

SCIENTIFIC INVESTIGATIONS

The Association between Sleep Disturbances and Depression among Firefighters: Emotion Dysregulation as an Explanatory Factor

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Study Objectives: To investigate emotion regulation difficulties in association with self-reported insomnia symptoms, nightmares, and depression symptoms in a sample of current and retired firefighters.

Methods: A total of 880 current and retired United States firefighters completed a web-based survey of firefighter behavioral health. Self-report measures included the Center for Epidemiologic Studies Depression Scale, Insomnia Severity Index, PTSD Checklist, and Difficulties in Emotion Regulation Scale.

Results: A notable portion of participants reported clinically significant depression symptoms (39.6%) and insomnia symptoms (52.7%), as well as nightmare problems (19.2%), each of which demonstrated a strong association with emotion regulation difficulties ($r_s = 0.56\text{--}0.80$). Bootstrapped mediation analyses revealed that the indirect effects of overall emotion regulation difficulties were significant both for the relationship between insomnia and depression (95% CI: 0.385–0.566) and nightmares and depression (95% CI: 1.445–2.365). Limited access to emotion regulation strategies emerged as the strongest, significant indirect effect for both relationships (insomnia 95% CI: 0.136–0.335; nightmares 95% CI: 0.887–1.931).

Conclusions: Findings extend previous affective neuroscience research by providing evidence that insomnia and nightmares may influence depression symptoms specifically through the pathway of explicit emotion regulation difficulties. Sleep disturbances may impair the ability to access and leverage emotion regulation strategies effectively, thus conferring risk for negative affect and depression.

Keywords: insomnia, nightmares, sleep, emotion regulation, depression

Citation: Hom MA, Stanley IH, Rogers ML, Tzoneva M, Bernert RA, Joiner TE. The association between sleep disturbances and depression among firefighters: emotion dysregulation as an explanatory factor. *J Clin Sleep Med* 2016;12(2):235–245.

INTRODUCTION

Firefighters are at elevated risk for sleep disturbances and depression.^{1–3} In one study utilizing a sample of 112 firefighters, 59% of respondents reported disturbed sleep patterns and/or sleep deprivation and 11% reported clinically significant depression symptoms.³ These observed rates have been attributed, in part, to the occupational hazards and stressors experienced by firefighters,^{1–3} such as exposure to trauma and shiftwork schedules. Given these findings, there is a clear need to identify points of intervention that can be effectively targeted to prevent the onset of sleep disturbances and depression within this high-risk population.

Although insomnia is a cardinal symptom of depression, research has also illuminated its role as a primary sleep disorder that may serve as a precursor to and prodromal feature of depression.⁴ Insomnia has been found to predict depression onset across age groups, populations, and diverse study designs, conferring an approximately two-fold increased risk for its development.⁵ Further, even though the temporal relationship between nightmares and depression is less well established, some reports demonstrate a positive association between nightmare severity and depression symptoms.^{6,7} Numerous studies have also found that greater severity and frequency of nightmares and insomnia serve as an independent risk factor for suicidal ideation and behaviors.⁸ Consequently, there is strong rationale

BRIEF SUMMARY

Current Knowledge/Study Rationale: Insomnia has been demonstrated to be a robust predictor of depression onset, and distinct yet related lines of inquiry from basic affective neuroscience research have established a relationship between sleep and emotion. Despite this, little is known about explicit emotion regulation difficulties as a possible explanatory factor in the association between sleep problems and depression symptoms, including among firefighters—a sample at elevated risk for insomnia, nightmares, and depression.

Study Impact: Difficulties in emotion regulation, particularly lack of access to emotion regulation strategies, may in part explain the link between sleep disturbances and depression among firefighters. Emotion dysregulation may be an important therapeutic target for reducing depression risk for firefighters and related groups experiencing insomnia and nightmares.

to delineate explanatory pathways that may help to explain symptom relationships between sleep disturbances (i.e., insomnia and nightmares) and depression.

A number of potential mechanisms have been proposed to explain this link. These include stress response as a mediator of the relationship between insomnia and depression, gene and environment contributions, shared neurobiological pathways (e.g., glutamate system, monoaminergic transmitters), learned helplessness and physiological hyperarousal, and the possibility that sleep disturbances impact the processing of

negative emotions.^{9–11} This latter conjecture that emotion regulation difficulties mediate the relationship between insomnia and depression is particularly compelling,¹² especially considering findings from basic affective neuroscience research evaluating the relationship between sleep and emotion, which will now be discussed.

Notably, experimental studies of sleep restriction demonstrate that sleep plays an important role in cognitive processing, with sleep disturbances negatively affecting functioning across a broad range of domains, including consolidation of memories and processing of information related to emotions.¹³ For example, laboratory studies among healthy young adults demonstrate that sleep deprivation (20 to 31 consecutive hours without sleep) may lead to impairments in accurate judgment of human facial emotions, less expressiveness when responding to positive film clips, greater elevations in subjective stress and negative mood when completing stressor tasks, and greater difficulties encoding positive emotional memories.^{14–17} Additionally, within clinical samples, those with primary insomnia appear to have greater difficulty perceiving emotional information from facial expressions using similar affect recognition paradigms.¹⁸

Several investigations also suggest that sleep disturbances may specifically impact emotion regulation abilities. For instance, Mauss and colleagues¹⁹ found that individuals with poorer sleep quality demonstrated greater difficulties using reappraisal strategies to decrease negative emotions after viewing sad (cf. depressogenic) film clips. Another study testing the effects of experimentally induced chronic sleep restriction found that adolescents in a sleep restriction condition reported significantly greater irritability, as well as poorer emotion regulation abilities, as compared to healthy controls.²⁰ In the same study, reports from parents, who were likely well-positioned informants of their child's emotion regulation abilities, revealed comparable results.

Results from neurobiological and functional magnetic resonance imaging (fMRI) studies also support the link between sleep and emotional processing/regulation abilities. For instance, an fMRI study conducted by Yoo and colleagues²¹ found that among individuals with sleep deprivation, the amygdala—the neurobiological epicenter for emotional experiences—exhibited an amplified response to negative emotional stimuli. Conversely, REM sleep appears to de-potentiate negative emotional reactivity towards negative facial expressions and standardized affective pictures with a negative valence.^{22,23} These findings are consistent with earlier, seminal work from Cartwright and colleagues²⁴ indicating that REM sleep may play an important role in mood regulation.

Multiple researchers have interpreted these and similar findings as evidence that emotion dysregulation (specifically, heightened emotional reactivity and emotion regulation deficits) mediates the relationship between insomnia and depression risk.^{4,9–12} Such pathways appear further implicated in animal studies demonstrating that chronic sleep restriction leads to desensitization of the serotonin (5-HT)_{1A} system,²⁵ long implicated in mood disorders. In comparison, relatively few studies have extended these results among high-risk

groups while using a gold standard self-report measure of explicit emotion regulation difficulties.

The Present Study

This cross-sectional study aimed: (1) to investigate the prevalence of sleep disturbances, depression symptoms, and emotion regulation difficulties among a large national sample of firefighters; and (2) to test emotion regulation difficulties as an explanatory link between sleep disturbances (insomnia, nightmares) and depression symptoms. Consistent with previous work, we hypothesized that (1) greater sleep disturbances would be significantly associated with impaired utilization of emotion regulation strategies and, subsequently, greater depression symptomatology; and (2) the indirect effects of greater emotion regulation difficulties would significantly account for the relationship between (a) insomnia and depression symptoms, controlling for nightmares, as well as (b) nightmares and depression symptoms, controlling for insomnia.

METHODS

Participants

The sample consisted of 880 current ($n = 788$) and retired ($n = 92$) firefighters who completed a nationwide, web-based survey of firefighter behavioral health. In order to consider occupational exposures (e.g., trauma) that may have conferred long-term and chronic risk for the development of sleep problems and depression, both current and retired firefighters were included. Participants ranged in age from 18 to 82 years (mean = 8.95, standard deviation = 11.52), and 91.4% were male. In terms of self-reported race/ethnicity, 88.2% identified as Caucasian/White, 6.8% as Native American/Alaska Native, and 4.9% as other. Firefighter rank varied, with 45.8% holding a lower rank (Firefighter I, Firefighter II, Engineer/Technician/Chauffeur), 32.9% holding a higher rank (Sergeant, Lieutenant, Captain), 17.9% holding an officer rank or above (Battalion Chiefs, Assistant Chiefs, Deputy Chiefs, Commissioners), and 3.4% reporting another rank. Department types also varied, with 41.8% serving in full-time departments, 27.8% in volunteer departments, 28.4% in hybrid full-time/volunteer departments, and 2.0% in military or wildland departments.

Measures

Demographics

Participants' demographic information (age, sex, race/ethnicity) and firefighter characteristics (rank, department type) were obtained using a brief self-report questionnaire.

Center for Epidemiologic Studies Depression Scale (CES-D)

The CES-D²⁶ is a 20-item self-report measure used to assess depression symptom severity in the general population. Participants rate the degree to which they have experienced each feeling or behavior (e.g., "I thought my life had been a failure") in the past week (0 = Less than 1 day, 1 = 1–2 days, 2 = 3–4

days, 3 = 5–7 days). Total scores range from 0 to 60, with higher scores indicating greater depression symptom severity, and scores ≥ 16 indicating clinical significance.²⁶ For the present study, the item probing sleep difficulties (i.e., “My sleep was restless”) was excluded from analyses; thus, total possible scores ranged from 0 to 57. The CES-D shows good internal consistency, test-retest reliability, and construct validity across populations.²⁶ Within this study, the CES-D demonstrated high internal consistency ($\alpha = 0.93$).

Difficulties in Emotion Regulation Scale (DERS)

The DERS²⁷ is a 36-item self-report measure used to assess emotion regulation difficulties across 6 distinct but related domains: (1) *Non-acceptance*: non-acceptance of emotional responses; (2) *Strategies*: limited access to effective emotion regulation strategies; (3) *Impulse*: impulse control difficulties; (4) *Goals*: difficulties engaging in goal-directed behavior; (5) *Clarity*: lack of emotional clarity; and (6) *Awareness*: lack of emotional awareness. Respondents rate the extent to which each item (e.g., “When I’m upset, I feel out of control”) applies to themselves, with possible responses being: 1 = Almost never (0% to 10%), 2 = Sometimes (11% to 35%), 3 = About half the time (36% to 65%), 4 = Most of the time (66% to 90%), and 5 = Almost always (91% to 100%). Items are summed to create a total score as well as subscale scores, with higher scores indicating greater difficulties in the corresponding specific area. The DERS total score and subscale scores have been shown to have high internal consistency, good test-retest reliability, and adequate construct and predictive validity within nonclinical populations.²⁷ In the present study, internal consistency was high for the DERS total score ($\alpha = 0.96$) and ranged from good to high across the 6 subscales ($\alpha = 0.83$ – 0.93).

Insomnia Severity Index (ISI)

The ISI²⁸ is a 7-item self-report questionnaire that measures severity of insomnia symptoms (e.g., difficulties falling asleep, difficulties staying asleep). Total scores range from 0 to 28, with higher scores indicating greater symptom severity and scores ≥ 10 indicating clinical significance.²⁹ The ISI shows good internal consistency and construct validity across samples²⁹ and demonstrated high internal consistency with the current study ($\alpha = 0.91$).

PTSD Checklist-Civilian Version (PCL-C)

The PCL-C³⁰ is a 17-item self-report measure that assesses severity of posttraumatic stress disorder (PTSD) symptoms in civilian community populations. The PCL-C has been shown to have strong psychometric properties.³¹ For the present study, a single item (Item 2) was used to assess nightmare severity, with participants asked to rate the extent to which they had been bothered by “Repeated, disturbing *dreams* of a stressful experience from the past” in the past month (1 = Not at all, 5 = Extremely). Previous studies have similarly used this single item as a measure of nightmare severity.^{32,33}

Procedures

This cross-sectional study represents a subset of a larger investigation of behavioral health among current and retired

firefighters (n = 1,027).³⁴ Participants who completed all relevant study measures were included in analyses for the present study (n = 880). Individuals were invited to participate in this study through listserv and social media announcements (a brief description of study and web link to survey portal) posted by the National Fallen Firefighters Foundation and other national and local firefighter organizations in February 2015. Probability sampling was not utilized and response rates were indeterminate; thus, the present sample was a convenience sample. Those interested in participating reviewed a web-based informed consent form and were required to answer correctly a series of comprehension questions based on the form. Individuals who consented to participating completed a 30-min battery of self-report measures through Qualtrics, a secure web-based survey platform. Following this, participants had the option to provide their email address to receive a \$10 electronic gift card as compensation. All survey respondents were presented with a debriefing form at the end of the survey, which included information for national resources, such as the National Suicide Prevention Lifeline (1-800-273-TALK). The university’s institutional review board approved all study procedures.

Analytic Plan

Bootstrapped mediation analyses³⁵ were conducted in order to test study hypotheses that the indirect effects of emotion regulation difficulties would significantly account for the relationship between (1) insomnia and depression symptoms, controlling for nightmare severity; and (2) nightmares and depression symptoms, controlling for insomnia severity. Control variables (insomnia or nightmare severity) were included to probe the specific effect of each type of sleep disturbance. First, only the DERS total score was included as a mediator variable. Then, additional indirect effects analyses were conducted to determine the parallel contributions of each of the DERS subscales. Pairwise contrasts were conducted to determine which statistically significant indirect path demonstrated the strongest indirect effect on depression symptoms.

Finally, in order to assess for the specificity of indirect effects, exploratory analyses were implemented to test whether overall emotion regulation difficulties and the DERS subscales in parallel would significantly account for the relationship between (1) depression and insomnia symptoms; and (2) depression and nightmare severity. Exploratory analyses were also conducted to examine whether the indirect effects of depression symptoms would significantly account for the relationship between insomnia symptoms and emotion regulation difficulties.

All analyses were conducted using Preacher and Hayes’ bias-corrected bootstrapping method³⁵ to test for indirect effects (5,000 bootstrapped resamples generated from observed data); a 95% confidence interval (CI) that did not cross zero was considered statistically significant. This statistical approach was selected in light of recent literature identifying bootstrapping as a robust alternative to historically utilized tests of mediation (e.g., Sobel test) that tend to be underpowered and that may yield underestimated mediated effects.³⁶ As noted, to reduce the plausibility of artificial multicollinearity, the CES-D’s single sleep item was removed from analyses.

Table 1—Means, standard deviations, and intercorrelations of measures.

	1	2	3	4	5	6	7	8	9	10
1. CES-D (no sleep item)	1.00									
2. Insomnia Severity Index, Total	0.66**	1.00								
3. PCL-C (nightmare item)	0.58**	0.55**	1.00							
4. DERS Total	0.80**	0.63**	0.56**	1.00						
5. DERS-Non-acceptance	0.60**	0.48**	0.48**	0.80**	1.00					
6. DERS-Strategies	0.79**	0.57**	0.56**	0.92**	0.73**	1.00				
7. DERS-Impulse	0.67**	0.53**	0.53**	0.85**	0.61**	0.81**	1.00			
8. DERS-Goals	0.62**	0.52**	0.41**	0.80**	0.60**	0.75**	0.70**	1.00		
9. DERS-Clarity	0.68**	0.53**	0.48**	0.83**	0.54**	0.70**	0.65**	0.54**	1.00	
10. DERS-Awareness	0.35**	0.31**	0.14**	0.49**	0.15**	0.28**	0.22**	0.19**	0.56**	1.00
Mean	13.49	10.18	1.77	78.67	13.56	12.17	10.91	15.85	15.74	10.44
Standard deviation	11.24	6.41	1.04	25.75	6.33	4.72	5.13	5.40	7.04	4.15
Minimum	0.00	0.00	1.00	36.00	6.00	5.00	6.00	6.00	8.00	5.00
Maximum	52.00	28.00	5.00	159.00	30.00	25.00	29.00	30.00	38.00	24.00
α	0.93	0.91	–	0.96	0.93	0.92	0.89	0.88	0.83	0.86

**p < 0.01. CES-D, Center for Epidemiologic Studies Depression Scale; DERS, Difficulties in Emotion Regulation Scale; PCL-C, PTSD Checklist—Civilian Version

RESULTS

Descriptive Statistics

Means, standard deviations, ranges, and zero-order Pearson *r* correlations for all self-report measures and DERS subscales are presented in **Table 1**. Both skew and kurtosis were in acceptable ranges for each measure and DERS subscale (between ± 2 and ± 1, respectively). A large portion of the sample reported clinically significant depression symptoms (39.6%) and insomnia symptoms (52.7%), and 44.8% reported at least some difficulties with PCL-C-assessed disturbing dreams, with 19.2% reporting moderate to extreme problems with nightmares. There were no statistically significant differences between current and retired firefighters' scores on the ISI ($F_{1,877} = 0.034$, $p = 0.854$), CES-D ($F_{1,877} = 0.497$, $p = 0.481$), PLC-C sleep item ($F_{1,877} = 2.774$, $p = 0.096$), or DERS ($F_{1,877} = 0.654$, $p = 0.419$).

Primary Analyses

Insomnia Severity: Effects on Depression Symptoms

Figure 1 presents the path coefficients from the bootstrapped regression and mediation analyses for the effects of ISI insomnia severity on CES-D depression symptoms through DERS overall emotion regulation difficulties (**Figure 1A**) and the 6 DERS subscales (**Figure 1B**).

For analyses examining the relationship between insomnia and depression symptoms, controlling for nightmare severity, the overall regression model explained a significant portion of the variance in depression symptoms ($R^2 = 0.69$, $F_{3,876} = 649.53$, $p < 0.001$). ISI severity significantly predicted overall DERS scores ($B = 1.84$, $SE = 0.12$, $p < 0.001$), and overall DERS scores significantly predicted CES-D total scores ($B = 0.26$, $SE = 0.01$, $p < 0.001$). The direct effects of ISI scores on CES-D scores were also significant ($B = 0.39$, $SE = 0.04$, $p < 0.001$). The

indirect effect of the DERS on CES-D scores was estimated to be between 0.385 and 0.566 (95% CI), indicating significance.

Consistent with primary mediation analyses, the DERS subscales were found to explain significant variance in the association between ISI scores and CES-D scores, controlling for nightmares. In particular, the indirect effects of the DERS-Strategies (95% CI: 0.255, 0.424) and DERS-Clarity (95% CI: 0.045, 0.155) subscales on the relationship between ISI and CES-D scores were significant. The indirect effects of the other DERS subscales were not significant. Pairwise contrasts revealed that the indirect effects of DERS-Strategies were significantly stronger than those of DERS-Clarity (95% CI: 0.136, 0.335).

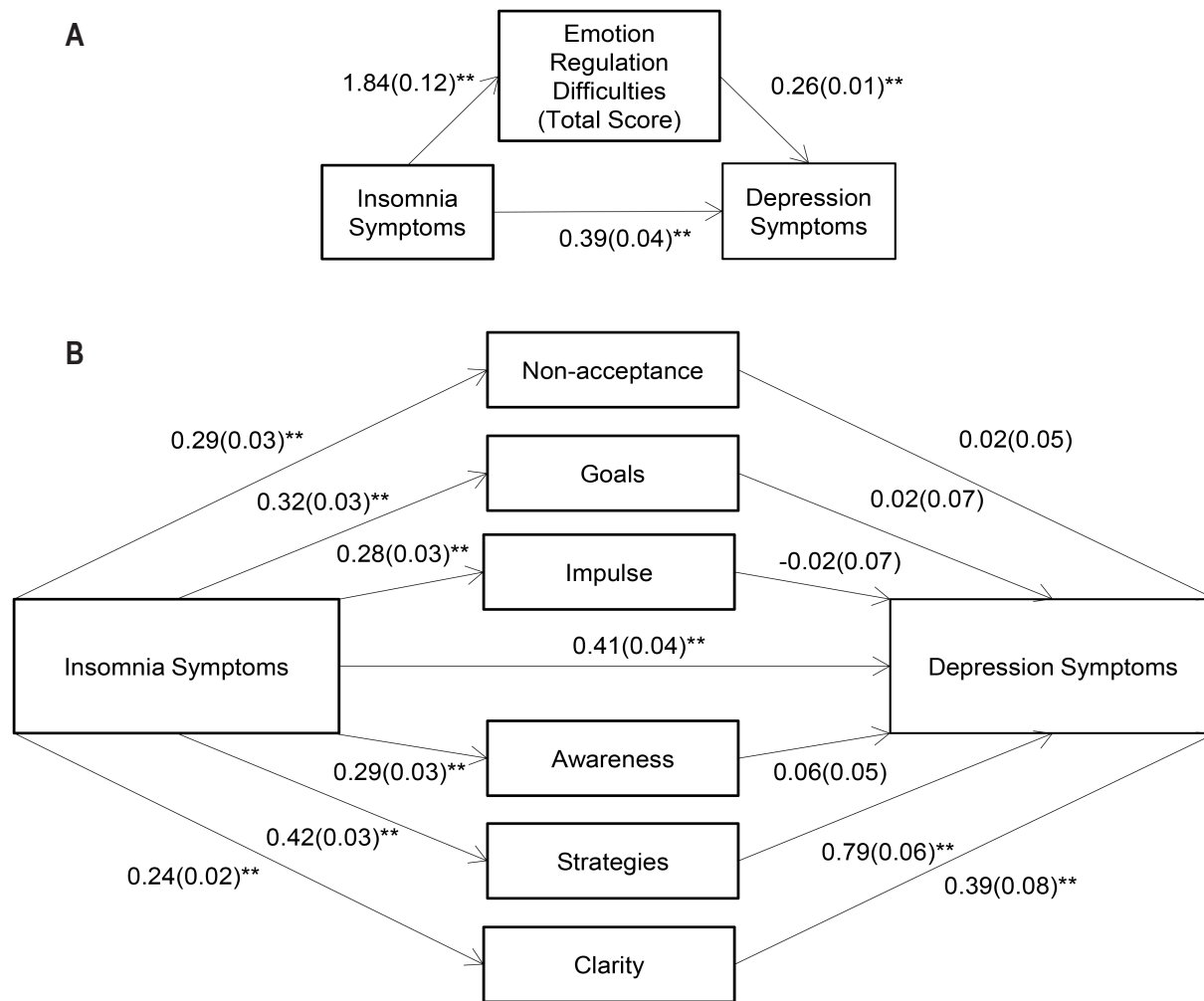
Nightmare Severity: Effects on Depression Symptoms

Path coefficients from the bootstrapped regression and mediation analyses for the effects of PCL-C nightmare severity on depression symptoms through overall DERS scores and the 6 DERS subscales are presented in **Figures 2A** and **2B**, respectively.

The overall regression model investigating the relationship between nightmares and depression symptoms, controlling for insomnia severity, accounted for a significant portion of the variance in depression symptoms ($R^2 = 0.69$, $F_{3,876} = 649.53$, $p < 0.001$). PCL-C Item 2 scores significantly predicted overall DERS scores ($B = 7.38$, $SE = 0.75$, $p < 0.001$), and overall DERS scores significantly predicted CES-D severity ($B = 0.26$, $SE = 0.01$, $p < 0.001$). The direct effects of PCL-C Item 2 on CES-D scores were also significant ($B = 1.56$, $SE = 0.26$, $p < 0.001$). The 95% CI for the indirect effect of the DERS was 1.445 to 2.365, suggesting that the observed indirect effects were significant.

Similarly, the DERS subscales significantly accounted for the association between PCL-C Item 2 and CES-D total scores, controlling for ISI severity. Again, only the indirect

Figure 1—Emotion regulation difficulties mediating the relationship between insomnia and depression symptoms, controlling for nightmare severity.



**p < 0.01.

effects of the DERS-Strategies (95% CI: 1.340, 2.330) and DERS-Clarity (95% CI: 0.204, 0.701) subscales on the relationship between ISI and CES-D scores were significant. Results from pairwise contrasts indicated that the indirect effects of DERS-Strategies were significantly stronger than those of DERS-Clarity (95% CI: 0.887, 1.931).

Exploratory Analyses

Depression Symptoms: Effects on Insomnia Severity

Path coefficients from the bootstrapped regression and mediation analyses examining the association between CES-D depression and ISI insomnia, through overall DERS scores (Figure 3A) and the 6 DERS subscales (Figure 3B), controlling for PCL-C nightmares, are presented in Figure 3.

The overall regression model examining the relationship between depression and insomnia symptoms explained a significant portion of the variance in insomnia symptom severity ($R^2 = 0.46$, $F_{2,877} = 367.32$, $p < 0.001$). CES-D scores significantly predicted overall DERS scores ($B = 1.81$, $SE = 0.05$, $p < 0.001$), and overall DERS scores significantly predicted ISI

severity ($B = 0.06$, $SE = 0.01$, $p < 0.001$). The direct effects of CES-D scores on ISI scores were significant ($B = 0.26$, $SE = 0.02$, $p < 0.001$). The indirect effects of the overall DERS were also significant (95% CI: 0.077, 0.160).

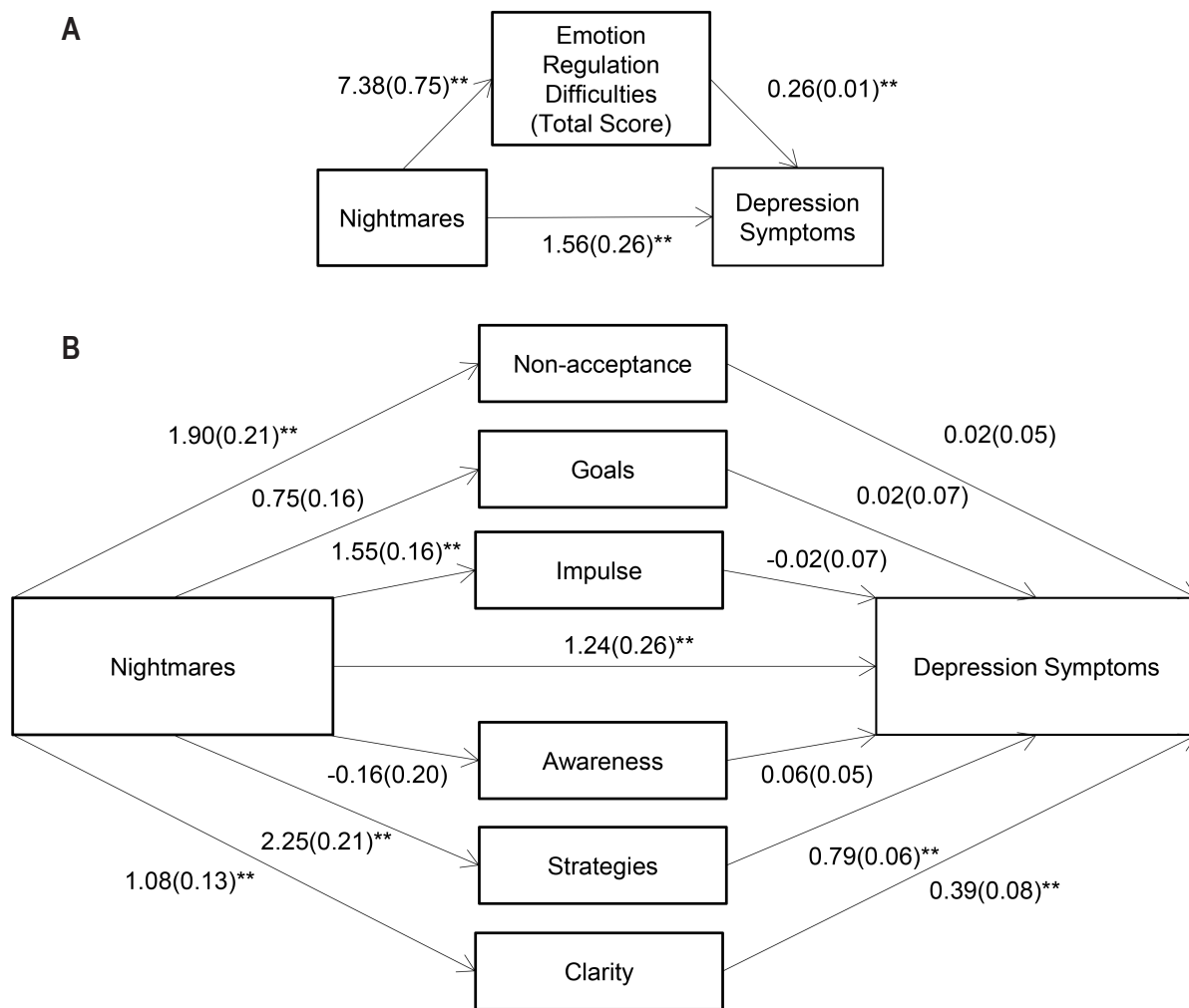
In examining the parallel contributions of each of the DERS subscales, the indirect effects of the DERS-Non-acceptance (95% CI: 0.002, 0.053), DERS-Goals (95% CI: 0.029, 0.085), DERS-Awareness (95% CI: 0.008, 0.035), and DERS-Strategies (95% CI: -0.110, -0.002) subscales were significant. Pairwise contrasts did not identify any particular subscale as having the significantly strongest indirect effects.

Depression Symptoms: Effects on Nightmare Severity

Figure 4 presents path coefficients from the bootstrapped regression and mediation analyses evaluating the association between CES-D depression and PCL-C nightmares through overall DERS scores (Figure 4A) and the DERS subscales (Figure 4B).

For analyses examining the association between depression symptoms and nightmare severity, the overall regression model explained a significant portion of the variance in

Figure 2—Emotion regulation difficulties mediating the relationship between nightmares and depression symptoms, controlling for insomnia severity.



**p < 0.01.

nightmare severity ($R^2 = 0.35$, $F_{2,877} = 253.79$, $p < 0.001$). CES-D scores significantly predicted overall DERS scores ($B = 1.81$, $SE = 0.05$, $p < 0.001$), and overall DERS scores predicted PCL-C Item 2 severity ($B = 0.01$, $SE = 0.001$, $p < 0.001$). The direct effects of CES-D scores on ISI severity were significant ($B = 0.04$, $SE = 0.004$, $p < 0.001$). The indirect effects of the DERS on PCL-C nightmare severity were also significant (95% CI: 0.010, 0.024).

Multiple mediation analyses revealed significant indirect effects for the following DERS subscales on nightmare severity: DERS-Non-acceptance (95% CI: 0.001, 0.013), DERS-Goals (95% CI: -0.011, -0.001), DERS-Impulse (95% CI: 0.002, 0.017), DERS-Awareness (95% CI: -0.006, -0.001), and DERS-Clarity (95% CI: 0.002, 0.016). That is, significant indirect effects emerged for each subscale, with the exception of DERS-Strategies. Pairwise contrasts did not identify any one subscale as having the significantly strongest indirect effects.

Depression Symptoms as a Mediator

Path coefficients from the bootstrapped regression and mediation analyses for the effects of ISI insomnia on the DERS

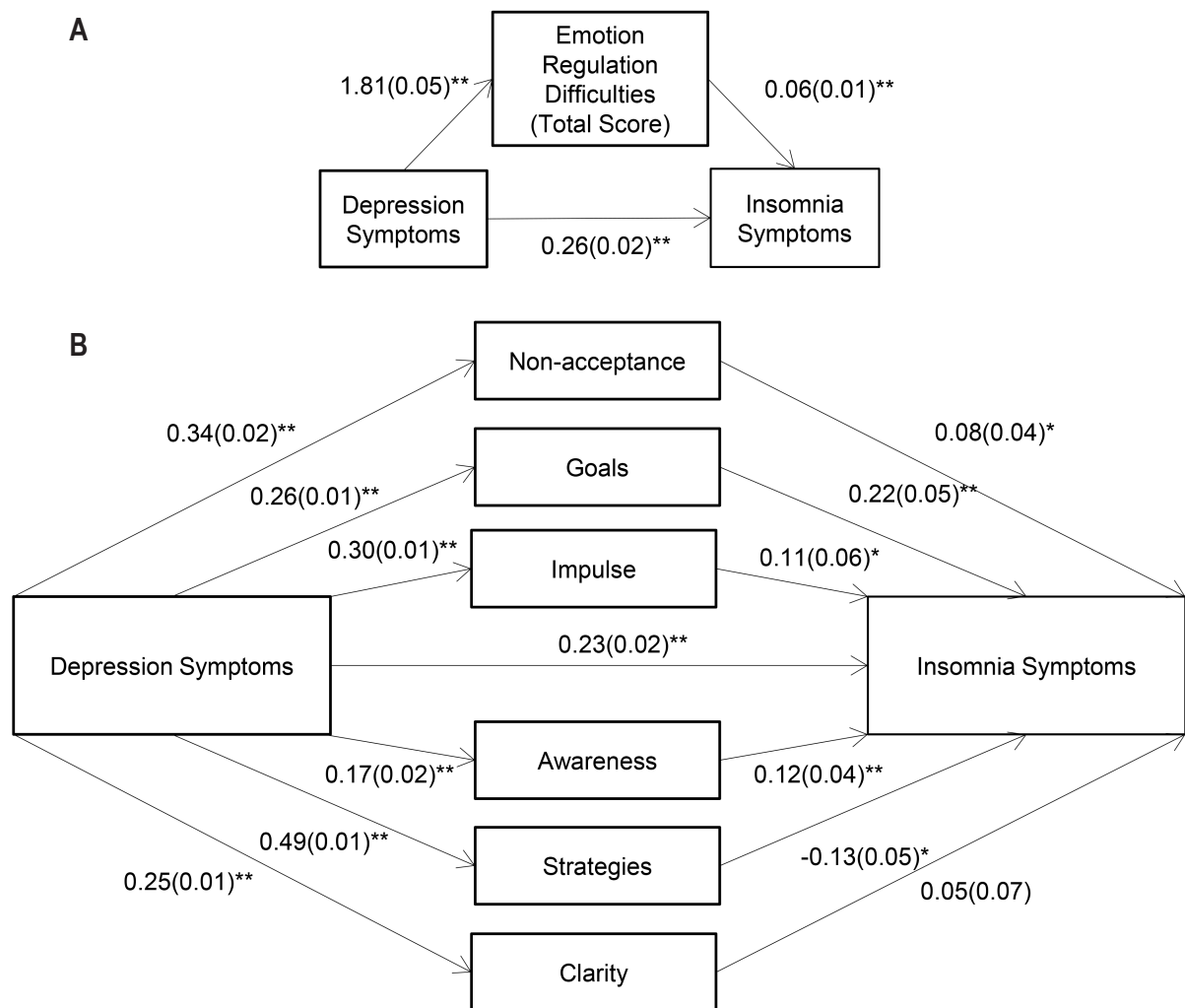
through the CES-D, controlling for PCL-C nightmares, are presented in **Figure 5**.

The overall regression model accounted for a significant portion of the variance in DERS scores ($R^2 = 0.62$, $F_{3,876} = 550.22$, $p < 0.001$). ISI severity significantly predicted CES-D scores ($B = 0.86$, $SE = 0.05$, $p < 0.001$), and CES-D scores significantly predicted overall DERS scores ($B = 1.48$, $SE = 0.06$, $p < 0.001$). The direct effects of ISI scores on the DERS ($B = 0.56$, $SE = 0.11$, $p < 0.001$) were significant. The indirect effects of the CES-D were also significant (95% CI: 1.099, 1.469).

DISCUSSION

This study aimed: (1) to investigate rates of sleep disturbances, depression symptoms, and emotion regulation difficulties, and (2) to examine emotion dysregulation as an explanatory factor in the relationship between sleep disturbances (insomnia, nightmares) and depression in a large sample of current and retired firefighters. Findings have a number of implications for future research investigating the link between sleep disturbances and

Figure 3—Emotion regulation difficulties mediating the relationship between depression and insomnia symptoms.



*p < 0.05, **p < 0.01.

depression, as well as clinical applications for the prevention and treatment of depression among firefighters.

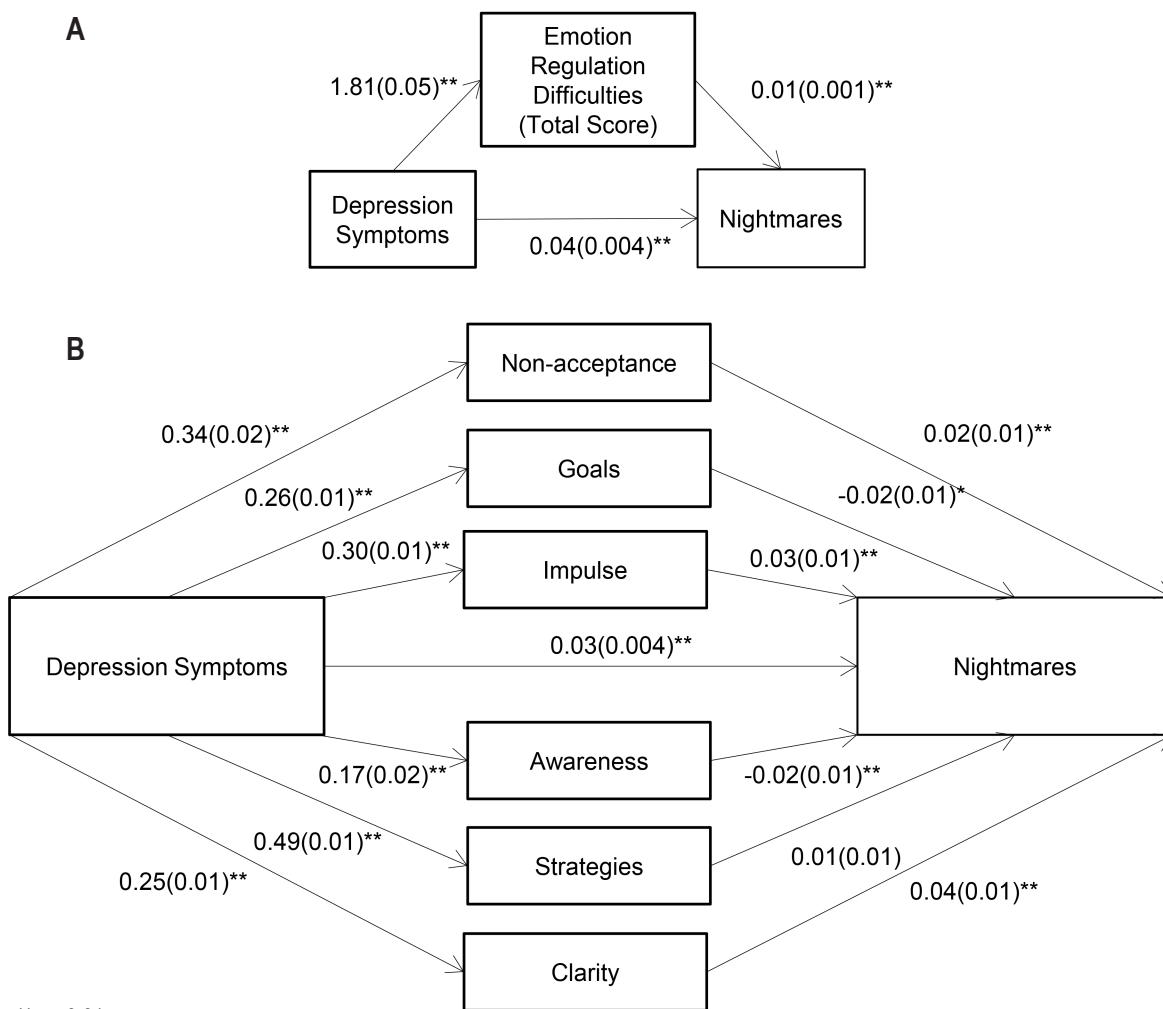
First, results revealed high rates of sleep disturbances and depression symptoms among participants, each of which demonstrated a strong association with emotion regulation difficulties. This supports our study hypothesis and replicates past work identifying firefighters as being at elevated risk for sleep and depressive disorders.¹⁻³ These results also indicate that these problems co-occur at high rates among those with a fire service history; thus, it may be advantageous to assess for and, if necessary, treat both sleep and depression complaints among current and retired firefighters. Additionally, these elevated rates of sleep and depression problems emphasize the critical need to further study the pathogenesis of risk for these psychiatric disorders in this largely understudied, yet evidently high-risk, population. The present study represents one of few large-scale studies examining the nature of psychiatric problems among individuals in the fire service. Research in this area is particularly important given the occupational hazards experienced by firefighters and the potential to extend findings to similar populations (e.g., emergency medical technicians,

paramedics, law enforcement officers, and other first responder groups).

Second, findings supported our hypothesis that emotion regulation difficulties would account for the relationship between sleep disturbances (insomnia, nightmares) and depression symptoms. By highlighting emotion dysregulation as an explanatory link in the robust relationship between sleep disturbances and depression, this study builds upon past research demonstrating that experimentally induced sleep deprivation and subjective sleep complaints may negatively affect use of emotion reappraisal strategies,¹⁹ processing of emotional stimuli and negative emotions,^{14,15,24} and effective endurance of stressful situations.¹⁶

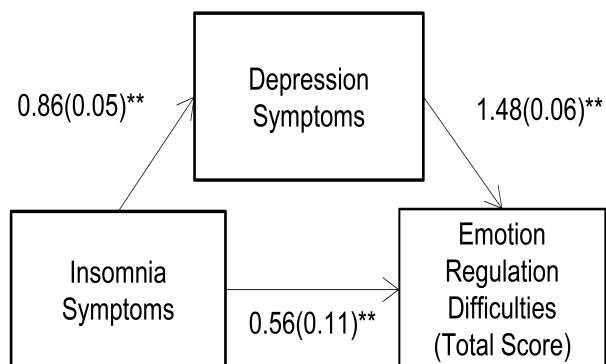
That the ability to access and successfully employ emotion regulation strategies (DERS-Strategies) emerged as the strongest indirect effect in the relationship between sleep disturbances and depression warrants discussion. This finding aligns with previous studies indicating the poor sleep quality may specifically impact individuals' problem-solving skills and ability to utilize reappraisal strategies to decrease negative emotions.¹⁹⁻²¹ It is also

Figure 4—Emotion regulation difficulties mediating the relationship between depression symptoms and nightmares.



*p < 0.05, **p < 0.01.

Figure 5—Depression symptoms mediating the relationship between insomnia symptoms and emotion regulation difficulties, controlling for nightmare severity.



**p < 0.01.

unsurprising that unresolved negative emotions or hopelessness in the face of unsolvable problems might confer risk for depression. Thus, difficulties utilizing emotion regulation strategies may represent a specific therapeutic target that

requires further investigation for the prevention and treatment of depression among firefighters suffering from sleep disturbances. It is worthwhile to note that difficulties interpreting one’s feelings (DERS-Clarity) were also revealed to be a significant, albeit weaker, explanatory link in the relationship between sleep disturbances and depression. This is consistent with previous studies suggesting that sleep deprivation may impact one’s ability to interpret emotions¹⁴ and perceive emotional information,¹⁸ and it identifies another potential therapeutic target requiring further investigation. Relatedly, the finding that only these two subscales significantly mediated the relationship between sleep problems and depression mitigates concerns regarding the relatively high correlations between the DERS and CES-D since this suggests that the DERS subscales measured meaningfully distinct constructs in the present sample.

Although there is significantly less evidence in the literature establishing a link between nightmares and depression risk, emotion regulation difficulties also emerged as a significant mediator of the relationship between nightmares and depression, even after controlling for the effects of insomnia. This reveals striking similarities in the mechanisms whereby

insomnia and nightmares independently relate to depression, yet also emphasizes the potential utility and value of separately assessing nightmare problems even after insomnia symptoms have been probed. Moreover, this finding expands what is known about the effects of nightmares on mental health, including, most relevantly, emerging literature on the role of nightmares in conferring risk for suicide.⁸

Third, given evidence that the relationship between depression and insomnia may be bidirectional,³⁷ our exploratory finding that depression is related to insomnia via deficits in emotion regulation is not surprising. However, only the indirect effects of the DERS-Awareness and DERS-Goals subscales were significant for this path, suggesting that depression may impact one's abilities to acknowledge aversive emotional states and enact goal-directed activities in light of negative emotions, subsequently affecting one's sleep quality. This contrasts with our other study findings identifying DERS-Strategies as the strongest indirect effect in the association between insomnia and depression. Interestingly, this suggests that depression and insomnia may affect one another through distinct emotion regulation pathways. This is understandable given that while depression and insomnia commonly co-occur, they are also both primary psychiatric disorders with distinct diagnostic criteria. Taken together, these data provide additional evidence for the relevance and value of targeting deficits in emotion regulation in the prevention and treatment of both insomnia and depression, although different therapeutic targets may be indicated depending on individuals' presenting problems.

Results from the exploratory analyses additionally indicated that depression might play an explanatory role in the relationship between insomnia and emotion regulation difficulties. This finding is consistent both with cognitive theories of depression, which suggest that individuals with depression may have greater negative attention biases,³⁸ and with the notion that other explanatory pathways between insomnia and depression exist.⁹ These results further confirm the highly interrelated nature of sleep disturbances, depression symptoms, and emotion dysregulation, particularly in the context of the fire service.

Finally, as previously alluded to, findings from this study have clinical applications based on the identification of emotion regulation difficulties as a potential therapeutic target for prevention of depression among individuals, especially firefighters, with sleep disturbances. Although efficacious interventions exist to treat insomnia, such as cognitive behavioral therapy for insomnia (CBT-I),³⁹ this study's results indicate that supplementation of CBT-I with modules from a therapy focused on addressing emotion dysregulation (e.g., dialectical behavior therapy [DBT], which enhances knowledge and effective utilization of emotion regulation skills) may bolster efforts to thwart the trajectory from insomnia to depression. This approach is supported by previous studies highlighting the strong interplay between sleep, emotion, and mood.^{20,24} Further work, however, is needed to establish whether DBT or similar treatments may serve as an effective adjunct to CBT-I, as conclusions regarding this therapeutic approach cannot be drawn from this study's findings. Even

so, these results provide evidence for a possible mechanism by which insomnia-focused treatments have been able to successfully reduce depression symptoms⁴⁰—through the enhancement of an individual's ability to utilize emotion regulation strategies.

Limitations and Future Directions

Limitations of the current study should also be noted. First, the cross-sectional study design precludes causal inferences. A prospective study would allow for delineation of the temporal relationships between these constructs and investigation of the acute and chronic effects of occupational exposure (this study assumed chronic effects by including retired firefighters). Second, our study utilized a convenience sample of firefighters recruited via web-based announcements, which potentially biased results. Firefighters with greater technological literacy, more severe symptoms (and consequently, potentially greater interest in completing a behavioral health survey), and lower functioning (e.g., having more available time) may have been more likely to complete the survey, limiting generalizability. Even though the large sample and high rate of self-reported sleep disturbances afforded us ample variability to detect even small effects, future studies may benefit from use of a representative sampling strategy. Nonetheless, Stanley et al.³⁴ reported that the sociodemographic and occupational characteristics of study respondents closely paralleled those of the U.S. fire service, attenuating concerns regarding representativeness. Third, use of a validated self-report measure of nightmares (e.g., Disturbing Dreams and Nightmare Severity Index) or an updated measure of depression symptoms excluding less relevant items (e.g., Hopkins Revised CES-D) would have strengthened analyses. Finally, parameters for the associations observed between sleep disturbances and DERS subscales (e.g., see **Figure 4**) may indicate that, in some cases, significant associations may have arisen as a result of the large sample size and ability to detect small and potentially trivial effects. Thus, further work is needed to evaluate these relationships, particularly by utilizing objective measures of emotion regulation (e.g., reaction time-based tasks) and sleep quality (e.g., polysomnography [PSG], electroencephalogram [EEG], actigraphy), as well as clinician-derived depression diagnoses, rather than relying solely on self-report data.

CONCLUSIONS

Past research has demonstrated that sleep disturbances are a strong predictor of depression onset, and it has been posited that emotion dysregulation might play a critical role in this relationship. Findings from this study of current and retired firefighters extend and integrate previous literature by demonstrating that difficulties with emotion regulation, specifically limited access to emotion regulation strategies, may be an explanatory factor in the link between subjective sleep disturbances and depression symptoms. Future research is recommended to replicate this finding across clinical samples while leveraging additional methodological approaches.

ABBREVIATIONS

CBT-I, cognitive behavioral therapy for insomnia
 CES-D, Center for Epidemiologic Studies Depression Scale
 DBT, dialectical behavior therapy
 DERS, Difficulties in Emotion Regulation Scale
 EEG, electroencephalogram
 fMRI, functional magnetic resonance imaging
 ISI, Insomnia Severity Index
 PCL-C, Posttraumatic Stress Disorder Checklist
 PSG, polysomnography
 PTSD, posttraumatic stress disorder
 REM, rapid eye movement

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SUBMISSION & CORRESPONDENCE INFORMATION

Submitted for publication July, 2015

Submitted in final revised form August, 2015

Accepted for publication August, 2015

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DISCLOSURE STATEMENT

This was not an industry supported study. This research was in part supported by grants from the National Fallen Firefighters Foundation, National Institutes of Health (K23MH093490), and Military Suicide Research Consortium, an effort supported by the Office of the Assistant Secretary of Defense for Health Affairs under Award No. (W81XWH-10-2-0181). Opinions, interpretations, conclusions and recommendations are those of the authors and are not necessarily endorsed by the Military Suicide Research Consortium or the Department of Defense. The authors have indicated no financial conflicts of interest. The work for this study was performed at Florida State University, Tallahassee, FL.