick, 2009; Gutner, Casement, Gilbert, & Resick, 2013; Pruiksma et al., 2016). For example, Pruiksma and colleagues (2016) found that among U.S. Army soldiers who no longer met the criteria for PTSD following treatment, 57% continued to report problems with insomnia.

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In addition to causing significant distress, sleep disturbance may negatively impact treatment outcomes for PTSD. Sleep has been shown to be important for memory and learning processes (Diekelmann & Born, 2010) that are thought to be crucial for effective cognitive behavioral treatments for PTSD. In several studies, poorer baseline sleep quality was not shown to reduce the overall effectiveness of prolonged exposure therapy (López, Lancaster, Gros, & Acierno, 2017; Sexton et al., 2017) or cognitive therapy for PTSD (Lommen et al., 2016). However, López and colleagues (2017) showed that residual sleep symptoms, calculated by predicting posttreatment scores from baseline scores, predicted poorer treatment outcomes. Additionally, Lommen and colleagues (2016) revealed a bidirectional association between changes in insomnia and changes in PTSD. These findings suggest that improvements in sleep quality during treatment may help to improve PTSD treatment outcomes and that adjunctive interventions may be needed to improve sleep in the context of PTSD to maximize both sleep and PTSD outcomes. Given evidence that although pretreatment sleep disturbance does not impact PTSD treatment outcomes, changes in sleep disturbance during treatment are predictive of treatment outcome, it may be that PTSD treatment and adjunctive sleep interventions need to be delivered simultaneously to be most effective.

Intensive PTSD treatments are increasingly being used to overcome traditional treatment barriers and offer the opportunity for clinicians to deliver multiple treatment modalities simultaneously (Beidel, Frueh, Neer, & Lejuez, 2017; Harvey et al., 2017). We recently demonstrated that a 3-week daily intensive treatment program (ITP) that delivered cognitive processing therapy (CPT), mindfulness, yoga, and other services led to large reductions in PTSD and depression symptoms among veterans with PTSD (Zalta et al., 2018). There is some evidence to suggest that integrative treatments, such as mindfulness and yoga, which are frequently offered in ITPs (Harvey et al., 2017), may lead to sleep improvements among veterans (McCarthy et al., 2017; Nakamura, Lipschitz, Landward, Kuhn, & West, 2011; Staples, Hamilton, & Uddo, 2013). Thus, we sought to

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examine (a) the degree to which self-reported insomnia symptoms improved over the course of the ITP, (b) whether baseline insomnia symptoms predicted changes in PTSD and depression severity, and (c) whether changes in self-reported insomnia symptoms predicted changes in PTSD and depression severity. Although we were unable to evaluate objective sleep measures and comorbid sleep conditions in the context of this effectiveness study, this study represents an important step in understanding the role of insomnia symptoms in intensive PTSD treatment.

Method

Participants and Procedure

The sample consisted of 165 U.S. veterans and service members (henceforth collectively referred to as "veterans") who completed a 3-week, cohort-based ITP at a mental health clinic that was not part of the Veterans Affairs (VA) health care system, between April 2016 and November 2017. Of note, the ITP program is still offered as of the writing of this paper. The study sample was limited to this date range because insomnia-related measures were not administered after this time. For cohorts that were treated during this time period, the median cohort size was 10 (range: 5–14). Veterans come from across the U.S. to attend the program, which is provided at no cost and includes nearby accommodation for the duration of the ITP. For participants in the present study, as for all program participants, accommodations included a private room in which veterans slept on their own, with the exception that spouses or other family members who chose to attend the program may have shared the veteran's room in Week 3. Veterans were asked to check in to the treatment location by 7:45 a.m. on weekdays for the intervention program; there was no set bedtime or sleep schedule on weekends.

Characteristics of the sample are reported in Table 1. Based on information from the American Community Survey Public Use Microdata Sample (U.S. Department of Veterans Affairs,

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2016), the demographic characteristics of our sample were similar to those for the general population of veterans who served following the September 11, 2001 (9/11), terror attacks, except that there was a larger percentage of female veterans in our sample. All veterans reported a history of military trauma and met diagnostic criteria for PTSD based on the Clinician-Administered PTSD Scale (CAPS) for the fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM-5*; Weathers et al., 2018). All study procedures were approved by the institutional review board at Rush University Medical Center, with a waiver of consent, as all assessments were collected as part of routine clinical care.

All veterans in the present sample completed a 3-week, cohort-based ITP (see Zalta et al., 2018 for a detailed description). The program offered two treatment tracks: one for combat-based PTSD and one for military sexual trauma (MST)–based PTSD. The primary treatment components included 14 sessions of individual CPT (Resick, Monson, & Chard, 2016); 13 sessions of group CPT; 13 sessions of group mindfulness, adapted from the mindfulness-based stress reduction program (Kabat-Zinn, 1990); and 12 sessions of yoga. In addition to these core components, veterans received several secondary interventions, including psychoeducation, nutrition and fitness, art therapy, case management, medication management (optional), and acupuncture (optional). One of the 1-hour psychoeducation sessions in Week 1 focused on sleep hygiene and included information and education on maintaining a regular sleep schedule, avoiding naps and substances that interfere with sleep, creating an environment to support sleep, stimulus control principles, and strategies to manage worry. Previous research with an overlapping sample of veterans showed that this treatment resulted in large pre- to posttreatment symptom reductions in PTSD and depression, *d*s = 1.04–1.41 (Zalta et al., 2018).

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Measures

Sample characteristics. Prior to the start of treatment, demographic and military characteristics were collected for all veterans; information collected included age; sex; race; ethnicity; deployment history, coded as number of deployments and location of deployments; service era, coded dichotomously as pre- or post-9/11; military service status, coded dichotomously as discharged/retired versus active duty/National Guard/reserves/inactive ready reserve; and branch of service. Participants' history of childhood trauma and combat exposure were assessed using an author-developed trauma history questionnaire (see Held, Boley, Karnik, Pollack, & Zalta, 2018 for details), which asked participants to respond to items about exposure to 21 types of traumatic events and, if they endorsed an item, to indicate whether the trauma occurred in childhood, adulthood, or both.

Self-reported insomnia symptoms. Participants completed the Insomnia Severity Index (ISI; Bastien, Vallières, & Morin, 2001) at pre- and posttreatment. The ISI is a 7-item measure that is used to assess symptoms of insomnia over the preceding 2 weeks. Responses are summed and categorized as no clinically significant insomnia (score of 0–7), subthreshold insomnia (score of 8–14), moderate clinical insomnia (score of 15–21), or severe clinical insomnia (score of 22–28; Morin, 1993). In the present sample, the Cronbach's alpha values for internal consistency for the ISI were .82 at pretreatment and .90 at posttreatment.

PTSD symptoms. Symptoms of PTSD were assessed at pretreatment, posttreatment, and approximately every other day during the course of treatment (i.e., a total of ten assessments over the 19-day treatment period). Past-week PTSD symptoms were assessed using the 20-item PTSD Checklist for *DSM-5* (PCL-5; Weathers et al., 2013). The PCL-5 asks respondents to rate the degree to which they have been bothered by each PTSD symptom on a 5-point Likert-type scale that ranges from 0 (*not at all*) to 4 (*extremely*). In order to avoid overlap in measuring the severity of sleep

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problems, we calculated a modified 18-item total score (PCL-5-18) that excluded the two sleep-related questions on the PCL-5 (Item 2: "repeated, disturbing dreams of the stressful experience" and Item 20: "trouble falling or staying asleep"). The PCL-5-18 exhibited strong internal consistency, with Cronbach's alpha values of .88 at pretreatment and .96 at posttreatment.

Depression symptoms. Depression symptoms were assessed at pre- and posttreatment as well as seven times during treatment (i.e., a total of nine assessments over the 19-day treatment period). The nine-item version of the Patient Health Questionnaire (PHQ-9; Kroenke, Spitzer & Williams, 2001) was used to assess symptoms of depression over the past 2 weeks. We calculated a modified total score that excluded Item 3, which is related to sleep disturbances, thus creating an eight-item measure of depression that does not include sleep problems (PHQ-8). The PHQ-8 exhibited strong internal consistency at both pretreatment, Cronbach's $\alpha = .81$, and posttreatment, Cronbach's $\alpha = .87$.

Data Analysis

A paired *t* test was conducted to assess pre- to posttreatment change in ISI scores. Due to their utility in modeling individual change over time and data that are missing at random (for review see Hedeker & Gibbons, 2006), mixed-effects regression models were used to assess predictors of change in PHQ-8 and PCL-5-18 over time. All reported models included time, with a quadratic time component for PCL-5-18, and were adjusted for sex, age, presence of childhood trauma, and cohort type (MST or combat). We conducted iterations of these models that (a) adjusted for combat exposure, number of deployments, major depression diagnosis, substance use diagnosis, and use of sleep medications, and (b) examined only PCL-5-18 hyperarousal–related symptoms as the outcome. None of the covariates were related to either outcome, and the pattern of results was not influenced in any meaningful way based on the inclusion of these covariates or the change in outcome to the

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hyperarousal-only items. Therefore, only models that adjusted for variables previously identified as relevant are reported here; the results of these supplemental analyses are available upon request.

A small number of participants with missing covariate data were excluded from analyses when these analyses included relevant covariates (see Table 1 for relevant sample sizes). Conditionally independent errors were selected based on Akaike information criteria (AIC) values as well as random intercept and slope components, due to improved model fit in likelihood ratio tests, *p*s < .001. Due to a lack of emphasis on comparing covariate slopes, unstandardized coefficients are reported. The results were considered significant at $p < .05$. All analyses were conducted in Stata (Version 15), and figures were created in Sigmaplot (Version 13).

The ISI captured ratings of insomnia symptoms that occurred during the past two weeks, which resulted in a large degree of overlap with the intervention period. Thus, we conducted a series of sensitivity analyses using PCL-5 Item 20 ("trouble falling or staying asleep"), for which participants used the past week as a reference for their rating. Specifically, we evaluated the degree to which changes in ISI scores were related to changes in scores on PCL-5 Item 20, the percentage of participants who reported at least moderate distress (score of 2–4) on the item at pre- and posttreatment, and the percentage of individuals with moderate distress at baseline who reported at least a 2-point improvement at endpoint. We also conducted the longitudinal mixed-effect regression models using PCL-5 Item 20 rather than ISI as a predictor. Of the 165 veterans in the sample, we were able to calculate a change score for the 143 who had a PCL-5 Item 20 score at pre- and posttreatment. Reasons for missing data on this variable included the fact that the past-week version of the PCL-5 was not added to the program until June 2016, and some veterans left the program prior to completing assessments on the last day. For the PCL-5-18 and PHQ-8, the amount of missingness at each time point ranged from 1.21% (Day 5) to 10.91% (Day 14). The amount of missingness was not significantly related to any demographic or outcome variable of interest.

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Results

Most veterans reported moderate-to-severe insomnia symptoms, using an ISI score of 15 or higher as a cutoff (Bastien et al., 2001), at both pretreatment (83.0%) and posttreatment (69.1%). Statistically significant reductions in self-reported insomnia severity occurred from pretreatment (M = 20.03, SD = 5.26) to posttreatment (M = 18.01, SD = 6.65), d = 0.33, p <.001. However, only 21.2% of all veterans and 23.4% of treatment responders, who reported a minimum 10-point reduction on the PCL-5-18 during treatment, demonstrated a clinically meaningful improvement in self-reported insomnia symptoms from pre- to posttreatment, based on a reduction in ISI score of at least 6 points (Yang, Morin, Schaefer, & Wallenstein, 2009).

The results of longitudinal mixed-effects regression models predicting PCL-5-18 and PHQ-8 are presented in Table 2. These models indicated that baseline ISI scores predicted both overall PCL-5-18 and PHQ-8 scores across all time points, ps < .001. However, Time x Baseline ISI Score interactions were not significant predictors of either the PCL-5-18, p = .123; or PHQ-8, p = .304, suggesting that outcome time trends did not differ based on baseline insomnia scores. Pre–post change in ISI score did not predict overall PCL-5-18 or PHQ-8 scores over time at the .05 level, ps = .159 and .084, respectively. However, Time x ISI Change interactions were significant for both the PCL-5-18, p < .001, and the PHQ-8, p =.002, suggesting that time trends in both outcomes differed based on the amount of ISI change during the program (see Figure 1 for the depiction of this interaction for PTSD symptoms). Participants who had a clinically meaningful improvement in ISI score (n = 35) had average posttreatment scores of 17.36 (SD = 16.17) on the PCL-5-18 and 6.66 (SD = 5.16) on the PHQ-8, whereas those who did not have a clinically meaningful improvement on the ISI (n = 130) had an average posttreatment score of 32.40 (SD = 15.82) on the PCL-5-18 and 10.98 (SD = 5.07) on the PHQ-8.

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Change in ISI score from pre- to posttreatment was associated with reported change in PCL-5 Item 20, $r = .36$, $p < .001$, suggesting moderate convergence between assessments of sleep difficulties. Of the participants with available data for PCL-5 Item 20 at baseline and endpoint (n = 143), 136 (95.1%) reported at least moderate distress at baseline and 102 (71.3%) reported at least moderate distress at the endpoint. Of individuals who reported at least moderate distress at baseline (n = 136), 35 (25.7%) reported an improvement of at least 2 points on PCL-5 Item 20 at the endpoint assessment. The longitudinal mixed-effect regression models using PCL-5 Item 20 indicated a similar Time x Sleep Change interaction for both the PCL-5-18, $B = -0.53$, $p < .001$; and PHQ-8, $B = -0.14$, $p < .001$, outcomes (see Supplemental Table 1).

Discussion

We have previously shown that our 3-week intensive outpatient program for veterans with PTSD leads to large and clinically meaningful changes in PTSD and depression symptoms (Zalta et al., 2018). However, the current results reveal that, despite these improvements, most veterans continue to report at least moderate sleep difficulties at posttreatment and few appear to have clinically meaningful improvements in insomnia symptoms during treatment. Our findings are similar to those reported in previous PTSD treatment studies (e.g., Belleville et al., 2009; Pruiksma et al., 2016). By contrast, research has shown that sleep-specific cognitive behavioral treatments lead to large reductions in insomnia among individuals with PTSD (Ho, Chan, & Tang, 2016). These findings suggest that to effectively target sleep among individuals with PTSD, adjunctive treatments may need to be sleep-specific rather than broad (e.g., mindfulness and yoga). Our ITP treatment included a 1-hour psychoeducational group on sleep hygiene; however, this appeared to be insufficient for making a meaningful impact on self-reported insomnia symptoms. Recent pilot data suggest that integrating aspects of established sleep interventions, such as cognitive behavioral therapy for insomnia (Morin, 2006), with PTSD treatments may be a promising approach (Colvonen, Drummond, Angkaw, &

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Norman, 2019). Further research is needed to determine the timing and dose needed to maximize both sleep and PTSD outcomes.

Consistent with previous research, our findings show that self-reported insomnia severity at baseline did not predict changes in PTSD and depression severity across time. However, larger improvements in ratings of insomnia symptoms were associated with better PTSD and depression outcomes. Notably, a PCL-5 score of 33 or higher is considered to be indicative of probable PTSD, which can be extrapolated to a score of 29.7 for the 18-item version used in the current study; individuals who had a clinically meaningful change in ISI score were well below this cutoff at treatment completion, whereas those who did not have a clinically meaningful change in ISI score were above the extrapolated cutoff at treatment completion. These findings suggest that having more severe insomnia prior to treatment does not diminish the likelihood of successful PTSD treatment although the improvement of insomnia during PTSD treatment does improve the likelihood of treatment success. One possible explanation for these findings is that sleep disturbances may be etiologically linked to PTSD symptoms for some individuals, and for these individuals, sleep disturbances respond to PTSD treatments. For others, the pathophysiology of sleep disturbances may be independent of PTSD; this comorbidity may require adjunctive interventions to address sleep problems and may make individuals more refractory to PTSD treatments. More research is needed to understand the underlying processes that contribute to co-occurring PTSD and sleep disturbance and help determine which individuals with PTSD would benefit from adjunctive sleep treatments.

One of the key limitations of our approach was that the ISI assessed insomnia symptoms that occurred over the past two weeks. Thus, the posttreatment assessment (i.e., end of Week 3) included a significant portion of the treatment period and may not have fully captured improvements in insomnia that occurred during treatment. To address this issue, we conducted sensitivity analyses using PCL-5 Item 20, which assesses past-week sleep disturbance. Overall, these sensitivity analyses showed a

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similar pattern of results with respect to the proportion of the sample who reported at least moderate distress at each timepoint and statistical significance of the interaction terms of interest. Thus, the sensitivity analyses increased confidence in our results with the ISI. However, a longer-term follow-up will be important to determine whether insomnia symptoms continued to improve or rebounded with more time and a return to the home environment after treatment termination.

Several additional limitations should be considered when interpreting our findings. We did not assess comorbid sleep disorders, such as sleep apnea, or changes in sleep medications over the course of the treatment; these factors may have an important impact on the degree to which insomnia changed over the course of treatment. We also did not examine our combined intensive treatment relative to a comparator group. Therefore, we cannot determine the degree to which changes in self-reported insomnia symptoms were due to the intervention versus the passage of time. Moreover, we cannot determine whether the addition of mindfulness, yoga, and other ancillary services had an impact on insomnia symptoms. For example, it is possible that the intensive delivery of trauma treatment may temporarily worsen insomnia symptoms and that the addition of mindfulness and yoga may have mitigated this. It is also possible that the intensive delivery of mindfulness and yoga over the short, 3-week duration had a diminished impact on sleep and that adjunctive delivery of these services in more traditional outpatient care would have larger benefits. Finally, it is also possible that insomnia symptoms were affected by the fact that veterans were sleeping in a dormitory facility and not in their natural environment.

Despite these limitations, our findings suggest that the simultaneous delivery of trauma-focused treatment, mindfulness, and yoga in an intensive treatment format did not have a meaningful impact on self-reported insomnia symptoms among veterans with PTSD, yet improvement in self-reported insomnia symptoms was linked to PTSD treatment outcomes. Addressing sleep concerns is important to patients with PTSD (Rosen et al., 2013) and is likely critical for the long-term well-being

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of veterans. More frequent sleep assessments during the course of trauma-focused PTSD treatment may be warranted to determine who may benefit from adjunctive services. Further research is needed to explore how to best address co-occurring PTSD and sleep disturbance and maximize symptom improvement.

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Table 1

Sample Characteristics

Variable	*n*	%	*N*	*M*	*SD*	Range
Sex						
Male	106	64.2				
Female	59	35.8				
Cohort type						
Combat cohort	112	67.9				
MST cohort	53	32.1				
Race/ethnicity						
Non-Hispanic White	94	57.0				
Black or African American	32	19.4				
Hispanic or Latino[a]	19	11.5				
American Indian or Alaska Native	4	2.4				
Asian	1	0.6				
Native Hawaiian or other Pacific Islander	2	1.2				
Other	13	7.9				

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Served after September 11, 2001		
Yes	145	87.9
No	20	12.1
Discharged/retired		
Yes	151	91.5
No	14	8.5
Service branch		
Army/Army Reserve/Army National Guard	110	66.7
Air Force/Air Force Reserve/Air National Guard	15	9.1
Marines	23	13.9
Navy	16	9.7
Coast Guard	1	0.6
History of childhood trauma		
Yes	101	61.6
No	63	38.4
Combat exposure		
Yes	140	86.4

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No		22	13.6		
Age (years)		165	40.81	9.57	24–67
Number of deployments		154	1.47	1.25	0–6
Pretreatment PCL-5 total score		151	55.97	11.67	22–80
Pretreatment PHQ-9 total score		165	17.72	4.93	6–27

Note. MST = military sexual trauma; PCL = Posttraumatic Stress Disorder Checklist; PHQ = Patient Health Questionnaire. [a]This category represents individuals with Hispanic or Latino ethnicity and White race. Individuals with Hispanic or Latino ethnicity who designated a non-White race were included in the designated race category.

Table 2

Longitudinal Random Effects Models of Insomnia Severity Index (ISI) Scores Predicting Posttraumatic Stress Disorder (PTSD) and Depression Symptoms During Treatment

Variable	PCL-5-18[a]		PHQ-8[b]	
	B	*SE*	*B*	*SE*
Time	-0.47	0.49	-0.59*	0.15
Time^2	-0.10*	0.02	-	
Sex (male = 0)	1.25	1.87	0.13	0.88
Childhood trauma (no = 0)	-3.18*	1.32	-0.30	0.62

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Cohort type (MST = 0)	-2.64	1.94	-2.10*	0.91
Age	0.01	0.07	-0.02	0.03
Baseline ISI	0.91*	0.15	0.26*	0.08
ISI pre–post change	-0.20	0.14	-0.13	0.08
Baseline ISI x Time	0.03	0.02	0.01	0.01
ISI Pre–Post Change x Time	-0.08*	0.02	-0.02*	0.01

Note. $N = 164$. PCL = PTSD Checklist; PHQ = Patient Health Questionnaire.

[a]18-item version, which excluded items related to sleep. [b]Eight-item version, which excluded one item related to sleep. The quadratic time component was not significant in models of PHQ-8 and was thus excluded from final PHQ-8 models.

*$p < .05$.

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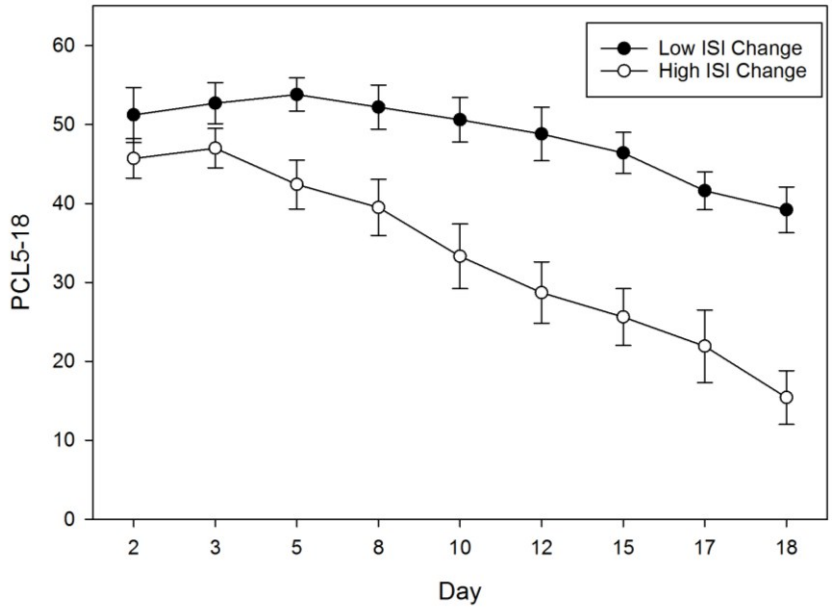

Figure 1. Interaction between change in insomnia symptoms and time predicting posttraumatic stress disorder (PTSD) symptoms during treatment. High and low Insomnia Severity Index (ISI) change groups were based on +/- 1 standard deviation from the mean of ISI change from pre- to posttreatment. The error bars represent standard error. The Posttraumatic Stress Disorder Checklist for *DSM-5* (PCL-5-18) comprised 18 items and excluded items related to sleep.

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