



# Anxiety sensitivity and sleep disturbance: Investigating associations among patients with co-occurring anxiety and substance use disorders<sup>☆</sup>



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## ABSTRACT

Sleep disturbance is a common problem among individuals with anxiety and substance use disorders (SUD). Anxiety sensitivity (AS) is elevated in patients with anxiety disorders and SUD and has been linked to sleep-related problems, including insomnia and somnolence (i.e., daytime sleepiness). We examined the unique roles of AS cognitive, physical, and social concerns in sleep disturbance among a sample of 99 residential SUD patients with anxiety disorders. Clinical levels of insomnia or somnolence were evidenced by 53.5% of the sample. Consistent with predictions, AS physical concerns was significantly associated with insomnia, and AS cognitive concerns was significantly related to insomnia and somnolence. Hierarchical linear regression models were conducted to test the association of AS cognitive and physical concerns with insomnia and somnolence symptoms while controlling for relevant factors. AS cognitive concerns accounted for unique variance, above and beyond withdrawal symptoms, anxiety, and depressive symptoms, in the model examining insomnia symptoms ( $B = 0.30$ ,  $SE = 0.13$ ,  $p = 0.023$ ). Results suggest that AS cognitive concerns may represent an important transdiagnostic mechanism underlying sleep disturbance among individuals with dual diagnosis.

## 1. Introduction

Both anxiety and substance use disorders (SUD) are highly prevalent in the general population, with 12-month prevalence rates of 11.1–18.1% and 3.8–9.4%, respectively (Grant et al., 2004; Kessler, Chiu, Demler, Merikangas, & Walters, 2005). Moreover, these disorders have been found to co-occur frequently in community and clinical samples (Conway, Compton, Stinson, & Grant, 2006; Grant et al., 2004; Lai, Cleary, Sitharthan, & Hunt, 2015). In particular, rates of anxiety disorders among individuals with SUD have been found to range from 17.7–29.9% in epidemiological studies (Conway et al., 2006; Grant et al., 2004) and from 26.4–38.8% in SUD treatment samples (Franken & Hendriks, 2001; McGovern, Xie, Segal, Siembab, & Drake, 2006). The co-occurrence of anxiety disorders and SUD has been found to be associated with numerous adverse outcomes, including increased symptom severity (McEvoy & Shand, 2008), greater treatment challenges (Wolitzky-Taylor, Operskalski, Ries, Craske, & Roy-Byrne, 2011), and early relapse to substance use (Schellekens, de Jong, Buitelaar, & Verkes, 2015). However, little research has examined sleep disturbance among individuals with co-occurring anxiety disorders and SUD.

Sleep disturbance, defined here as self-reported poor sleep quality,

somnolence (i.e., daytime sleepiness), and insomnia symptoms, has been consistently linked to both anxiety disorders and SUD separately (Ara, Jacobs, Bhat, & McCall, 2016; Cox & Olatunji, 2016). Approximately 11.8–58.4% of individuals with SUD and 32.5–45.6% of those with anxiety disorders experience sleep disturbance (Brower, 2015; Roth et al., 2006; Soehner & Harvey, 2012). Though rates of sleep disturbance among individuals with co-occurring anxiety disorders and SUD are difficult to estimate, co-occurring psychiatric disorders in general have been found to be positively associated with sleep disturbance. Specifically, the risk of sleep disturbance increases by 2.2–3.2 times for individuals with two psychiatric disorders and 4.6–6.3 times for individuals with three or more psychiatric disorders (compared to individuals with no psychiatric disorders; Roth et al., 2006). Notably, studies have found that sleep disturbance has a negative impact on mental and physical health (LeBlanc et al., 2007), has significant economic costs (Leger & Bayon, 2010), is associated with higher rates of disability and lower quality of life (Foley, Sarsour, Kalsekar, & Walsh, 2010; Magnee, de Weert-van Oene, Wijdeveld, Coenen, & de Jong, 2015; Ramsawh, Stein, Belik, Jacobi, & Sareen, 2009), and increases risk for suicidality, even after controlling for psychiatric symptoms (Pigeon, Bishop, & Titus, 2016; Wojnar et al., 2009). Furthermore,

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concomitant sleep disturbance is associated with worse treatment outcomes and increased relapse in both anxiety disorder (Belleville, Cousineau, Levrier, & St-Pierre-Delorme, 2011; Zalta et al., 2013; Zayfert & DeViva, 2004) and SUD (Brower, 2015; Brower, Aldrich, Robinson, Zucker, & Greden, 2001; Brower & Perron, 2010; Garcia & Salloum, 2015) samples.

Research and theoretical models suggest a complex, reciprocal relationship between sleep disturbance and both anxiety disorders (Alvaro, Roberts, & Harris, 2013; Glidewell, McPherson Botts, & Orr, 2015) and SUD (Ara et al., 2016), respectively. For example, prospective studies have demonstrated that SUD and anxiety disorders each predict sleep disturbance and vice-versa (Batterham, Glozier, & Christensen, 2012; Breslau, Roth, Rosenthal, & Andreski, 1996; Ford & Kamerow, 1989; Jansson-Frojmark & Lindblom, 2008; Pieters et al., 2015). Likewise, although sleep disturbance is a well-known consequence of intoxication, chronic substance use, and withdrawal symptoms across substances (Garcia & Salloum, 2015), individuals with SUD may also use substances to mitigate sleep disturbance. For example, one study found that patients with alcohol dependence and insomnia frequently use alcohol to induce sleep (Brower et al., 2001), whereas chronic substance users have been theorized to abuse stimulants to reverse somnolence (Roehrs & Roth, 2015). Similarly, researchers postulate that sleep disturbance occurs as both a cause and consequence of anxiety disorders (Cox & Olatunji, 2016), with some literature emphasizing the role of common, underlying processes in this relationship, such as physiological arousal and dysfunctional thoughts (Cox, Ebesutani, & Olatunji, 2015; Harvey, 2002).

Taken together, it is evident that anxiety disorders, SUD, and sleep disturbance commonly co-occur and contribute to a more severe clinical profile. Yet, remarkably few studies have investigated factors that may account for sleep disturbance among adults with co-occurring anxiety disorders and SUD. One factor that warrants examination is anxiety sensitivity (AS). Defined as a trait-like fear of anxiety-related feelings and sensations, AS is posited to amplify one's reactions to physiological arousal due to the perceived dangerousness of the cues (Reiss & McNally, 1985). To illustrate, an individual with high AS may misinterpret the experience of her or his mind racing or going blank as a sign that s/he is losing it or going crazy, resulting in increased anxiety and further exacerbation of the individual's physiological arousal. The construct of AS comprises three separate dimensions, including physical concerns (e.g., heart racing is a sign of an impending heart attack), cognitive concerns (e.g., mind going blank is a sign of mental incapacitation or 'craziness'), and social concerns (e.g., observable symptoms, such as blushing, will result in social rejection; Taylor et al., 2007).

Extant research strongly supports AS as a transdiagnostic factor that contributes to anxiety and other emotional disorders (Boswell et al., 2013; Naragon-Gainey, 2010), substance use (Norton, 2001; Stewart & Kushner, 2001), and physical health conditions (Asmundson, Wright, & Hadjistavropoulos, 2000). In addition, a growing body of research links AS to sleep disturbance. Specifically, studies have found that high AS and its dimensions are related to sleep disturbance, short sleep duration, poor sleep quality, sleep dysfunction, prolonged sleep onset latency, and sleep-related impairment, even after accounting for relevant psychological factors (e.g., depression; Alcantara, Cosenzo, Fan, Doyle, & Shaffer, 2017; Babson, Boden, Woodward, Alvarez, & Bonn-Miller, 2013; Babson, Trainor, Bunaciu, & Feldner, 2008; Calkins, Hearon, Capozzoli, & Otto, 2013; Hoge et al., 2011; Raines et al., 2015; Weiner, Meredith Elkins, Pincus, & Comer, 2015). Moreover, preliminary evidence indicates that the physical and cognitive concerns dimensions of AS may be particularly relevant to sleep. In one study, AS physical concerns moderated the relation between sleep anticipatory physical symptoms and sleep onset latency, such that the association was significant at high, but not low, AS (Babson et al., 2008). Other studies have shown that cognitive concerns is the only AS dimension associated with sleep disturbance and sleep-related impairment (when controlling

for psychological variables; Calkins et al., 2013; Vincent & Walker, 2001). For example, Raines et al. (2015) found that obsessive-compulsive disorder symptoms were indirectly associated with insomnia symptoms through AS cognitive concerns, but not physical or social concerns. Notably, the findings from these studies are consistent with Harvey's cognitive model of insomnia (2002). According to this model, individuals with high AS may be more aware of and likely to detect sleep-related symptoms, such as fatigue, heavy legs, and concentration problems (i.e., physical and mental symptoms), during daytime activities and at bedtime. Consequently, these cues are catastrophized as signs that they are not getting enough sleep, falling asleep quickly enough, or functioning well enough during the day, all of which have the effect of increasing arousal and alertness, ultimately contributing to further distress and sleep disturbance.

## 2. Present study

Cumulatively, prior research has demonstrated that AS is relevant to co-occurring anxiety disorders and SUD (Norton, 2001; Stewart & Kushner, 2001), and that AS cognitive and physical concerns are particularly associated with sleep disturbance (Babson et al., 2008; Raines et al., 2015). However, the association between AS dimensions and sleep disturbance among individuals with co-occurring anxiety disorders and SUD has not been examined. Accordingly, the aim of the current study was to examine associations between AS dimensions and insomnia and somnolence severity among SUD patients with a co-occurring anxiety disorder diagnosis. In particular, we sought to examine the unique contribution of each AS dimension to sleep disturbance after accounting for variance attributable to relevant covariates. Further, given both theoretical and empirical support for the relevance of AS cognitive and physical concerns in particular to sleep disturbance, we hypothesized that AS cognitive and physical concerns would relate to insomnia and somnolence above and beyond other factors relevant to both SUD and sleep disturbance.

## 3. Method

### 3.1. Participants

Participants were drawn from a sample of 227 patients admitted to a residential SUD treatment facility in the Southern United States. Individuals were excluded from the study if they reported current psychotic symptoms (i.e., delusions, hallucinations) or cognitive impairment as indicated by a score of < 24 on the Mini-Mental Status Exam (Folstein, Folstein, & McHugh, 1975). The current study included only those participants ( $n = 133$ ) who met *Diagnostic and Statistical Manual of Mental Disorders* (4th Ed., Text Revision; American Psychiatric Association, 2000) criteria for at least one current anxiety disorder based on semi-structured clinical interviews (see Measures). The final sample was comprised of 99 participants (50.5% female;  $M_{age} = 34.00$ ,  $SD = 10.49$ ) with complete data. Participants primarily identified as White (67.7%) or Black/African American (28.3%). Detailed information on the demographic and diagnostic characteristics of the sample is presented in Table 1.

### 3.2. Measures

#### 3.2.1. Anxiety sensitivity

AS dimensions were measured by the 18-item Anxiety Sensitivity Index – 3 (ASI-3; Taylor et al., 2007). The ASI-3 has demonstrated good reliability and validity (Taylor et al., 2007). Items are rated on a 5-point Likert-type scale (0 = *very little* to 4 = *very much*). The ASI-3 yields a total score and three subscale scores that correspond to concerns about potential Physical, Cognitive, or Social consequences of anxious arousal. The ASI-3 subscales demonstrated good internal consistency in this sample (Physical  $\alpha = 0.86$ ; Cognitive  $\alpha = 0.90$ ; Social  $\alpha = 0.83$ ).

**Table 1**  
Sample Characteristics,  $N = 99$ .

	$M(SD)/\%$
Sociodemographics	
Age	34.00 (10.49)
Sex (% female)	50.5%
Race (% White)	67.7%
Education	
High School Diploma/G.E.D.	31.3%
Higher Education	44.4%
Marital Status (% Single)	65.6%
Unemployed	70.7%
Anxiety Disorders <sup>a</sup>	
Panic disorder	83.8%
Agoraphobia	46.5%
Posttraumatic stress disorder	32.2%
Social anxiety disorder	40.4%
Obsessive-compulsive disorder	38.4%
Generalized anxiety disorder	17.2%
Current Substance Use Disorders <sup>a</sup>	
Alcohol dependence	52.5%
Cannabis dependence	84.9%
Sedative dependence	72.7%
Stimulant dependence	28.3%
Opioid dependence	25.3%
Cocaine dependence	26.3%
Hallucinogen dependence	28.3%
	55.6%
	4.0%

<sup>a</sup> Percent of sample meeting criteria for > 1 anxiety or substance use disorder.

### 3.2.2. Insomnia

The Insomnia Severity Index (ISI) is a brief self-report questionnaire that assesses the nature, severity, and interference of insomnia symptoms (Bastien, Vallières, & Morin, 2001). The seven items are summed to yield a total score that denotes the absence of insomnia (0–7), sub-threshold insomnia (8–14), moderate insomnia (15–21), or severe insomnia (22–28). The ISI is a reliable and valid measure of insomnia symptom severity and has good diagnostic properties (Chiu, Chang, Hsieh, & Tsai, 2016). In this study, internal consistency was excellent ( $\alpha = 0.93$ ).

### 3.2.3. Somnolence

The Epworth Sleepiness Scale (ESS) was used to measure sleepiness during daytime activities (i.e., somnolence; Johns, 1991). Sleepiness and likelihood of falling asleep during activities (e.g., sitting and reading) are rated on a 4-point Likert-type scale (0 = *would never doze* to 3 = *high chance of dozing*). Responses are summed to compute a total score ranging from 0 to 24, with a score higher than 10 indicating excessive daytime sleepiness. The ESS has been shown to be valid and reliable (Kendzierska, Smith, Brignardello-Petersen, Leung, & Tomlinson, 2014). The ESS demonstrated good internal consistency in this sample ( $\alpha = 0.82$ ).

### 3.2.4. Depression and anxiety

Depression and anxiety symptoms were assessed by the Depression Anxiety Stress Scales – 21 (DASS-21; Lovibond & Lovibond, 1995). Each scale is comprised of seven items that are rated on a 4-point Likert-type scale (0 = *never* to 3 = *almost always*). The DASS-21 has good psychometric properties (Antony, Bieling, Cox, Enns, & Swinson, 1998). Internal consistency in this sample was good for both the Depression ( $\alpha = 0.90$ ) and Anxiety ( $\alpha = 0.82$ ) subscales.

### 3.2.5. Substance withdrawal symptoms

Participants completed a 28-item questionnaire assessing substance use withdrawal symptoms identified by the DSM-IV-TR for alcohol, sedatives/hypnotics/anxiolytics, stimulants/cocaine, and opioids (Tull, McDermott, & Gratz, 2016). The severity of each withdrawal symptom was rated on a 5-point Likert-type scale ranging from 0 (*not at all*) to 4 (*extremely severe*). Responses were summed to derive a substance use

withdrawal symptom severity total score. Internal consistency for this scale was excellent ( $\alpha = 0.96$ ).

### 3.2.6. Clinical interviews

Post-baccalaureate and master's level research assistants conducted semi-structured and structured clinical interviews with each participant. The Mini International Neuropsychiatric Interview was administered to assess for the presence of DSM-IV anxiety disorders, including panic disorder, agoraphobia, social anxiety disorder, obsessive-compulsive disorder, and generalized anxiety disorder (Lecrubier et al., 1997). To assess current SUD, the substance dependence module of the Structured Clinical Interview for DSM-IV Axis I Disorders was administered (First, Spitzer, Gibbon, & Williams, 1997). The following substance classes were examined: alcohol, sedatives, cannabis, stimulants, opioids, cocaine, and hallucinogens. In the current study, the term "SUD" refers to individuals who meet DSM-IV criteria for current substance dependence. Finally, the Clinician-Administered PTSD Scale (CAPS) was used to assess current posttraumatic stress disorder based on DSM-IV criteria (Blake et al., 1995). The CAPS is a structured diagnostic interview with adequate interrater reliability and convergent validity with validated measures of PTSD (Weathers, Keane, & Davidson, 2001). All interviewers were trained to reliability with the principal investigator or co-investigator (MTT or KLG). All interviews were reviewed, and diagnoses were discussed and confirmed in consensus meetings with the principal investigator (MTT).

### 3.3. Procedure

Data were collected as a part of larger study examining risk-taking behaviors and psychopathology among patients in a residential SUD treatment facility. Upon admission to the treatment facility, patients were required to abstain from alcohol and psychoactive substances. Patients were recruited for this study at least 72 h following admission to decrease effects of withdrawal and adjustment to the residential environment. Eligible patients received information about the study procedures, risks, and benefits, and written informed consent was obtained from interested patients. During the study session, clinical interviews were administered, and participants completed a battery of questionnaires. Participants received \$25 for participation in this session. All procedures were approved by the University of Mississippi Medical Center and Mississippi State Department of Mental Health State Hospital's Institutional Review Boards.

### 3.4. Data analytic approach

#### 3.4.1. Selection of covariates

Potential covariates were initially identified based on theoretical relevance and past research. Specifically, previous studies have demonstrated that withdrawal symptoms (Brower, 2003; Schierenbeck, Riemann, Berger, & Hornyak, 2008), anxiety symptom severity (Cox & Olatunji, 2016), and depression symptom severity (Alvaro et al., 2013) affect sleep disturbance. Although study procedures required a delay of at least 72 h after admission before recruitment into the study, withdrawal symptoms were examined as a possible covariate to account for potential residual symptoms that may affect insomnia and/or somnolence. In addition, given the relevance of anxiety and depression symptoms to both sleep disturbance (Alvaro et al., 2013) and SUD (Lai et al., 2015), each of these variables was also identified as a potential covariate. Potential covariates that demonstrated significant zero-order correlations with insomnia or somnolence were subsequently included in the hierarchical regression analyses. This two-stage approach to covariate selection was used to limit the confounding of variables while minimizing bias introduced by inclusion of extraneous variables (Sauer, Brookhart, Roy, & Vanderweele, 2013).

### 3.4.2. Data analyses

First, all variables were assessed for outliers, and distributions were examined. Descriptive statistics were used to characterize the sample. Next, Pearson correlations were conducted to examine associations among study variables. Finally, separate hierarchical regression analyses were conducted to examine the unique relations of each AS dimension to insomnia and somnolence. Each model consisted of two levels: Step 1 included covariates (withdrawal, anxiety, and/or depression symptoms), and Step 2 included one of the AS dimensions (AS cognitive, physical, or social concerns). Only AS dimensions that demonstrated significant zero-order correlations with insomnia or somnolence were included in the regressions to limit potentially spurious suppressor effects and reduce the number of statistical tests and associated type I error. Given the high correlations among the AS subscales (Allan, Albanese, Short, Raines, & Schmidt, 2015), separate regression models were conducted for each AS dimension. Unstandardized regression coefficients are reported. Statistical analyses were performed using SPSS, version 23.0.

## 4. Results

### 4.1. Descriptive statistics

The means, standard deviations, and zero-order correlations for the primary study variables are presented in Table 2. Fifty-three participants (53.5%) reported clinically significant insomnia symptom severity (i.e., ISI scores  $\geq 15$ ) or somnolence (i.e., ESS scores  $> 10$ ). Notably, where all AS dimensions were significantly associated with insomnia, only AS cognitive concerns was associated with somnolence.

### 4.2. Insomnia

See Table 3 for a full summary of the results of the hierarchical regressions. In the models examining insomnia, the covariates (i.e., withdrawal, anxiety, and depressive symptoms) accounted for 17.6% of the variance in Step 1 ( $DF [3,95] = 6.74, p < 0.001$ ). Contrary to predictions, AS physical concerns did not account for a significant amount of unique variance in insomnia symptom severity. However, consistent with our hypothesis, AS cognitive concerns did account for a significant amount of unique variance in insomnia symptoms ( $DR^2 = 0.044; DF [1,94] = 5.35, p = 0.023$ ). Finally, AS social concerns did not account for a significant amount of unique variance in insomnia symptoms severity above and beyond the covariates. Overall, the models suggest that AS cognitive concerns, but not AS physical or social concerns, are significantly related to greater insomnia symptoms, above and beyond other relevant clinical variables.

**Table 2**  
Correlations, means, and standard deviations for primary study variables.

	1	2	3	4	5	6	7	8
1. Withdrawal symptoms	–							
2. Anxiety	0.44***	–						
3. Depression	0.32***	0.67***	–					
4. AS Physical	0.05	0.47***	0.37***	–				
5. AS Cognitive	0.03	0.41***	0.50***	0.67***	–			
6. AS Social	0.18	0.37***	0.42***	0.64***	0.72***	–		
7. Insomnia	0.28**	0.40***	0.30**	0.21*	0.33**	0.29**	–	
8. Somnolence	–0.04	0.27**	0.26**	0.13	0.30**	0.18	0.16	–
Mean	18.71	11.31	13.47	7.16	6.87	9.15	11.65	8.94
SD	22.36	9.96	11.28	6.10	6.43	6.15	7.92	5.32

Note: Anxiety = Depression Anxiety and Stress Scales (DASS-21) – Anxiety scale; Depression = DASS-21 – Depression scale; AS Physical = Anxiety Sensitivity Index – 3 (ASI-3) Physical Concerns subscale; AS Cognitive = ASI-3 Cognitive Concerns subscale; AS Social = ASI-3 Social Concerns subscale; Insomnia = Insomnia Severity Index; Somnolence = Epworth Sleepiness Scale.

\*  $p < 0.05$ .

\*\*  $p < 0.01$ .

\*\*\*  $p < 0.001$ .

**Table 3**  
Hierarchical linear regression models examining the incremental relations of anxiety sensitivity to insomnia and somnolence.

	Insomnia				Somnolence			
	DR <sup>2</sup>	B	SE	p	DR <sup>2</sup>	B	SE	p
Step 1	0.176			< 0.001	0.084			.015
Withdrawal symptoms		0.05	0.04	0.216	–	–	–	–
Anxiety		0.24	0.11	0.025		0.09	0.07	0.216
Depression		0.04	0.09	0.629		0.03	0.07	0.640
Step 2: AS	0.003			0.556	–			–
Physical Model								
AS Physical		0.08	0.14	0.556		–	–	–
Step 2: AS	0.044			0.023	0.035			0.055
Cognitive Model								
AS Cognitive		–0.16	0.17	0.023		0.18	0.09	0.055
Step 2: AS Social	0.021			0.123	–			–
Social Model								
AS Social		0.21	0.13	0.123		–	–	–

Note: Step 1 is the same in each model and reported one time to avoid redundancy. Unstandardized regression coefficients and standard error (SE) are reported. Insomnia = Insomnia Severity Index; Somnolence = Epworth Sleepiness Scale; Anxiety = Depression Anxiety and Stress Scales (DASS-21) – Anxiety scale; Depression = DASS-21 Depression scale; AS Physical = Anxiety Sensitivity Index – 3 Physical Concerns subscale; AS Cognitive = Anxiety Sensitivity Index – 3 Cognitive Concerns subscale; AS Social = Anxiety Sensitivity Index – 3 Social Concerns subscale.

### 4.3. Somnolence

Anxiety and depression symptoms accounted for 8.4% of the variance in somnolence symptoms in Step 1 ( $DF [2,96] = 4.40, p = 0.015$ ). Although AS cognitive concerns did not account for a significant amount of unique variance in somnolence symptoms, this AS dimension explained an additional 3.5% of the variance in these symptoms ( $DF [1,95] = 3.78, p = 0.055$ ).

## 5. Discussion

The results of this study highlight the differential relevance of specific AS dimensions to sleep disturbance among patients with co-occurring anxiety disorders and SUD. Specifically, results revealed significant zero-order associations between AS cognitive concerns and both insomnia and somnolence symptoms, as well as a significant unique relation of AS cognitive concerns to insomnia symptoms (above and beyond relevant covariates). Notably, however, the unique

variance in somnolence symptoms accounted for by AS cognitive concerns did not reach significance. Conversely, whereas AS physical and social concerns evidenced significant zero-order associations with insomnia symptoms, neither accounted for unique variance in insomnia symptoms above and beyond the covariates. Although the study hypotheses were only partially supported, this pattern of results underscores the particular importance of sensitivity to and fear of mental anxiety symptoms (e.g., difficulty focusing, disorganized thoughts) in sleep disturbance, relative to anxiety's physical symptoms. These findings are consistent with the results of several studies examining AS cognitive concerns and sleep disturbance in nonclinical samples (Calkins et al., 2013; Raines et al., 2015) and adults with insomnia (Vincent & Walker, 2001).

Indeed, though heightened physiological and cognitive arousal are key components of sleep disturbance (Bonnet & Arand, 2010), there is some evidence that cognitive arousal may be more integral to chronic sleep problems. For instance, Yang, Lin, and Cheng (2013) found that whereas both cognitive and somatic arousal accounted for significant variance in insomnia symptoms among adults without insomnia, only cognitive (and not somatic) arousal symptoms were associated with insomnia symptoms among patients with chronic insomnia. Together with the results of the present study, these findings highlight the relevance of cognitive arousal and the perception of this arousal in sleep disturbance, particularly in clinical populations. Replication of these findings in other patient populations is warranted to further explicate the relative importance of somatic and cognitive arousal, as well as perceptions of this arousal (i.e., AS), in sleep disturbance.

Another possible explanation for the current findings is that the AS cognitive concerns subscale of the ASI-3 may be more representative of the symptoms and consequences of sleep disturbance than the AS physical concerns subscale. Items on the ASI-3 physical concerns subscale focus on cardiac and respiratory catastrophic interpretations, whereas sleep-relevant AS physical concerns may be characterized by misinterpretations of other physiological symptoms of anxiety (such as restlessness or tension), which may signal impending sleep difficulties or confirm perceptions of poor sleep. As a next step in this line of research, it would be beneficial for researchers to examine interoceptive sensitivity more broadly and/or AS in the context of sleep-related consequences (e.g., chronic fatigue, physical or mental "slowness", sleep deprivation).

This study has several limitations, including the cross-sectional study design and the reliance on self-report measures to assess the primary study variables. Future studies could improve upon this methodology through the use of prospective designs and objective measures of sleep quality, such as polysomnography or actigraphy. Although the clinical nature of this sample and the inclusion of patients with co-occurring anxiety disorders and SUD is a strength of the study, the specificity of this sample limits the generalizability of the current findings. Replication of these results among patients in outpatient treatment settings and individuals with less severe anxiety and substance use problems is needed. Furthermore, given that this study relied on DSM-IV criteria, it would be advantageous for future studies to use the DSM-5 SUD criteria and severity ratings. In addition, future investigations should examine these relations in samples with greater socioeconomic and racial/ethnic diversity. For instance, a recent study found that AS accounted for differences in sleep duration between Black and White individuals (Alcantara et al., 2017); therefore, extending this line of research to the relations examined here may advance our knowledge of racial disparities in sleep quality.

The present study has several important clinical implications. In this sample, approximately half of the participants reported clinical levels of sleep disturbance, suggesting the relevance of these difficulties to patients with co-occurring anxiety disorders and SUD. This specific finding adds to the literature in this area and is consistent with past research documenting an insomnia prevalence rate of 56% among male residential SUD patients with a co-occurring psychological disorder

(Albanese & Albanese, 2010). Unfortunately, prior work indicates that sleep disturbance is often not identified in this vulnerable population and/or may be misattributed to other symptoms (Leger & Bayon, 2010). Yet, when present, these difficulties contribute to poor treatment response and early relapse (Belleville et al., 2011; Brower et al., 2001; Zalta et al., 2013). Altogether, these findings underscore the importance of screening and systematically treating sleep problems among patients with anxiety disorders and SUD. To date, few studies have examined the efficacy of behavioral or pharmaceutical sleep interventions for dual diagnosis patients. Nonetheless, although pharmaceutical interventions for sleep disturbance are often contraindicated for individuals with SUD (Kolla, Mansukhani, & Schneekloth, 2011; Longo & Johnson, 1998), brief cognitive-behavioral treatments for sleep disturbance are well-supported by the literature and have been identified as the frontline treatment for insomnia (Riemann & Perlis, 2009). Further, cognitive-behavioral treatments for insomnia may provide the added benefit of reducing psychiatric symptoms (Harvey, Murray, Chandler, & Soehner, 2011).

This study highlights the potential to develop supplementary interventions targeting AS as a transdiagnostic construct among individuals with co-occurring sleep, anxiety, and substance use problems. AS interventions are relatively brief, involve minimal resources (e.g., Keough & Schmidt, 2012; Worden, Davis, Genova, & Tolin, 2015) and can directly target AS cognitive concerns (Schmidt, Capron, Raines, & Allan, 2014). Reductions in AS have been found to contribute to positive treatment outcomes for patients with anxiety (Smits, Berry, Tart, & Powers, 2008), SUD (Worden et al., 2015), and insomnia (Short, Allan, Raines, & Schmidt, 2015). Accordingly, a supplementary AS intervention may contribute to symptom amelioration across psychiatric difficulties.

## 6. Conclusion

Sleep disturbance is common, impairing, and associated with significant economic costs (Foley et al., 2010), particularly for individuals with co-occurring psychiatric disorders (Roth et al., 2006). The current study examined AS and sleep disturbance among patients with co-occurring anxiety disorders and SUD, finding that AS cognitive concerns, but not physical or social concerns, was significantly related to insomnia and somnolence symptoms. These findings emphasize the importance of AS cognitive concerns in sleep disturbance and identify AS as a promising treatment target for dual diagnosis patients struggling with sleep problems.

## References

- Albanese, M. J., & Albanese, A. M. (2010). Insomnia in dual diagnosis patients. *The American Journal on Addictions*, 19(4), 382–383. <http://dx.doi.org/10.1111/j.1521-0391.2010.00056.x>.
- Alcantara, C., Cosenzo, L. A. G., Fan, W., Doyle, D. M., & Shaffer, J. A. (2017). Anxiety sensitivity and racial differences in sleep duration: Results from a national survey of adults with cardiovascular disease. *Journal of Anxiety Disorders*, 48, 102–108. <http://dx.doi.org/10.1016/j.janxdis.2016.10.002>.
- Allan, N. P., Albanese, B. J., Short, N. A., Raines, A. M., & Schmidt, N. B. (2015). Support for the general and specific bifactor model factors of anxiety sensitivity. *Personality and Individual Differences*, 74, 78–83. <http://dx.doi.org/10.1016/j.paid.2014.10.003>.
- Alvaro, P. K., Roberts, R. M., & Harris, J. K. (2013). A systematic review assessing bidirectionality between sleep disturbances, anxiety, and depression. *Sleep*, 36(7), 1059–1068. <http://dx.doi.org/10.5665/sleep.2810>.
- American Psychiatric Association (2000). *Diagnostic and statistical manual of mental disorders* (4 ed. text revision). Washington, DC: Author.
- Antony, M. M., Bieling, P. J., Cox, B. J., Enns, M. W., & Swinson, R. P. (1998). Psychometric properties of the 42-item and 21-item versions of the Depression Anxiety Stress Scales in clinical groups and a community sample. *Psychological Assessment*, 10(2), 176.
- Ara, A., Jacobs, W., Bhat, I. A., & McCall, W. V. (2016). Sleep disturbances and substance use disorders: A Bi-directional relationship. *Psychiatric Annals*, 46(7), 408–412. <http://dx.doi.org/10.3928/00485713-20160512-01>.
- Asmundson, G. J. G., Wright, K. D., & Hadjistavropoulos, H. D. (2000). Anxiety sensitivity and disabling chronic health conditions: State of the art and future directions. *Scandinavian Journal of Behaviour Therapy*, 29(3–4), 100–117. [http://dx.doi.org/10.1002/1521-0391\(200003\)29:3<100::AID-SJB2901000300>3.0.CO;2-1](http://dx.doi.org/10.1002/1521-0391(200003)29:3<100::AID-SJB2901000300>3.0.CO;2-1).

- 1080/028457100300049719.
- Babson, K. A., Trainor, C. D., Bunaciu, L., & Feldner, M. T. (2008). An examination of anxiety sensitivity as a moderator of the relation between sleep anticipatory anxiety and sleep onset latency. *Journal of Cognitive Psychotherapy*, 22(3), 258–270. <http://dx.doi.org/10.1891/0889-8391.22.3.258>.
- Babson, K. A., Boden, M. T., Woodward, S., Alvarez, J., & Bonn-Miller, M. (2013). Anxiety sensitivity and sleep quality: Independent and interactive predictors of posttraumatic stress disorder symptoms. *Journal of Nervous and Mental Disease*, 201(1), 48–51. <http://dx.doi.org/10.1097/NMD.0b013e31827ab059>.
- Bastien, C. H., Vallières, A., & Morin, C. M. (2001). Validation of the Insomnia Severity Index as an outcome measure for insomnia research. *Sleep Medicine*, 2(4), 297–307.
- Batterham, P. J., Glozier, N., & Christensen, H. (2012). Sleep disturbance, personality and the onset of depression and anxiety: Prospective cohort study. *Australian and New Zealand Journal of Psychiatry*, 46(11), 1089–1098.
- Belleville, G., Cousineau, H., Levrier, K., & St-Pierre-Delorme, M. E. (2011). Meta-analytic review of the impact of cognitive-behavior therapy for insomnia on concomitant anxiety. *Clinical Psychology Review*, 31(4), 638–652. <http://dx.doi.org/10.1016/j.cpr.2011.02.004>.
- Blake, D. D., Weathers, F. W., Nagy, L. M., Kaloupek, D. G., Gusman, F. D., Charney, D. S., & Keane, T. M. (1995). The development of a clinician-administered PTSD scale. *Journal of Traumatic Stress*, 8(1), 75–90.
- Bonnet, M. H., & Arand, D. L. (2010). Hyperarousal and insomnia: State of the science. *Sleep Medicine Reviews*, 14(1), 9–15. <http://dx.doi.org/10.1016/j.smrv.2009.05.002>.
- Boswell, J. F., Farchione, T. J., Sauer-Zavala, S., Murray, H. W., Fortune, M. R., & Barlow, D. H. (2013). Anxiety sensitivity and interoceptive exposure: A transdiagnostic construct and change strategy. *Behavior Therapy*, 44(3), 417–431. <http://dx.doi.org/10.1016/j.beth.2013.03.006>.
- Breslau, N., Roth, T., Rosenthal, L., & Andreski, P. (1996). Sleep disturbance and psychiatric disorders: A longitudinal epidemiological study of young adults. *Biological Psychiatry*, 39(6), 411–418.
- Brower, K. J., & Perron, B. E. (2010). Sleep disturbance as a universal risk factor for relapse in addictions to psychoactive substances. *Medical Hypotheses*, 74(5), 928–933. <http://dx.doi.org/10.1016/j.mehy.2009.10.020>.
- Brower, K., Aldrich, M. S., Robinson, E. A., Zucker, R. A., & Greden, J. F. (2001). Insomnia, self-medication, and relapse to alcoholism. *American Journal of Psychiatry*, 158(3), 399–404.
- Brower, K. J. (2003). Insomnia, alcoholism and relapse. *Sleep Medicine Reviews*, 7(6), 523–539.
- Brower, K. J. (2015). Assessment and treatment of insomnia in adult patients with alcohol use disorders. *Alcohol*, 49(4), 417–427. <http://dx.doi.org/10.1016/j.alcohol.2014.12.003>.
- Calkins, A. W., Hearon, B. A., Capozzoli, M. C., & Otto, M. W. (2013). Psychosocial predictors of sleep dysfunction: The role of anxiety sensitivity, dysfunctional beliefs, and neuroticism. *Behavioral Sleep Medicine*, 11(2), 133–143. <http://dx.doi.org/10.1080/15402002.2011.643968>.
- Chiu, H.-Y., Chang, L.-Y., Hsieh, Y.-J., & Tsai, P.-S. (2016). A meta-analysis of diagnostic accuracy of three screening tools for insomnia. *Journal of Psychosomatic Research*, 87, 85–92. <http://dx.doi.org/10.1016/j.jpsychores.2016.06.010>.
- Conway, K. P., Compton, W., Stinson, F. S., & Grant, B. F. (2006). Lifetime comorbidity of DSM-IV mood and anxiety disorders and specific drug use disorders: Results from the National Epidemiologic Survey on Alcohol and Related Conditions. *The Journal of Clinical Psychiatry*, 67(2), 247–257.
- Cox, R. C., & Olatunji, B. O. (2016). A systematic review of sleep disturbance in anxiety and related disorders. *Journal of Anxiety Disorders*, 37, 104–129. <http://dx.doi.org/10.1016/j.janxdis.2015.12.001>.
- Cox, R. C., Ebesutani, C., & Olatunji, B. O. (2015). Linking sleep disturbance and maladaptive repetitive thought: The role of executive function. *Cognitive Therapy and Research*, 40(1), 107–117. <http://dx.doi.org/10.1007/s10608-015-9713-5>.
- First, M. B., Spitzer, R. L., Gibbon, M., & Williams, J. B. (1997). *User's guide to the structured clinical interview for DSM-IV axis I disorders—clinician version (SCID-CV)*.
- Foley, K. A., Sarsour, K., Kalsekar, A., & Walsh, J. K. (2010). Subtypes of sleep disturbance: Associations among symptoms, comorbidities, treatment, and medical costs. *Behavioral Sleep Medicine*, 8(2), 90–104. <http://dx.doi.org/10.1080/15402001003622842>.
- Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). Mini-mental state: A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research*, 12(3), 189–198.
- Ford, D. E., & Kamerow, D. B. (1989). Epidemiologic study of sleep disturbances and psychiatric disorders: An opportunity for prevention? *Journal of the American Medical Association*, 262(11), 1479–1484.
- Franken, I. H., & Hendriks, V. M. (2001). Screening and diagnosis of anxiety and mood disorders in substance abuse patients. *The American Journal on Addictions*, 10(1), 30–39.
- García, A. N., & Salloum, I. M. (2015). Polysomnographic sleep disturbances in nicotine, caffeine, alcohol, cocaine, opioid, and cannabis use: A focused review. *The American Journal on Addictions*, 24(7), 590–598. <http://dx.doi.org/10.1111/ajad.12291>.
- Glidewell, R. N., McPherson Botts, E., & Orr, W. C. (2015). Insomnia and anxiety: Diagnostic and management implications of complex interactions. *Sleep Medicine Clinics*, 10(1), 93–99. <http://dx.doi.org/10.1016/j.jsmc.2014.11.008>.
- Grant, B. F., Stinson, F. S., Dawson, D. A., Chou, S. P., Dufour, M. C., Compton, W., ... Kaplan, K. (2004). Prevalence and co-occurrence of substance use disorders and independent mood and anxiety disorders: results from the national epidemiologic survey on alcohol and related conditions. *Archives of General Psychiatry*, 61(8), 807–816.
- Harvey, A. G., Murray, G., Chandler, R. A., & Soehner, A. (2011). Sleep disturbance as transdiagnostic: Consideration of neurobiological mechanisms. *Clinical Psychology Review*, 31(2), 225–235. <http://dx.doi.org/10.1016/j.cpr.2010.04.003>.
- Harvey, A. G. (2002). A cognitive model of insomnia. *Behaviour Research and Therapy*, 40(8), 869–893.
- Hoge, E. A., Marques, L., Wechsler, R. S., Lasky, A. K., Delong, H. R., Jacoby, R. J., ... Simon, N. M. (2011). The role of anxiety sensitivity in sleep disturbance in panic disorder. *Journal of Anxiety Disorders*, 25(4), 536–538. <http://dx.doi.org/10.1016/j.janxdis.2010.12.008>.
- Jansson-Frojmark, M., & Lindblom, K. (2008). A bidirectional relationship between anxiety and depression, and insomnia? A prospective study in the general population. *Journal of Psychosomatic Research*, 64(4), 443–449. <http://dx.doi.org/10.1016/j.jpsychores.2007.10.016>.
- Johns, M. W. (1991). A new method for measuring daytime sleepiness: The Epworth sleepiness scale. *Sleep*, 14(6), 540–545.
- Kendzierska, T. B., Smith, P. M., Brignardello-Petersen, R., Leung, R. S., & Tomlinson, G. A. (2014). Evaluation of the measurement properties of the Epworth sleepiness scale: A systematic review. *Sleep Medicine Reviews*, 18(4), 321–331.
- Keough, M. E., & Schmidt, N. B. (2012). Refinement of a brief anxiety sensitivity reduction intervention. *Journal of Consulting and Clinical Psychology*, 80(5), 766–772. <http://dx.doi.org/10.1037/a0027961>.
- Kessler, R. C., Chiu, W. T., Demler, O., Merikangas, K. R., & Walters, E. E. (2005). Prevalence, severity, and comorbidity of 12-month DSM-IV disorders in the national comorbidity survey replication. *Archives of General Psychiatry*, 62(6), 617–627. <http://dx.doi.org/10.1001/archpsyc.62.6.617>.
- Kolla, B. P., Mansukhani, M. P., & Schneekloth, T. (2011). Pharmacological treatment of insomnia in alcohol recovery: A systematic review. *Alcohol and Alcoholism*, 46(5), 578–585. <http://dx.doi.org/10.1093/alcalc/agr073>.
- Lai, H. M., Cleary, M., Sitharthan, T., & Hunt, G. E. (2015). Prevalence of comorbid substance use, anxiety and mood disorders in epidemiological surveys, 1990–2014: A systematic review and meta-analysis. *Drug and Alcohol Dependence*, 154, 1–13. <http://dx.doi.org/10.1016/j.drugalcdep.2015.05.031>.
- LeBlanc, M., Beaulieu-Bonneau, S., Mérette, C., Savard, J., Ivers, H., & Morin, C. M. (2007). Psychological and health-related quality of life factors associated with insomnia in a population-based sample. *Journal of Psychosomatic Research*, 63(2), 157–166. <http://dx.doi.org/10.1016/j.jpsychores.2007.03.004>.
- Leclercq, Y., Sheehan, D. V., Weiller, E., Amorim, P., Bonora, L., Sheehan, K. H., ... Dunbar, G. C. (1997). The Mini International Neuropsychiatric Interview (MINI). A short diagnostic structured interview: Reliability and validity according to the CID. *European Psychiatry*, 12(5), 224–231.
- Leger, D., & Bayon, V. (2010). Societal costs of insomnia. *Sleep Medicine Reviews*, 14(6), 379–389. <http://dx.doi.org/10.1016/j.smrv.2010.01.003>.
- Longo, L. P., & Johnson, B. (1998). Treatment of insomnia in substance abusing patients. *Psychiatric Annals*, 28(3), 154–159. <http://dx.doi.org/10.3928/0048-5713-19980301-11>.
- Lovibond, P. F., & Lovibond, S. H. (1995). The structure of negative emotional states: Comparison of the depression anxiety stress scales (DASS) with the beck depression and anxiety inventories. *Behaviour Research and Therapy*, 33(3), 335–343.
- Magnee, E. H., de Weert-van Oene, G. H., Wijdeveld, T. A., Coenen, A. M., & de Jong, C. A. (2015). Sleep disturbances are associated with reduced health-related quality of life in patients with substance use disorders. *The American Journal on Addictions*, 24(6), 515–522. <http://dx.doi.org/10.1111/ajad.12243>.
- McEvoy, P. M., & Shand, F. (2008). The effect of comorbid substance use disorders on treatment outcome for anxiety disorders. *Journal of Anxiety Disorders*, 22(6), 1087–1098. <http://dx.doi.org/10.1016/j.janxdis.2007.11.007>.
- McGovern, M. P., Xie, H., Segal, S. R., Siembab, L., & Drake, R. E. (2006). Addiction treatment services and co-occurring disorders: Prevalence estimates, treatment practices, and barriers. *Journal of Substance Abuse Treatment*, 31(3), 267–275. <http://dx.doi.org/10.1016/j.jsat.2006.05.003>.
- Naragon-Gainey, K. (2010). Meta-analysis of the relations of anxiety sensitivity to the depressive and anxiety disorders. *Psychological Bulletin*, 136(1), 128–150. <http://dx.doi.org/10.1037/a0018055>.
- Norton, G. R. (2001). Substance use/abuse and anxiety sensitivity: What are the relationships? *Addictive Behaviors*, 26(6), 935–946.
- Pieters, S., Burk, W. J., Van der Vorst, H., Dahl, R. E., Wiers, R. W., & Engels, R. C. (2015). Prospective relationships between sleep problems and substance use, internalizing and externalizing problems. *Journal of Youth and Adolescence*, 44(2), 379–388. <http://dx.doi.org/10.1007/s10964-014-0213-9>.
- Pigeon, W. R., Bishop, T. M., & Titus, C. E. (2016). The relationship between sleep disturbance, suicidal ideation, suicide attempts, and suicide among adults: A systematic review. *Psychiatric Annals*, 46(3), 177–186. <http://dx.doi.org/10.3928/00485713-20160128-01>.
- Raines, A. M., Short, N. A., Sutton, C. A., Oglesby, M. E., Allan, N. P., & Schmidt, N. B. (2015). Obsessive-compulsive symptom dimensions and insomnia: The mediating role of anxiety sensitivity cognitive concerns. *Psychiatry Research*, 228(3), 368–372. <http://dx.doi.org/10.1016/j.psychres.2015.05.081>.
- Ramsawh, H. J., Stein, M. B., Belik, S. L., Jacobi, F., & Sareen, J. (2009). Relationship of anxiety disorders, sleep quality, and functional impairment in a community sample. *Journal of Psychiatric Research*, 43(10), 926–933. <http://dx.doi.org/10.1016/j.jpsychores.2009.01.009>.
- Reiss, S., & McNally, R. J. (1985). Expectancy model of fear. In S. Reiss, & R. Bootzin (Eds.). *Theoretical issues in behavior therapy* (pp. 107–121). New York: Academic Press.
- Riemann, D., & Perlis, M. L. (2009). The treatments of chronic insomnia: A review of benzodiazepine receptor agonists and psychological and behavioral therapies. *Sleep Medicine Reviews*, 13(3), 205–214. <http://dx.doi.org/10.1016/j.smrv.2008.06.001>.
- Roehrs, T. A., & Roth, T. (2015). Sleep disturbance in substance use disorders. *Psychiatry Clinics of North America*, 38(4), 793–803. <http://dx.doi.org/10.1016/j.psc.2015.07.008>.

- Roth, T., Jaeger, S., Jin, R., Kalsekar, A., Stang, P. E., & Kessler, R. C. (2006). Sleep problems, comorbid mental disorders, and role functioning in the national comorbidity survey replication. *Biological Psychiatry*, *60*(12), 1364–1371. <http://dx.doi.org/10.1016/j.biopsych.2006.05.039>.
- Sauer, B. C., Brookhart, M. A., Roy, J., & Vanderweele, T. (2013). Covariate selection. In P. Velentgas, N. A. Dreyer, P. Nourjah, S. R. Smith, & M. M. Tochia (Eds.). *Developing a protocol for observational comparative effectiveness research: A users guide* (pp. 93–108). Rockville, MD: Agency for Healthcare Research and Quality.
- Schellekens, A. F., de Jong, C. A., Buitelaar, J. K., & Verkes, R. J. (2015). Co-morbid anxiety disorders predict early relapse after inpatient alcohol treatment. *European Psychiatry*, *30*(1), 128–136. <http://dx.doi.org/10.1016/j.eurpsy.2013.08.006>.
- Schierenbeck, T., Riemann, D., Berger, M., & Hornyak, M. (2008). Effect of illicit recreational drugs upon sleep: Cocaine, ecstasy and marijuana. *Sleep Medicine Reviews*, *12*(5), 381–389. <http://dx.doi.org/10.1016/j.smrv.2007.12.004>.
- Schmidt, N. B., Capron, D. W., Raines, A. M., & Allan, N. P. (2014). Randomized clinical trial evaluating the efficacy of a brief intervention targeting anxiety sensitivity cognitive concerns. *Journal of Consulting and Clinical Psychology*, *82*(6), 1023–1033. <http://dx.doi.org/10.1037/a0036651>.
- Short, N. A., Allan, N. P., Raines, A. M., & Schmidt, N. B. (2015). The effects of an anxiety sensitivity intervention on insomnia symptoms. *Sleep Medicine*, *16*(1), 152–159. <http://dx.doi.org/10.1016/j.sleep.2014.11.004>.
- Smits, J. A., Berry, A. C., Tart, C. D., & Powers, M. B. (2008). The efficacy of cognitive-behavioral interventions for reducing anxiety sensitivity: A meta-analytic review. *Behaviour Research and Therapy*, *46*(9), 1047–1054.
- Soehner, A. M., & Harvey, A. G. (2012). Prevalence and functional consequences of severe insomnia symptoms in mood and anxiety disorders: Results from a nationally representative sample. *Sleep*, *35*(10), 1367–1375. <http://dx.doi.org/10.5665/sleep.2116>.
- Stewart, S. H., & Kushner, M. G. (2001). Introduction to the special issue on Anxiety Sensitivity and Addictive Behaviors. *Addictive Behaviors*, *26*(6), 775–785.
- Taylor, S., Zvolensky, M. J., Cox, B. J., Deacon, B., Heimberg, R. G., Ledley, D. R., ... Cardenas, S. J. (2007). Robust dimensions of anxiety sensitivity: Development and initial validation of the Anxiety Sensitivity Index-3. *Psychological Assessment*, *19*(2), 176–188. <http://dx.doi.org/10.1037/1040-3590.19.2.176>.
- Tull, M. T., McDermott, M. J., & Gratz, K. L. (2016). Marijuana dependence moderates the effect of posttraumatic stress disorder on trauma cue reactivity in substance dependent patients. *Drug and Alcohol Dependence*, *159*, 219–226. <http://dx.doi.org/10.1016/j.drugalcdep.2015.12.014>.
- Vincent, N., & Walker, J. (2001). Anxiety sensitivity: Predictor of sleep-related impairment and medication use in chronic insomnia. *Depression and Anxiety*, *14*(4), 238–243. <http://dx.doi.org/10.1002/da.1073>.
- Weathers, F. W., Keane, T. M., & Davidson, J. R. (2001). Clinician-Administered PTSD Scale: A review of the first ten years of research. *Depression and Anxiety*, *13*(3), 132–156.
- Weiner, C. L., Meredith Elkins, R., Pincus, D., & Comer, J. (2015). Anxiety sensitivity and sleep-related problems in anxious youth. *Journal of Anxiety Disorders*, *32*, 66–72. <http://dx.doi.org/10.1016/j.janxdis.2015.03.009>.
- Wojnar, M., Ilgen, M. A., Wojnar, J., McCammon, R. J., Valenstein, M., & Brower, K. J. (2009). Sleep problems and suicidality in the national comorbidity survey replication. *Journal of Psychiatric Research*, *43*(5), 526–531. <http://dx.doi.org/10.1016/j.jpsychires.2008.07.006>.
- Wolitzky-Taylor, K., Operskalski, J. T., Ries, R., Craske, M. G., & Roy-Byrne, P. (2011). Understanding and treating comorbid anxiety disorders in substance users: Review and future directions. *Journal of Addiction Medicine*, *5*(4), 233–247. <http://dx.doi.org/10.1097/ADM.0b013e31823276d7>.
- Worden, B. L., Davis, E., Genova, M., & Tolin, D. F. (2015). Development of an anxiety sensitivity (AS) intervention for high-AS individuals in substance use disorders treatment. *Cognitive Therapy and Research*, *39*(3), 343–355. <http://dx.doi.org/10.1007/s10608-014-9666-0>.
- Yang, C. M., Lin, S. C., & Cheng, C. P. (2013). Transient insomnia versus chronic insomnia: A comparison study of sleep-related psychological/behavioral characteristics. *Journal of Clinical Psychology*, *69*(10), 1094–1107. <http://dx.doi.org/10.1002/jclp.22000>.
- Zalta, A. K., Dowd, S., Rosenfield, D., Smits, J. A., Otto, M. W., Simon, N. M., ... Pollack, M. H. (2013). Sleep quality predicts treatment outcome in CBT for social anxiety disorder. *Depression and Anxiety*, *30*(11), 1114–1120.
- Zayfert, C., & DeViva, J. C. (2004). Residual insomnia following cognitive behavioral therapy for PTSD. *Journal of Traumatic Stress*, *17*(1), 69–73.