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The Pittsburgh Sleep Quality Index in Older Primary Care Patients with Generalized Anxiety Disorder: Psychometrics and Outcomes Following Cognitive Behavioral Therapy

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Abstract

The Pittsburgh Sleep Quality Index (PSQI) is a widely used, comprehensive self-report measure of sleep quality and impairment, which has demonstrated good psychometric properties within various populations, including older adults. However, the psychometric properties of the PSQI and its component scores have not been evaluated for older adults with generalized anxiety disorder (GAD). Additionally, changes in PSQI global or component scores have not been reported following cognitive-behavioral treatment (CBT) of late-life GAD. This study examined (1) the psychometric properties of the PSQI within a sample of 216 elderly primary care patients age 60 or older with GAD who were referred for treatment of worry and/or anxiety; as well as (2) response to CBT, relative to usual care, for 134 patients with principal or coprincipal GAD. The PSQI demonstrated good internal consistency reliability and adequate evidence of construct validity. Those receiving CBT experienced greater reductions in PSQI global scores at post-treatment, relative to those receiving usual care. Further, PSQI global and domain scores pertaining to sleep quality and difficulties falling asleep (i.e., sleep latency and sleep disturbances) demonstrated response to treatment over a 12-month follow-up period. Overall, results highlight the usefulness of the PSQI global and component scores for use in older adults with GAD.

Keywords

Pittsburgh Sleep Quality Index; psychometrics; generalized anxiety disorder; elderly; cognitive behavioral therapy

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1. Introduction

Generalized anxiety disorder (GAD), a psychiatric disorder marked by chronic, excessive worry and a number of somatic symptoms (American Psychiatric Association, 2000), is one of the most common psychiatric disorders among older adults, with prevalence ranging from 1.2% to 7.3% (Byers et al., 2010; Wolitzky-Taylor et al., 2010). One particularly debilitating feature of GAD is sleep disturbance (Brenes et al., 2009; Spira et al., 2009). GAD is linked with sleep quality and daytime dysfunction, while health-related quality of life and disability are both uniquely impacted by sleep loss above and beyond the effects of GAD alone (Ramsawh et al., 2009). Sleep difficulty is common among the elderly, in general (Foley et al., 1995; Reid et al., 2006; Spira et al., 2009) and among older adults with GAD, ranging from 56-70% reporting some kind of sleep disturbance (Wetherell et al., 2003; Belanger et al., 2004; Brenes et al., 2009).

Cognitive Behavioral Therapy (CBT) may be a beneficial treatment for older adults with anxiety and associated sleep problems, given the efficacy of this approach among older-adult chronic insomniacs (e.g., Rybarczyk et al., 2009) and older people with GAD (Stanley et al., 2003b; Stanley et al., 2009). In fact, CBT for anxiety has reduced overall sleep difficulties (measured by the Insomnia Severity Index; Morin, 1993) in older adults with anxiety disorders (Brenes et al., in press) and GAD (Belanger et al., 2004).

Clinical measures of sleep quality are important for further assessing this area of treatment outcome. Sleep disturbances increase with age (Ohayon et al., 2004) and, of all mental disorders, GAD is the most strongly linked to insomnia (Monti and Monti, 2000). Therefore, when examining the effects of CBT for older adults with GAD, it may be particularly beneficial to investigate whether all facets of sleep disturbance are uniformly improved. Because sleep difficulties are multifaceted and vary with age (Roepke and Ancoli-Israel, 2010), exclusive use of unidimensional measures or global scores may be inadequate for providing a detailed picture of the nature of sleep dysfunction and value of CBT. For instance, since GAD has been associated with lowered sleep quality and greater daytime dysfunction (Ramsawh et al., 2009), examination of whether CBT improves one or both of these domains is important. Several multidimensional measures that assess various aspects of sleep disturbance are frequently used.

The Pittsburgh Sleep Quality Index (PSQI; Buysse et al., 1989) is a widely used, multidimensional self-report measure of sleep quality and impairment in older adults (Smyth, 2008). Designed for use in clinical samples, the measure is not specific to chronic insomnia, making it a good option for measuring sleep difficulties in older adults suffering with GAD (Buysse et al., 1989). The PSQI contains 19 items aggregated into seven component scores assessing subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleep medications, and daytime dysfunction. These component scores can be summed to create a global sleep-quality/impairment score, with higher scores indicating greater sleep impairment; and a cutoff score of 5 discriminates between those with "good" and "poor" sleep (Buysse et al., 1989). The psychometric properties of the PSQI among older adults with GAD, for whom it may have particular utility, are unknown.

Although the PSQI provides a comprehensive assessment of numerous dimensions of perceived sleep quality and impairment, outcome studies assessing treatment response for insomnia in older adults (Lai and Good, 2004; Reid et al., 2010) and the utility of CBT for insomnia and pain management (Morgan et al., 2004; Cunningham et al., 2011) have exclusively examined global scores on the PSQI, ignoring the seven component domains. However, CBT for insomnia has been shown to improve subjective sleep quality, sleep

latency, and sleep duration (but not habitual sleep efficiency) in adult outpatients (Sato et al., 2010), suggesting that the components do not uniformly respond to treatment. To better understand the precise effects of CBT for anxiety on sleep difficulties in older adults, an examination of the results of treatment on both global and individual domains is warranted.

The first goal of the current study was to provide a preliminary evaluation of the psychometric properties of the PSQI global and component scores in a sample of older adults with principal or coprincipal GAD being treated in primary care. Therefore, we examined the internal consistency reliability of the global PSQI and construct validity of both the global and component scores of the PSQI in a sample of older adults with GAD. Convergent validity would be demonstrated by positive associations between global and component scores of the PSQI and both worry and depressive symptoms (assessed by the Pennsylvania State Worry Questionnaire [PSWQ] and Beck Depression Inventory [BDI-II], respectively). Additionally, we expected the PSQI sleep-medications component score to be most strongly related to self-reported use of hypnotic/sedative medications. Further, to examine discriminant validity, we assessed associations between global and component scores of the PSQI and both optimism and social support, with the expectation that sleep dysfunction would generally be unrelated to these psychosocial variables.

We compared scores on the PSQI between older adults with GAD and three groups of older adults without GAD: those without GAD, but with another anxiety diagnosis; those with another non-anxiety diagnosis (primarily depression); and those with no psychiatric diagnoses. We expected that older adults with GAD would have greater sleep difficulties at both global and component levels, relative to older adults without GAD (especially those with no diagnoses).

Prior investigations using the PSQI as an indicator of treatment effectiveness typically have not examined changes in component scores following treatment. As treatment may not uniformly alleviate all realms of sleep disturbance, our second goal was to examine sensitivity to change of the PSQI global and component scores in a subsample who received CBT for GAD. Consistent with prior studies examining changes in sleep difficulty in response to treatment for GAD (e.g., Belanger et al., 2004), it was hypothesized that there would be significant decreases in PSQI global and component scores following CBT relative to those in a usual-care condition. To examine the value of global and component scores to assess longer-term change, we also examined maintenance of reduction in sleep difficulties over a 1-year period following treatment.

2. Methods

2.1 Participants

Recruitment occurred through two large primary care centers in Houston, Texas, via primary care physician referrals, letters of invitation to patients, and/or educational brochures advertising a study on worry and anxiety (see Stanley et al., 2009, for more details). Referred patients who consented ($n = 381$) were initially screened for symptoms of GAD over the telephone, using two probes from the Patient Questionnaire portion of the Primary Care Evaluation of Mental Disorders (Spitzer et al., 1994). Those who screened positive ($n = 323$) were further evaluated at a subsequent diagnostic session, which consisted of a cognitive impairment screen (using the Mini-Mental State Exam [Folstein et al., 1975]) and administration of the Structured Clinical Interview for the *DSM-IV* Axis I (First et al., 1997). These measures were administered in person by trained research staff, pre- and postdoctoral interns, and advanced graduate students. Fifty-three participants were excluded after the diagnostic session (42 were ineligible because they had cognitive impairment [defined as a Mini Mental State Exam < 24] [$n = 23$], secondary GAD [$n = 9$], substance

abuse [$n = 9$], or hypomania [$n = 1$]; and 11 were clinical training cases), leaving 260 patients (112 with no GAD diagnosis and 148 with principal or coprincipal GAD). Of those with no GAD diagnosis, 30 did not complete the baseline assessment; and of the 148 with principal or coprincipal GAD, 14 dropped out prior to randomization to treatment condition. These exclusions resulted in a final sample of 216 patients (82 with no GAD diagnosis and 134 with principal or coprincipal GAD). The *treatment sample* consisted of participants from the full sample with a diagnosis of principal or coprincipal GAD who were randomly assigned to receive either CBT ($n = 70$) or enhanced usual care (EUC; $n = 64$) as part of a larger treatment study (see Stanley et al., 2009, for further details). The *comparison sample* consisted of 82 participants who did not meet criteria for the study because they had no GAD diagnosis. Of the 82 with no GAD diagnosis, 34 had no diagnosis, and 48 had other diagnoses ($n = 15$ depression, $n = 13$ other anxiety, $n = 13$ depression and other anxiety, and $n = 7$ with another disorder [e.g., pain disorder, adjustment disorder, somatization disorder]). All participants were older adults age 60 or older. See Table 1 for demographic information.

2.2 Measures

2.2.1 Sleep quality and impairment—The PSQI (Buysse et al., 1989) is a 19-item self-report measure of sleep quality over the previous month. It consists of seven component scores, each rated on a 0 to 3 scale, with higher scores implying greater difficulties. *Subjective sleep quality* is measured with one item and assesses how one rates one's overall sleep quality. *Sleep latency* consists of two items and is the average length of time it takes one to fall asleep. *Sleep duration* is measured with one item and is the average hours of sleep one engages in each night. *Habitual sleep efficiency* is calculated from three items and represents the number of hours slept, given the number of hours spent in bed. *Sleep disturbance* measures the frequency with which various situations have troubled one's sleep and consists of nine items representing different situations (e.g., bad dreams, pain, inability to breathe well). *Use of sleep medications* consists of one item inquiring about how frequently one has taken medicine to aid sleep. The seventh component is *daytime dysfunction*, which consists of two items and measures daily problems related to sleep, such as having trouble staying awake or having enough enthusiasm to get things done. These seven component scores can be summed to form a single global score, which ranges from 0 to 21, with higher scores reflecting greater overall sleep disturbance. The PSQI has demonstrated adequate internal consistency, test-retest reliability, and discriminative validity in a mixed sample of participants ages 19 to 83 ($M = 49.5$), with major depressive disorder, sleep disorders, or no psychiatric disorder (Buysse et al., 1989). A global PSQI score of 5 or greater is indicative of poor sleep quality among younger adults (Buysse et al., 1989), though others suggest a cut-off of 8 (Carpenter and Andrykowski, 1998; Fictenberg et al., 2001). Older primary care patients with and without GAD show significantly different ratings on the global PSQI (Stanley et al., 2003a).

2.2.2 Worry severity—The PSWQ (Meyer et al., 1990) is a 16-item self-report measure of pathological worry with good psychometric properties with older adults (Beck et al., 1995; Stanley et al., 2001), including strong internal consistency reliability and construct validity.

2.2.3 Depressive symptoms—The BDI-II (Beck et al., 1996) is a widely used, 21-item self-report measure assessing depressive symptoms. It has good internal consistency reliability and construct validity in samples of older adults (Snyder et al., 2000).

2.2.4 Medication use—Patient self-reports were used to assess medication use, in particular, whether one had taken any psychotropic medications over the past 3 months. Use of each anti-anxiety, antidepressant, and hypnotic/sedative medication was coded

dichotomously such that a value of 1 indicated that the patient was taking the medication; and a value of 0 indicated that the patient was not.

2.2.5 Social support—The Multidimensional Scale of Perceived Social Support (MSPSS; Zimet et al., 1988) consists of 12 items. It was used to assess perceived availability of social support. Items are rated on a 1 to 7 scale, where 1 = “Very Strongly Disagree” and 7 = “Very Strongly Agree.” Items are averaged such that higher scores indicate greater perceived availability of support. The MSPSS has adequate internal consistency reliability and validity among various populations (Zimet et al., 1990), including older adults with GAD or without any psychiatric diagnosis (Stanley et al., 1998).

2.2.6 Optimism—The Life Orientation Test (LOT; Scheier and Carver, 1985), consisting of eight scored items and four filler items, was used to measure dispositional optimism. Items are rated on a 5-point scale from 0 = “Strongly Disagree” to 4 = “Strongly Agree.” Negatively scored items were reverse scored before summing such that higher scores indicate greater optimism. The LOT has good content validity (Scheier and Carver, 1985) and demonstrates adequate internal consistency reliability in older adults with GAD (Stanley et al., 2002).

2.3 Procedures

Within several weeks of the in-person diagnostic assessment, an independent clinician, who was unaware of diagnoses assigned, administered a baseline assessment battery over the telephone. Instruments administered included self-reported medication use, as well as the PSQI, PSWQ, BDI-II, MSPSS, and LOT. Participants were provided with blank copies of the measures to reference during the telephone assessment and were mailed a \$20 gift card upon completion of the telephone interview.

Following baseline assessment, participants who met treatment study inclusion criteria were randomized to receive either CBT ($n = 70$) or Enhanced Usual Care (EUC; $n = 64$). Randomization procedure and treatment condition are described in detail elsewhere (Stanley et al., 2009). Briefly, CBT consisted of up to 10 individual sessions focusing on psychoeducation, motivational interviewing, relaxation training, cognitive restructuring, exposure, problem-solving skills training, and behavioral sleep management; while EUC consisted of 15-minute biweekly telephone conversations with a study therapist, focusing on providing support and safety monitoring. The PSQI was administered via telephone at post-treatment (3 months) and over a subsequent 12-month interval (6, 9, 12, and 18 months).

2.4 Data analyses

2.4.1 Reliability and validity—With the exception of comparing PSQI global and component scores between patients with and without GAD, all analyses were conducted using the treatment sample of those with GAD. Internal consistency of the global PSQI was assessed with Cronbach’s alpha coefficient. To examine convergent validity, PSQI global and component scores were correlated with the PSWQ, BDI-II, and self-reported medication use. Zero-order correlations assessed relationships of the PSQI with the PSWQ and BDI-II, whereas point biserial correlations (r_{bp}) were used to examine associations between the PSQI and medication use. Additionally, a series of one-way, between-groups analysis of variance tests examined differences in PSQI global and component scores by whether one had a GAD diagnosis, other diagnosis, or no diagnosis. Homogeneity of variance was examined across diagnostic categories with the Brown Forsyth test, and Welch’s correction was used when this assumption was violated. Significant omnibus tests were followed-up with pairwise comparisons, with Tukey’s WSD method employed to correct for multiple comparisons and prevent alpha inflation. To examine discriminant validity, zero-order

correlations were calculated to examine associations between PSQI global and component scores and the MSPSS and LOT.

2.4.2 Response to treatment—All analyses for the treatment sample were conducted on patients with a principal or coprincipal diagnosis of GAD ($n = 134$), randomized to receive either CBT or EUC. Active-phase analyses for the treatment sample compared group differences from pre- to post-treatment (3 months) in PSQI global and component scores, using a between-groups analysis of covariance, with pretreatment PSQI global (or component) score as a covariate. Intent-to-treat analyses were conducted and employed using the PROC MI and MINANALYZE multiple imputation procedure in SAS version 9.2 (SAS Institute, Inc., Cary, NC) to address missing data. Analyses of long-term outcomes (6, 9, 12, and 15 months following pretreatment) were examined, using a repeated-measures analysis of covariance procedure using the PROC MIXED routine in SAS (Littell et al., 1996; Singer, 1998). As before, pretreatment PSQI global (or component) score was included as a covariate.

3. Results

3.1 Reliability

The internal consistency of the global PSQI was good (Cronbach's $\alpha = 0.80$). Interitem correlations suggested low-to-moderate correlations between individual component scores ($r = 0.10$ to 0.56) and moderate-to-high correlations between individual component scores and the global score ($r = 0.53$ to 0.76 ; see Table 2).

3.2 Construct validity

There was some evidence for convergent validity in that global PSQI scores (where higher scores indicate greater sleep difficulties) were associated with the BDI-II ($r = 0.50$, $P < 0.001$), PSWQ ($r = 0.25$, $P < 0.01$), and anti-anxiety medication use ($r_{bp} = 0.20$, $P < 0.05$; see Table 3). All components (except sleep latency) were associated with the BDI-II (r s between 0.22 and 0.53), and nearly all components (sleep latency and use of sleep medication were exceptions) were associated with the PSWQ (r s between 0.19 and 0.28). Although global PSQI scores were associated with use of hypnotic/sedative medication ($r_{bp} = 0.22$, $P < 0.05$), use of sleep medication was the only component score associated with anti-anxiety medication ($r_{bp} = 0.24$, $P < 0.007$) and was one of two components associated with hypnotic/sedative medication use ($r_{bp} = 0.32$, $P < 0.001$).

Additionally, associations with social support and optimism revealed some evidence for discriminant validity. As expected, global and component scores of the PSQI were generally not associated with the MSPSS, with the exception of daytime dysfunction ($r = -0.24$, $P < 0.01$). However, global PSQI, use of medications, and daytime dysfunction were negatively associated with optimism (r s between -0.24 and -0.26).

Although those with GAD, those with other anxiety diagnoses, those with other non-anxiety diagnoses, and those with no diagnoses all had mean scores on the global PSQI that were greater than or equal to 5, suggesting sleep disturbance in all groups (Buysse et al., 1989), only those with GAD met the stricter criteria of a score of 8 on the global PSQI (e.g., Carpenter and Andrykowski, 1998). Furthermore, global PSQI scores differed significantly between patients, based on their diagnosis ($F(3, 212) = 2.75$, $P < 0.05$; see Table 4). Patients also differed significantly on subjective sleep quality and daytime dysfunction. In all cases, significant differences indicated greater sleep disturbances for patients with GAD, relative to those with no diagnosis. Sleep latency, sleep duration, habitual sleep efficiency, sleep

disturbances, and use of sleep medications did not differ significantly between patients with and without GAD.

3.3 Response to treatment

At post-treatment, ITT analyses suggested significantly greater reductions on the global PSQI (where higher scores indicate greater sleep difficulties) for those completing CBT, relative to those completing EUC (see Table 5). Pre- and post-treatment changes on PSQI component scores were not significantly different between groups. Follow-up analyses indicated that post-treatment group differences in global PSQI continued over the follow-up phase. Additionally, those in CBT reported better subjective sleep quality, shorter sleep latency, and less frequent sleep disturbances over the follow-up phase, relative to those in EUC.

4. Discussion

This study provides preliminary support for use of the PSQI among older adults with GAD. Although other sleep measures exist, the PSQI is ideal for examining sleep practices in older adults with GAD because it was developed as a multidimensional assessment of self-reported sleep behaviors and is useful for more varied samples, consisting of those who are not exclusively chronic insomniacs. Importantly, the global PSQI demonstrated good internal consistency; and correlations between individual component scores and between the global score and component scores suggest that the global score represents each domain, but that domains do not overlap completely. Additionally, the PSQI demonstrated adequate construct validity. Convergent validity of the global PSQI and most domains was demonstrated by positive associations with depression and worry symptoms, as well as associations with hypnotic/sedative medication use. Further, those with principal or coprincipal GAD showed greater difficulties on the PSQI global score, subjective sleep quality and daytime dysfunction, relative to those with no diagnosis. Of interest is the lack of relationship found between sleep latency and worry or depression. This is an unexpected finding given that older adults (especially those with anxiety or depression) generally report difficulty with not only maintaining sleep, but also with initial onset of sleep (Brabbins et al., 1993; Taylor et al., 2005). Although there is some evidence that difficulty maintaining sleep appears to be more common in older adults than difficulties with sleep latency (Gislason et al., 1993), this lack of relationship may warrant further investigation. Discriminant validity was evidenced by minimal associations with psychosocial constructs, in particular, social support. Although we did not anticipate that daytime dysfunction would be associated with social support, daytime dysfunction can have meaningful implications for interpersonal processes, as it captures the effects of sleep on everyday life. Those who have trouble staying awake and who have less enthusiasm may have strained social relationships. Finally, mean scores for the PSQI global and component scores provide normative values for older primary care patients with GAD, which may be useful for future studies with this population.

One particularly notable finding is the support for use of the PSQI as an outcome measure in a randomized clinical trial of CBT for older adults with GAD. Patients receiving CBT for anxiety showed greater improvement (i.e., greater reductions in scores) on the PSQI global score relative to patients receiving EUC, and this improvement was maintained up to 1 year following treatment. Although there were no differences in PSQI component scores between patients receiving CBT or EUC at post-treatment, those who received CBT for anxiety experienced greater improvements (i.e., greater reductions) on a number of component scores (i.e., subjective sleep quality, sleep latency, and sleep disturbances) over the follow-up phase, relative to those who received EUC. Therefore, CBT for anxiety reduced sleep disturbances associated with one's overall perception of sleep quality and ability to fall

asleep; whereas it did not improve sleep disturbances associated with staying asleep (e.g., sleep duration), daily functioning (e.g., daytime dysfunction), or use of sleep medications.

This suggests utility of the global measure and several of its specific components as outcome measures in clinical trials with older adults with GAD. It also suggests that CBT for anxiety alleviates some aspects of sleep difficulty over time; whereas other aspects are not improved, which is consistent with research examining CBT for insomnia (Sato et al., 2010). It is evident that exclusive reliance on the global score would not allow one to capture which specific aspects of sleep are improved following treatment. CBT for insomnia has been shown to improve subjective sleep quality, sleep latency, and sleep duration (Sato et al., 2010), whereas the current findings suggest that CBT for anxiety improves only global sleep difficulties immediately following active treatment. Therefore, although CBT targeting insomnia may immediately improve several specific qualities or domains of sleep disturbance, CBT for anxiety may be useful in immediately attenuating general sleep disturbances as a secondary symptom in older adults with GAD.

There were a number of limitations in this study, the most significant of which was the nature of the sample. First, the total sample was very well educated, which limits the degree to which results can generalize to less-educated older primary care patients. Also, included participants were not randomly selected, since all (even those with no diagnosis or a diagnosis other than GAD) were self- or physician-referred for evaluation of worry and/or anxiety. Therefore, comparisons between the GAD and non-GAD groups may have been overly conservative. The GAD group may not have had significantly higher habitual sleep efficiency, sleep duration, and use of sleep medications relative to those without a GAD diagnosis because all participants had at least minimal worry/anxiety, warranting referral. Thus, a sample more representative of older adults in primary care would be useful in evaluating the utility of the PSQI with this population. Further, although this work examines self-reported changes in sleep behaviors and practices following treatment for GAD, these findings would be nicely complemented by examination of physiological sleep characteristics, including estimation of sleep based on rest/activity data of actigraphs (e.g., Sato et al., 2010) or electroencephalogram recordings (e.g., O'Donnell et al., 2009).

Overall, results indicate that the PSQI may be useful with older primary care patients with GAD. Several positive psychometric properties of the global score and component scores were demonstrated, and findings show that the global score and component scores may provide useful information as an outcome measure for clinical trials with older adults. Future studies will need to replicate the psychometric properties of the PSQI found in this study in larger samples and evaluate its use in controlled outcome studies, especially with a more diverse sample of older primary care patients.

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Table 1

Demographic characteristics of GAD and no-GAD samples.

	Treatment Sample (<i>n</i> = 134)	No GAD sample (<i>n</i> = 82)
Females, N (%)	105 (78.4)	55 (67.1)
Age, mean years (SD)	66.9 (5.8)	68.2 (6.2)
Years of education, mean years (SD)	15.9 (3.0)	15.7 (2.8)
Race/ethnicity, N (%)		
Non-Hispanic White	94 (70.2)	53 (65.4)
Hispanic	11 (8.2)	4 (4.9)
African American	25 (18.7)	21 (25.9)
Asian American	3 (2.2)	1 (1.23)
Mixed heritage	1 (0.7)	2 (2.5)
Occupational status (%)		
Retired	74 (55.2)	45 (54.9)
Employed full-time or part time	48 (35.8)	31 (37.8)
Homemaker	7 (5.2)	2 (2.4)
Not employed	5 (3.7)	4 (4.9)

Note. Treatment sample is the subgroup of the full sample that had a principal or coprincipal diagnosis of generalized anxiety disorder and who received treatment (cognitive behavioral therapy or enhanced usual care).

GAD = generalized anxiety disorder

Table 2

Zero-order correlations between PSQI global and component scores for those with principal or coprincipal GAD ($n = 134$)

	Global	1	2	3	4	5	6	7
Global PSQI	1.00							
1. Subjective sleep quality	0.76***	1.00						
2. Sleep latency	0.67***	0.36***	1.00					
3. Sleep duration	0.68***	0.56***	0.26**	1.00				
4. Habitual sleep efficiency	0.64***	0.54***	0.26**	0.48***	1.00			
5. Sleep disturbances	0.58***	0.39***	0.29***	0.30***	0.30***	1.00		
6. Use of sleep medication	0.61***	0.33***	0.43***	0.10	0.21*	0.23**	1.00	
7. Daytime dysfunction	0.53***	0.36***	0.25**	0.31***	0.24**	0.31***	0.11	1.00

Note.

* $p < 0.05$,

** $p < 0.01$,

*** $p < 0.001$

PSQI = Pittsburgh Sleep Quality Index; GAD = generalized anxiety disorder

Table 3

Zero-order and point-biserial correlations between the PSQI and other measures for those with principal or copincipal GAD ($n = 134$)

	Convergent Validity		Medication use (1 = yes, 0 = no)		Discriminant Validity	
	PSWQ	BDI-II	Anti-Anxiety	Anti-Depressant	Hypnotic/Sedative	LOT
Global PSQI	0.25**	0.50***	0.20*	-0.08	0.22*	-0.14 -0.26**
Component Scores						
1. Subjective sleep quality	0.25**	0.44***	0.15	-0.16	0.22*	0.04 -0.17
2. Sleep latency	0.11	0.17	0.10	0.03	0.14	-0.02 -0.14
3. Sleep duration	0.19*	0.38***	0.12	-0.27**	0.08	0.01 -0.16
4. Habitual sleep efficiency	0.19*	0.28**	0.13	-0.20*	0.10	-0.14 -0.11
5. Sleep disturbances	0.28**	0.28**	0.06	-0.14	0.00	-0.13 -0.07
6. Use of sleep medication	0.02	0.22*	0.24**	0.14	0.32***	-0.13 -0.24**
7. Daytime dysfunction	0.22*	0.53***	0.04	0.20*	0.00	-0.24** -0.24**

Note.

* $p < 0.05$,

** $p < 0.01$,

*** $p < 0.001$.

PSQI = Pittsburgh Sleep Quality Index; PSWQ = Penn State Worry Questionnaire; BDI-II = Beck Depression Inventory-II; MSPSS = Multidimensional Scale of Perceived Social Support; LOT = Life Orientation Test

Table 4

Global and component PSQI means (SDs) by diagnostic category

	Principal or Coprincipal GAD (<i>n</i> = 134)	Other Anxiety (<i>n</i> = 29)	Other – No Anxiety (<i>n</i> = 19)	No Diagnosis (<i>n</i> = 34)	Omnibus <i>F</i> (<i>df</i>)	Omnibus <i>P</i> value
Global PSQI ^a	8.74 (4.05)	7.86 (3.67)	7.68 (4.11)	6.65 (3.70)	2.75 (3, 212)	0.04
Component Scores						
1. Subjective sleep quality ^a	1.31 (0.76)	1.17 (0.89)	1.05 (0.71)	0.82 (0.83)	3.76 (3, 212)	0.01
2. Sleep latency	1.40 (1.03)	0.86 (0.95)	1.05 (1.31)	0.94 (1.13)	3.40 (3, 212)	0.02
3. Sleep duration	1.48 (1.11)	1.69 (1.07)	1.16 (1.21)	1.24 (1.13)	1.32 (3, 211)	0.27
4. Habitual sleep Efficiency	0.66 (0.68)	0.90 (1.18)	1.00 (1.05)	0.97 (1.03)	1.99 (3, 211)	0.12
5. Sleep disturbances	1.60 (0.65)	1.38 (0.56)	1.37 (0.60)	1.35 (0.49)	2.43 (3, 212)	0.07
6. Use of sleep medication	1.05 (1.27)	0.79 (1.26)	0.79 (1.23)	0.62 (1.04)	1.37 (3, 212)	0.25
7. Daytime dysfunction ^b	1.20 (0.72)	1.07 (0.70)	1.26 (0.73)	0.71 (0.68)	4.59 (3, 211)	0.00

Note. PSQI = Pittsburgh Sleep Quality Index; GAD = generalized anxiety disorder. The Other – No Anxiety group includes those diagnosed with depression (*n* = 15) and those diagnosed with other disorders (*n* = 4). The *F*- and *p*-values refer to the omnibus test. Outcomes with subscripts indicate that there are differences between diagnosis groups that are significant at *p* < 0.05 following Tukey's adjustment.

^aGAD > No Diagnosis; All other groups are statistically equivalent

^bGAD > No Diagnosis; Other- No Anxiety > No Diagnosis; All other groups are statistically equivalent

Table 5
Mean (SD) scores on PSQI global and component scores for patients receiving CBT or EUC (treatment sample only).

	Treatment Effect					Treatment Effect			Time Effect			Treatment × Time Effect	
	Baseline (n = 134)	3 mo (n = 115)	F (df)*	p-value	d (95% CIs)	6 mo (n = 95)	9 mo (n = 96)	12 mo (n = 92)	15 mo (n = 94)	F (df)	p-value	F (df)	p-value
Global PSQI													
CBT	9.12 (4.55)	7.26 (4.00)	6.76 (1, 96.76)	.0107	0.49 (0.11, 0.86)	7.31 (4.54)	6.94 (4.38)	6.41 (3.83)	5.78 (3.25)	9.65 (1, 113)	.0024	1.36 (4, 372)	0.25
EUC	8.89 (4.22)	8.34 (4.45)				7.86 (4.23)	7.57 (3.95)	7.66 (3.33)	8.21 (3.79)				0.15
SSQ													
CBT	1.34 (0.80)	.97 (0.77)	3.80 (1, 90.99)	.055	0.37 (-0.01, 0.74)	0.98 (.95)	0.85 (0.86)	0.82 (0.77)	0.73 (0.66)	13.61 (1, 113)	.0003	0.27 (4, 372)	0.89
EUC	1.28 (0.72)	1.20 (0.83)				1.14 (.81)	1.17 (0.79)	1.20 (0.71)	1.29 (0.77)				0.33
SL													
CBT	1.40 (0.97)	1.08 (0.91)	2.96 (1, 95.02)	.089	0.32 (-0.05, 0.69)	0.98 (1.01)	0.98 (1.00)	0.86 (0.92)	0.92 (0.97)	4.10 (1, 113)	.045	0.73 (4, 372)	0.57
EUC	1.42 (1.11)	1.30 (0.95)				1.24 (1.14)	1.07 (0.95)	1.22 (1.06)	1.17 (0.99)				0.57
Sdur													
CBT	1.43 (1.16)	1.15 (1.08)	0.79 (1, 92.83)	0.38	0.17 (-0.20, 0.54)	1.30 (1.15)	1.17 (1.18)	0.96 (1.15)	1.06 (1.04)	0.51 (1, 112)	0.47	0.44 (4, 371)	0.78
EUC	1.54 (1.06)	1.32 (1.11)				1.19 (.99)	1.12 (1.06)	1.20 (0.95)	1.38 (1.13)				0.35
HSE													
CBT	1.04 (1.15)	.75 (1.06)	1.19 (1, 89.56)	0.28	0.21 (-0.17, 0.57)	0.89 (1.15)	0.70 (1.13)	0.80 (1.08)	0.52 (0.85)	0.40 (1, 112)	0.53	0.58 (4, 371)	0.68
EUC	1.10 (1.23)	.92 (1.14)				0.83 (1.01)	0.67 (1.00)	0.66 (0.96)	1.00 (1.17)				0.10
Sdist													
CBT	1.69 (0.67)	1.35 (0.62)	1.77 (1, 94.28)	0.19	0.25 (-0.12, 0.62)	1.42 (.60)	1.37 (0.62)	1.16 (0.50)	1.10 (0.60)	8.47 (1, 113)	.0043	2.48 (4, 372)	.043
EUC	1.50 (0.62)	1.44 (0.67)				1.50 (.67)	1.52 (0.67)	1.46 (0.60)	1.48 (0.74)				0.17
USM													
CBT	1.06 (1.30)	.94 (1.21)	1.80 (1, 95.60)	0.19	0.25 (-0.12, 0.62)	0.89 (1.20)	.89 (1.28)	1.00 (1.36)	0.60 (1.07)	2.20 (1, 113)	.14	2.38 (4, 372)	.051
EUC	1.05 (1.25)	1.16 (1.31)				1.10 (1.23)	1.12 (1.27)	1.07 (1.25)	1.00 (1.21)				0.60
DD			0.00 (1, 85.05)	0.94	0.01 (-0.36, 0.38)					1.20 (1, 112)	.28	2.13 (4, 370)	.076

		Treatment Effect				Time Effect				Treatment × Time Effect			
	Baseline (<i>n</i> = 134)	3 mo (<i>n</i> = 115)	<i>F</i> (<i>df</i>)*	<i>p</i> -value	<i>d</i> (95% CIs)	6 mo (<i>n</i> = 95)	9 mo (<i>n</i> = 96)	12 mo (<i>n</i> = 92)	15 mo (<i>n</i> = 94)	<i>F</i> (<i>df</i>)	<i>p</i> -value	<i>F</i> (<i>df</i>)	<i>p</i> -value
CBT	1.25 (0.69)	1.03 (0.66)				0.85 (0.63)	0.98 (0.71)	0.80 (0.60)	0.85 (0.70)				
EUC	1.14 (0.75)	.98 (0.59)				0.88 (0.59)	0.93 (0.81)	0.85 (0.73)	0.90 (0.58)				

Note: CBT = cognitive behavioral therapy; EUC = enhanced usual care; baseline = pretreatment assessment; Global PSQI = Global sleep quality/impairment; SSQ = Subjective sleep quality; SL = Sleep latency; Sdur = Sleep duration; HSE = Habitual sleep efficiency; Sdist = Sleep disturbances; USM = Use of sleep medication; DD = Daytime dysfunction.

* Error/denominator degrees of freedom are adjusted based on number of imputations and relative increase in variance due to non-response. Complete error degrees of freedom is 133.