

Sleep Quality as a Mediator of Binge Eating in Seasonal Affective Disorder

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Abstract

Given the comorbidity of seasonal affective disorder (SAD) and binge eating disorder (BED), identifying common causal factors or mechanisms explaining the comorbidity might help in determining a treatment target to improve both disorders. This study assessed sleep quality and binge eating symptoms in those with SAD, and tested whether sleep quality mediates the relationship between SAD and binge eating. Although SAD severity was a significant predictor of both binge eating symptoms and poor sleep quality, no effects of mediation were found from sleep quality on the relationship between SAD severity and binge eating symptoms. Future research should continue to investigate potential mediators in order to identify an effective treatment target to combat the prevalence of two highly comorbid psychopathologies.

Keywords: seasonal affective disorder, binge eating disorder, sleep

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Seasonal affective disorder (SAD) affects 0% to 9.7% of the population varying with latitudes, and binge eating disorder (BED) affects roughly 2.8% of the population (Magnusson, 2000; Hudson, Hiripi, Pope, & Kessler, 2007). These two disorders show a high comorbidity rate with 8.9% of individuals with SAD meeting full diagnostic criteria for BED, indicating that identifying a factor that mediates the relationship could be essential to developing effective treatment (Donofry, Roecklein, Rohan, Wildes, & Kamarck, 2014). Previous studies show that a commonality in the symptoms for both of these is a correlation with poor sleep quality, suggesting that sleep quality might be a target for intervention. The current study aims to test whether poor sleep quality serves to mediate the correlation of symptoms between SAD and BED.

Seasonal affective disorder is a specifier of major depressive disorder (MDD) in which the depressive symptoms occur at the same time each year, in the fall or winter, and remit in the spring or summer months (Rosenthal et al., 1984). It is often characterized by anhedonia, hypersomnia, and an increase in appetite. Binge eating disorder is defined by eating a definitively greater amount of food in a given time than what most people would under similar circumstances, feeling a loss of control and marked distress during the episode (DSM-V, APA 2015). The association between SAD and BED is evident, as they share many symptoms, such as binge eating, carbohydrate craving, and negative mood (Rosenthal, Carpenter, & James, 1987). Notably, in one study, 26.5% of those in a SAD sample reported binge eating and 30% of those in a BED sample reported a decline in their mood with the seasons (Donofry, Roecklein, Rohan, Wildes, & Kamarck, 2014). Furthermore, data shows that food intake patterns in bulimia nervosa, a disorder characterized by binge eating, varies seasonally (Blouin et al., 1992). Given

the comorbidity of SAD and BED and the overlap in symptoms, variables explaining this comorbidity must be studied.

Emotion regulation deficits in those with BED likely contribute to the correlation between SAD and BED, accounting for some dysfunctional coping strategies. Previous studies find that in those with BED, negative mood serves as a reliable precursor to engaging in such behaviors (Wegner et al., 2002; Svaldi, Griepenstroh, Tuschen-Caffier, & Ehring, 2012). Identifying a factor that influences mood regulation as it pertains to BED and SAD, as well as influencing other symptoms of BED and SAD themselves, would provide a study target that could most likely and most accurately explain the comorbidities.

The association of poor sleep quality with these complications is clear. Sleep deprivation significantly worsens mood states, and negative mood is an important symptom of both seasonal affective disorder and binge eating disorder (Short & Louca, 2015). SAD is characterized by sleep disturbances, increased sleep latency, and hypersomnia, and data from studies on sleep and BED has also shown that those with BED have significantly lower sleep efficiency and more wakefulness during sleep (Rosenthal et al., 1984; Kaplan & Harvey, 2009; Harvey, 2011; Tzischinsky, Latzer, Epstein, & Tov 2000). Though these associations between SAD, BED, and poor sleep quality exist, there are currently no studies examining the interrelatedness of the three factors; specifically, whether sleep quality mediates the relationship between symptoms in SAD and BED. However, specific research is necessary to address theories to better understand the disorders and develop effective approaches to treatment.

This study aims to identify sleep quality as a mechanism of comorbidity between SAD and BED. It is possible that poor sleep could explain both eating and mood symptoms in SAD, in which case it is important to intervene on sleep habits to alleviate both of these types of

symptoms. Previous findings suggest associations between SAD symptoms, binge eating symptoms, and sleep quality. It is hypothesized that in adults with SAD, the strength of the association between SAD symptoms and binge eating severity symptoms will be moderated by poor sleep quality. If this hypothesis is supported, it may provide a treatment target and a possible intervention point for both mood and binge eating problems in those with SAD.

Methods

Participants

Participants ages 18-65 were recruited via community advertisements from the greater metropolitan area of Pittsburgh, Pennsylvania (Roecklein et al., 2013). This study was approved by the IRB at the University of Pittsburgh. Participants completed informed consent and were compensated for their time. All subjects included in the study were assigned a diagnosis of Major Depressive Disorder, With Seasonal Pattern in accordance with the Diagnostic and Statistical Manual of Mental Disorders (DSM-V, APA 2015). Diagnoses were based on the use of the Structured Clinical Interview for DSM-V (SCID-V-RV; First et al., 2015). All participants were assessed in fall or winter months during a SAD episode, with use of the Structured Interview Guide for the Hamilton Depression Rating Scale – Seasonal Affective Disorder Version (SIGH-SAD; Williams et al., 1992) confirming the current experience of a SAD episode. Participants with bipolar disorder, psychotic disorders, substance use disorders, somatic symptom disorders, anorexia nervosa, and PTSD were not included in this study.

Clinical Assessments

Structured Interview Guide for the Hamilton Depression Rating Scale – Seasonal Affective Disorder Version (SIGH-SAD)

This structured interview is used to measure symptom severity and changes of seasonal affective disorder, with a score greater than 20 indicating that those in the SAD group have sufficient symptoms to meet criteria for a current major depressive episode in SAD (Williams et al., 1992). This clinical assessment is used both as criteria to categorize individuals into the SAD diagnosis group of interest for this study, and to measure SAD symptom severity for analysis. Each SIGH-SAD is videotaped and rated by a second trained rater, increasing reliability of administration and scores from the first rater. Inter-rater reliability is high, with a .92-.97 intra-class correlation (Rohan et al., 2016).

Questionnaire of Eating and Weight Related Problems – Revised (QEWPR)

This self-report questionnaire is used to screen for eating disorders, including binge eating disorder, along with other milder forms of BED such as episodic over eating and binge eating syndrome. This questionnaire asks about behaviors and cognitions including gaining weight, overeating, feelings of lack of control, weight as influence of self-image, purging behaviors, and dieting patterns. It is used as a screener for anorexia nervosa, bulimia nervosa, binge eating disorder, and subclinical pathological eating behaviors. Scores from this measure indicating binge eating severity were used in the statistical analysis, and corresponding QEWPR diagnoses are reported in Table 1 (Yanovski, Marcus, Wadden, & Walsh, 2015). This assessment yields a sensitivity value of .74 and a specificity of .35 in the identification of BED, and test-retest reliability is adequate (Celio, Wilfley, Crow, Mitchell, & Walsh, 2004).

Pittsburgh Sleep Quality Index (PSQI)

This self-report questionnaire is used to identify participants' sleep characteristics over the course of the previous month at the time of assessment. It gathers information about subjective sleep quality via sleep latency, sleep duration, habitual sleep efficiency, sleep

disturbances, daytime dysfunction, and use of sleep medication. Higher scores on this questionnaire indicate higher sleep disturbance, and thus poorer sleep quality. Scores were assessed as a possible mediator for the relationship between SAD and BED symptoms. The PSQI is both reliable and valid in distinguishing good from poor sleepers. It demonstrates a high degree of internal consistency, with an overall reliability coefficient of 0.83, and a post hoc cutoff score of 5 yields a sensitivity of .90 and a specificity of .87 (Buysse, Reynolds, Monk, Berman, & Kupfer, 1988).

Analytic Plan

Prior to analyses, demographic variables of the sample were observed and are reported in Table 2, along with the means and standard deviations for each clinical measure. Sixteen participants who did not have a score on one or more of the measures used were excluded from the analyses. All analyses were conducted in SPSS Version 25 (IBM; Armonk, NY). Statistical significance was set at $p < 0.05$ for all analyses, and unstandardized beta correlation coefficients are reported.

To test whether sleep quality mediates the relationship between symptoms of seasonal affective disorder and binge eating disorder, Sobel's test for mediation was conducted, comparing the associations between SAD, BED, and sleep quality (Sobel, 1982). A beta value was calculated via linear regression analyses to examine the relationships between: SAD and binge eating symptoms (β^1); SAD symptoms and poor sleep quality (β^2); poor sleep quality and binge eating symptoms (β^3); and SAD and binge eating symptoms, controlling for poor sleep quality (β'). If the value of β' is less than β^1 , this will indicate that sleep quality mediates the relationship between SAD symptoms and binge eating symptoms. All beta values and their corresponding significance levels are illustrated in Figure 1.

Results

Mediation Analysis

SIGH-SAD total score was a significant predictor of the binge eating severity score above and beyond that predicted by the covariates of age and gender in Step 1 of the model ($\beta = .086, p = .013, 95\%CI (.018-.153), R^2 \text{ change} = .086$). SIGH-SAD total was also a significant predictor of PSQI total score above and beyond that predicted by covariates in Step 1 of the model ($\beta = .142, p = .019, 95\%CI .0(24-.260), R^2 \text{ change} = .075$). However, PSQI total score did not significantly predict binge eating severity ($\beta = .009, p = .895, 95\%CI (-.129-.148), R^2 \text{ change} = .000$). Regardless, the association between SIGH-SAD and binge eating severity, after controlling for PSQI, was significant ($\beta = 0.091, p = 0.012$). Therefore, a Sobel test was conducted to determine if significant mediation was present. After conducting the mediation analysis, it was determined that sleep quality did not significantly mediate the relationship between SAD symptoms and binge eating severity (*Sobel* $z = 0.130, p = 0.896$).

Post Hoc Analysis

A post hoc analysis was conducted for individuals with a binge eating severity score greater than 1, because above this threshold a positive correlation between PSQI total score and binge eating score appeared more evident (see Figure 2). SIGH-SAD total score remained a significant predictor of the binge eating severity score above and beyond that predicted by the covariates of age and gender in Step 1 of the model ($\beta = .059, p = .032, 95\%CI (.006-.112), R^2 \text{ change} = .121$). However, SIGH-SAD total score did remain a significant predictor of PSQI total score ($\beta = .081, p = .349, 95\%CI (-.094-.255), R^2 \text{ change} = .033$). Similarly, PSQI total score did not significantly predict binge eating severity ($\beta = .003, p = .965, 95\%CI (-.136-.143), R^2 \text{ change} = .000$). Although the association between SIGH-SAD and binge eating severity was significant

after controlling for PSQI ($\beta = .061, p = .033$), with no significant association between SIGH-SAD total score and PSQI total score, a Sobel test for mediation was not conducted.

Discussion

The present study aimed to test the relationships among seasonal affective disorder severity, binge eating severity, and sleep quality; specifically, whether sleep quality mediates the relationship between SAD and binge eating. As hypothesized and consistent with previous research, higher SAD symptom severity was a significant predictor of both increased binge eating severity and poorer sleep quality. While poor sleep quality did not have a significant association with binge eating, the association between SAD symptoms and binge eating remained significant after controlling for sleep quality. However, no significant mediation of sleep quality on the relationship between SAD and binge eating was found. With the basic regression hypotheses from SAD to BED and SAD to sleep quality supported, previous literature that characterizes poor eating and sleep habits as symptoms of SAD is substantiated. This further emphasizes that individuals with SAD may benefit from interventions that focus on sleep quality and binge eating to alleviate some of the unpleasant symptoms of SAD.

However, a notable aspect of the study's hypothesis was not supported, with no significant association between sleep quality and binge eating severity. A post-hoc analysis was conducted because an association between these two variables appeared more evident above a certain threshold of binge eating severity. Examining a scatterplot of these data suggested that the relationship deserved further investigation. However, this post-hoc analysis yielded no significant results. Part of this might be attributed to the small sample size available for the post-hoc ($n=28$), and future research with a larger sample size might provide more meaningful results.

The inaccuracy of self-reported measures of eating and sleep habits is also important limitations of this study. Self-report ratings might be influenced by response biases and mood, and thus are not always the most accurate means of measurement. Participants with greater symptom severity have a tendency to underreport their symptoms, which could lead to a lack of a significant correlation where one should be present. Because these associations are supported in previous literature, it would be beneficial to replicate this study using objective measures to improve the validity of the findings, perhaps yielding a significant correlation where one is not currently found.

Generalizability of this study should also be taken into account when drawing conclusions from these results. While the age included in the study ($M = 39.25$, $SD = 13.994$) is successful because it lies above the average age of onset of 27, other demographic variables such as gender and location are limited. While SAD affects more females than males, 83% of the participants in this study self-identified as female, which is greater than the general prevalence of females with a SAD diagnosis. Furthermore, use of a measure specific to the Pittsburgh area does not provide information regarding the relationship of these variables in individuals at different latitudes, which is known to be an important factor in the expression of SAD symptoms (Magnusson, 2000).

The results from this study provide important insight on the possible mechanisms that account for the comorbidity between SAD and BED. While poor sleep quality was not found to be a significant mediator of the relationship between SAD severity and binge eating severity, it remains important to identify a mediating variable to provide a treatment target. Background of this study identified the role of emotion regulation deficits in both disorders, hypothesizing that poor sleep quality influenced mood regulation as it pertains to SAD and BED. Although sleep

quality was not found to be a mediator, it is likely that another mechanism is responsible.

Perhaps the hormonal and neurochemical imbalances influenced by sleep deprivation are at the core of both types of psychopathology. Hormone levels such as a decrease in leptin and an increase in ghrelin are have known associations with both short sleep duration and weight regulation (Spiegel, Tasali, Penev, & Van Cauter, 2004), and neurotransmitters such as 5-HT (serotonin) that are responsible for mood regulation. Both leptin and ghrelin are knowingly affected by light input, leading to complications in those with SAD due to decreased daylight in fall and winter months, further indicating a correlation with neurochemical mechanisms (Rohan, Roecklein, & Haaga, 2009). Future research should examine the role of hormonal and neurochemical imbalances as a mediator of the association between SAD and binge eating severity, in a continued effort to identify a treatment target.

In conclusion, although the associations between SAD severity and poor sleep quality and SAD severity and binge eating severity were supported, the hypothesized mediation of sleep quality on the relationship between SAD and binge eating was not supported. It is necessary to further investigate possible factors that might serve as a mediating variable to develop novel treatments to alleviate symptoms of these two disorders with high comorbidity rates.

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Table 1

QEW P Scores and Diagnoses

Score	Diagnosis
1	Episodic Overeating
2	Binge Eating
3	Binge Eating Syndrome
4	Binge Eating Syndrome with Distress
5	Binge Eating Disorder

Table 2

Characteristics of the sample (n=72).

Variable	Mean	SD
Age (yrs)	39.25	13.994
Female – n (%)	60 (83.3%)	
SIGH-SAD	30.01	6.956
PSQI	7.58	3.471
Binge Eating Severity	1.65	1.951

Table 3

Characteristics of the sample (n=28).

Variable	Mean	SD
Age (yrs)	40.68	14.476
Female – n (%)	23 (82.1%)	
SIGH-SAD	31.18	7.587
PSQI	7.46	2.887
Binge Eating Severity	3.89	1.100

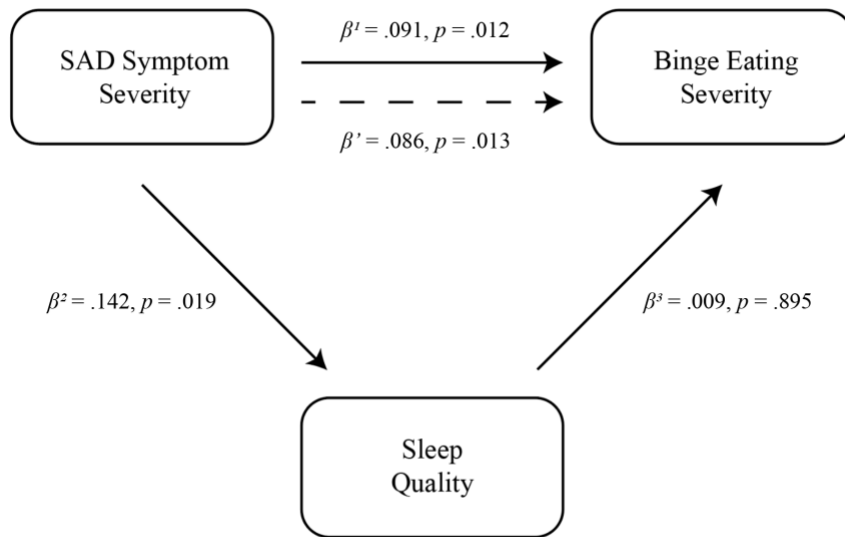


Figure 1. Beta values and significance levels for the relationships between the three variables of interest

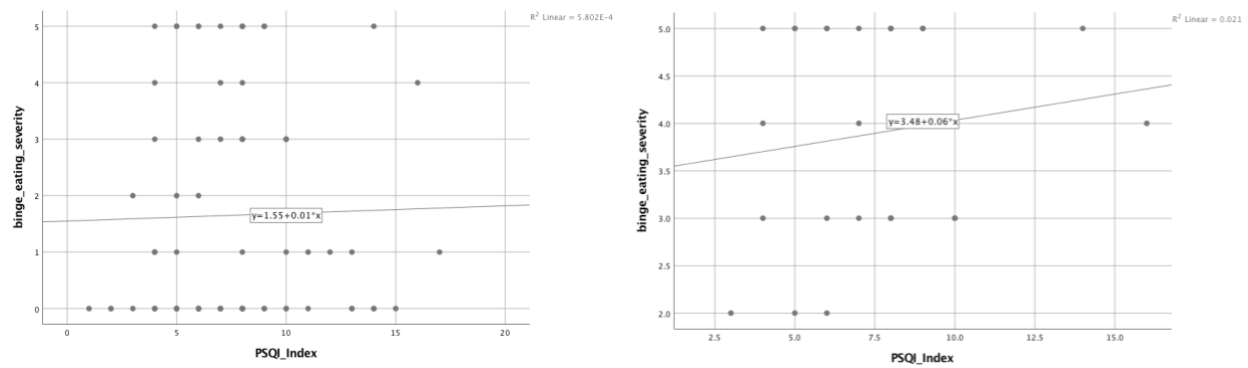


Figure 2. Relationship between PSQI Index and Binge Eating Severity scores for those included in the initial mediation analysis and the post hoc analysis, respectively