Short Communication

Dysfunctional Cognitions Mediate the Relationship between Symptoms of Depression, Anxiety, and Sleep Quality in a Non-Clinical Population

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Abstract

Dysfunctional beliefs and attitudes about sleep such as faulty beliefs, worry, and attentional bias have been shown to perpetuate or even exacerbate poor sleep. Additionally, individuals with depressive or anxiety disorders have been shown to have decreased sleep quality. This study, however, will examine the mediating effects of dysfunctional cognitions about sleep between depressive and anxiety related symptoms and sleep quality in a non-clinical population. A total of 446 participants completed an online survey including the Pittsburgh Sleep Quality Index (PSQI), the Hospital Anxiety and Depression Scale (HADS), and the Dysfunctional Beliefs and Attitudes about Sleep (DBAS-16). Mediation analysis indicated that the relationship between depressive symptoms and sleep quality was significantly mediated by DBAS-16 scores (z = 6.258, p< .001). Additionally, the relationship between anxiety symptoms and sleep quality was significantly mediated by DBAS-16 scores (z = 6.433, p< .001). Based on our data, dysfunctional beliefs and attitudes about sleep are potential mechanisms by which depressive and anxiety disorders may lead to poor sleep quality in the general population. This research highlights the importance of incorporating belief-targeted insomnia treatment into the cognitive behavioral therapy for depressive and anxiety disorders.

ABBREVIATIONS

CBT: Cognitive Behavioral Therapy; CI: Confidence Interval; Dysfunction beliefs and attitudes about sleep; DSM-5: DBAS-16: Diagnostic and Statistical Manual for Mental Disorders16 –Fifth Edition; GAD: Generalized Anxiety Disorder; HADS: Hospital Anxiety and Depression Scale; PSQI: Pittsburgh Sleep Quality Index; PTSD: Posttraumatic Stress Disorder; SD: Standard Deviation.

INTRODUCTION

Mood disorders and anxiety disorders are often comorbid with sleep problems[1]. Previous studies on normal sleep and sleep disturbances have shown that most of the systems involved in the regulation of mood also appear to be involved in the regulation of sleep and wakefulness, suggesting that dysfunction in such brain systems might lead to abnormalities in both mood and sleep [1]. Sleep has been studied more profoundly in patients with depressive disorder than with any other psychiatric disorders [2]. Major depression is often associated with insomnia or hypersomnia, and poor sleep quality is a risk factor for onset, severity, and recurrence of depression [3]. Insomnia also occurs after the onset of anxiety disorders [4]. Insomnia often precedes the onset of first episode of major depression or mania; in contrast, insomnia occurs after the onset of anxiety disorders [5]. Sleep disturbances were included in the diagnostic

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Submitted: 20 August 2015
Accepted: 09 October 2015
Published: 12 October 2015

ISSN: 2379-0822

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Keywords
- DBAS
- PSQI
- HADS
- Insomnia
- Mood disorders
The hypothesis was that anxiety, depression, maladaptive beliefs about sleep, and worry excessively when such expectations are not fully met. Such faulty expectations and excessive worry will contribute to the emotional distress and heightened arousal, which in turn aggravate the insomnia. McCall and colleagues [15] found dysfunctional beliefs about sleep mediates a relationship which in turn aggravate the insomnia. McCall and colleagues [15] found dysfunctional beliefs about sleep mediates a relationship between insomnia and suicidal ideation in depressed patients.

To the author’s knowledge, the relationship between depression, anxiety, and sleep quality as potentially mediated through dysfunctional beliefs and attitudes about sleep in the general population has not been studied. In the present study, anxiety, depression, maladaptive beliefs about sleep, and sleep quality were examined in a non-clinical population. The hypotheses were as follows: 1) The relationship between depressive symptoms and sleep quality would be mediated by dysfunctional cognitions about sleep; 2) The relationship between anxiety symptoms and sleep quality were examined in a non-clinical population. The hypotheses were as follows: 1) The relationship between depressive symptoms and sleep quality would be mediated by dysfunctional cognitions about sleep; 2) The relationship between anxiety symptoms and sleep quality were mediated by dysfunctional sleep-related cognitions [13].

Participants
Participants (N = 446, age: M = 34, SD = 12.02, 68% female) who resided in the United States, the majority of whom were recruited through Amazon’s Mechanical Turk platform (mTurk.com). Additionally 18.4% of participants was recruited from university students. Previous studies has suggested that data collected through mTurk are at least as reliable as the data collected through traditional methods (e.g. [16]). The sample consisted of 59.2% of White/Non-Hispanic, 11.9% of African American/Black, 9.0% of Hispanic/Latino, and 5.6% of Asian/Pacific Islander. When asked to describe their present state of health along a 4 point scale, 79.9% indicated good or very good.

Measures

Hospital Anxiety and Depression Scale (HADS) [17]: HADS is a 14-item scale, which has been validated to measure the feelings of anxiety and depression in the past week in people with sleep disorders [18]. Previous study indicated that the average Cronbach’s alpha for HADS-A is .83, and the average Cronbach’s alpha for HADS-D is .82 [17]. Seven of the items belong to anxiety (Cronbach’s alpha: .83) and seven of them belong to Depression (Cronbach’s alpha: .82). A sample item of anxiety is, “I feel tense or wound up”, with 0 being not at all, and 3 being most of the time. A sample item for depression is, “I still enjoy the things I used to enjoy”, with 0 being definitely as much, and 3 being hardly at all. Higher scores are indicative of higher levels of depression or anxiety. The correlations between HADS and other commonly used anxiety/depression scales were in range of .49 to .83 [17].

Pittsburgh Sleep Quality Index (PSQI)[19]: The PSQI is a validated 19-item questionnaire of sleep quality scores with a Cronbach’s alpha of .83 and test-retest reliability r = .85 [19]. A high score indicates poor sleep quality. The PSQI contains items inquiring about sleep time and efficiency along with four point choices for items related to reasons for trouble sleeping. A global PSQI score greater than 5 yielded high diagnostic sensitivity and specificity (i.e., > 85%; [19]).

Dysfunctional Beliefs and Attitudes about Sleep Scale-16-items version (DBAS-16): DBAS-16 measures beliefs and attitudes about sleep, and a previous study showed that DBAS-16 has a Cronbach’s alpha of .79 and test-retest reliability r = .83 (our current study indicated a Cronbach’s alpha of .89) [9,20]. DBAS-16 is a 16-item scale, which was modified from the original DBAS version with 30 items and four subscales. The four subscales describe (a) perceived consequences of insomnia (e.g., “After a poor night’s sleep, I know that it will interfere with my daily activities on the next day”; 5 items, Cronbach’s alpha: .80), (b) worry or helplessness about sleep (e.g., I am concerned that chronic insomnia may have serious consequences for my physical health”; 6 items, Cronbach’s alpha: .84 ), (c) sleep expectations (e.g., “I need 8 hours of sleep to feel refreshed and function well during the day”; 2 items, Cronbach’s alpha: .65), and (d) medication (e.g., “In order to be alert and function well during the day, I am better off taking a sleeping pill rather than having a poor night’s sleep”; 3 items, Cronbach’s alpha: .66) [10]. The responses are along an 11-point scale. A higher score indicates a higher dysfunctional beliefs and attitudes about sleep. It was shown that the total score of DBAS-16 were significantly correlated with measures of insomnia, and anxiety/depressive symptoms scales [20].

RESULTS AND DISCUSSION

Preliminary Analysis

Bivariate correlation analysis indicated that anxiety, depression, PSQI, and DBAS, were all significantly positively correlated (r ranging from .40 to .58, p < .001; see Table 1). Specifically, higher anxiety/depression was associated with poor sleep quality and higher dysfunctional beliefs about sleep. Further, higher dysfunctional beliefs about sleep were associated with poor sleep quality.

Depression, DBAS, and Sleep Quality

Based on Baron and Kenny’s [21] procedure of testing...
mediation effects, the following regression tests were conducted and results showed that: (a) depression was significantly related to the level of sleep quality ($B = .535$, $SE = .04$, $p < .001$), (b) depression was significantly related to DBAS ($B = 3.107$, $SE = .349$, $p < .001$), (c) DBAS was significantly related to sleep quality ($B = .044$, $SE = .005$, $p < .001$), after controlling for depression, and (d) after controlling for DBAS, depression was still a significant predictor of sleep quality ($B = 4.00$, $SE = .041$, $p < .001$). However, a Sobel test ($z = 6.258$, $p < .001$) was conducted and found partial mediation in the model. Further, a mediation analysis using the Bootstrapping method with bias corrected confidence estimate was conducted [22,23]. In the present study, the 95% confidence interval of the indirect effects was obtained with 5000 bootstrap samples [24]. Results confirmed the partial mediation was significant ($B = .137$, CI = .095 to .185). Thus, the relationship between depression and sleep quality was significantly mediated by DBAS (Figure 1). Therefore, Hypothesis 1 is supported.

### Anxiety, DBAS, and Sleep Quality

Based on Baron and Kenny’s [21] procedure of testing mediation effects, the following regression tests were conducted and results revealed that: (a) anxiety was significantly related to the level of sleep quality ($B = .416$, $SE = .039$, $p < .001$), (b) anxiety was significantly related to DBAS ($B = 3.322$, $SE = .318$, $p < .001$), (c) DBAS was significantly related to sleep quality ($B = .049$, $SE = .006$, $p < .001$), after controlling for anxiety, and (d) the relationship between anxiety and sleep quality remained significant after controlling for DBAS ($B = .256$, $SE = .042$, $p < .001$). However, a Sobel test ($z = 6.433$, $p < .001$) indicated significant partial mediation in the model. Further, a mediation analysis using the Bootstrapping method with bias corrected confidence estimate was conducted [22,23]. In the present study, the 95% confidence interval of the indirect effects was obtained with 5000 bootstrap samples [24]. Results confirmed the partial mediation was significant ($B = .162$, CI = .116 to .217). Therefore, the relationship between anxiety and sleep quality was significantly mediated by DBAS (Figure 2). Thus, Hypothesis 2 is supported.

### Further Examining the Mediating Role of the Four Subtypes of DBAS

We also examined the mediating role of each subtype of DBAS between depression/anxiety and sleep quality (Table 2) for the mediation analysis coefficients and the bootstrap test results. A series of mediation tests were conducted and results indicated that the relationship between depression/anxiety and sleep quality was significantly mediated by perceived consequences of insomnia, worry or helplessness of insomnia, and medication. However, sleep expectation was not a significant mediator between depression/anxiety and sleep quality.

### CONCLUSION

In the current study, we found that depression and sleep quality were significantly related to each other. The relationship between depression and sleep quality was mediated by dysfunctional beliefs and attitudes about sleep. As expected, we found that attitudes about sleep were correlated with sleep quality. Additionally, the relationship between anxiety and sleep quality was also mediated by dysfunctional beliefs and attitudes about sleep.

Findings in our study were consistent with previous research [10, 13, 25]. Kloss and colleagues found that maladaptive cognitions associated with depressive and anxiety disorders may further fuel the dysfunctional beliefs about sleep [25]. Ashworth and colleagues found that pain at night, dysfunctional beliefs about sleep, and depression were significant predictors of sleep quality [10]. Interestingly, Brand and colleagues found that depressive disorders are more strongly associated with dysfunctional beliefs in women than in men [13]. While gender differences were not a focus in our current study, post hoc analysis of our data indicated that there were no gender differences in the relationship between depression and dysfunctional beliefs (male: $r(120) = .44$, $p < .001$; female: $r(268) = .40$, $p < .001$; $z = .42$, $p = .67$).

Measuring dysfunctional beliefs and attitudes about sleep through the DBAS-16 has been a focal point in several studies [25–28]. However, these previous studies had not directly
examined the mediating role of dysfunctional beliefs about sleep in the relationship between depression/anxiety and sleep quality in the general population. Our research has established such mediating effects. Based on our data, dysfunctional beliefs and attitudes about sleep are potential mechanisms by which depressive and anxiety disorders may lead to poor sleep quality. Further, the three subtypes of DBAS (i.e., perceived consequences of insomnia, worry or helplessness of insomnia, and medication) each significantly mediated the effect of depression and anxiety on sleep quality. A possible explanation could be that symptoms of depression and anxiety are associated with more dysfunctional beliefs about sleep in the areas of perceived consequences, worries, and using medication for insomnia. Those dysfunctional beliefs could be potentially associated with more negative emotions toward sleep (e.g., worry, concerns, anxious) and poorer sleep hygiene, thus resulting in poor sleep quality.

Many items on the PSQI relate to insomnia symptomatology. According to the DSM-5, insomnia disorder can be diagnosed as an independent condition or as a comorbid condition with another mental disorder or medical condition, and dysfunctional sleep-related cognitions are considered to be associated features supporting a diagnosis of insomnia disorder[6]. Reduction of such beliefs is important in the treatment of insomnia. Manber et al. had proposed for the addition of cognitive behavioral therapy (CBT) for insomnia to be included in the behavioral therapy for depressive disorders to alleviate both conditions [29]. Previous studies have demonstrated that dysfunctional sleep related cognitions are more likely to improve with belief targeted CBT for insomnia than pharmacotherapy or non-belief targeted CBT [4]. Carney et al. had also proposed for the addition of cognitive and psycho-educational modules about sleep to the belief targeted CBT [4].

Even though PSQI is good in discriminating poor sleepers and good sleepers, it assesses the sleep quality in general and does not assess the narrowly defined insomnia symptoms, which can lead to an overestimation of residual insomnia [4]. Future research can specifically examine insomnia symptomatology. It should also be pointed out that the PSQI items also have some overlap with depressive symptoms. Sleep quality, along with depression and anxiety related symptoms, can vary over time. Following participants over time would give us a better picture of the evolving relationship among these variables. As with any non-experimental research design, the results presented are correlative and a clear cause and effect cannot be established.

The mediation-models presented here are based on a theoretical understanding of the literature and the supporting data analysis. However, this model is likely in need of further elaboration. For example, our study found DBAS partially instead of fully mediates the effects of depression and anxiety on sleep quality. DBAS only explained 26% of variance in PSQI. Thus, other mediators, such as other cognitive measures or demographic variables, could be further examined. We explored other possible mediators, such as age, and we found that age is a significant mediator in the relationship between anxiety and PSQI; whereas, age is not a significant mediator in the effect of depression on PSQI. In addition, the current study does not have objective sleep measures of sleep quality (e.g., polysomnography or actigraphy), and self-reported surveys are susceptible to expectation bias [4].

Future studies could utilize clinical interviews. Additionally, a disproportionate number of females participated in the study. Future research could aim for a more balanced respondent sample.

This study adds to the previous reports that poor sleep quality is problematic for people suffering from anxiety and depressive symptoms. This study highlights the importance of maladaptive sleep beliefs as significant mediators between mood and sleep quality. Incorporating effective insomnia treatments, particularly those targeting dysfunctional beliefs about sleep into CBT for depressive and anxiety disorders might improve patients’ sleep quality in context of mood disorders.

Table 2: Mediation Analysis Using Each of the Four Subtypes of DBAS as Mediator Variable, Depression and Anxiety as Predictor Variable, and PSQI as Criterion Variable.

<table>
<thead>
<tr>
<th>Mediators</th>
<th>Mean(SD)</th>
<th>Predictors</th>
<th>a path</th>
<th>b path</th>
<th>c path</th>
<th>c' path</th>
<th>Bootstrap Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consequences</td>
<td>24.85(11.06)</td>
<td>Depression</td>
<td>.05(SE)</td>
<td>.07(SE)</td>
<td>.54(SE)</td>
<td>.48(SE)</td>
<td>.06(.035, .096)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Anxiety</td>
<td>.92(SE)</td>
<td>.08(SE)</td>
<td>.42(SE)</td>
<td>.35(SE)</td>
<td>.07(.042, 1.111)</td>
</tr>
<tr>
<td>Worry</td>
<td>24.83(14.72)</td>
<td>Depression</td>
<td>1.70(SE)</td>
<td>.11(SE)</td>
<td>.54(SE)</td>
<td>.34(SE)</td>
<td>.20(.147, 2.57)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Anxiety</td>
<td>.70(SE)</td>
<td>.13(SE)</td>
<td>.42(SE)</td>
<td>.20(SE)</td>
<td>.22(.172, 2.79)</td>
</tr>
<tr>
<td>Expectation</td>
<td>12.51(5.20)</td>
<td>Depression</td>
<td>-.05(SE)</td>
<td>.57(SE)</td>
<td>.54(SE)</td>
<td>.54(SE)</td>
<td>.0008(-.002, .013)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Anxiety</td>
<td>.08(SE)</td>
<td>.09</td>
<td>.42(SE)</td>
<td>.42(SE)</td>
<td>-.005(-.019, .001)</td>
</tr>
<tr>
<td>Medication</td>
<td>10.41(7.20)</td>
<td>Depression</td>
<td>.61(SE)</td>
<td>.15(SE)</td>
<td>.54(SE)</td>
<td>.45(SE)</td>
<td>.09(.056, .135)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Anxiety</td>
<td>.62(SE)</td>
<td>.16(SE)</td>
<td>.42(SE)</td>
<td>.32(SE)</td>
<td>.10(.064, .152)</td>
</tr>
</tbody>
</table>

Abbreviations: CI: Confidence Interval; DBAS: Dysfunctional Beliefs and Attitudes about Sleep; PSQI: Pittsburgh Sleep Quality Index; SD: Standard Deviation.

Note: a path indicates the effect of predictor variable on the mediator variable; b path indicates the effect of the mediator variable on the criterion variable, after controlling for the predictor variable; c path indicates the effect of the predictor variable on the criterion variable; c’ path indicates the effect of the predictor variable on the criterion variable, after controlling for the mediator variable.
REFERENCES


