EXAMINATION OF SLEEP QUALITY AND ADHD SYMPTOMATOLOGY ON COLLEGE STUDENTS' ACADEMIC PERFORMANCE

by

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ABSTRACT

MICHELLE J. CHEN: Examination of Sleep Quality and ADHD Symptomatology on College Students' Academic Performance. (Under the direction of DR. GEORGE DEMAKIS)

College students frequently struggle to obtain a sufficient amount and quality of sleep. National Sleep Foundation (NSF) guidelines recommend that young adults aged 18 to 25 obtain 7 to 9 hours of sleep per night – a goal that less than 50% of students meet. Attention-Deficit/Hyperactivity Disorder (ADHD) is another growing area of interest, with prevalence rates estimated as high as 8%. Insufficient sleep and ADHD are independently associated with greater academic concerns and lower average GPAs. However, as poor sleep and ADHD are bidirectionally related, such that insufficient sleep is linked to increased ADHD symptoms and vice versa, these two factors may interact to create a compounding effect on academic performance. The current study sought to fill the gap in the literature regarding academic performance among college students by examining ADHD symptom subtypes and aspects of sleep quality as separate and combined predictors of students' GPA. Analyses revealed main effects of ADHD but not sleep on GPA. In addition, inattentive symptoms accounted for most of the variance observed in GPA. These results have implications for the importance of routine screening of college students for mental health disorders and sleep difficulties that significantly impact academic performance and student retention. Future research should include a wider range of factors known to affect academic performance, such as study skills and executive functioning.

DEDICATION

I would like to dedicate this thesis to the two most important people in my world: Alexis and Shawn. Thank you for your unconditional love and support.

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I would like to express my gratitude to my advisor, Dr. George Demakis for his guidance and support throughout this project. His patience, insight, and commitment have been invaluable in supporting my scholarly development. I would also like to thank my committee members, Dr. Jane Gaultney and Dr. LuAnn Jordan for their invaluable time and feedback. I would also like to thank my friends, family, and colleagues at UNC Charlotte for their support and encouragement over the course of this project. Lastly, I would like to express my gratitude to my past mentors who have contributed to my personal and professional development over the years, namely Dr. Antolin Llorente and Dr. Brian Allen.

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CHAPTER 1: INTRODUCTION

A frequent problem among college students is obtaining a sufficient amount and quality of sleep (Buboltz et al., 2001; Orzech et al., 2011). The National Sleep Foundation (NSF) guidelines recommend that young adults aged 18 to 25 obtain 7 to 9 hours of sleep per night (Hirshkowitz et al., 2015). However, data from over 50,000 undergraduate students at 98 schools collected by the American College Health Association National College Health Assessment (ACHA-NCHA-II, 2018) revealed that less than half of students reported getting enough sleep (7 hours) at least 3 to 5 days out of the last 7 days. Erratic sleeping schedules are also common, with college students sleeping less during the school/work week and more on the weekends (Gaultney, 2010; Lund et al., 2010). Overall, an estimated 60% of college students are characterized as "poor-quality sleepers" (Lund et al., 2010).

Sleep has substantial implications for academic performance due to its association with various cognitive functions. Specifically, insufficient sleep is linked to impairments in neurocognitive functions, especially those involving the prefrontal cortex (i.e., executive functioning; Lim & Dinges, 2010; Lowe et al., 2017). Accordingly, students reporting inadequate and/or insufficient amounts of sleep consistently perform more poorly in academics than healthy controls (e.g., Gilbert & Weaver, 2010; Gomes et al., 2011; Howell et al., 2004). A longitudinal study of over 3,500 U.S. college students between 2007 and 2012 revealed chronic sleep deprivation (obtaining insufficient sleep over an extended period) to be associated with lower GPA and graduation rates even after controlling for health variables such as smoking and exercise (Chen & Chen, 2019). Other research has found evidence to suggest that a quarter of college students are at risk

of at least one sleep disorder, with those at risk also more likely to have GPAs lower than 2.0 (Gaultney, 2010).

Another growing area of interest among college students is Attention-Deficit/ Hyperactivity Disorder (ADHD). Though previously considered a childhood disorder, recent research has demonstrated that symptoms of ADHD may appear in adolescence and persist into adulthood in up to 90% of childhood cases (Biederman et al., 2006; Faraone et al., 2000). Indeed, estimated prevalence rates are as high as 6% among first-year students (Eagan et al., 2017) and 8% among college students overall (DuPaul et al., 2009). ADHD has also been cited as one of the fastest-growing disability categories on college campuses (United States Government Accountability Office, 2009), with an estimated 25% of students utilizing disability services on campus receiving such services for ADHD (Wolf, 2001). This growing prevalence is a critical area of concern, as ADHD symptoms are strongly associated with academic achievement (Arnold et al., 2020) and psychological difficulties in college students (e.g., Weyandt & DuPaul, 2006; Weyandt et al., 2013). For example, students with ADHD tend to demonstrate significantly lowered GPAs (Gormley et al., 2019), higher rates of course withdrawal (Advokat et al., 2011), and a higher likelihood of dropout (Hechtman et al., 2016).

In a study of self-reported ADHD and college adjustment (N=3,379), Blasé et al. (2009) found that students with a current diagnosis of ADHD earn GPAs up to half a standard deviation below students with a past or past or no diagnosis. Frazier et al. (2007) found that college students with ADHD report greater academic performance concerns and lower average GPAs (M=2.87, SD=0.65). A longitudinal study examined students at three time points (i.e., cumulative high school, first semester, second semester), finding

GPAs significantly lower for students with ADHD at all three time points (Gormley et al., 2019). Moreover, while there are no significant differences in academic behavior (e.g., number of credits per semester, hours of study per week, studying habits), students with ADHD still obtain lower average GPAs (M=2.94, SD=0.43) compared to healthy controls (M=3.12; SD=0.49; Advokat et al., 2011). Differences in ADHD symptom subtypes have also been demonstrated. In a study of over 300 college students, Schwanz et al. (2007) found problems with attention to account for more variability in GPAs (7%) than hyperactivity (2%). However, it is important to note that symptoms of ADHD often present differently in adults – inattention tends to increase while hyperactivity and impulsivity decrease with age (Sobanski et al., 2008a, Volkow & Swanson, 2013, Wilens et al., 2009).

1.1 ADHD and Sleep

Individuals with ADHD are at increased risk for co-occurring conditions such as learning disabilities, sleep disorders, and mood disorders (e.g., Langer et al., 2019; Lin et al., 2016; Tsai et al., 2019). In particular, sleeping problems such as restless and disturbed sleep are common among children and adolescents diagnosed with ADHD (e.g., Cohen-Zion & Ancoli-Israel, 2004; Owens, 2006). Similarly, Adults with ADHD endorse sleep problems at higher rates than those without (Díaz-Román et al., 2018; Schredl et al., 2007). Such differences include longer sleep onset latency (taking longer to fall asleep) and night awakenings, poorer perceived sleep quality and efficiency (ratio of total sleep time to time in bed), and more sleep problems in general (Díaz-Román et al., 2018; Garbazza et al., 2018). The effects of sleep also appear to differ by ADHD symptom subtype. A recent study examined the association of sleep and ADHD symptoms with a

large sample of college students from six universities (N=7,626; Becker et al., 2018). Results suggested inattentive ADHD symptoms to be uniquely related to decreased perceived sleep quality and worse daytime functioning (due to increased sleepiness). In contrast, hyperactivity ADHD symptoms were more uniquely associated with better daytime functioning (due to decreased sleepiness) and increased sleep disturbances (having trouble sleeping due to factors such as feeling too hot or cold, snoring, and getting up to use the bathroom).

The most widely prescribed medications for ADHD are psychostimulants containing methylphenidate and amphetamine (Schneider & Enenbach, 2014). Although effective, commonly reported side effects of such medications include insomnia and other sleep-related problems. However, objective evidence generally does not support this claim, dependent upon the specific sleep parameters assessed (Snitselaar et al., 2017). For example, one study of medicated and unmedicated adults with ADHD actually suggested treatment with methylphenidate to be associated with increased sleep efficiency and a perception of increased restorative value of sleep (Sobanski et al., 2008b). Interestingly, unmedicated adults in the same study demonstrated increased nocturnal activity and awakenings, poorer sleep efficiency, and reduced time spent in REM sleep. However, another study found methylphenidate to be associated with decreased nocturnal awakenings and increased consolidated sleep, though it was also associated with delayed sleep onset and reduced sleep duration (Boonstra et al., 2007). A more recent study of outpatient adults with ADHD (n = 268) suggested that medication use is not associated with an increase in sleep problems and may even decrease cataplexy (a temporary loss of voluntary muscle tone associated with narcolepsy) occurrence (Bjorvatn et al., 2017).

These results collectively suggest that stimulant medication has varying effects on different sleep aspects (Snitselaar et al., 2017).

Perhaps most confusing to this picture is the finding that poor sleep and ADHD appear to have a bidirectional relationship; insufficient sleep has been linked to an increase in ADHD symptoms (Bolden et al., 2019; Konofal et al., 2010) and an increase in ADHD symptoms appear to worsen sleep problems (Wagner et al., 2004). Several explanations for this relationship have been proposed. One possibility is that sleep problems, such as difficulties with sleep onset and poorer sleep quality, occur partially because of behavioral issues associated with ADHD (Chervin et al., 2002). For instance, adults with ADHD may obtain less sleep simply because of poor time management (Weiss & Weiss, 2004).

On the other hand, sleep problems may contribute to ADHD symptomatology (Gau et al., 2007). Increased daytime sleepiness and behavioral issues that occur because of sleep problems may present as frequent shifts in attention and stimulus-seeking behaviors that mimic hyperactive and inattentive symptoms of ADHD. Research has provided evidence to support this hypothesis. For example, restless syndrome (RLS), a condition that causes an uncontrollable urge to move one's legs (National Institute of Neurological Disorders and Stroke, n.d.), is associated with sleep disturbances that cause inattentiveness and hyperactivity in children (Cortese et al., 2009). Additionally, sleep deprivation, sleep-disordered breathing, and circadian rhythm disorders are implicated as predictors of ADHD in children and adults (Um et al., 2017). Another notable study looking at the effects of tonsillectomies for sleep-disordered breathing in children found

that ADHD resolved itself one year later in 50% of cases resulting from treating the child's sleep problems (Chervin et al., 2006).

Lastly, the relationship between sleep and ADHD is posited to result from shared underlying physical and genetic factors. The central nervous system centers for sleep regulation overlap considerably with those responsible for attention and arousal (Owens, 2006). Additionally, certain insufficiencies in neurotransmitters, such as dopamine, are common factors found in both ADHD and sleep disorders, including RLS (Cortese et al., 2005). Curiously, iron deficiency has also been explored as a common underlying factor (Konofal et al., 2004). A randomized pilot trial of 23 children between the ages of 5 and 8 diagnosed with ADHD and low iron levels compared the effects of oral iron supplementation or placebo (Konofal et al., 2008). At the end of the 12-week trial, the severity of ADHD symptomatology decreased to a level comparable with the effects of stimulant medications within the experimental group.

1.2 The Present Study

The individual relations between sleep or daytime sleepiness and ADHD on academic functioning are well-supported within the existing literature. However, only two published studies have examined the possible interaction effects of sleep-related constructs and ADHD symptomatology on academic performance, and neither study produced a significant interaction. In Gaultney (2014), full-time first-year students (N=1,085) were assessed for risk of sleep disorders, daytime sleepiness, and disability status (i.e., a diagnosis of ADHD or learning disability). Although both ADHD diagnosis and risk for sleep disorder independently predicted a lower GPA, there was no observed interaction effect. Second, daytime sleepiness and academic functioning were examined

in undergraduate students (N=62) diagnosed with ADHD over a year by Langberg et al. (2014). Self-reported daytime sleepiness levels longitudinally predicted higher levels of school maladjustment, functional impairment, and the number of D and F grades received but not overall GPA. However, this association was stronger for students with GPAs of 2.0 or lower.

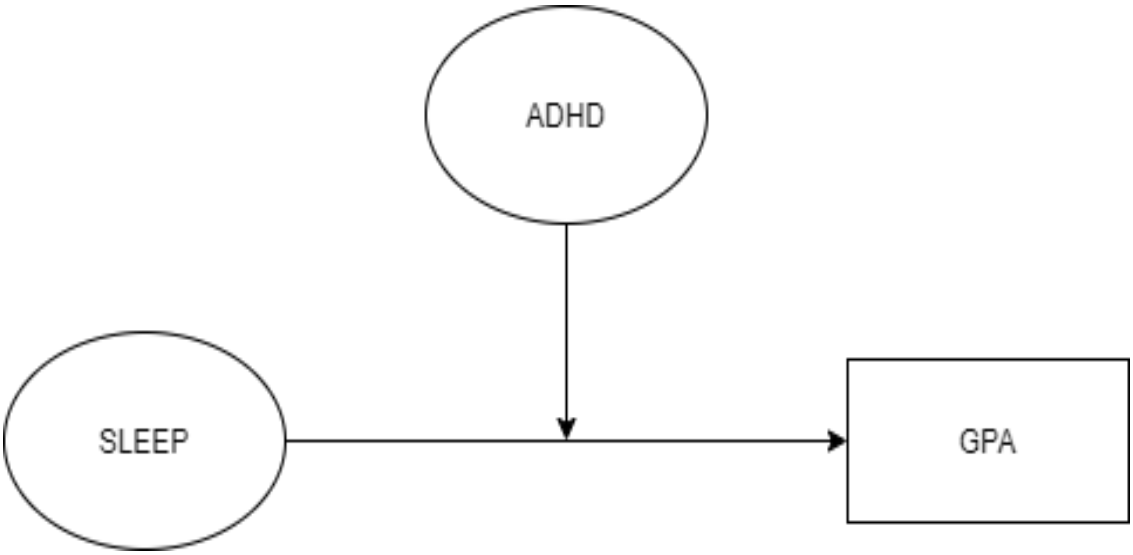
While interaction effects were not found in either study, it is essential to note that the constructs examined were the risk for sleep disorders or daytime sleepiness, which are outcomes of sleep rather than components of sleep. Existing literature has found evidence to support connections between aspects of sleep quality (e.g., sleep onset latency, sleep efficiency) and specific ADHD symptom types (Becker et al., 2018). Adults with ADHD more frequently endorse problems with delayed sleep onset latency, increased sleep disturbances, lower sleep quality, and lower sleep efficiency (Díaz-Román et al., 2018; Garbazza et al., 2018). More specifically, hyperactive, as opposed to inattentive or impulsive ADHD symptoms are more strongly associated with worse sleep quality and better daytime functioning. In contrast, inattentive, as opposed to hyperactive or impulsive symptoms of ADHD are more strongly associated with an increase in sleep disturbances and worse daytime functioning (Becker et al., 2018). As such, the possibility exists that academic performance may be differentially related to specific subcomponents of sleep quality (i.e., daytime functioning, perceived sleep quality, sleep disturbances) and ADHD symptom subtypes.

The present study hopes to fill this gap in the existing literature by investigating (1a) the independent associations of global sleep quality and overall ADHD symptomatology with academic performance and (1b) the association of global sleep

quality and ADHD on academic performance. Given the bidirectional relationship between ADHD and sleep (Bolden et al., 2019; Konofal et al., 2010; Wagner et al., 2004), the interaction of global sleep quality and ADHD symptomatology is expected to produce a synergistic effect beyond the individual main effects of each variable on academic performance. In other words, participants that endorse both poor global sleep quality and elevated levels of ADHD symptoms will have the lowest GPA. See Figure 1 for the proposed moderation analysis.

Figure 1

Proposed moderation analysis



Prior literature also suggests inattentive ADHD symptoms to be uniquely related to decreased sleep quality, worse daytime functioning (due to increased sleepiness), and hyperactive ADHD symptoms to be uniquely related to better daytime functioning (due to reduced sleepiness) and increased sleep disturbances (Becker et al., 2018). Thus, the following are hypothesized: (2a) perceived sleep quality will decrease more significantly with symptoms of inattention relative to symptoms of hyperactivity, and (2b) sleep disturbances will increase more significantly with symptoms of inattention relative to

symptoms of hyperactivity. Next, (3a) daytime functioning will be significantly and negatively associated with inattention, and (3b) significantly and positively associated with hyperactivity.

The association between ADHD and academic performance has also been found to vary as a function of symptom subtype. Problems with inattention account for more variability in college students' GPAs relative to hyperactivity (Schwanz et al., 2007). as ADHD presents itself differently in adults, with hyperactivity decreasing while inattentiveness, impulsivity, and restlessness remain problematic (Sobanski et al., 2008a, Volkow & Swanson, 2013, Wilens et al., 2009). Therefore, (4) inattention is expected to account for more variability in GPA, followed by hyperactivity and impulsivity.

CHAPTER 2: METHOD

2.1 Participants And Procedure

Three hundred participants were recruited through the Research Participation System at the University of North Carolina at Charlotte, SONA, which allows students to receive course credit as an incentive in return for their participation. Participants consisted of currently enrolled undergraduate students older than 18 in the Summer 2021 or Fall 2021 semester. However, students who completed the survey in Summer 2021 were not included in the final analyses as only data regarding Fall 2021 semester GPA could be obtained. Prior to receiving access to online study sign-ups, participants completed a pre-screener for SONA that included questions regarding exclusionary criteria, which included a history of head injury, seizures, other neurological disorders, and significant psychological disorders such as bipolar disorder, schizophrenia, and severe depression or anxiety. The survey was not viewable or accessible to those meeting any exclusionary criteria. Eligible and interested participants completed an online questionnaire containing five parts, including a demographics survey and the four self-report instruments listed below.

2.2 Measures

Sleep. Participants' perceptions of sleep quality were assessed using the Pittsburgh Sleep Quality Inventory (PSQI; Buysse et al., 1989). The PSQI is a self-report measure designed to assess sleep quality and disturbance retrospectively over the past month. The full measure includes 19 self-rated questions and five questions rated by the bed partner or roommate, if applicable. These collateral items are customarily used to collect additional clinical information and are not included in the total score; therefore,

only self-report items were used in this study. Completion of the PSQI yields seven component scores: perceived sleep quality, sleep latency (how long it takes to fall asleep), sleep duration, habitual sleep efficiency (percentage of time in bed asleep), sleep disturbance, use of sleeping medications, and daytime dysfunction (difficulty in staying awake and maintaining “enthusiasm to get things done.” , as well as a global sleep quality score calculated as the sum of component scores. It is important to note that the global sleep quality score is a comprehensive measure of overall sleep difficulties, while the component score of perceived sleep quality is the individual's subjective evaluation of how well they sleep. Each component is scored on a scale of 0 to 3. Global scores of 5 or less indicate "good-quality sleep," and scores higher than 5 indicate "poor-quality sleep." Only perceived sleep quality, daytime dysfunction, and sleep disturbances were analyzed in this study. A systematic review and meta-analysis of the use of PSQI among both non-clinical (healthy) and a variety of clinical populations (e.g., veterans with post-traumatic stress disorder [PTSD], cancer patients, participants with chronic fatigue syndrome, temporomandibular disorder) revealed good internal consistency (α = .70 to .83) and adequate test-retest reliability (intraclass correlation coefficient = .70 to .86). The PSQI also demonstrated excellent divergent validity (i.e., the results of this scale do not correlate significantly with other scales of different traits) and known-group validity (i.e., the scale is able to discriminate between two or more groups known to differ on the variable of interest; Mollayeva et al., 2015)

Mental Health. Participants' levels of depression were assessed using the Beck Depression Inventory – Second Edition (BDI-II; Beck et al., 1996). The BDI-II is a 21-item self-report measure designed to assess the severity of depressive symptoms in an

individual over the past two weeks. Completing the BDI-II requires approximately 5 to 10 minutes and is normed for individuals between the ages of 13 and 80. Each answer is scored on a scale value of 0 to 3, with total scores computed as the sum of all responses. Higher total scores on the BDI-II indicate higher levels of depression, and lower total scores indicate lower levels of depression. A comprehensive review of the psychometric properties of the BDI-II by Wang and Gorenstein (2013) demonstrated excellent internal consistency (α = .90) and good to excellent test-retest reliability (α = .73 to .96), as well as good sensitivity (α = .65 to .96) and adequate specificity (α = .56 to .92) across a wide range of clinical and non-clinical populations (e.g., outpatient/inpatient, participants with depression, epilepsy, stroke).

Participants' anxiety levels were assessed using the *Beck Anxiety Inventory (BAI*; Beck et al., 1988). The BAI is a 21-item self-report measure designed to assess the severity of anxiety in an individual over the past month. Completing the BAI requires approximately 5 to 10 minutes and is normed for individuals between the ages of 17 and 80. Each answer is scored on a scale value of 0 to 3, with total scores computed as the sum of all responses. Higher total scores on the BAI indicate higher levels of anxiety, and low scores indicate lower levels of anxiety. A meta-analysis of the BAI's psychometric properties among a range of non-clinical and clinical populations (e.g., outpatient/inpatient, undergraduates, adults with sleep apnea) revealed robust internal consistency (α = .91), adequate test-retest reliability (α = .65), as well as good mean sensitivity (α = .62) and specificity (α = .69) for diagnosis of anxiety using a cutoff score of 16 (Bardhoshi et al., 2016).

ADHD. Participants' overall endorsement of ADHD symptomatology was assessed using the Conner's Adult ADHD Rating Scale—Self Report: Short Version (CAARS-S:S; Conners et al., 1999). The CAARS-S:S is a 26-item self-report measure designed to assess for symptoms of attention deficit, hyperactivity, and impulsivity in adults based on DSM-IV criteria for ADHD. Completion of the CAARS-S:S yields five subscale scores: inattention/memory problems, hyperactivity/restlessness, impulsivity/emotional lability, problems with self-concept (e.g., self-esteem, quality of social relationships), and an overall ADHD index. There is also one inconsistency index designed to identify individuals who consistently exaggerate or fabricate symptoms. Participants who scored above the recommended cutoff of 8 were excluded from the final analyses (n=0). In addition, the CAAR-S:S is a gender-normed scale, thus precluding the inclusion of participants who did not identify a gender (n=3) or identified as non-binary (n=6). All subscales except problems with self-concept were analyzed in the current study. Internal consistency of this measure is robust and ranged from .81 (inattention/memory problems, hyperactivity/restlessness, impulsivity/emotional lability) to .88 (problems with self-concept) for men and from .80 (inattention/memory problems, impulsivity/emotional lability) to .85 (problems with self-concept) for women (Conners et al., 1999).

Academics. Participants' academic performance was assessed via their current semester GPA. Official records were obtained through UNCC's Office of Institutional Research and Decision Support (https://ir.charlotte.edu/) following the end of Fall 2021 on January 5th, 2022, in addition to self-reported GPAs collected at the time of survey completion.

CHAPTER 3: RESULTS

3.1 Data Screening

Cases were excluded if they were collected during Summer 2021 (*n*=45) or no formal reported GPA (*n*=7). Additionally, participants with no reported (*n*=3) or non-binary gender (*n*=6), incomplete surveys (n=9), or erroneous data (n=6; e.g., reported more than an average of 24 hours of actual sleep per night or invalid text responses such as “almost instantly,” and “Some days, 0 minutes, some days, 60 or 120 minutes,” and “often” to PSQI question 2: “During the past month, how long (in minutes) has it usually taken you to fall asleep each night?”) were also excluded. The final sample consisted of 224 students with a mean age of 19.36 years (*SD* =3.09). The majority of participants were predominantly female (*n*=130; 58.0%), White (*n*=129, 57.6%), and in their first year of college (*n*=107, 47.8%). Regarding formal diagnoses, 19 participants reported a formal current or prior diagnosis of ADHD, 3 reported a diagnosis of a specific learning disorder (SLD), 3 reported a sleep disorder diagnosis, and 3 reported having some combination of the above. Two individuals reported receiving services from the Office of Disability Services (ODS), one for ADHD and the other for disorders other than those listed above (i.e., gastrointestinal disease, hearing impairment). See Table 1 for a full breakdown of participant characteristics. Means, standard deviations, and intercorrelations among all included study variables are presented in Table 2.

Table 1
Participant demographics

Total Sample (N=224)	N	Range or %
Age	*M* = 19.36 *SD* = 3.09	18 – 50
Gender		
Male	94	42.0
Female	130	58.0
Race/Ethnicity		
White	129	57.6
Black or African American	27	12.1
Latinx	26	11.6
American Indian or Alaskan Native	1	0.4
Asian	32	14.3
Other	9	4.0
Year		
Freshman	107	47.8
Sophomore	82	36.6
Junior	22	9.8
Senior +	13	5.8
Formal Diagnosis		
None	196	87.5
ADHD	19	8.5
SLD	3	1.3
Sleep Disorder	3	1.3
Multiple	3	1.3

Note: Percentages may not total 100% due to rounding. ADHD = Attention Deficit, Hyperactivity Disorder; SLD = Specific Learning Disorder.

Table 2

Descriptive statistics and correlations for all study variables

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9	10
1. GPA	3.24	.70	--									
2. Anxiety (BAI)	12.50	11.44	-0.05	--								
3. Depression (BDI)	14.33	10.63	-.17*	.61**	--							
4. Subjective Sleep Quality (PSQI)	1.22	.65	-0.05	.29**	.44**	--						
5. Sleep Disturbances (PSQI)	1.14	0.56	-0.48	.49**	.37**	.32**	--					
6. Daytime Dysfunction (PSQI)	1.17	0.75	-0.12	.48**	.64**	.41**	.26**	--				
7. Global Sleep Quality (PSQI)	7.31	3.60	-0.12	.51**	.59**	.69**	.50**	.58**	--			
8. Inattention/Memory Problems (CAARS)	63.68	12.00	-.28**	.44**	.57**	.31**	.22**	.43**	.42**	--		
9. Hyperactivity/Restlessness (CAARS)	63.13	10.44	-.14*	.41**	.50**	.30**	.33**	.38**	.40**	.67**	--	
10. Impulsivity/Emotional Lability (CAARS)	60.18	8.12	-.17*	.44**	.43**	.22**	.31**	.33**	.35**	.54**	.49**	--
11. ADHD Index (CAARS)	58.36	8.04	-.24**	.42**	.53**	.30**	.30**	.40**	.38**	.76**	.73**	.68**

Note: $^{*}p < .05$. $^{**}p < .01$. BDI = Beck Depression Inventory; BAI = Beck Anxiety Inventory; CAARS = Conner's Adult ADHD Rating Scale; PSQI = Pittsburgh Sleep Quality Inventory. $N = 224$.

3.2 Preliminary Analyses

Academics. The mean official GPA was for the total sample 3.24 (*SD*=0.70), with 118 students providing self-reported GPAs with a mean of 3.45 (*SD*=0.51). Official and self-reported GPAs were significantly correlated (*r*=0.60, *p*<.001), but paired-samples t-tests revealed significant differences between official and self-reported GPAs ($t(223) = -14.16$, $p<.001$).

Sleep variables. Nearly 65% of students (n=146) were categorized as "poor-quality" sleepers using a PSQI cutoff score of greater than or equal to 5. The average hours slept during the week and weekend were 6.82 (*SD*=1.22) and 8.29 (*SD*=1.47), respectively.

ADHD variables. Based on categories of ranges presented in the CAARS test manual, participants endorsed an “above average” level of inattention/memory problems (*M*=63.68, *SD*=12.00) and hyperactivity/restlessness (*M*=63.13, *SD*=10.44). Impulsivity/emotional lability symptoms fell in the “slightly above average” range (*M*=60.18, *SD*=8.12), and the mean overall ADHD index score fell in the “average” range (*M*=58.36, *SD*=8.04).

Depression and Anxiety. Based on ranges developed for the BDI-II and BAI (Beck et al., 1996, Beck et al., 1998), participants endorsed mild levels of depression (*M*=12.49, *SD*=11.44) and anxiety (*M*=14.33, *SD*=10.63).

3.3 Primary Analyses

Hypothesis 1: A four-step hierarchical entry multiple regression analysis with GPA as the predicted variable was run to assess both parts of hypothesis one. Primary predictors were centered (CAARS ADHD Index and PSQI Global Sleep Quality), and an interaction

term for ADHD Index and Global Sleep Quality was computed based upon these centered variables. In the first step, centered covariates, depression and anxiety, were input as control variables, as both ADHD and sleep disorders are associated with higher psychiatric comorbidities rates (Baglioni et al., 2016; Klassen et al., 2009). Centered PSQI global sleep quality and CAARS ADHD index were then entered separately on the second and third steps, respectively, followed by the interaction of PSQI global sleep quality and CAARS ADHD on the fourth step (Weiss & Weiss, 2004). See Table 3 for a summary of the first hierarchical regression.

Results revealed partial support for Hypothesis 1a such that, when controlling for depression and anxiety, independent main effects on GPA were demonstrated by the CAARS ADHD Index (R^2=.07, ΔR^2=.04, F(1, 220)=8.45, p=.004), but not PSQI Global Sleep Quality (R^2=.07, ΔR^2=.001, F(1, 219)=0.18, p=.67). Moreover, no significant interaction effects (R^2=.07, ΔR^2=.004, F(1, 218)=.86, p=.36) were observed, precluding support for Hypothesis 1b.

Table 3

Summary of First Hierarchical Multiple Regression Results (*Outcome variable: GPA)*

Predictors		*b*	*S.E.*	*β*	R^2	ΔR^2
					.03	.03*
Step 1	Depression (BDI)*	-0.014	0.006	-0.218		
	Anxiety (BAI)	0.005	0.005	0.082		
					.07	.04*
Step 2	Depression (BDI)	-0.008	0.006	-0.117		
	Anxiety (BAI)	0.007	0.005	0.114		
	ADHD Index (CAARS)*	-0.02	0.007	-0.226		
					.07	.001
	Depression (BDI)	-0.007	0.006	-0.103		
Step 3	Anxiety (BAI)	0.008	0.005	0.122		
	ADHD Index (CAARS)*	-0.019	0.007	-0.223		
	Global Sleep Quality (PSQI)	-0.007	0.016	-0.036		
					.07	.004
	Depression (BDI)	-0.006	0.006	-0.09		
Step 4	Anxiety (BAI)	0.008	0.005	0.124		
	ADHD Index (CAARS)*	-0.02	0.007	-0.233		
	Global Sleep Quality (PSQI)	-0.007	0.016	-0.037		
	PSQIxCAARS	-0.001	0.001	-0.061		

Note. N = 253. **p<.05*. All variables were mean-centered, and the interaction term was calculated based on centered variables. BDI = Beck Depression Inventory; BAI = Beck Anxiety Inventory; CAARS = Conner's Adult ADHD Rating Scale; PSQI = Pittsburgh Sleep Quality Inventory; *b* = unstandardized regression coefficient; *S.E.* = standard error of the unstandardized coefficient; *β* = standardized regression coefficient.

Hypothesis 2: The secondary goals of this study were to compare the strength of correlations between perceived sleep quality, sleep disturbances, inattentive ADHD symptoms, and hyperactive ADHD symptoms. Fisher *r*-to-*Z*-Transformations were utilized to test the significance of the difference between the correlation coefficients (Silver & Dunlap, 1987; Weiss, 2011). Results did not provide support for either 2a or 2b such that there were no significant differences between the strength of correlations of perceived sleep quality and inattentive (r=.31) or hyperactive (r=.30) ADHD symptoms (z = 0.12, p=.92), or between sleep disturbances and inattentive (r=.22) and hyperactive (r=.33) ADHD symptoms (z = 0.58, p=.57).

Two follow-up regression analyses were conducted to explore this finding further, with component scales of subjective sleep quality and sleep disturbances (both centered) as outcomes and depression and anxiety entered as covariates. Results of the first analysis revealed that neither inattention (R^2=.2, ΔR^2=.005, F(1, 220)=1.44, p=0.23) nor hyperactivity (R^2=.2, ΔR^2=.004, F(1, 219)=1.06, p=0.30) were significant predictors of subjective sleep quality. However, hyperactivity was a significant predictor of sleep disturbances (R^2=.28, ΔR^2=.024, F(1, 219)=7.27, p=0.01). Inattention remained a nonsignificant predictor of sleep disturbances (R^2=.25, ΔR^2=.001, F(1, 220)=0.27, p=0.55).

Hypothesis 3: The tertiary goals of this study were examined via partial correlations of the association of daytime functioning with inattention/memory and hyperactivity/restlessness and were conducted using partial correlations. The first partial correlation was utilized to determine the relationship between daytime functioning as measured via PSQI and inattentive ADHD symptoms while controlling for depression,

anxiety, and hyperactive and impulsive symptoms of ADHD. A second partial correlation was utilized to determine the relationship between daytime functioning and hyperactive ADHD symptoms while controlling for depression, anxiety, and inattentive and impulsive symptoms of ADHD. While daytime dysfunction was indeed positively correlated with inattention, results ultimately did not support either hypothesis 3a (r=.09, p=.21) or 3b (r=.07, p=.29).

Hypothesis 4: A second hierarchical multiple regression was run with GPA as the dependent variable to examine the final hypothesis. All variables were centered. In the first step, depression and anxiety were input as covariates. Next, ADHD subscales were input on separate steps in the hypothesized order (i.e., inattention, hyperactivity, impulsivity). Results provided support for this hypothesis such that, when controlling for depression and anxiety, inattention was found to account for around 6% of the variance in reported GPA (R^2=.09, ΔR^2=.06, F(1, 220)=14.11, p<.001). Hyperactivity and impulsivity accounted for an additional 0.4% (R^2=.9, ΔR^2=.004, F(1, 219)=0.86, p=0.36), and 0.2% (R^2=.097, ΔR^2=.002, F(1, 218)=0.59) of the variance in GPA, respectively. See Table 4 for a summary of the second hierarchical regression.

Table 4

Summary of Second Hierarchical Multiple Regression Results (Outcome variable: GPA)

Predictors		*B*	*S.E.*	*β*	R^2	ΔR^2
					.03	.03*
Step 1	Depression (BDI)*	-0.014	0.006	-0.218		
	Anxiety (BAI)	0.005	0.005	0.082		
					.09	.06**
	Depression (BDI)	-0.005	0.006	-0.078		
Step 2	Anxiety (BAI)	0.008	0.005	0.127		
	Inattention/Memory Problems (CAARS)*	-0.017	0.005	-0.296		
					.09	.004
	Depression (BDI)	-0.006	0.006	-0.089		
Step 3	Anxiety (BAI)	0.007	0.005	0.120		
	Inattention/Memory Problems (CAARS)*	-0.020	0.005	-0.341		
	Hyperactivity/Restlessness (CAARS)	0.006	0.006	0.082		
					.10	.002
	Depression (BDI)	-0.006	0.006	-0.086		
Step 4	Anxiety (BAI)	0.008	0.005	0.132		
	Inattention/Memory Problems (CAARS)*	-0.019	0.006	-0.322		
	Hyperactivity/Restlessness (CAARS)	0.006	0.006	0.093		
	Impulsivity/Emotional Lability (CAARS)	-0.005	0.007	-0.062		

Note. $N = 253$. *$p<.05$. All variables were mean-centered. BDI = Beck Depression Inventory; BAI = Beck Anxiety Inventory; CAARS = Conner's Adult ADHD Rating Scale; *b* = unstandardized regression coefficient; *S.E.* = standard error of the unstandardized coefficient; *β* = standardized regression coefficient.

CHAPTER 4: DISCUSSION

Although previous research has found evidence to support independent links between ADHD, sleep, and academic performance (e.g., Gormley et al., 2019), including a bidirectional relationship between aspects of sleep quality (e.g., sleep onset latency, sleep efficiency; Becker et al., 2018) and ADHD symptom types, few studies have examined the possibility of an interaction effect of ADHD and sleep on academic functioning. The only two studies that have explored this possibility examined sleep outcomes, including risk for sleep disorders (Gaultney, 2014) and daytime sleepiness (Langberg et al., 2014), rather than specific components of sleep or ADHD symptom type. The current study sought to fill this gap by examining ADHD symptom subtypes and aspects of sleep quality as separate and combined predictors of students' GPA.

While a number of hypotheses were formed regarding the interrelationship of ADHD symptoms, sleep, and academic functioning, only two were supported or partially supported. First, ADHD symptoms, but not sleep or the interaction of ADHD and sleep were significant predictors of GPA. Second, after controlling for depression and anxiety, only inattentive/memory symptoms of ADHD were significant predictors of GPA. Additional post-hoc analyses indicated that hyperactive/restless symptoms of ADHD predicted sleep disturbances but not subjective sleep quality. Several potential explanations for these findings are discussed below.

First and foremost, the most notable outcome of this study was that the hypothesis regarding the differential impact of ADHD symptom subtypes on academic performance was supported. Inattentive symptoms were most predictive of GPA (Schwanz et al., 2007). While this may be partially attributed to the varying presentation of ADHD in

adults relative to children (i.e., increased inattention and impulsivity and decreased hyperactivity; Volkow & Swanson, 2013), similar outcomes have been found in the child and adolescent ADHD literature (Gray et al., 2017; Tan et al., 2022). In a qualitative review synthesis of 27 articles examining preschool and elementary school children, higher levels of teacher-reported inattentive behavior were associated with lower levels of standardized test scores and teacher-rated classroom performance (Gray et al., 2017). A more recent series of studies on school-age children in China found similar results, with inattentive behaviors accounting for a similar amount of variance in academic performance as inattention and hyperactivity combined (Tan et al., 2022).

Indeed, as academic functioning is linked to differences in individual attributes, especially those most impacted by inattention (e.g., information processing capacity, study skills, learning strategies, and goal setting; Geller et al., 2018), inattentive symptoms of ADHD have stronger implications for academic performance than hyperactivity and impulsivity. A recent longitudinal study revealed that students with ADHD report less frequent and less effective use of study skill strategies and significantly lower GPAs (DuPaul et al., 2021). Other notable areas of weakness were found to include greater difficulties with motivation (e.g., self-discipline), time management, attitude (e.g., interest in academic success), academic anxiety, test strategies, and selecting main ideas (i.e., the ability to distinguish between critical and non-critical information).

Next, given the myriad research demonstrating links between impaired sleep and academic performance (e.g., Gomes et al., 2011), the finding that neither sleep nor the interaction of ADHD and sleep quality significantly predicted GPA was unexpected.

However, one potential explanation may be that previous research in this area has largely neglected to account for depression and anxiety, the former of which is significantly associated with sleep and sleep quality (e.g., Li et al., 2020). For instance, one of the few studies that assessed depression found that sleep quality was linked to lowered academic achievement only in non-depressed students (Gilbert & Weaver, 2010). The possibility thus exists that current research demonstrating links between sleep and academics may fail to acknowledge the impact of depression or other mental health variables in addition to sleep. Indeed, the National Comorbidity Survey found the prevalence of ADHD among adults with any depressive disorder was 22.6% (Kessler et al., 2006). Future research would benefit from examining this possibility.

Finally, post-hoc analyses revealed hyperactive symptoms of ADHD to be a significant predictor of sleep disturbances but not sleep quality. This. finding partially supports existing literature suggesting hyperactivity to be uniquely related to increased sleep disturbances (Becker et al., 2018). However, the overarching literature on the association between sleep quality and specific ADHD symptom subtypes is limited. The current finding does not align with the sole existing study demonstrating sleep duration, sleep efficiency, and sleep quality to be uniquely associated with hyperactive and impulsive symptoms (Mahajan et al., 2010). As such, no conclusions can be made at this time, though this may be an area of interest for future research.

4.1 Strengths, Limitations, and Future Directions

Several strengths aided the present study. First, while GPA is most frequently assessed via self-report, the inclusion of official GPA data allowed for a more accurate examination of academic functioning. Second, the current study included a diverse

sample roughly representative of the larger university community (UNC Charlotte Demographics & Diversity Report, 2021), though it is important to note that the sample consisted primarily of college students enrolled in psychology courses at a four-year institution. Preliminary research has found evidence to suggest symptoms of ADHD have differential impacts on academic performance dependent on course material. For example, in a recent study of 639 children diagnosed with ADHD, attention ability was found to predict performance in mathematics significantly but not language (Cheng et al., 2022). Another study found symptoms of ADHD to account for a significant amount of variance in reading and writing achievement, but not mathematics (NoackLeSage et al., 2019). The possibility thus exists that the overall impact of ADHD is greater for students enrolled in humanities courses, including psychology, as these are generally considered reading- and writing-intensive subjects.

The use of self-report measures of sleep and ADHD symptoms presented another challenge. Despite the anonymity of this survey, participants are still subject to response biases such as recall bias (due to incomplete or inaccurate memory recall) and respondent fatigue (resulting from the length of the survey). In addition, small but significant differences have been found between subjective (e.g., self-report) and objective (e.g., polysomnography, actigraphy) measures of sleep (Matthews et al., 2018). Polysomnograms (i.e., sleep studies) are generally considered the gold standard for sleep assessment and refer to a comprehensive procedure that often requires an overnight stay to evaluate a variety of physiological functions, including brain waves, heart rate, breathing, blood oxygen level, and eye and leg movements (Rundo & Downey, 2019). Actigraphy is a more accessible method that refers to activity-based sleep-wake

monitoring via small, computerized devices worn on the body (often in watch format; Sadeh, 2011). Polysomnography has been found to assess sleep duration as shorter by 20-30 minutes than subjective measures of sleep and longer by 7-20 minutes compared to actigraphy-assessed sleep within healthy adults (Matthews et al., 2018). Further, subjective sleep parameters tend to yield higher estimates of sleep onset latency, nighttime awakenings, daytime sleepiness, and significantly lowered sleep quality and sleep efficiency in adults with ADHD (Díaz-Román et al., 2018). Because college students were asked to retroactively self-report aspects of their sleep, the outcomes of the current study may not accurately reflect the true impacts of sleep and sleep quality on GPA.

Next, the current study did not account for caffeine consumption or stimulant medications, both commonly believed to improve cognition while simultaneously impairing sleep. Interestingly, while caffeine has been linked to decreased sleep quality (e.g., reduced sleep efficiency and total sleep time; Clark & Landolt, 2017), caffeine has also been shown to counteract the cognitive and physical impairments associated with acute sleep loss (Irwin et al., 2020). As for healthy controls, findings are mixed for both caffeine- (McLellan et al., 2016) and stimulant-induced improvements in cognition (Ilieva & Farah, 2019, Munro et al., 2017). Nonetheless, these elements are still important to consider as potential moderating factors.

As a final point, the researcher would be remiss to neglect the impact of COVID-19. While some restrictions were loosening at the time of this study (Fall 2021), these changes varied widely by state, county, and school, resulting in a mixture of classroom formats (i.e., virtual, face-to-face, hybrid) or an unexpected switch to virtual-only due to

the Delta variant (Golembeski, 2021). The differential impact of such classroom formats on academic and learning outcomes has yet to be seen and will likely vary according to individual characteristics (e.g., some students do better in distance education versus traditional classroom formats; El Said, 2021). Such cohort effects may have stronger impacts on students with ADHD, who often find it more difficult to sustain attention or maintain self-discipline without the structural support that a classroom offers.

Future research should rectify the limitations mentioned above by utilizing objective sleep and cognitive functioning measures and examining a wider range of variables, including study skills, mental health, caffeine, stimulant medication, choice of academic major, and class format. Prospective longitudinal studies could also help elucidate specific mechanisms underlying the associations between ADHD, sleep, and academic performance. For example, since executive functioning is implicated in both ADHD (DuPaul et al., 2021) and sleep (Lim & Dinges, 2010; Lowe et al., 2017), one fruitful avenue of research may be to examine executive functioning as a potential mediating factor between ADHD/sleep and academic performance.

More specifically, ADHD has previously been conceptualized as a disorder in which deficits in executive functioning are both a characteristic and causal factor (Nigg & Casey, 2005). This argument is supported by findings of diminished levels of executive functioning ability in both adults and children with ADHD (Boonstra et al., 2005; Woods et al., 2002). Moreover, self-reported levels of executive functioning were observed to be uniquely associated with symptoms of ADHD after controlling for sleep quality in a recent study of over 300 undergraduate students (Bolden et al., 2019). In another study, Gaultney et al. (2019) speculated that symptoms of ADHD may result

from sleep's influence on the functioning of the prefrontal cortex and downstream executive functions. Accordingly, findings from the current study support this position as main effects of ADHD but not sleep on GPA were observed. The possibility thus exists that ADHD and sleep are related to academic performance through their impact on executive functioning.

4.2 Summary and Implications

As academic performance is a known predictor of student withdrawal/retention, particularly for those in their first year (Ortiz-Lozano et al., 2020), the findings of this study have several implications for institutes of higher education. College is a crucial developmental period for young adults associated with increased independence and various new experiences, such as living away from home for the first time. Students often experience an abrupt loss of structure and an influx of new responsibilities related to self-management, for instance, structuring their own schedules and regulating their sleep/wake cycles (Arnett, 2000).

Unfortunately, due to the disorder's characteristic deficits in attention and executive functioning, this transition often proves particularly challenging for students with ADHD. Case in point, a recent study of college readiness in first-year undergraduates revealed that students with ADHD most often struggle with functional impairments in self-determination (e.g., managing one's daily schedule), life skills (e.g., difficulties with health behaviors related to personal hygiene, sleep, exercise, and nutrition), and academic readiness (e.g., having insufficient study skills; Canu et al., 2021). The impact of such struggles on academic performance can be seen in the plethora of research demonstrating associations between ADHD and (lowered) academic

achievement (see Arnold et al., 2020 for a review). Additionally, as previously discussed, students presenting with predominantly inattentive symptoms of ADHD are more likely to endorse less frequent and less effective use of study skill strategies and significantly lower GPAs (DuPaul et al., 2021).

In sum, the results of this study indicate that symptoms of ADHD (especially inattention) are important factors to consider in academic achievement. There are many evidence-based treatments available for both ADHD and sleep, including, but not limited to, pharmacology, such as stimulants and sleep medications, and psychotherapy, including cognitive-behavioral therapy. Such interventions have the potential to produce long-term effects on student outcomes and retention, in addition to overall health and quality of life. Institutes of higher learning would consequently benefit from early and routine screening of such difficulties and subsequent referral for treatment as appropriate.

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APPENDIX A: DEMOGRAPHIC QUESTIONS

1. How old are you?
2. What gender do you best identify with?
    - Male
    - Female
    - Non-binary/third gender
    - Prefer not to say
3. What race/ethnicity best describes you?
    - White
    - Black or African American
    - Latino/a
    - American Indian or Alaska Native
    - Asian
    - Native Hawaiian or Pacific Islander
    - Other
4. What is your current student status?
    - Freshman
    - Sophomore
    - Junior
    - Senior
    - Senior + (5^{th} year or higher)
5. What is your current overall GPA? Please give your best estimate or input 999 if unknown.
6. Are you formally diagnosed with any of the following? (select all that apply)
    - ☐ Specific learning disability in reading, math, or writing
    - ☐ Attention-Deficit, Hyperactivity Disorder (ADHD)
    - ☐ Sleep disorder (e.g., insomnia, obstructive sleep apnea)
    - ☐ None of the above
7. Do you currently receive services from UNCC's Office of Disability Services?
8. If yes, what do you receive services from UNCC's Office of Disability Services for?
    - ☐ Specific learning disability in reading, math, or writing
    - ☐ Attention-Deficit, Hyperactivity Disorder (ADHD)
    - ☐ Sleep disorder (e.g., insomnia, obstructive sleep apnea)
    - ☐ Other (please describe)
    - ☐ Not Applicable
9. How much sleep do you get on average (per night) during the school/work week?
10. How much sleep do you get on average (per night) during the weekend?

APPENDIX B: PITTSBURGH SLEEP QUALITY INVENTORY (PSQI)

PITTSBURGH SLEEP QUALITY INDEX (PSQI)

INSTRUCTIONS: The following questions relate to your usual sleep habits during the past month only. Your answers should indicate the most accurate reply for the majority of days and nights in the past month. Please answer all questions.

1. During the past month, when have you usually gone to bed at night?

   USUAL BED TIME _____

2. During the past month, how long (in minutes) has it usually take you to fall asleep each night?

   NUMBER OF MINUTES _____

3. During the past month, when have you usually gotten up in the morning?

   USUAL GETTING UP TIME _____

4. During the past month, how many hours of actual sleep did you get at night? (This may be different than the number of hours you spend in bed.)

   HOURS OF SLEEP PER NIGHT _____

INSTRUCTIONS: For each of the remaining questions, check the one best response. Please answer all questions.

5. During the past month, how often have you had trouble sleeping because you...

	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
(a) ...cannot get to sleep within 30 minutes	☐	☐	☐	☐
(b) ...wake up in the middle of the night or early morning	☐	☐	☐	☐
(c) ...have to get up to use the bathroom	☐	☐	☐	☐
(d ...cannot breathe comfortably	☐	☐	☐	☐
(e) ...cough or snore loudly	☐	☐	☐	☐
(f) ...feel too cold	☐	☐	☐	☐
(g) ...feel too hot	☐	☐	☐	☐
(h) ...had bad dreams	☐	☐	☐	☐
(i) ...have pain	☐	☐	☐	☐
(j) Other reason(s), please describe _____ _____				
How often during the past month have you had trouble sleeping because of this?	☐	☐	☐	☐

	Very good	Fairly good	Fairly bad	very bad
6. During the past month, how would you rate your sleep quality overall?	☐	☐	☐	☐

	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
7. During the past month, how often have you taken medicine (prescribed or "over the counter") to help you sleep?	☐	☐	☐	☐
8. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?	☐	☐	☐	☐

	No problem at all	Only a very slight problem	Somewhat of a problem	A very big problem
9. During the past month, how much of a problem has it been for you to keep up enough enthusiasm to get things done?	☐	☐	☐	☐

	No bed partner or roommate	Partner/ roommate in other room	Partner in same room, but not same bed	Partner in same bed
10. During the past month, how much of a problem has it been for you to keep up enough enthusiasm to get things done?	☐	☐	☐	☐

If you have a roommate or bed partner, ask him/her how often in the past month you have had...

	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
(a) ...loud snoring	☐	☐	☐	☐
(b) ...long pauses between breaths while asleep	☐	☐	☐	☐
(c) ...legs twitching or jerking while you sleep	☐	☐	☐	☐
(d) ...episodes of disorientation or confusion during sleep	☐	☐	☐	☐
(e) Other restlessness while you sleep; please describe	☐	☐	☐	☐

_____

_____

SCORING INSTRUCTIONS FOR THE PITTSBURGH SLEEP QUALITY INDEX:

The Pittsburgh Sleep Quality Index (PSQI) contains 19 self-rated questions and 5 questions rated by the bed partner or roommate (if one is available). Only self-rated questions are included in the scoring. The 19 self-rated items are combined to form seven "component" scores, each of which has a range of 0-3 points. In all cases, a score of "0" indicates no difficulty, while a score of "3" indicates severe difficulty. The seven component scores are then added to yield one "global" score, with a range of 0-21 points, "0" indicating no difficulty and "21 " indicating severe difficulties in all areas.

Scoring proceeds as follows:

Component 1: Subjective sleep quality

Examine question #6, and assign scores as follows:

Response	Component 1 score
"Very good"	0
"Fairly good"	1
"Fairly bad"	2
"Very bad"	3

Component 1 score:_____

Component 2: Sleep latency

1. Examine question #2, and assign scores as follows:

Respo\nse	Score
≤15 minutes	0
16-30 minutes	1
31-60 minutes	2
> 60 minutes	3
Question #2 score:	_____

2. Examine question #5a, and assign scores as follows:

Response	Score
Not during the past month	0
Less than once a week	1
Once or twice a week	2
Three or more times a week	3
Question #5a score:	_____

3. Add #2 score and #5a score

Sum of #2 and #5a: _____

4. Assign component 2 score as follows:

Sum of #2 and #5a	Component 2 score
0	0
1-2	1
3-4	2
5-6	3

Component 2 score:_____

Component 3: Sleep duration

Examine question #4, and assign scores as follows:

Response	Component 3 score
> 7 hours	0
6-7 hours	1
5-6 hours	2
< 5 hours	3

Component 3 score:_____

Component 4: Habitual sleep efficiency

1. Write the number of hours slept (question #4) here:_____
2. Calculate the number of hours spent in bed:

   Getting up time (question #3):_____

   Bedtime (question #1):_____

   _____

   *Number of hours spent in bed:*_____

3. Calculate habitual sleep efficiency as follows:

   (Number of hours slept/Number of hours spent in bed) X 100 = Habitual sleep efficiency (%)

   (_____/_____) X 100 = %

4. Assign component 4 score as follows:

Habitual sleep efficiency %	Component 4 score
> 85%	0
75-84%	1
65-74%	2
< 65%	3

Component 4 score:_____

Component 5: Step disturbances

1. Examine questions #5b-5j, and assign scores for each question as follows:

Response	Score
Not during the past month	0
Less than once a week	1
Once or twice a week	2
Three or more times a week	3

5b score: _____

5c score: _____

5d score: _____

5e score: _____

5f score: _____

5g score: _____

5h score: _____

5i score: _____

5j score: _____

2. Add the scores for questions #5b-5j:

Sum of #5b-5j: _____

3. Assign component 5 score as follows:

Sum of #5b-5j	Component 5 score
0	0
1-9	1
10-18-4	2
19-27	3

Component 5 score: _____

Component 6: Use of sleeping medication

Examine question #7 and assign scores as follows:

Response	Component 6 score
Not during the past month	0
Less than once a week	1
Once or twice a week	2
Three or more times a week	3

Component 6 score: _____

Component 7: Daytime dysfunction

1. Examine question #8, and assign scores as follows:

Response	Score
Never	0
Once or twice	1
Once or twice each week	2
Three or more times each week	3

Question#8 score: _____

2. Examine question #9, and assign scores as follows:

Response	Score
No problem at all	0
Only a very slight problem	1
Somewhat of a problem	2
A very big problem	3

Question #9 score: _____

3. Add the scores for question #8 and #9:

Sum of #8 and #9: _____

4. Assign component 7 score as follows:

Sum of #8 and #9	Component 7 score
0	0
1-2	1
3-4	2
5-6	3

Component 7 score: _____

Global PSQI Score

Add the seven component scores together:

Global PSQI Score: _____

APPENDIX C: BECK DEPRESSION INVENTORY – SECOND EDITION (BDI-II)

BDI-2

Date:

Name: _____ Marital Status: _____ Age: _____ Sex: _____

Occupation: _____ Education: _____

Instructions: This questionnaire consists of 21 groups of statements. Please read each group of statements carefully, and then pick out the **one statement** in each group that best describes the way you have been feeling during the **past two weeks, including today.** Circle the number beside the statement you have picked. If several statements in the group seem to apply equally well, circle the highest number for that group. Be sure that you do not choose more than one statement for any group, including Item 16 (Changes in Sleeping Pattern) or Item 18 (Changes in Appetite).

1. Sadness
- 0 I do not feel sad.
- 1 I feel sad much of the time.
- 2 I am sad all the time.
- 3 I am so sad or unhappy that I can't stand it.

2. Pessimism
- 0 I am not discouraged about my future.
- 1 I feel more discouraged about my future than I used to be.
- 2 I do not expect things to work out for me.
- 3 I feel my future is hopeless and will only get worse.

3. Past Failure
- 0 I do not feel like a failure.
- 1 I have failed more than I should have.
- 2 As I look back, I see a lot of failures.
- 3 I feel I am a total failure as a person.

4. Loss of Pleasure
- 0 I get as much pleasure as I ever did from the things I enjoy.
- 1 I don't enjoy things as much as I used to.
- 2 I get very little pleasure from the things I used to enjoy.
- 3 I can't get any pleasure from the things I used to enjoy.

5. Guilty Feelings
- 0 I don't feel particularly guilty.
- 1 I feel guilty over many things I have done or should have done.
- 2 I feel quite guilty most of the time.
- 3 I feel guilty all of the time.

6. Punishment Feelings
- 0 I don't feel I am being punished.
- 1 I feel I may be punished.
- 2 I expect to be punished.
- 3 I feel I am being punished.

7. Self-Dislike
- 0 I feel the same about myself as ever.
- 1 I have lost confidence in myself.
- 2 I am disappointed in myself.
- 3 I dislike myself.

8. Self-Criticalness
- 0 I don't criticize or blame myself more than usual.
- 1 I am more critical of myself than I used to be.
- 2 I criticize myself for all of my faults.
- 3 I blame myself for everything bad that happens.

9. Suicidal Thoughts or Wishes
- 0 I don't have any thoughts of killing myself.
- 1 I have thoughts of killing myself, but I would not carry them out.
- 2 I would like to kill myself.
- 3 I would kill myself if I had the chance.

10. Crying
- 0 I don't cry any more than I used to.
- 1 I cry more than I used to.
- 2 I cry over every little thing.
- 3 I feel like crying, but I can't.

_____ Subtotal Page 1 **Continued on Back**

11. Agitation

0 I am no more restless or wound up than usual.
1 I feel more restless or wound up than usual.
2 I am so restless or agitated that it's hard to stay still.
3 I am so restless or agitated that I have to keep moving or doing something.

12. Loss of Interest

0 I have not lost interest in other people or activities.
1 I am less interested in other people or things than before.
2 I have lost most of my interest in other people or things.
3 It's hard to get interested in anything.

13. Indecisiveness

0 I make decisions about as well as ever.
1 I find it more difficult to make decisions than usual.
2 I have much greater difficulty in making decisions than I used to.
3 I have trouble making any decisions.

14. Worthlessness

0 I do not feel I am worthless.
1 I don't consider myself as worthwhile and useful as I used to.
2 I feel more worthless as compared to other people.
3 I feel utterly worthless.

15. Loss of Energy

0 I have as much energy as ever.
1 I have less energy than I used to have.
2 I don't have enough energy to do very much.
3 I don't have enough energy to do anything.

16. Changes in Sleeping Pattern

0 I have not experienced any change in my sleeping pattern.
1a I sleep somewhat more than usual.
1b I sleep somewhat less than usual.
2a I sleep a lot more than usual.
2b I sleep a lot less than usual.
3a I sleep most of the day.
3b I wake up 1–2 hours early and can't get back to sleep.

17. Irritability

0 I am no more irritable than usual.
1 I am more irritable than usual.
2 I am much more irritable than usual.
3 I am irritable all the time.

18. Changes in Appetite

0 I have not experienced any change in my appetite.
1a My appetite is somewhat less than usual.
1b My appetite is somewhat greater than usual.
2a My appetite is much less than before.
2b My appetite is much greater than usual.
3a I have no appetite at all.
3b I crave food all the time.

19. Concentration Difficulty

0 I can concentrate as well as ever.
1 I can't concentrate as well as usual.
2 It's hard to keep my mind on anything for very long.
3 I find I can't concentrate on anything.

20. Tiredness or Fatigue

0 I am no more tired or fatigued than usual.
1 I get more tired or fatigued more easily than usual.
2 I am too tired or fatigued to do a lot of the things I used to do.
3 I am too tired or fatigued to do most of the things I used to do.

21. Loss of Interest in Sex

0 I have not noticed any recent change in my interest in sex.
1 I am less interested in sex than I used to be.
2 I am much less interested in sex now.
3 I have lost interest in sex completely.

_____ Subtotal Page 2
_____ Subtotal Page 1
_____ Total Score

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APPENDIX D: BECK ANXIETY INVENTORY (BAI)

BAI

NAME _____ DATE _____

Below is a list of common symptoms of anxiety. Please carefully read each item in the list. Indicate how much you have been bothered by each symptom during the PAST WEEK, INCLUDING TODAY, by placing an X in the corresponding space in the column next to each symptom.

	NOT AT ALL	MILDLY It did not bother me much.	MODERATELY It was very unpleasant, but I could stand it.	SEVERELY I could barely stand it.
1. Numbness or tingling.				
2. Feeling hot.				
3. Wobbliness in legs.				
4. Unable to relax.				
5. Fear of the worst happening.				
6. Dizzy or lightheaded.				
7. Heart pounding or racing.				
8. Unsteady.				
9. Terrified.				
10. Nervous.				
11. Feelings of choking.				
12. Hands trembling.				
13. Shaky.				
14. Fear of losing control.				
15. Difficulty breathing.				
16. Fear of dying.				
17. Scared.				
18. Indigestion or discomfort in abdomen.				
19. Faint.				
20. Face flushed.				
21. Sweating (not due to heat).				

APPENDIX E: CONNER'S ADULT ADHD RATING SCALE—SELF REPORT: SHORT VERSION (CAARS-S:S)

CAARS–Self-Report: Short Version (CAARS–S:S)

by C. K. Conners, Ph.D., D. Erhardt, Ph.D., & E. P. Sparrow, M.A.

Client ID: _____ **Gender:** M F (Circle One)

Birthdate: ___/___/___ (Month / Day / Year) **Age:** _____ **Today's Date:** ___/___/___ (Month / Day / Year)

Instructions: Listed below are items concerning behaviors or problems sometimes experienced by adults. Read each item carefully and decide how much or how frequently each item describes you recently. Indicate your response for each item by circling the number that corresponds to your choice. Use the following scale: 0 = Not at all, never; 1 = Just a little, once in a while; 2 = Pretty much, often; and 3 = Very much, very frequently.

	Not at all, never	Just a little, once in a while	Pretty much, often	Very much, very frequently
1. I interrupt others when talking.	0	1	2	3
2. I am always on the go as if driven by a motor.	0	1	2	3
3. I'm disorganized.	0	1	2	3
4. It's hard for me to stay in one place very long.	0	1	2	3
5. It's hard for me to keep track of several things at once.	0	1	2	3
6. I'm bored easily.	0	1	2	3
7. I have a short fuse/hot temper.	0	1	2	3
8. I still throw tantrums.	0	1	2	3
9. I avoid new challenges because I lack faith in my abilities.	0	1	2	3
10. I seek out fast paced, exciting activities.	0	1	2	3
11. I feel restless inside even if I am sitting still.	0	1	2	3
12. Things I hear or see distract me from what I'm doing.	0	1	2	3
13. Many things set me off easily.	0	1	2	3
14. I am an underachiever.	0	1	2	3
15. I get down on myself.	0	1	2	3
16. I act okay on the outside, but inside I'm unsure of myself.	0	1	2	3
17. I can't get things done unless there's an absolute deadline.	0	1	2	3
18. I have trouble getting started on a task.	0	1	2	3
19. I intrude on others' activities.	0	1	2	3
20. My moods are unpredictable.	0	1	2	3
21. I'm absent-minded in daily activities.	0	1	2	3
22. Sometimes my attention narrows so much that I'm oblivious to everything else; other times it's so broad that everything distracts me.	0	1	2	3
23. I tend to squirm or fidget.	0	1	2	3
24. I can't keep my mind on something unless it's really interesting.	0	1	2	3
25. I wish I had greater confidence in my abilities.	0	1	2	3
26. My past failures make it hard for me to believe in myself.	0	1	2	3