

The Effects of Insomnia and Psychological Distress on Cognitive Performance Among Veterans

by

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A Thesis Submitted in Partial Fulfillment of the

Requirements for the Degree of Bachelor of Science

With Honors in Biopsychology, Cognition, and Neuroscience from the

University of Michigan

2013

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Abstract

Inadequate sleep is a pervasive problem for many and may have serious consequences on a multitude of health factors that affect overall well-being. In veterans, psychiatric conditions are often comorbid with each other and other health concerns, such as insomnia and cognitive problems. There is significant overlap between domains of cognitive inefficiency among individuals with symptoms of sleep disturbance, depression, and PTSD. Based on previous research, it is hypothesized that individuals endorsing insomnia, depression, and PTSD symptoms will show impairments in attention, executive functioning, and short-term memory. It is also hypothesized that these distress comorbidities will result in additive cognitive deficits. The 135 veteran participants were surveyed regarding their insomnia, depression, and posttraumatic stress symptoms; while also receiving neuropsychology tests assessing attention, executive functioning, and memory. A one-way ANOVA found that distress comorbidity negatively affected overall cognition ($F(3, 141) = 5.89, p < .01$); attention ($F(3, 153) = 6.99, p < .01$); and executive functioning ($F(3, 145) = 3.15, p < .05$); but not memory recall ($F(3, 142) = 1.08, p = .36$). However, results did not find an additive effect of comorbidities on cognitive performance. Regardless, this suggests that it is important to address and treat distress conditions before assessing and diagnosing cognitive inefficiency.

Keywords: cognition, sleep, depression, posttraumatic stress disorder, comorbidity

The Effects of Insomnia and Psychological Distress on Cognitive Performance Among Veterans

Inadequate sleep is a pervasive problem for many and may have serious consequences across a multitude of health factors that affect overall well-being. In 2011, approximately one third of Americans reported sleeping less than the American Medical Association's recommended eight hours per night (Collop, 2011; Wheaton, Liu, Perry, & Croft, 2011). These deficits result in a significant impact on healthcare costs, with fourteen billion dollars spent annually to cover costs due to insomnia related healthcare services, treatment, and care (Gillin, Roehrs, & Roth, 2011). While sleep disturbance is associated with a number of prevalent health concerns, such as obesity, diabetes, and heart disease (Dijk, 2012), sleep loss alone is associated with a variety of physical and mental health conditions such as Major Depressive Disorder (MDD), Generalized Anxiety Disorder, and Posttraumatic Stress Disorder (PTSD; Krystal, 2012). While physical and emotional correlates of sleep disturbance have been well studied, deficits in cognition secondary to sleep disturbance have also been recognized (Dodds et al., 2011; Kronholm et al., 2011; Stenuit & Kerkhofs, 2008; Waters & Bucks, 2011; Zimmerman, Bigal, Katz, Brickman, & Lipton, 2012). The most common disturbances in cognition associated with poor sleep include deficits in attention, executive functioning, and memory (Zimmerman et al., 2012). Overall, sleep disturbance is a serious concern that crosses many health domains and presents a substantial challenge to health care providers.

Sleep and Veterans

While sleep disturbance is a significant problem for the general population, veterans are particularly at risk. Physical health problems are a primary concern for deployed troops, as veterans with combat exposure often report physical pain symptoms that greatly disrupt their sleep and exacerbate problems with their psychiatric health (Ruff, Ruff, & Wang, 2009).

Veterans from Operation Enduring Freedom and Iraqi Freedom (OEF/OIF) benefit from a greater than 90% survival rate following combat injury due to advances in military healthcare and preventative measures, such as improved body armor (Clark, Bair, Buckenmaier, Girona, & Walker, 2007). However, as a consequence of fewer fatalities, there are new challenges in the rehabilitation of chronic pain. Clark et al. (2007) found in his sample that 14% of veterans with chronic pain also had impairments to their sleep, however there were no reports of a specific treatment or rehabilitation option to address this pain-related symptom. Additionally, 78% of these veterans experienced mental health concerns in addition to their chronic pain (Clark et al., 2007).

Sleep and Depression

Lack of sleep may additionally exacerbate psychiatric concerns, such as symptoms of depression. In fact, a change in sleep pattern is a key identifier of many mood disorders. According to the American Psychological Association's (2000) Diagnostic and Statistical Manual of Mental Disorders, sleep dysregulation is a main diagnostic criterion for MDD. While endorsing sleep problems is not essential for an MDD diagnosis, around 90% of adults with depressive symptoms complain of impaired sleep and it is the second most frequently endorsed MDD symptom after depressed mood (Urrila et al., 2012). Research has also revealed that individuals who report severe depression are more likely to have sleep problems than individuals with mild depression (Urrila et al., 2012). Of note, the relationship between insomnia and depression appears to be bidirectional, as depression results in disturbed sleep and sleep loss escalates the severity of depression. This comorbidity represents a strong reciprocal relationship, which may benefit from concurrent treatment.

Sleep and Posttraumatic Stress Disorder

Sleep disruption also has a strong relationship with PTSD: 17% of OEF/OIF veterans reporting symptoms of PTSD following active duty (Strachan, Gros, Ruggiero, Lejuez, & Acierno, 2012). The growing number of individuals endorsing PTSD symptoms related to their military service provides impetus to examine the causes and consequences of this mental health concern. Around 70% of individuals with PTSD report difficulties with sleep due to the main diagnostic symptoms of PTSD: re-experiencing, avoidance, and hyper-arousal (American Psychiatric Association, 2000; Babson & Feldner, 2010). These symptoms alter an individual's ability to enter the relaxed state necessary for rest and sleep. After experiencing a trauma, the most frequently reported symptom is insomnia (Brown, Mellman, Alfano, & Weems, 2011). Additionally, McLay, Klam, and Volkert (2010) found that OEF/OIF veterans complaining of sleep problems endorsed higher symptom severity of PTSD. This evidence suggests comorbidity between self-reported sleep deficits and PTSD symptomatology.

The relationship between insomnia and PTSD also seems to be reciprocal. While the consequences of PTSD result in less sleep, a lack of sleep exacerbates the symptoms of PTSD. Germain et al. (2012) found that patients who received treatment for their sleep concerns not only had improved sleep, but also had a reduction in the severity of PTSD symptoms. Therefore, focusing on symptoms of sleep among PTSD patients may be an important treatment strategy. Of note, diagnoses of depression and PTSD are often comorbid, especially in a veteran population with combat exposure (Strachan et al., 2012). As such, treatment of sleep disturbance may result in concurrent management of both trauma and mood symptoms.

Sleep and Cognition

Taken together, physical and psychological stressors present a multifactorial challenge to individuals with sleep disturbances. These same factors may also impact cognitive function.

Zimmerman et al. (2012) found that disruptions in sleep behavior, such as difficulty falling or staying asleep, were correlated with a decline in cognitive ability. Specifically, individuals reporting these symptoms display inefficiencies in processing speed (Mackin, Lesselyong, & Yaffe, 2012; Stenuit & Kerkhofs, 2008; Waters & Bucks, 2011), sustained attention, memory, and select aspects of executive functioning (Dodds et al., 2011; Mackin et al., 2012; Qureshi et al., 2011; Stenuit & Kerkhofs, 2008; Waters & Bucks, 2011; Zimmerman et al., 2012).

Depression and Cognition

Psychiatric complaints may also impact cognitive performance. As denoted in the Diagnostic and Statistical Manual of Mental Disorders, fourth edition, diagnostic criterion for MDD includes altered thinking and an inability to concentrate (American Psychiatric Association, 2000). There is some controversy regarding the mechanism for this cognitive inefficiency. Watkins and Teasdale (2001) found that individuals with depression often possess an overgeneralized memory; implying they do not recall specific details of events. They further conclude that suboptimal memory recall may be caused by distraction due to thinking analytically about unrelated topics (Watkins & Teasdale, 2001). In contrast, others have suggested that depression may affect task engagement (Bienenfeld, 2009); therefore individuals with depression have reduced scores on cognitive measures. It appears that depressive symptoms impact performance on attention and executive functioning measures, however, performance on memory measures appear less affected (Royall, Palmer, Chiodo, & Polk, 2012). Furthermore, Wright and Persad (2007) theorized that cognitive impairments and depression are often comorbid. Therefore, it is uncertain if inefficiency in cognition is due to symptoms of depression or if cognitive impairments affect depressive symptoms.

Posttraumatic Stress Disorder and Cognition

Individuals with PTSD may also be vulnerable to mild cognitive impairments. Intrusive thoughts, nightmares, and hyper-arousal symptoms often prevent sleep in veterans. These same symptoms may also affect attention, which affects one's ability to concentrate and effectively perform simple cognitive tasks. When an individual ruminates about their trauma, their ability to focus on current mental tasks may be undermined. Therefore, mental resources are focused on past trauma and may inhibit recovery from trauma (Wells & Sembi, 2004). While PTSD seems to broadly affect cognition, veterans with symptoms of PTSD have most commonly reported deficits on measures of sustained attention, executive functioning, memory recall, and processing speed (Mackin et al., 2012; Qureshi et al., 2011).

Sleep Disturbance, Psychiatric Comorbidities, and Cognition

In veterans, psychiatric conditions are often comorbid with each other and other health concerns, such as insomnia and cognitive problems. Muran and Motta (1993) found that patients with PTSD had high comorbidities with depression and that individuals with comorbid diagnoses had significant deficits in cognition. Due to these highly prevalent comorbidities, it is often difficult to ascertain the exact etiology of cognitive impairments. The correlation between PTSD and deficient cognition may be unidirectional or due to the mediating comorbid symptoms of depression. Alternatively, depression and cognitive problems may be mediated by disturbances in sleep. Additionally, sleep deficits and impairments in cognition may be due to a variety of psychiatric symptoms. Therefore, it is difficult to tease apart the direct causes of cognitive impairments because there may not necessarily be one explanation or origin for disturbances in one's cognitive ability.

There is significant overlap between domains of cognitive inefficiency among individuals with symptoms of sleep disturbance, depression, and PTSD. Each of these behavioral health

concerns has been associated with inefficiencies in sustained attention, executive functioning, and memory (Dodds et al., 2011; Mackin et al., 2012; Qureshi et al., 2011; Stenuit & Kerkhofs, 2008; Waters & Bucks, 2011; Zimmerman et al., 2012). Research demonstrates, however, that deficits in processing speed may be especially prominent among those with PTSD (Mackin et al., 2012; Stenuit & Kerkhofs, 2008; Waters & Bucks, 2011). Of note, Qureshi et al. (2011) emphasizes that PTSD mainly affects attention, while evidence of deficits in executive functioning and memory are more inconsistent. The relationship between depression and memory performance is also a matter of debate (Royall et al., 2012; Wright & Persad, 2007).

Given the significant overlap in sleep, psychiatric, and cognitive symptoms among veterans, evaluating the effects of both individual and comorbid diagnoses on cognition may prove to be a useful, and more ecologically valid, approach to assessing this population. As such, the purpose of this study is to assess potential cognitive inefficiencies associated with sleep disturbances, depression symptoms, and reports of PTSD among veterans in a polytrauma clinic. It is hypothesized that individuals endorsing insomnia symptoms will show impairments in attention, executive functioning, and short-term memory. It is also expected that individuals with PTSD will show deficits in the same cognitive domains as individuals with sleep impairments. Individuals endorsing depression symptoms are expected to display significant deficits in attention and executive functioning, with modest impairments to short-term memory. Additionally, it is hypothesized that individuals endorsing significant sleep disturbance symptoms will be more likely to endorse significant symptoms of psychological distress. Finally, it is hypothesized that comorbidity among sleep disturbance, depression, and PTSD will result in additive cognitive deficits.

Method

Participants

Participants were consecutively assessed in an outpatient polytrauma clinic at the Veteran Affairs Ann Arbor Healthcare System. The 135 veteran participants were 94% male and ranged in age from 21 years old to 88 years old ($M = 35.02$, $SD = 12.75$). The veterans identified as 63% Caucasian, 5% African American, 2% Hispanic, 2% other, and 28% declined to answer. The veteran participants had a range of 8 to 19 years of education ($M = 13.15$, $SD = 1.74$).

Measures

Sleep disturbance. Sleep disturbance was assessed using the Insomnia Severity Index (ISI). The ISI is a 7-item questionnaire that evaluates severity of sleep problems; sleep satisfaction; and interference of sleep in everyday life using a 5-point Likert scale (highest possible score= 28). The ISI does not determine an insomnia diagnosis, but rather the presence and severity of clinically significant symptoms, such as satisfaction with the amount and quality or sleep and interference with daily functioning. Participants were categorized into subclinical (0-7), mild (8-14), moderate (15-21), and severe (22-28) insomnia symptoms. The internal consistency coefficient for the ISI is 0.90. The ISI has 0.99 sensitivity and 0.91 specificity (Morin, Belleville, Bélanger, & Ivers, 2011).

Psychological distress.

Depression. Depression was assessed using the depression subscale of the Hospital Anxiety and Depression Scale (HADS-D). The depression subscale consists of seven questions that assess the severity of depressive symptoms, such as mood, motivation, and loss of interest. Depression severity was categorized as 0-7 indicating normal range, 8-10 mild depression, 11-14 moderate depression, and 15-21 severe depression. HADS-D has 0.79 specificity and 0.83 sensitivity, which supports that the depression subscale is a good indicator of symptomatology

and predicting severity. Cronbach's alpha is 0.82 for HADS-D, indicating good internal consistency (Bjelland, Dahl, Haug & Neckelmann, 2002).

Posttraumatic Stress Disorder. PTSD was assessed using the PTSD Checklist-Military Version (PCL-M), a 17-item questionnaire that evaluates the severity of PTSD symptoms (re-experiencing, avoidance, and hyperarousal) using a 5-point Likert scale. Total scores range from 17-85 with scores above 49 indicating clinically significant PTSD symptoms. The PCL-M has an internal consistency of 0.97 (Wilkins, Lang, & Norman, 2011).

Cognition.

General cognition. General cognition was assessed using the Montreal Cognitive Assessment (MoCA). The MoCA consists of several subsections that measure different cognitive domains, such as visuo-spatial skills, memory, attention, language, abstraction, orientation, and executive functioning. The highest possible score is 30 points, with scores falling below 26 indicating probable impairments in cognition (Smith, Gildeh, & Holmes, 2007). The MoCA has a specificity of 0.50 and a sensitivity of 0.83 in detecting mild cognitive impairments (Smith et al., 2007).

Attention. Attention was assessed using the Digit Span subtest of the Wechsler Adult Intelligence Scale-4. The forward test of Digit Span, which requires participants to repeat a sequence of numbers, measures simple attention. The backward test of digit span, which requires participants to repeat sequences of numbers in reverse order, and the sequencing test of digit span, which requires participants to repeat sequences of numbers in ascending order, measure complex attention and working memory. Digits forward has a specificity of 0.91 and Digits backward has a specificity of 0.10 (Cicerone & Azulay, 2002).

Executive functioning. Executive functioning was assessed using the Trail Making Test, Part B. Trails B is a set-switching test that requires participants to alternate between letters and numbers in ascending sequential order, which is a good indicator of set shifting and mental flexibility. Scores on this test were derived from the amount of time taken to complete the test. The time was then normed by age, education, gender, and ethnicity. Specificity for Trails B is 0.90 and sensitivity is 0.19 (Cicerone & Azulay, 2002).

Memory. Memory was assessed using the delayed memory recall subsection of the Montreal Cognitive Assessment (MoCA). The memory subsection required participants to recall five previously learned words after a short time delay. Scores range from 0 to 5. Markwick, Zamboni, and de Jager (2012) found that the memory recall subsection was a good discriminator of memory problems in individuals who scored above the mild cognitive impairment cutoff.

Procedure

The participants in this sample were veterans referred to the Ann Arbor VA's polytrauma clinic. The veterans reported to the clinic after screening positive with their primary care provider for a potential Traumatic Brain Injury. A trained undergraduate research assistant, social worker, psychologist, and a physician specializing in physical medicine and rehabilitation assessed each participant. Upon arrival at the clinic, the veterans received a self-report packet, which assessed their level of pain, anxiety, depression, posttraumatic stress, affect, substance use, somatic perception, and cognitive symptoms. Once the packet was complete, the participants met with a research assistant, who administered a battery of neuropsychology tests assessing effort, attention, visuo-spatial skills, language, memory, executive functioning, and orientation.

Design

Bivariate correlations were used to investigate the relationship between cognitive performance and symptom severity of insomnia, depression, and PTSD. Independent samples t-tests were used to investigate the mean differences in cognitive performance among individuals with clinically significant symptoms of sleep disturbance, depression, and PTSD. Sleep disturbance severity was determined clinically significant at a cutoff score of 15. Clinically significant depression included individuals endorsing moderate to severe symptoms. PTSD was determined as clinically significant when symptoms were above the cutoff score of 49. ANOVA analyses were then used to evaluate the potential additive effects of behavioral health comorbidity on cognitive performance. To code comorbidity, each distress variable was coded dichotomously as clinically significant or subclinical. A cumulative score was then calculated based on the number of clinically significant syndromes present. Comorbidity scores ranged from 0 to 3, with 0 indicating no significant distress syndromes and 3 indicating clinically significant levels of sleep disturbance, depression, and PTSD.

Results

Symptom Prevalence

Participants reported sleeping an average of five hours of sleep per night and 68% endorsed clinically significant insomnia or sleep disturbance. Table 1 shows the breakdown of severity of the veterans' difficulty falling asleep, staying asleep, and waking up too early. Seventy-seven percent of veterans reported being dissatisfied with their current sleep pattern and 73% reported being distressed about their current sleep problem. Eighty-two percent reported that they believed their sleep problem interfered with their daily functioning, while 70% of veterans reported that they felt their sleep problems were noticeably impairing their quality of life.

Thirty-five percent of participants reported subclinical symptoms of depression, 22% reported mild depressive symptoms, 31% reported moderate depressive symptoms, and 12% reported symptoms categorized as severe depression. Sixty-five percent of participants endorsed significant symptoms of PTSD.

Sleep Disturbance and Cognition

There was a significant negative correlation between sleep disturbance severity and scores on the MoCA ($r = -.24, p < .01$), suggesting that individuals reporting greater sleep disturbance had lower scores on overall cognition. Additionally, there was a significant difference between individuals with sleep disturbance ($M = 23.79, SD = 3.54$) and individuals without sleep disturbance ($M = 25.33, SD = 2.30$) on the MoCA ($t(142) = 3.31, p < .01$).

There was a significant negative correlation between sleep disturbance severity and attention ($r = -.19, p < .05$), such that attention scores were lower for individuals reporting greater disturbances in their sleep. Furthermore, there was a significant difference between individuals with sleep disturbance ($M = 8.83, SD = 2.50$) and individuals without sleep disturbance ($M = 9.21, SD = 2.50$) in attention ($t(170) = 2.05, p < .05$).

Though sleep disturbance severity was not significantly related to executive functioning ($r = -.12, p = .12$), there was a significant difference between individuals with sleep disturbance ($M = 42.31, SD = 12.32$) and individuals without sleep disturbance ($M = 45.79, SD = 8.89$) in executive functioning ($t(134) = 2.05, p < .05$).

Sleep disturbance severity and memory recall were not significantly related ($r = -.14, p = .09$). Additionally, there was no significant difference between individuals with sleep disturbance ($M = 2.54, SD = 1.58$) and individuals without sleep disturbance ($M = 2.96, SD = 1.37$) in memory recall ($t(161) = 1.66, p = .10$).

Depression and Cognition

There was a significant negative correlation between depressive symptoms and the MoCA ($r = -.29, p < .01$), confirming that individuals with more severe depressive symptoms had decreased overall cognition. Furthermore, there was a significant difference between individuals with depression ($M = 23.53, SD = 3.46$) and individuals without depression ($M = 24.94, SD = 3.00$) on the MoCA ($t(158) = 2.77, p < .01$).

There was a significant negative correlation between depressive symptoms and attention ($r = -.37, p < .01$), such that higher depressive symptom severity was associated with lower attention scores. Additionally, there was a significant difference between individuals with depression ($M = 7.74, SD = 2.33$) and individuals without depression ($M = 9.37, SD = 2.46$) in attention ($t(168) = 4.40, p < .01$).

There was a significant negative correlation between depressive symptoms and executive functioning ($r = -.28, p < .01$), with more severe depressive symptoms associated with lower scores in executive functioning. Additionally, there was a significant difference between individuals with depression ($M = 40.70, SD = 12.15$) and individuals without depression ($M = 45.83, SD = 10.37$) in executive functioning ($t(159) = 2.89, p < .01$).

Finally, there was no significant correlation between depressive symptoms and memory recall ($r = -.07, p = .40$). Furthermore, there was no significant difference between individuals with depression ($M = 2.67, SD = 1.59$) and individuals without depression ($M = 2.71, SD = 1.51$) in memory recall ($t(159) = 0.17, p = .86$).

Posttraumatic Stress Disorder and Cognition

There was a significant negative correlation between PTSD symptoms and scores on the MoCA ($r = -.33, p < .01$), suggesting that individuals with higher severity of PTSD symptoms

had lower overall cognition. Additionally, there was a significant difference between individuals with PTSD ($M = 23.87$, $SD = 3.32$) and individuals without PTSD ($M = 25.40$, $SD = 2.15$) on the MoCA ($t(142) = 3.42$, $p < .01$).

There was a significant negative correlation between PTSD and attention ($r = -.29$, $p < .01$), which shows that lower attention scores were associated with greater severity of PTSD symptoms. Furthermore, there was a significant difference between individuals with PTSD ($M = 8.20$, $SD = 2.41$) and individuals without PTSD ($M = 9.41$, $SD = 2.42$) in attention ($t(160) = 3.05$, $p < .01$).

There was a significant negative correlation between PTSD symptoms and executive functioning ($r = -.20$, $p < .05$), which reveals that greater severity of PTSD was associated with lower scores in executive functioning. However, there was not a significant difference between individuals with PTSD ($M = 42.12$, $SD = 12.43$) and individuals without PTSD ($M = 45.59$, $SD = 9.55$) in executive functioning ($t(152) = 1.81$, $p = .07$).

There was no significant correlation between PTSD severity and memory recall scores ($r = -.14$, $p = .10$). Additionally, there was no significant difference between individuals with PTSD ($M = 2.61$, $SD = 1.59$) and individuals without PTSD ($M = 2.90$, $SD = 1.38$) in memory recall ($t(149) = 1.14$, $p = .25$).

Sleep Disturbance and Psychological Distress

There was a significant positive correlation between sleep disturbance and symptoms of depression ($r = .54$, $p < .01$), which reveals that endorsing greater symptoms of depression was associated with endorsing greater symptoms of sleep disturbance. There was also a significant positive correlation between sleep disturbance and symptoms of PTSD ($r = .71$, $p < .01$), indicating that greater severity of PTSD was also associated with greater disturbances in sleep.

Finally, there was a significant difference in sleep disturbance symptoms between participants with comorbid depression and PTSD ($M = 20.61, SD = 5.00$) and participants who did not have comorbid symptoms ($M = 13.39, SD = 6.30; t(144) = -8.07, p < .01$). Individuals with comorbid psychological distress were more likely to have disturbances in sleep than individuals without this psychological comorbidity.

Distress Comorbidities and Cognition

Table 2 displays the means and significance for all distress comorbidity groups and their relationship with each cognitive domain. A one-way ANOVA found a significant effect of distress comorbidity on scores on the MoCA ($F(3, 141) = 5.89, p < .01$). Post-hoc analyses indicated that the group with three distress comorbidities (i.e. insomnia, depression, and PTSD; $M = 23.11, SD = 3.48$) performed more poorly on the MoCA than the no distress group ($M = 25.53, SD = 2.21$), the one distress group ($M = 25.09, SD = 2.39$), and the group with two distress comorbidities ($M = 24.95, SD = 2.85$). These results reveal that overall cognition was lowest for veterans with three distress comorbidities and highest for veterans with no distress.

A one-way ANOVA found a significant effect of distress comorbidity on attention ($F(3, 153) = 6.99, p < .01$). Post-hoc analyses indicated that the group with three distress comorbidities ($M = 7.62, SD = 2.30$) differed significantly from the no distress group ($M = 9.26, SD = 2.44$), the one distress group ($M = 9.92, SD = 2.38$), and the group with two distress comorbidities ($M = 8.87, SD = 2.38$). These results reveal that attention was lowest for veterans with three distress comorbidities and greater for individuals with no significant distress or one distress group.

A one-way ANOVA found a significant effect of distress comorbidity on executive functioning ($F(3, 145) = 3.15, p < .05$). Post-hoc analyses indicated that the group with three

distress comorbidities ($M = 40.07$, $SD = 12.35$) differed significantly from the no distress group ($M = 45.94$, $SD = 8.91$), the one distress group ($M = 46.00$, $SD = 9.88$), and the group with two distress comorbidities ($M = 45.84$, $SD = 12.07$). These results reveal that executive functioning was greatest in individuals with no significant distress and most impaired in individuals with three distress comorbidities.

A one-way ANOVA found no significant effect of distress comorbidity on memory recall ($F(3, 142) = 1.08$, $p = .36$). The greatest mean scores on memory recall occurred in veterans with no significant distress, though their memory scores were not different enough from the distress groups to be significant. Figure 1 displays the means of each cognitive domain for the four different distress comorbidity groups.

Discussion

Sleep Disturbance and Cognition

The present study aimed at assessing the potential cognitive inefficiencies associated with sleep disturbances, depression symptoms, and reports of PTSD among veterans. It was hypothesized that veterans endorsing sleep disturbance would show impairments in overall cognition, attention, executive functioning, and memory. Results showed that the greater an individual's severity in sleep disturbance, the lower their scores were on measures of overall cognition and attention. This is consistent with previous findings on the correlation between insomnia and cognitive ability (Dodds et al., 2011; Mackin et al., 2012; Qureshi et al., 2011; Ruff et al., 2009; Stenuit & Kerkhofs, 2008; Waters & Bucks, 2011; Zimmerman et al., 2012). However, there were conflicting results in regard to the effect of sleep disturbance on executive functioning. Individuals above the severity cutoff for insomnia performed significantly worse on measures of executive functioning than those with insignificant symptoms. This is consistent

with past findings on the effect of insomnia on executive functioning (Dodds et al., 2011; Stenuit & Kerkhofs, 2008; Waters & Bucks, 2011; Zimmerman et al., 2012). Nevertheless, there was no significant correlation between the severity of insomnia symptoms and performance on measures of executive functioning. This disparity may be due to the comorbidities of other distress conditions. Individuals endorsing insomnia may also have significant symptoms of depression and PTSD, which would confound the relationship of executive functioning. Finally, there was no significant relationship between sleep disturbance and memory recall, which was inconsistent with the findings from past research. This may be due to the memory measure used in this study, which had a short delay, which left less room for variability in performance.

Depression and Cognition

Depression was also hypothesized to have a negative effect on overall cognition, attention, and executive functioning; with modest effects on memory. Results showed significant correlations between depression symptoms and poor performance on overall cognition, attention, and executive functioning. Individuals with significant symptoms of depression performed worse on all measures of cognition, except memory. Memory recall was not related to depressive symptoms in this sample. These results are consistent with previous findings of the contradictory and unclear relationship of depression and memory recall (Royall et al., 2012; Wright & Persad, 2007).

Posttraumatic Stress Disorder and Cognition

Posttraumatic Stress Disorder was also hypothesized to negatively affect overall cognition, attention, executive functioning, and memory. Results showed that PTSD symptoms had a negative relationship with overall cognition and attention. The greater the severity of PTSD symptoms, the worse participants performed on measures of attention and overall

cognition. This is consistent with previous findings that emphasized the affect on PTSD on attention (Qureshi et al., 2011) due to the intrusive thoughts associated with PTSD symptomatology (Wells & Sembi, 2004). However, the effect of PTSD on executive functioning was contradictory. There was a significant relationship between the severity of PTSD symptoms and performance on executive functioning measures, however, individuals with PTSD symptoms above cutoff did not perform significantly worse than individuals below cutoff. Results showed that individuals with PTSD did perform worse than those without significant PTSD, however the differences in their scores were not quite large enough to be significant. These results are not consistent with previous findings that executive functioning was negatively affected by PTSD symptoms (Mackin et al., 2012; Qureshi et al., 2011). This discrepancy may be due to the loss of data quality when dichotomizing participants into diagnosis groups based on a cutoff score. Finally, there was no relationship between PTSD symptoms and memory recall. This finding was consistent with the conflicting research on the effect of PTSD on memory. Mackin et al. (2012) reported short-term memory impairments in individuals with PTSD; however, Qureshi et al.'s (2011) findings on memory were more conflicting. Additionally, these inconsistencies are also most likely due to the measure used to assess memory in veterans.

Sleep Disturbance and Psychological Distress

It was hypothesized that there would be positive correlations between sleep disturbance and psychological distress. Results showed that individuals reporting greater severity of depression and PTSD also reported greater severity of sleep disturbance. This is consistent with previous findings that sleep is significantly affected by symptoms of depression and PTSD (Babson & Feldner, 2010; Germain et al., 2012; McLay et al., 2010; Urrila et al., 2012). Furthermore, results revealed that individuals with comorbid depression and PTSD had

significantly greater sleep disturbance than individuals with one diagnosis. This reveals that comorbid psychological distress symptoms have an additive effect on sleep behavior.

Distress Comorbidities and Cognition

Finally, it was hypothesized that comorbidities of distress would result in additive effects on overall cognition, attention, executive functioning, and memory. Results confirmed that having three distress comorbidities was significantly more detrimental to cognitive performance than none, one, or two distress conditions. However, individuals with none, one, and two diagnoses did not differ significantly from one another on cognitive performance. Therefore, it would seem that distress comorbidities do not have an additive effect, but that individuals with three or multiple diagnoses are more likely to perform poorly. This may be due to a variety of reasons including over-reporting of symptoms and poor task engagement on cognitive measures, which are both seen in a veteran population. Additionally, attention and executive functioning performance were greatest in individuals with no distress and lowest in individuals with three distress comorbidities. Finally, memory recall scores were best in individuals with no distress, though their results were not significantly different than individuals with varying levels of distress comorbidities.

Limitations, Further Research, and Implications

Memory recall results were likely not significant for any distress because the measure consisted of only five items and may not have been a sufficient indicator of short-term memory capacity. Further research may want to use multiple measures of this and other cognitive domains. Another limitation was that sleep disturbance and psychological distress were determined using self-report, which is not always reliable. Further research should be done using clinician diagnoses of insomnia, depression, and PTSD. Additionally, the participants were not

screened for effort; therefore the data may include veterans who over-reported their symptoms. Veterans reporting multiple comorbidities may not truly meet criteria for all or any conditions and may have poor task engagement on cognitive tests. Future research should include measures of effort and malingering that could eliminate participants with inaccurate data that would skew results. Finally, the results of this study reveal that the comorbidities of sleep and psychological distress have a significant impact on cognitive performance. Therefore, it may be beneficial to address these conditions and account for these symptoms when assessing cognitive inefficiencies. There is a clear implication that managing sleep disturbance and psychological distress symptoms may alleviate concerns with deficits in cognition. By thus identifying a non-organic and treatable etiology for cognitive inefficiencies, such assessment can significantly affect self-perception of cognitive decline and its impact on daily life functioning.

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I would like to thank Dr. Linas Bieliauskas, Dr. Laura Boxley, and Dr. Nicolette Gabel for collaborating with me on this project and sharing their knowledge and experience with me. Their support and guidance has been instrumental in shaping the course of this project. I would also like to thank the Veterans Affairs Ann Arbor Healthcare System for providing an opportunity to administer neuropsychological tests to the participants used in this study. Finally, I would like to thank all the VA employees who assisted in executing this research study. Correspondence concerning this paper should be addressed to Dana A. Kelly, 808 Oakland Ave. Ann Arbor, MI 48104. E-mail: danaak@umich.edu.

Table 1

Percentage of Sleep Disturbance Severity on Insomnia Severity Index (ISI)

	None		Mild		Moderate		Severe		Very Severe	
	Total	%	Total	%	Total	%	Total	%	Total	%
Sleep Disturbance										
Difficulty falling asleep	21	11.5	18	9.8	59	32.2	42	23.0	43	23.5
Difficulty staying asleep	24	13.1	11	6.0	48	26.2	54	29.5	46	25.1
Problem waking up too early	29	15.8	26	14.2	40	21.9	52	28.4	36	19.7

Table 2

ANOVA of Distress Comorbidities and Cognitive Domains

Cognitive Domains	Distress Comorbidities				F	Sig.
	None	One	Two	Three		
Overall	25.53	25.09	24.95	23.11	5.885**	.001
Cognition	(2.21)	(2.39)	(2.85)	(3.48)		
Attention	9.26	9.92	8.87	7.62	6.994**	.000
	(2.44)	(2.38)	(2.38)	(2.30)		
Executive Functioning	45.94	46.00	45.84	40.07	3.150*	.027
	(8.91)	(9.88)	(12.07)	(12.35)		
Memory Recall	3.07	2.50	2.82	2.50	1.082	.359
	(1.31)	(1.57)	(1.57)	(1.61)		

Note: * = $p < .05$, ** = $p < .01$. Standard deviations appear in parentheses below means.

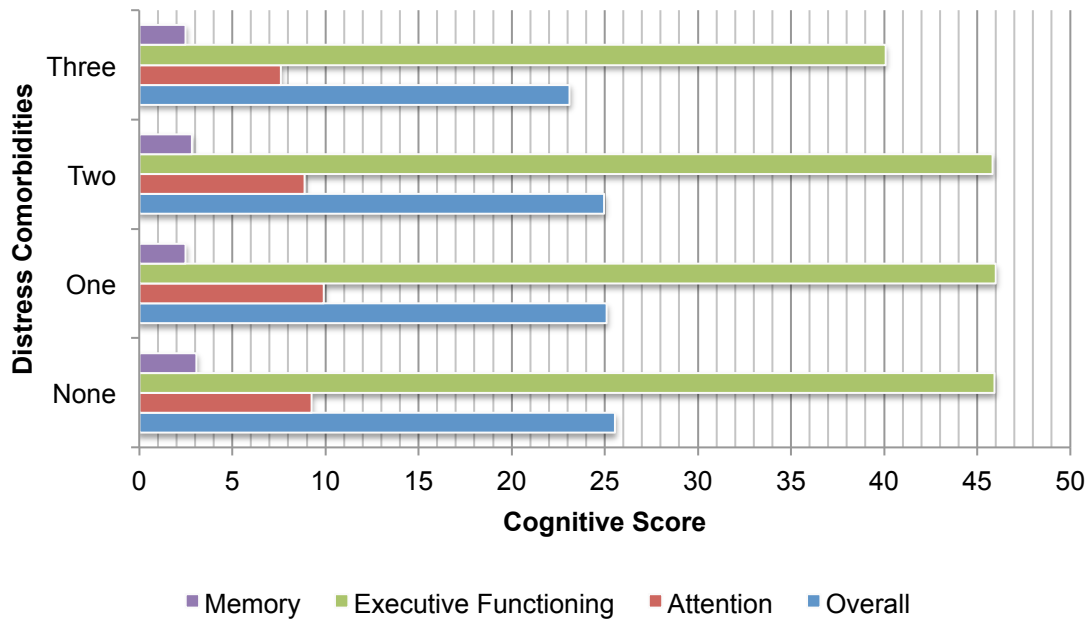


Figure 1. ANOVA means of cognitive domains in varying distress comorbidities.