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**SLEEP AND ACADEMICS AMONG COLLEGE STUDENTS: ROLE OF  
EXECUTIVE FUNCTIONING AND SLEEP HYGIENE**

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SLEEP AND ACADEMICS AMONG COLLEGE STUDENTS: ROLE OF  
EXECUTIVE FUNCTIONING AND SLEEP HYGIENE

A dissertation submitted in partial fulfillment  
of the requirements for the degree of

DOCTOR OF PSYCHOLOGY

to the faculty of the

DEPARTMENT OF PSYCHOLOGY

of

ST. JOHN'S COLLEGE OF LIBERAL ARTS AND SCIENCES

at

ST. JOHN'S UNIVERSITY

New York

by

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Date Submitted: \_\_\_\_\_

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## **ABSTRACT**

### **SLEEP AND ACADEMICS AMONG COLLEGE STUDENTS: ROLE OF EXECUTIVE FUNCTIONING AND SLEEP HYGIENE**

Mary Christine O'Brien

Sleep is a vital human function, critical to health across the lifespan. However, college students report significant disturbances in sleep quality and sleep hygiene (ACHA, 2019; Moulin & Chung, 2016). The consequences of poor sleep include lower cognitive and executive functioning abilities (Honn et al., 2019; Whitney et al., 2015) and poorer academic performance (Okano et al., 2019). Given the prevalence of these issues and the deleterious consequences, several sleep hygiene interventions have been developed for college students. However, the effectiveness of sleep hygiene education is not fully supported (Dietrich et al., 2016), and the role of individual characteristics that impact treatment effectiveness (i.e., executive functioning ability) has not been studied. The present study will examine the role of executive functioning in sleep quality and sleep hygiene, which may highlight the need for executive functioning supports within sleep educational programs. Executive functioning allows individuals to engage in health-promoting behaviors (Hall & Marteau, 2014), though limited research is available on its contribution to sleep-specific health behaviors. Given that executive functioning deficits (Sheehan & Iarocci 2019) and sleep problems (Hayley et al., 2017) independently predict lower academic achievement, it is crucial to understand the relationship among these three factors to better understand how to support college students and promote academic success.

## ACKNOWLEDGEMENTS

I embarked on the journey to this degree in 2016, uncertain, apprehensive, and cautiously optimistic. American novelist E. L. Doctorow (1963) once said, “Writing is like driving at night in the fog. You can only see as far as your headlights, but you can make the whole trip that way.” I have called upon this metaphor often, especially when the journey felt particularly arduous. It only feels right to acknowledge these words, and their profound impact on me, with the destination in sight.

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I have tremendous respect and affection for my classmates at St. John’s University, particularly my 2017 cohort. We consciously chose collaboration over competition, and in doing so built a meaningful bond and source of mutual support that I look forward to continuing as professional colleagues.

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## Chapter I

### INTRODUCTION

Sleep is a vital human function, critical to health across the lifespan. However, college students report significant disturbances in sleep quality and maladaptive sleep hygiene behaviors (ACHA, 2019; Johnston et al., 2019; Moulin & Chung, 2016). For college students, the consequences of poor sleep include functional impairments in cognitive, academic, and emotional functioning (Gruber & Cassoff, 2014; Hayley et al., 2017; Wilckens et al., 2014; Whitney et al., 2015; Wong et al., 2013).

Given the importance of sleep, the prevalence of sleep problems, and the maladaptive sleep behaviors among college students, several educational sleep hygiene interventions have been developed for this population (e.g., Hershner & O'Brien, 2018; Kloss et al., 2016; Levenson et al., 2016). However, sleep knowledge does not necessarily equate to changes in sleep hygiene nor does it consistently predict improvements in sleep quality (e.g., Blunden et al., 2012; Kloss et al., 2016; Peach et al., 2018).

Executive functioning abilities allow individuals to engage in health-promoting behaviors, despite the presence of distraction, tempting situational cues, and visceral desires (Hall & Marteau, 2014). The role of executive functioning in predicting healthy sleep hygiene practices is supported in emerging literature (Kor & Mullan, 2011; Todd & Mullan, 2013). However, these findings are somewhat limited, and more research is needed to better understand the role of executive functions in the implementation of healthy sleep hygiene practices (Kor & Mullan, 2011; Todd & Mullan, 2013).

Given that both executive functioning deficits (Knouse et al., 2014; Sheehan & Iarocci 2019) and sleep problems (Hayley et al., 2017; Wong et al., 2013) have been found to independently predict lower academic achievement among college students, it is crucial to understand the relationship between these two factors to better understand how to support college students and promote academic success. Specifically, individuals with deficits in executive functioning may be at higher risk for sleep problems, further compounding the negative impact on academic achievement.

## Chapter II

### LITERATURE REVIEW

#### **Sleep Problems Among College Students**

Sleep is fundamental to overall health across the lifespan and problems with sleep are linked to a wide range of cognitive, behavioral and emotional disturbances (e.g., Hershner & Chervin, 2014; Medic et al., 2017). Despite the importance of sufficient and restorative sleep, most college students report feeling tired or sleepy during the day, and report that most days, they do not obtain adequate sleep and do not feel well rested in the morning (American College Health Association [ACHA], 2019). Sleep deprivation is typically referred to in the literature as acute sleep deprivation or chronic partial sleep deprivation (Philip et al., 2012). For college students, acute sleep deprivation occurs when students “pull an all-nighter” (ACHA, 2019). More commonly, students demonstrate chronic partial sleep deprivation, in which they obtain some but not adequate sleep; sometimes referred to as sleep deficits or sleep debt (ACHA, 2019). Sleepiness is defined as the inability or difficulty in maintaining alertness during the major wake period of the day, resulting in unintended lapses into drowsiness or sleep (American Academy of Sleep Medicine [AASM], 2014). Sleep deprivation and sleepiness are caused by a myriad of environmental and contextual factors and have significant deleterious consequences (AASM, 2014; ACHA, 2019, National Sleep Foundation [NSF], 2015).

Sleep disturbances are common among college students, as about half of undergraduate students report poor quality sleep (Bolden et al., 2019; Schlarb et al., 2017; Zhou et al., 2022). The ACHA recently published a study on the health habits of

college students that indicates half of college students report sleeping fewer than 7 hours on weekday nights, and nearly a quarter of students sleep less than 7 hours on weekend nights (ACHA, 2020). These findings are supported by several studies that estimate the average sleep duration for college students is between 6.7 to 7.1 hours of sleep per night (Nota & Coles, 2015; Okano et al., 2019; Orzech et al., 2011; Peltzer & Pengpid, 2015). Students seem to be especially vulnerable to insufficient sleep on weeknights, with 20 percent of college students reporting fewer than 6 hours of sleep during the week (ACHA, 2020). These averages are at or below the lowest end of the recommended sleep duration for young adults ages 18 to 25 years, which is 7 to 9 hours of sleep each night (NSF, 2015).

### **Sleep Hygiene Practices Among College Students**

The NSF recommends several practices to promote healthy sleep, which include maintaining a regular sleep schedule, abstaining from alcohol, nicotine, and caffeine consumption, and avoiding electronics before bed or in the middle of the night (NSF, 2019). The term *sleep hygiene* is used to describe behaviors intended to promote healthy sleep and was originally designed to treat mild to moderate insomnia (Hauri, 1977). Positive sleep hygiene behaviors are strongly associated with overall sleep quality among college students (Carrión-Pantoja et al., 2022; Kloss et al., 2016).

In a recent review of sleep hygiene recommendations, Irish et al. (2015) found evidence that specific sleep hygiene practices improve sleep quality. The authors confirmed that caffeine consumption close to bedtime disrupts sleep, as does both acute and chronic nicotine use. They also found that although alcohol decreases sleep latency (the time it takes to fall asleep), it increases arousal during the second half of the night

(Irish et al., 2015) and therefore diminishes sleep quality. These behaviors and contextual factors are particularly salient for college students, who are often experiencing newfound autonomy, less adult oversight, and demonstrate high rates of alcohol, nicotine, and caffeine use (ACHA, 2019; Hershner & Chervin, 2014).

Alcohol, nicotine, and caffeine are becoming increasingly common among college students (ACHA, 2019; Johnston et al., 2019; Mahoney et al., 2019). In a recent survey, 77 percent of college students reported they had tried alcohol and two-thirds reported they had been intoxicated (Johnston et al. 2019). Further, 58 percent of college students report drinking alcohol in the past month (ACHA, 2019). Caffeine consumption is nearly ubiquitous on college campuses with 92 percent of college students reporting regular caffeine use (Mahoney et al., 2019). Further, nicotine use is on the rise among college students, due in part to the increase in vaping and electronic cigarettes (Johnston et al., 2019). Specifically, in 2018 a quarter of college students reported vaping nicotine at least once; 16 percent reported vaping nicotine in the last month, up from 6.1 percent in 2017 (Johnston et al., 2019).

Another behavior that impacts healthy sleep is the use of technology before bed, which is associated with sleep difficulties and daytime sleepiness (NSF, 2011). Specifically, the use of a phone or computer before bed is associated with daytime sleepiness, poorer sleep quality, delayed sleep initiation, and more frequent night wakings among young adults (NSF, 2011). Two thirds of young adults report using cell phones and nearly three quarters report using computers or laptops within one hour of trying to fall asleep (NSF, 2011). In a study of college students' technology use, Moulin & Chung (2016) found that more than 80 percent of students reported using a cell phone and 50

percent reported using a computer within one hour of sleep. Eighty-five percent of students reported they used devices in bed prior to sleep, from 5-minutes to more than 2-hours; more than half used devices from 15-minutes to over 2-hours in bed (Moulin & Chung, 2016).

Finally, a regular sleep-wake schedule is considered an important factor in sleep hygiene (NSF, 2019). Individuals who maintain consistent sleep schedules, including going to bed and waking up within 30 minutes of their usual bedtime and rise time, are more likely to report better quality sleep (NSF, 2019). This seems to be particularly salient among college students, as sleep schedules tend to be erratic in this population. For instance, students report weekend bedtimes averaging 87 minutes later than weekday bedtimes, and rise times averaging more than 120 minutes later than weekday rise times (Lund et al., 2010). Additionally, 20 percent of college students report staying up all night at least once in the last month, and over a third report staying up until 3 a.m. at least once a week (Lund et al., 2010).

### **Circadian Chronotype and Social Jetlag**

In examining the sleep habits of college students, it is important to consider the relevant developmental factors that impact sleep health. Beginning in adolescence, individuals tend to demonstrate a delayed *circadian preference* (i.e., a later internal clock) as well as a lower *homeostatic sleep drive* (i.e., the drive to sleep that increases the longer someone is awake); changes that are associated with puberty onset (Hershner & Chevin, 2014). Consequently, several sleep-related behavioral changes occur during this stage. Adolescents and young adults report feeling more awake in the evening, difficulty falling



asleep until later; and thus, insufficient sleep during the week and a desire to catch-up on weekends (Hershner & Chevin, 2014).

Given these physiological shifts, college students are at an increased risk of experiencing social jetlag (Moon et al., 2017). Social jetlag is the discrepancy between an individual's biological sleep rhythm, or chronotype, and the daily timing of social and occupational obligations (Wittman et al., 2006). College students with an evening chronotype, often have to conform to traditional school and business hours, as modern life tends to cater to individuals with morning chronotypes (Beauvalet et al., 2017). However, because social activities are held at night, college students with morning chronotype may also be at risk for social jetlag, as they likely will need to shift their sleep schedule to accommodate evening extracurricular activities and social events (Lau et al. 2013).

### **Consequences of Poor Sleep**

Sleep problems are associated with a wide range of impairments in college students, including lower cognitive and executive functioning abilities (Honn et al., 2019; Whitney et al., 2015; Wilckens et al., 2014), diminished academic performance (Okano et al., 2019; Wong et al., 2013), and psychiatric and mood disturbances (Becker et al., 2018).

Executive functioning is comprised of a broad range of higher order cognitive functions involving an individual's ability to engage in goal-directed behavior, both in terms of planning and working toward goals, as well as the ability to maintain flexibility when unexpected situations arise (Pickens et al., 2010). Importantly, executive functions are vulnerable to diminished sleep quality (Bolden et al., 2019). Specifically, sleep

deprivation has been shown to adversely affect cognitive flexibility, attentional control, inhibition, task-goal switching, reaction times, and vigilant attention in samples of college students and young adults. (Honn et al., 2019; Taheri & Arabameri, 2012; Whitney et al., 2015).

Sleep quality is related to poorer overall executive functioning among college students, such that students who report poor sleep quality also report more difficulty with motivational drive, impulse control, cognitive flexibility, organization, and strategic planning, than peers reporting better quality sleep (Cifre et al., 2020; Ferraro et al., 2015; Honn et al., 2019; Sandru, & Voinescu, 2014; Whitney et al., 2015). Sleep problems are also associated with difficulties with emotion regulation, time management, organization, motivation, and issues engaging in goal-directed behaviors (Cifre et al., 2020; Sandru, & Voinescu, 2014). Sleep quality and duration also affect daytime mood, emotional reactivity, and the ability for individuals to regulate both positive and negative emotions (Gruber & Cassoff, 2014).

Cifre and colleagues (2020) demonstrated the moderating effect of impulsivity on the relationship between sleep and executive functioning skills. Specifically, in a study of college students, highly impulsive individuals with sleep disturbances exhibited increased executive dysfunction, including difficulties with self-restraint and self-motivation, however lower impulsivity levels attenuated these effects (Cifre et al., 2020).

Sleepiness and deficient sleep have also been shown to have significant negative impact on academic outcomes among college students (Almojali et al., 2017; Carrión-Pantoja et al., 2022; Hayley et al., 2017; Wong et al., 2013). Specifically, sleep duration and sleep quality are significant predictors of academic achievement in college students,

such that students with shorter sleep duration and poorer sleep quality earn lower grades than peers with longer sleep durations and higher reported sleep quality (Carrión-Pantoja et al., 2022; Gomes et al., 2011; Wong et al., 2013). Additionally, difficulties initiating and maintaining sleep are associated with lower academic achievement among college students. A strong and consistent dose–response relationship is evident between reported sleep disturbances and poorer academic outcomes (Hayley et al., 2017). Further, later bedtimes and sleep schedule inconsistency are also related to lower academic performance among college students (Taylor et al., 2013).

In a study of undergraduate college students, Okano et al. (2019) used activity trackers to measure sleep in a sample of undergraduate chemistry students. The researchers found that better sleep quality, longer sleep durations, and greater sleep consistency were significantly related to better grades in the course. Further, they reported that data from the sleep measures accounted for nearly 25 percent of the variance in academic performance (Okano et al., 2019). Importantly, the study reported no relationship between single-night sleep measures one night before a test and test performance. Rather, sleep duration and quality for the month and the week before a test were associated with better grades (Okano et al., 2019). These results indicate that students' sleep quality may be more important for the duration of the course, while they are learning the material, rather than the days leading up to a test (Okano et al., 2019).

Among college students at a large public university, Orzech et al. (2011) found a negative association between subjective ratings of sleep quality and GPA. As sleep quality increased following a brief intervention, the authors found a modest increase in overall GPA (Orzech et al., 2011), indicating that improvements in sleep quality are

related to academic improvements. Additionally, this study found that students who had reported an all-nighter in the past week had a significantly lower GPA than peers who did not, which supports the idea that sleep schedule consistency is important to academic outcomes.

In addition to academic outcomes, cognitive skills, and executive functioning, sleep disturbance is associated with a range of psychiatric and mood problems among college students. Specifically, sleep disturbance is associated with depressive symptoms among college students (Huang & Kämpfen, 2021; Taylor et al., 2013).

Additionally, overall sleep problems are significantly associated with suicidal behaviors among college students, even when controlling for gender and depressive symptoms (Becker et al., 2018). Some specific sleep behaviors, including shorter sleep duration, frequent bad dreams, and greater sleep medication use are associated with increased suicidal behaviors among college students (Becker et al., 2018). Finally, sleep duration and timing are also associated with repetitive negative thinking in this population (Nota & Coles, 2015).

### **Sleep Hygiene Interventions**

Given that sleep hygiene practices are strongly associated with sleep quality (Kloss et al., 2016), several recent sleep hygiene interventions have emerged to combat the significant deleterious effects of poor sleep among college students (e.g., Hershner & O'Brien, 2018; Kloss et al., 2016; Levenson et al., 2016). Sleep hygiene education is commonly used, readily available, and does not require the direct involvement of a clinician, making it a relatively inexpensive lifestyle intervention (Irish et al., 2015).

However, the effectiveness of sleep hygiene interventions is not fully supported (Dietrich et al., 2016).

One recent meta-analysis by Friedrich and Schlarb (2018) reported small effects for sleep duration and medium effects for sleep onset latency. In a systematic review of sleep education programs in college students, Dietrich and colleagues (2016) reported insufficient evidence to determine the effectiveness of sleep hygiene education programs on sleep hygiene behavior and sleep quality. Specifically, the authors found that of two studies reporting on sleep hygiene behavior as an outcome variable, one showed no difference and one showed significant improvement (Dietrich et al., 2016). Of the four studies that reported on sleep quality post-intervention, only one reported a statistically significant improvement in sleep quality (Dietrich et al., 2016).

### **The Role of Executive Functioning**

Executive functioning is a broad term used to describe the cognitive processes that collectively serve to assist with top-down control of thoughts, behaviors, and emotions (Miyake & Friedman, 2012). Specific abilities include behavioral inhibition, cognitive flexibility, emotion regulation, self-monitoring, planning, and organization, which allow individuals to engage in goal-directed behavior (Naglieri & Goldstein, 2017).

Evidence demonstrates a clear link between executive functions and academic outcomes in college students, and executive functioning is an important predictor of academic success (Baars et al., 2015; Gilmore et al., 2013; Knouse et al., 2014; Sheehan & Iarocci 2019; Vadnais et al., 2018). In particular, self-reported ratings of executive

functioning have been shown to be predictive of academic achievement among college students (Knouse et al., 2014; Wingo et al., 2013).

For instance, self-reported executive functioning is related to the implementation of important study and test-taking behaviors including self-testing, the use of study aids and additional resources; the use of study schedules and other time management techniques, as well as comprehension monitoring techniques that reflect self-monitoring abilities (Petersen et al., 2006). Further, executive dysfunction, such as impairments in initiation, planning, organizational skills, inhibition, self-monitoring, working memory, and task monitoring significantly predict academic procrastination among college students (Rabin et al., 2011).

Specific domains of executive functioning have also been found to be related to academic achievement, including cognitive flexibility (Kercood et al., 2017), inhibition (Job et al., 2015), and self-regulation (Komarraju & Nadler, 2013). In one study, cognitive flexibility predicted academic achievement, such that reading skills increased as cognitive flexibility increased, and as the tendency to perseverate decreased (Kercood et al., 2017). In addition, cognitive flexibility also significantly predicted skills in mathematics and writing (Kercood et al., 2017).

Inhibition, also referred to as inhibitory control, is the ability to control one's attention, behavior, thoughts or emotions; and suppress automatic or competing responses (Diamond, 2013). This ability is significantly related to academic achievement among college students (Job et al., 2015; Semrud-Clikeman & Harder, 2011). Specifically, inhibition has been found to be related to math achievement and writing ability (Gilmore et al., 2013; Vadnais et al., 2018). Students with adequate behavioral inhibition

demonstrate self-control, meaning they have the discipline to stay on task despite distractions, and the ability to complete a task despite a desire to give up or engage in a more reinforcing task (Diamond, 2013). Without this aspect of inhibitory control, individuals would not be able to delay gratification or persist through arduous academic tasks (Diamond, 2013).

Self-regulation is also closely linked to academic motivation, as self-regulated learning positively predicts academic achievement (Mega et al., 2014). Students who demonstrate self-monitoring and self-regulatory abilities tend to achieve better academic outcomes, due in part to their ability to persist and sustain motivation in the presence of difficult academic task demands (Komarraju & Nadler, 2013).

In addition to predicting behaviors associated with academic achievement, executive functioning abilities are associated with the implementation of important health-related behaviors (Reimann et al., 2020). Specifically, executive skills contribute to an individual's capacity to engage in health-promoting behaviors, despite the presence of distraction, tempting situational cues, and visceral desires (Hall & Marteau, 2014; Reimann et al., 2020). The Temporal Self-Regulation Theory (TST; Hall & Fong, 2013; 2015) proposes that the ability to engage in health behaviors that have short-term costs and longer-term benefits is associated with one's natural executive control ability (Allan et al., 2016; Hall & Fong, 2015). TST posits that individuals with higher levels of executive functioning are more likely to turn healthy intentions into healthy behaviors, due to an ability to resist temptation, suppress previous habits, and inhibit responses to counterproductive cues (Allan et al., 2016). Further, those with adequate executive

functioning may also be more likely to avoid temptation in the first place, thereby improving chances of success (Allan et al., 2016; Hofmann et al., 2012a).

Support for this theory comes from studies that show individual differences in executive functioning moderate associations between intentions and health behaviors (Hall et al., 2008). Compared with individuals with poorer executive functioning, those with higher skills are more likely to “stick with stated dietary intentions” (Allan et al., 2016), correctly adhere to medication regimens (Panos et al., 2014), and regularly attend exercise classes (McAuley et al., 2011). They are also less likely to drink alcohol in excess or develop problems with alcohol abuse (Ferne et al., 2013; Allan et al., 2016). Evidence indicating a causal role of executive functioning in determining future health behavior comes from cohort and experimental studies showing that executive functioning predicts when young adults and adolescents begin drinking alcohol, as well as whether or not they drink in excess (Ferne et al., 2013; Peeters et al., 2015). Some evidence points to behavioral inhibition as a particularly important ability, such that those with higher response inhibition abilities are more likely to resist cigarettes and unhealthy food when attempting to quit smoking and lose weight, respectively, than those with lower inhibition abilities (Berkman et al., 2011; Hofmann et al., 2014).

Despite the demonstrated role of executive functioning in several health-promoting behaviors, limited research is available on the contribution of executive functioning to sleep-specific health behaviors. For instance, Kor and Mullan (2011) found that behavioral response inhibition predicted sleep hygiene behavior (Kor & Mullan, 2011). In a follow up study, Todd and Mullan (2013) found that cognitive flexibility and behavioral inhibition were positively associated with sleep hygiene (Todd & Mullan,



2013). Finally, improvements in some sleep behaviors following a self-monitoring intervention might indicate that self-regulation is associated with healthy sleep hygiene (Todd & Mullan, 2014). However, these findings are somewhat limited, and more research is needed to better understand the role of executive functions in the implementation of healthy sleep hygiene practices (Kor & Mullan, 2011; Todd & Mullan, 2013; Todd & Mullan, 2014).

### **Implications of the Present Study**

The college years provide emerging adults with many opportunities for social, emotional, and academic growth. However, the significant financial investment makes it imperative these years be as efficacious as possible (Hershner & Chervin, 2014). One potential threat to the efficacy and productivity of this experience is the significant problem with sleep among college students. Sleep problems are widespread in this population and the consequences include a myriad of cognitive, behavioral, and emotional problems that pose a threat to the efficacy of these experiences (ACHA, 2019; Becker et al., 2018; Wilckens et al., 2014). Therefore, college administrations and the clinicians who work with college students would benefit from effective sleep interventions that improve sleep hygiene practices and sleep quality. Despite a clear link between sleep hygiene practices and sleep quality, interventions that target sleep hygiene education have demonstrated mixed effectiveness in promoting adaptive sleep behaviors and improving sleep quality (Dietrich et al., 2016).

Behavioral health research indicates that executive functioning is a key ingredient in the implementation of health behaviors, however research into the role of executive functioning in sleep hygiene practices is limited (Allan et al., 2016; Todd & Mullan,

2014). This study will elucidate the role of executive functioning in healthy sleep hygiene practices, which might explain which individuals are most likely to benefit from these interventions, and which might be at increased risk for poor sleep behaviors and diminished sleep quality. A better understanding of the role of executive functioning in sleep hygiene behaviors might help to determine whether individuals with low executive functions are at an increased risk for poor sleep hygiene and poor sleep quality. Findings would enable clinicians to consider the individual differences of students' abilities when designing and implementing sleep hygiene interventions. For instance, executive functioning supports may boost the effectiveness of sleep interventions.

## Chapter III

### **HYPOTHESES**

The purpose of the present study is two-fold. The first goal is to evaluate the role of executive functioning abilities in predicting sleep hygiene behaviors among college students.

Behavioral health research indicates that executive functioning is a key ingredient in the implementation of health behaviors (Allan et al., 2016). While some researchers have demonstrated positive associations between executive functioning skills and sleep hygiene, the research is limited and the contribution of executive functioning to sleep-specific health is not well understood (Todd & Mullan, 2014). The present study will assess one hypothesis related to this goal. Given that research has shown executive functioning is related to health-promoting behaviors, it is hypothesized that:

1. Executive functioning abilities will predict healthy sleep hygiene practices.

The second goal of this study is to clarify the role of executive functioning within the relationship between sleep and academic outcomes among college students. A clear link exists between sleep and academic performance (e.g., Okano et al., 2019), sleep and executive functioning abilities (e.g., Cifre et al., 2020), and academic performance and executive functioning (e.g., Sheehan & Iarocci 2019). This study will evaluate the relationship among these three variables. The present study assesses two hypotheses related to this goal. As research has shown that executive functioning is independently related to both sleep quality and academic achievement among college students, it is hypothesized that:

2. Executive functioning abilities will moderate the relationship between sleep quality and academic achievement.

Further, as research has shown that executive functioning is independently related to both sleep hygiene and academic achievement among college students, it is hypothesized that:

3. Executive functioning abilities will moderate the relationship between sleep hygiene and academic achievement.

## Chapter IV

### METHOD

#### Procedure

To address the hypotheses related to sleep, executive functioning, and academic outcomes among college students, undergraduate students were recruited from a large, private, metropolitan University, which will henceforth be referred to as the University. Recruitment and data collection occurred during the Fall 2021 semester. Two data sources were incorporated into the present study: (1) survey data was used to measure participants' self-reported sleep quality, sleep hygiene practices, and executive functioning skills; and (2) the University's Office of Institutional Research provided academic data, including participants' cumulative grade point average (GPA), high school transcript, and standardized test scores (ACT, SAT), if available. First, approval was sought from and granted by the University's Institutional Review Board (IRB) and Office of Institutional Research (OIR). To be eligible for this study, participants had to be at least 18 years of age at the time of their participation and enrolled in full-time or part-time study as an undergraduate at the University. In order to participate, subjects were required to consent to the release of academic records by providing their University identification number.

Prior to data collection, a power analysis for a multiple regression with four predictors was conducted in order to determine a sufficient sample size using an alpha of coefficient of 0.05, a power of 0.80, and a medium effect size ( $f^2 = 0.15$ ). A medium effect size was used based on previous research (Todd & Mullan, 2014). Based on these

parameters, the minimally acceptable sample size was 85 participants, therefore the desired sample size was at least 150 participants.

Study recruitment began in September 2021. Students enrolled in introductory psychology classes were eligible to earn 1 research credit for study participation. In order to diversify the study sample, recruitment materials were also distributed to instructors of several large introductory courses in other disciplines (e.g., BIO 1000, ECON 1001, JOURN 1000, MTH 1000). As an added incentive, participants were able to register for a lottery to win one of two \$50 gift certificates.

Survey data was collected online using the Qualtrics survey software from September 2021 to December 2021. Prospective participants were presented with a consent form, describing the purpose and nature of the study (Appendix C). Following the completion of consent, participants were presented with the survey. Question blocks were randomized to reduce confounding variables. Once all survey data was collected, University identification numbers were sent to the Office of Institutional Research to enable the provision of participants' academic records.

### **Survey Measures**

The Pittsburgh Sleep Quality Index (PSQI) is a self-rated 19-item instrument intended to assess sleep quality and sleep disturbance over a 1-month period in clinical and nonclinical populations (Buysse et al., 1989). Scores range from 0 to 21 with higher scores indicating poorer sleep quality (Buysse et al., 1989). The PSQI has been demonstrated to have good internal reliability, stability over time, evidence of validity (Buysse et al., 1989), and is well regarded in the sleep research community (Mastin et al., 2006). Studies have demonstrated cross-cultural comparability of sleep quality and

excessive daytime sleepiness using the PSQI in college students and young adults (e.g., Gelaye et al., 2014). A global PSQI score  $> 5$  has the best sensitivity and specificity in distinguishing adequate and inadequate sleep quality (Buysse et al., 1989).

The Sleep Hygiene Index (SHI) is a 13-item survey that measures waking behaviors that affect sleep, derived from the diagnostic criteria for inadequate sleep hygiene in the International Classification of Sleep Disorders (American Sleep Disorders Association, 1990; Mastin et al., 2006). Each item is rated on a five-point scale ranging from 0 (never) to 4 (always). Total scores range from 0 to 52, with a higher score representing poorer sleep hygiene. The SHI has demonstrated moderate internal consistency, good 2-week test-retest stability ( $r = .71, p < .001$ ), and an association with sleep quality and daytime sleepiness in a nonclinical sample (Mastin et al., 2006). Test authors also provide evidence that sleep hygiene behavior is related to sleep quality and daytime sleepiness (Mastin et al., 2006). Among college students, a total score of 16 on the SHI has the best sensitivity and specificity in identifying individuals experiencing poor sleep quality (Seun-Fadipe et al., 2018).

The Sleep Beliefs Scale (SBS; Adan et al., 2006) is a 20-item survey that assesses knowledge of sleep practices by asking participants to rate whether specific behaviors have a positive, negative, or neutral effect on sleep. This measure was adapted from the Sleep Hygiene Awareness and Practice Scale (SHAPS; Lacks & Rotert; 1986). The SBS demonstrates good internal consistency and reliability ( $\alpha = 0.714$ ) and is an effective instrument among college students (Adan et al., 2006).

The Comprehensive Executive Function Inventory, Adult (CEFI-A; Naglieri & Goldstein, 2017) is a rating scale designed to measure behaviors associated with

executive function in adults aged 18 years and older. It is composed of items that assess nine domains of executive functioning: attention, emotion regulation, flexibility, inhibitory control, initiation, organization, planning, self-monitoring, and working memory (Naglieri & Goldstein, 2017). The CEFI-A provides a full-scale score to represent overall executive functioning, which demonstrates excellent internal consistency ( $\alpha = .97$ ) and test-retest reliability ( $r = .93$ ). The nine CEFI-A scales also demonstrate strong internal consistency (CEFI A scales median  $\alpha = .83$ ) and excellent test-retest reliability (CEFI A scales median  $\alpha = .91$ ).

To assess respondents' prior behaviors, participants were asked to answer questions about their functioning as a high school senior. Twenty-three survey questions from the sleep hygiene, sleep quality, and executive functioning measures were modified to ask participants to recall details from their senior year in high school (e.g., "During your senior year of high school, how would you rate your sleep quality overall?"). In addition to modified survey questions, participants were asked five questions regarding the level of parental involvement they had during their senior year in high school (e.g., "During my senior year of high school, my parent(s) reminded me to study for tests.>").

The following composite scores were created to estimate respondents' prior functioning: HS Parent Involvement (scores range from 0-3 with higher scores indicating more parental involvement), HS Sleep Quality (scores range from 0 to 3 with higher scores indicating greater sleep disturbances), HS Sleep Hygiene (scores range from 0 to 4 with higher scores indicating poorer sleep hygiene), and HS Executive Functioning (scores range from 0 to 5 with higher scores indicating higher executive functioning). It is



important to note these questions and composite are not standardized and are only meant to estimate participants' prior functioning.

Participants also completed a demographic questionnaire to provide information including age, race, ethnicity, living situation (e.g., dormitory, off campus housing, etc.), sleeping arrangement (e.g., shared room, private room, etc.), year in school, and typical bedtimes and wake times.

As noted, to evaluate academic achievement, participants provided consent for release of academic records from the University, including GPA, high school transcript, and standardized testing scores.

### **Statistical Procedures**

Data was analyzed using IBM SPSS Statistics software, version 28. Independent sample t tests, one-way analysis of variance (ANOVA), and Pearson chi-square tests were used to compare demographic information and sleep characteristics. Pearson's correlation coefficients were calculated to examine the strength and direction of the bivariate relationships between sleep variables (i.e., sleep quality, sleep knowledge, and sleep hygiene), executive functioning abilities (i.e., CEFI-A Full Scale); and academic achievement (i.e., cumulative undergraduate GPA). Linear regression was used to examine the comparative strength of sleep variables in predicting GPA. Using the PROCESS macro version 4.1 for SPSS, a multiple regression with moderation analysis (Model 1) was performed to explore the influence of executive functioning on the relationship between sleep and academic performance. Prior to analyses, variables were assessed for skew and kurtosis. Significance for all analyses was set at  $p < .05$ , two-

tailed. Effect sizes were calculated and interpreted using Cohen's criteria for correlation coefficients ( $r^2$ ) and mean between group differences (Cohen's D).

### **Data Preparation**

Data was screened to confirm eligibility for study inclusion and analyses. Twenty-three subjects participated in the survey more than once (i.e., submitting 2-4 entries). Therefore 30 duplicate responses were removed from the data set. In the instance of multiple entries, data was included first based on the highest completion rate. When a participant had completed the full survey more than once, the first response was included.

A total of 64 participants were excluded from analyses for being younger than 18 years of age and as such could not consent ( $n=4$ ), unavailability of GPA data for current undergraduates ( $n=55$ ), insufficient completion of items to calculate CEFI-A Full Scale score ( $n=31$ ) and/or the PSQI Global score ( $n=2$ ), and/or inattentive/inconsistent responding as defined by choosing the same answer for all questions on a measure ( $n=1$ ). Thus, of the 291 individuals who participated in the survey, a total of 227 participants were retained for the present study.

## Chapter V

### RESULTS

The present chapter is comprised of 6 sections. First, socio-demographic characteristics of the sample will be reported. Second, descriptive analyses of participants' sleep quality, sleep hygiene practices, sleep hygiene knowledge, executive functioning abilities, and academic achievement will be reported. The third section will evaluate the relationship between students' sleep hygiene practices and executive functioning abilities (Hypothesis 1). The fourth section will examine the relationship among sleep quality, executive functioning, and academic performance (Hypothesis 2). The fifth section will examine the relationship among sleep hygiene practices, executive functioning, and academic performance (Hypothesis 3). The final section will report exploratory analyses.

#### **Socio-Demographic Characteristics**

Most participants were female (81.2%), white (52.4%), and non-Hispanic (74.7%). The average age of participants was 19.21 years ( $SD=1.23$ ). More than half (59.4%) declared psychology as their major field of study, while nearly a quarter had declared Biology (12.7%), Speech Pathology & Audiology (6.6%), and Childhood Education (4.4%) as their major field of study. Regarding participants' housing arrangement, 22.9% ( $n=52$ ) lived on campus, 13.7% ( $n=31$ ) lived off campus, and 63.4% ( $n=144$ ) lived with family and commuted to school. Two-thirds (65.9%;  $n=151$ ) reported sleeping in a private bedroom while sharing a living space (e.g., shared apartment), while about a quarter reported sharing a bedroom (26.4%;  $n=60$ ).

No demographic differences were identified for sleep variables, executive functioning abilities, or academic performance. Independent sample t-tests demonstrated

no significant differences between participants' housing arrangement (i.e., on-campus, off campus) or living situation (i.e., private bedroom, shared bedroom) and their sleep hygiene, sleep quality, executive skills, or academic performance. Table 1 provides additional details about sample characteristics.

## **Descriptive Statistics**

### ***Sleep Quality***

More than 60% of the sample reported “poor” sleep quality (62.7%;  $n=142$ ; Global PSQI score  $> 5$ ). The average sleep duration for the sample was 6.7 hours per night. About half of the sample reported sleeping the recommended 7-9 hours (49.2%,  $n=112$ ), while nearly half reported sleeping fewer than 7 hours (48.4%,  $n=110$ ). Very few participants reported sleeping more than 9 hours per night (2.1%,  $n=5$ ). Nearly a quarter of the sample reported sleeping fewer than 6 hours per night (24.1%;  $n=55$ ). Of the nine factors that underlie sleep difficulties on the PSQI, respondents most often reported difficulties due to waking up during the night or early morning (64.8%,  $n=147$ ) and an inability to fall asleep within 30 minutes (46.7%,  $n=106$ ). Significant daytime dysfunction was also observed in the sample. Nearly a quarter of the sample reported difficulty staying awake during the day while engaging in activities (23.4%,  $n=53$ ) and nearly half reported difficulty keeping up enough enthusiasm to get things done during the day (44.1%,  $n=100$ ). Table 2 provides additional descriptive statistics for sleep quality.

### ***Sleep Hygiene***

More than 80% of the sample reported “poor” sleep hygiene practices (83.1%;  $n=189$ ; SHI $>16$ ; Seun-Fadipe et al., 2018). For example, more than three quarters of the

sample reported they “sometimes,” “frequently,” or “always” go to bed at different times every day, get out of bed at different times every day, engage in important work before bedtime (e.g., studying, scheduling, paying bills), do something that might wake them up before bedtime (e.g., play video games, use the internet), use their bed for activities other than sleeping or sex (e.g., watching TV, studying, reading), think, plan, and worry while in bed, and go to bed feeling stressed, angry, upset, or nervous. Table 2 provides additional descriptive statistics for sleep hygiene.

### ***Sleep Hygiene Knowledge***

On a measure of sleep hygiene knowledge, the average score was 11.6 out of 20, or 57.9% correct ( $n=225$ ,  $SD=18.5\%$ ), indicating a significant knowledge deficit in regard to healthy sleep hygiene practices. For example, only 15% ( $n=34$ ) correctly answered that getting up when it is difficult to fall asleep has a *positive* effect on sleep. Only 23.5% ( $n=53$ ) correctly answered that intense physical exercise close to bedtime has a *negative* effect on sleep. Table 2 provides additional descriptive statistics for sleep hygiene knowledge.

### ***Executive Functioning***

Overall executive functioning skills were normally distributed and consistent with the normative sample. Specifically, 12% ( $n=28$ ) reported below average abilities (CEFI-A Full Scale  $\leq$  16th percentile), 72.1.2% ( $n=163$ ) reported average abilities (84th percentile  $>$  CEFI-A Full Scale  $>$ 16th percentile), and 15.7% ( $n=36$ ) reported above average abilities (CEFI-A Full Scale  $\geq$  84th percentile). Table 2 provides additional descriptive statistics for executive functioning.

### ***Academic Functioning***

Overall, the sample demonstrated relatively high academic achievement, with the average GPA=3.54 ( $n = 227$ ;  $SD = .46$ ). About one third of the sample earned an A (GPA  $\geq 3.8$ ; 34.9%;  $n = 83$ ) and another third earned an A- ( $3.79 \geq \text{GPA} \geq 3.40$ ; 33%,  $n = 79$ ). Ten percent of the sample earned a 4.0 GPA ( $n = 21$ ). The University's undergraduate GPA for Fall 2021 was 3.47. A one sample t-test confirmed the sample GPA was higher than the University's undergraduate GPA,  $t(228) = 2.2$ ,  $p = .029$ .

### **Primary Analyses**

#### ***Hypothesis 1: Executive functioning will predict healthy sleep hygiene practices.***

To evaluate the relationship between sleep hygiene (SHI) and executive functioning (CEFI-A), Pearson correlations were calculated (Table 3). Overall executive functioning ability (CEFI-A Full Scale) was strongly negatively associated with sleep hygiene behaviors (SHI)  $r(226) = -.41$ ,  $p < .001$ , which represents a large effect size ( $r^2 = .166$ ). Pearson correlations were also calculated for each of the executive functioning subdomains (Table 3). Further, all executive functioning subdomains were negatively correlated with sleep hygiene (SHI Total Score;  $p$ 's  $< .01$ ,  $r^2$  range = .05 to .187). Specifically, large effect sizes were observed for the Emotional Regulation ( $r^2 = .187$ ) and Planning ( $r^2 = .146$ ) subscales, while medium effect sizes were observed for the Attention ( $r^2 = .107$ ), Flexibility ( $r^2 = .05$ ), Inhibitory Control ( $r^2 = .078$ ), Initiation ( $r^2 = .094$ ), Organization ( $r^2 = .122$ ), Self Monitoring ( $r^2 = .101$ ), and Working Memory ( $r^2 = .118$ ) subscales.

To test the first hypothesis, a regression analysis was used to determine whether executive functioning abilities significantly predicted participants' sleep hygiene practices (Table 4). The results of the regression indicated that overall executive

functioning (CEFI-A Full Scale) significantly predicted sleep hygiene practices (SHI;  $B = -.407, p < .001$ ). Further, executive functioning abilities explained 16.2% of the variance in sleep hygiene behaviors ( $R^2 = .166, F(1,224) = 44.55, p < .001$ ).

To better understand the differential contributions of the various CEFI-A subscales on sleep hygiene practices, exploratory analyses were conducted (Table 5). Because the CEFI-A Emotion Regulation subscale had the largest effect size when correlated with sleep hygiene, a hierarchical regression analysis was used to assess if emotional regulation (CEFI-A ER) predicted sleep hygiene practices (SHI) more so than the other executive functioning domains. The results of the regression, demonstrated in Table 5, indicated that Emotional Regulation was the primary predictor of sleep hygiene practices ( $B = -.413, p < .001$ ) and accounted for 17.1% of the variance ( $R^2 = .171, F(1,223) = 45.75, p < .001$ ).

***Hypothesis 2: Executive functioning will moderate the relationship between sleep quality and academic achievement.***

To evaluate the relationship among sleep quality, executive functioning, and academic performance, Pearson correlations were calculated (Table 3). Sleep quality (PSQI Global Score) was negatively associated with academic performance (GPA),  $r(227) = -.18, p = .007$  and executive functioning (CEFI-A Full Scale)  $r(227) = -.382, p < .001$ . Executive functioning (CEFI-A Full Scale) was positively correlated with academic performance (GPA)  $r(227) = .22, p = .001$ .

To investigate the hypothesis that executive functioning ability moderates the relationship between sleep quality and academic achievement, a simple moderation analysis was performed, using sleep quality (PSQI Global Score) as the predictor,

executive functioning (CEFI-A Full Scale) as the moderator, and academic performance (GPA) as the outcome variable (Table 6). As shown in Figure 1, there was a significant moderation effect operationalized via the interaction of sleep quality (PSQI Global Score) and executive functioning (CEFI-A Full Scale) for predicting academic performance (GPA),  $b = .001$ , 95% CI [0.000, 0.003],  $p = 0.04$ .

As illustrated by an analysis of conditional effects on the focal predictor, executive functioning moderates the relationship between sleep quality and academic achievement such that sleep disturbance (i.e., higher PSQI scores) predicts lower academic achievement for students with below average (CEFI-A  $\leq$  16th percentile) executive functioning ability,  $b = -.032$ , 95% CI [-.06, -.01],  $p = .013$ .

Simply put, above average, and to a lesser extent, average executive functioning skills, appear to serve a protective function against the deleterious consequences of poor sleep quality on academic achievement.

***Hypothesis 3: Executive functioning will moderate the relationship between sleep hygiene and academic achievement.***

To evaluate the relationship among sleep hygiene practices, executive functioning, and academic performance, Pearson correlations were calculated (Table 3). Sleep hygiene practices (SHI) were significantly negatively correlated with executive functioning (CEFI-A Full Scale;  $r(227) = -.407$ ,  $p < .001$ , and represent a large effect size. As noted, executive functioning (CEFI-A Full Scale) was positively correlated with academic performance (GPA),  $r(227) = .21$ ,  $p < .001$ , and represents a large effect size. Surprisingly, sleep hygiene practices (SHI) were not associated with academic performance (GPA),  $r(227) = -.07$ ,  $p = .271$ .



To investigate the hypothesis that executive functioning moderates the relationship between sleep hygiene and academic achievement, a second moderation analysis was performed with sleep hygiene (SHI) as the predictor, executive functioning (CEFI-A Full Scale) as the moderator, and academic achievement (GPA) as the outcome variable (Table 7). As shown in Figure 2, there was a significant moderation effect operationalized via the interaction of sleep hygiene (SHI) and executive functioning (CEFI-A Full Scale) for predicting academic performance (GPA),  $b = .001$ , 95% CI [0.00, 0.00],  $p = 0.01$ . The results indicate that above average, and to a lesser extent average executive functioning skills, protect against the deleterious consequences of poor sleep hygiene practices on academic achievement.

While academic performance (GPA) was positively associated with overall executive functioning abilities (CEFI-A Full Scale;  $r(229) = .21$ ,  $p < .001$ ), associations with specific domains were variable. Academic performance was positively correlated with Inhibitory Control, Initiation, Organization, Planning, Self-Monitoring, and Working Memory, while no relationship was observed between GPA and the Attention, Emotion Regulation, or Flexibility subscales.

### **Exploratory Analyses**

Given that sleep knowledge does not necessarily predict sleep hygiene nor does it predict improvements in sleep quality (e.g., Blunden et al., 2012; Kloss et al., 2016; Peach et al., 2018), and sleep hygiene interventions demonstrate mixed effectiveness (e.g., Dietrich et al., 2016), exploratory analyses were conducted to examine the relationship between sleep hygiene knowledge and practices. Sleep hygiene knowledge (SBS) was not related to sleep quality (PSQI), sleep hygiene (SHI), or executive

functioning (CEFI-A). However, sleep hygiene knowledge was associated with academic performance (GPA),  $r(227) = .29, p < .001$ .

To better understand the relationships among prior sleep quality, sleep hygiene, and executive abilities, Pearson correlations were calculated (Table 8). Prior sleep quality was significantly correlated with prior sleep hygiene,  $r(227) = .535, p < .001$ , prior executive functioning  $r(227) = -.337, p < .001$ , and high school GPA,  $r(227) = -.133, p < .05$ . Standardized test scores (i.e., ACT, SAT) were positively associated with high school GPA  $r(150) = .162, p < .05$ . However, no significant associations were reported with prior sleep hygiene, sleep quality, or executive functioning. To evaluate the relationship between prior behavior and current functioning, Pearson correlations were calculated (Table 9). Unsurprisingly, significant correlations were observed between prior and current sleep hygiene [ $r(226) = .410, p < .001$ ]; prior and current sleep quality [ $r(227) = .245, p < .001$ ]; prior and current executive functioning [ $r(227) = .678, p < .001$ ], and high school GPA and college GPA [ $r(227) = .424, p < .001$ ].

As demonstrated in Table 8, parental involvement during high school was not associated with any of the prior functioning variables (i.e., high school sleep hygiene, executive functioning, sleep quality, GPA, or standardized test scores). However, high levels of parental involvement in high school were negatively correlated with cumulative undergraduate GPA  $r(227) = -.162, p < .05$ , indicating that students who reported more parental involvement in high school demonstrated lower grades as undergraduates (Table 9). Further, higher levels of parental involvement in high school were positively correlated with current sleep disturbance (PSQI Global Score)  $r(226) = .140, p < .05$  and poorer sleep hygiene (SHI)  $r(226) = .161, p < .05$ .

## Chapter VI

### DISCUSSION

The present study reports data from a survey of undergraduate college students' sleep quality, sleep hygiene behaviors, and executive functioning skills, as well as participants' academic outcomes reported by the University's Office of Institutional Research. The purpose of this study was to: (1) evaluate the role of executive functioning in predicting healthy sleep hygiene behaviors among college students; and (2) clarify the role of executive functioning within the relationship between sleep variables and academic outcomes.

The present chapter is comprised of 5 sections. The first section summarizes the state of sleep quality, hygiene, and knowledge among the present sample of college students as well as the discrepancies between reports on a standardized measure of sleep quality and perceived sleep quality. The second section discusses the role of executive functioning abilities in predicting healthy sleep hygiene practices and the moderating role of executive functioning on the relationship between sleep variables (i.e., sleep quality and sleep hygiene) and academic achievement. The third section discusses the association between parental involvement during high school and subsequent functioning in college. The fourth section discusses the study's strengths, limitations, and contextual factors that warrant consideration. The fifth and final section proposes areas of additional research and future directions.

#### **The State of Sleep Among College Students**

Consistent with prior research, findings from the present study revealed more than three quarters of the sample reported "poor" sleep hygiene practices (e.g., Al-Kandari et

al., 2017). On average, participants reported sleeping only 6.7 hours per night, which is consistent with recent, large-scale studies estimating the average sleep duration for college students is between 6.7 to 7.1 hours of sleep per night (e.g., Nota & Coles, 2015; Okano et al., 2019; Orzech et al., 2011).

Nearly half of the sample reported sleeping fewer than 7 hours per night, consistent with previous research showing college students sleep less than 7 hours per night most of the time (ACHA, 2020). Specifically, participants reported several maladaptive practices including inconsistent sleep schedules, participating in arousing activities before bedtime, going to bed feeling stressed or upset, using their bed for activities other than sleeping or sex, thinking, planning, and worrying while in bed, and doing important work before bedtime. It is no wonder then, that participants reported significant sleep disturbances and diminished sleep quality. Most of the sample reported Global PSQI scores within the “poor” range, which was consistent with prior research among college students (e.g., Al-Kandari et al., 2018).

As expected, findings provide further support for the positive relationship between sleep hygiene and sleep quality among college students (e.g., Kloss et al., 2016). This study also provides support for the relationship between sleep quality and executive functioning (e.g., Ferraro et al., 2015; Sandru, & Voinescu, 2014) and sleep quality and academic outcomes (e.g., Hayley et al., 2017; Wong et al., 2013; Okano et al., 2019) among college students. Further, findings are consistent with prior studies demonstrating a positive relationship between executive functioning and academic outcomes (e.g., Gilmore et al., 2013; Knouse et al., 2014; Sheehan & Iarocci 2019; Vadnais et al., 2018).

Overall, a significant deficit in sleep hygiene knowledge was seen among the sample, as on average, participants answered knowledge questions with less than 58% accuracy. For instance, more than two thirds of participants did not know that going to bed 2 hours earlier than their habitual bedtime has a negative impact on sleep. Further, half of participants answered incorrectly when asked if using sleep medication regularly impacts sleep. That said, in the present study sleep hygiene knowledge was not related to sleep quality, sleep hygiene behaviors, overall executive functioning abilities, nor individual executive functioning domains. This is consistent with literature suggesting that sleep knowledge does not consistently predict sleep hygiene behaviors or sleep quality (Blunden et al., 2012; Kloss et al., 2016; Peach et al., 2018).

Interestingly, a significant proportion of the sample demonstrated a poor awareness of their own sleep disturbance. For example, while two thirds of the sample reported a Global PSQI score within the “poor” range, only a third rated their sleep quality as “fairly bad” or “very bad.” This means that at least one-third of the sample reported clinically significant sleep disturbance and “poor” overall sleep quality but when asked directly about how they sleep, reported they experience “very good” or “fairly good” sleep.

This misperception of ones’ own sleep quality, coupled with inaccurate beliefs about healthy sleep behaviors, likely contributes to college students’ neglect of their sleep health as well as the ineffectiveness of sleep hygiene interventions developed for this population. Perhaps if participants do notice sleep-related mood or cognitive changes, they attribute these symptoms to other factors, such as adjustment to life as a college student, stress, diet, substance use, or other lifestyle factors.

## **The Role of Executive Functioning**

Consistent with prior research (Knouse et al., 2014), self-reported executive functioning was associated with academic performance in the present study. Findings from the present study demonstrate a small effect size, consistent with Knouse and colleagues (2014) finding that self-rated executive functioning abilities were associated with GPA among college students.

The results of the present study also provide support for the hypothesis that executive functioning predicts healthy sleep hygiene practices among college students. Todd and Mullan (2013, 2014) provided preliminary evidence that specific executive domains (e.g., inhibition, self-monitoring) predicted some sleep hygiene behaviors. Not only does the present study support these findings, but the use of different measures provides additional, concurrent validity for this conclusion.

The present study also provides further support for the Temporal Self-Regulation Theory (TST; Hall & Fong, 2013; 2015), which proposes that the ability to engage in health behaviors that have short-term costs and longer-term benefits is associated with one's executive control (Allan et al., 2016; Hall & Fong, 2015). While prior research has demonstrated the influence of global executive skills on other health-promoting behaviors, such as medication and diet adherence, (e.g., Allan et al., 2016; Panos et al., 2014), this study supports extending this theory to include sleep-specific health behaviors. In the same way that executive functioning supports one's ability to engage in health-promoting behaviors (i.e., adhere to medication regimens, avoid cigarettes, exercise regularly, etc.), this study demonstrates that executive skills also predict one's

ability to engage in healthy sleep hygiene behaviors (i.e., maintain a consistent sleep schedule, obtain 7-9 hours of sleep, avoid caffeine, etc.).

Overall, this finding provides support for the commonsense idea that skills such as planning, organization, inhibition, and self-monitoring help students engage in healthy sleep hygiene. For instance, students with adequate planning skills are likely better able to go to bed on time, and students with adequate inhibition skills are, as an example, likely able to put down their video games when it's time to go to sleep.

While all executive functioning subdomains were related to healthy sleep hygiene, emotional regulation skills emerged as the best predictor of healthy sleep behaviors. Specifically, students with higher emotional regulation abilities tended to demonstrate healthier sleep hygiene practices. Because we know that mood is highly impactful on sleep, it is no surprise that emotional regulation is so important to healthy sleep hygiene. For instance, most common sleep disturbance reported by the sample was awakening in the middle of the night or early morning. Unsurprisingly, frequent awakening was associated with poor sleep hygiene practices. While this sleep disturbance was not associated with global executive functioning ability, findings from the present study revealed awakening was negatively correlated with emotional regulation. This relationship demonstrates that individuals with higher emotional regulation skills were less likely to report difficulty with sleep due to nighttime awakenings.

This finding might be explained by the idea that students with emotional regulation deficits may be more likely to engage in maladaptive behaviors upon awakening, which further contributes to diminished sleep quality. For instance, a student prone to anxiety or depression, may wake in the middle of the night and engage in

ruminative thinking, which is associated with increased sleep onset latency and sleep disturbance (Lancee et al., 2017). On the other hand, a student with adequate emotional regulation may be able to better cope with the frustration associated with nighttime awakening, employ effective self-soothing strategies, and subsequently fall back asleep more quickly and with fewer associated disturbances.

Overall, this finding supports research demonstrating that emotional distress predicts sleep disturbance (Seixas et al., 2015). It demonstrates the crucial role of mood functioning in healthy sleep and has important implications for college students and the clinicians tasked with supporting them. As such, these implications will be discussed in the following section.

### ***Moderating Role of Executive Functioning on Sleep and Academic Achievement***

Results of the present study support the hypotheses that executive functioning skills moderate the relationship between sleep quality and academic achievement. Specifically, sleep disturbance predicted lower academic achievement for students with below average executive functioning skills, and to a lesser extent, for students with average executive functioning skills. These results indicate that sleep disturbance poses a significant risk of academic underachievement and students with executive dysfunction are especially vulnerable to the consequences of poor sleep. The current findings extend the work of Cifre and colleagues (2020), who demonstrated the moderating role of impulsivity in the relationship between sleep difficulties and executive functioning, suggesting that college students with higher impulsivity were particularly vulnerable to the consequences of poor sleep.



While prior research demonstrates the increased risk for academic underachievement among students with executive dysfunction, the present study provides insight into the way in which sleep disturbance worsens these outcomes. Students with executive dysfunction likely have difficulty implementing effective cognitive and behavioral strategies to mitigate the consequences of diminished sleep quality.

Interestingly, for students with above average executive functioning abilities, sleep quality did not exert a significant influence on academic achievement. Based on these findings, executive functioning skills appear to serve a protective function against the deleterious consequences of poor sleep quality on academic outcomes. Students with superior executive skills are likely able to self-employ compensatory strategies that shield them from some consequences of sleep disturbance.

For instance, a student with excellent time management skills is likely able to make it to class on time, despite sleeping poorly or oversleeping. Further, a student with high levels of executive functioning may benefit from an executive reserve, so that even when experiencing diminished functioning due to sleep disturbance, they can demonstrate adequate skills compared to peers. They may also use individual executive strengths to compensate for areas of weakness caused by sleep disturbance. Students with above average executive functioning skills may also be better equipped to mitigate sleep disturbances and proactively promote improved sleep quality.

Additionally, results of the present study support the hypotheses that executive functioning skills moderate the relationship between sleep hygiene and academic achievement. Specifically, poor sleep hygiene predicted lower academic achievement for students with below average executive functioning skills, and to a lesser extent, for

students with average executive functioning skills. These results indicate that diminished sleep hygiene poses a significant risk of academic underachievement for most students.

Contrary to the hypothesis that healthy sleep hygiene is associated with higher academic outcomes, undergraduates with above average executive functioning abilities demonstrated higher academic performance when engaging in poorer sleep hygiene practices. One possible explanation for this finding is that these undergraduates are able to sacrifice some healthy sleep habits (e.g., later bedtimes) to reap academic benefits (e.g., additional study time) without suffering the deleterious consequences students with below average executive skills encounter. It is important to note, however, that this counterintuitive relationship was found only regarding sleep hygiene practices and was not demonstrated for sleep quality. This nuanced finding might suggest that students with above average executive skills are more adept at obtaining adequate sleep quality despite diminished sleep hygiene.

College students are notorious for poor sleep hygiene and images of students studying all night before a test prevail in popular culture and in real life (e.g., ACHA, 2019, 2020; Hershner & Chervin, 2014; Johnston et al., 2019; Mahoney et al., 2019). While we know this unhealthy behavior has adverse consequences for academic performance for most students, individuals with superior executive functioning abilities may be able to sacrifice healthy sleep hygiene practices to the benefit of their GPA.

### **Report of Prior Functioning**

Students' report of prior functioning was positively associated with reports of their current functioning, across sleep hygiene behaviors and sleep quality. This is consistent with research suggesting that an important determinant of future behavior is

past behavior (Sheeran et al., 2017). Given this association, early education regarding appropriate sleep hygiene behaviors is indicated. This might include educating high school students, as well as parents and caregivers, educators, and pediatricians.

Intervention within this population has the benefit of supervision and oversight, as parents are more involved with their children's sleep schedules during high school than during college.

Students who reported higher levels of parental involvement during high school tended to demonstrate diminished academic performance and report poorer sleep hygiene as an undergraduate. The social and academic demands of undergraduate life are surely an adjustment for all students, however, the participants who reported their parents set their bedtimes and reminded them to complete assignments during high school seem to have struggled the most to establish the independence required of undergraduate students.

Students with highly involved parents might not have had the opportunity to develop adequate planning, organizational, and self-monitoring abilities during adolescence, leading to increased difficulty as a college student. Parental over-involvement may also be related to a student's executive dysfunction, as parents of students with poor executive skills might have stepped in to provide support. As such, it is difficult to say whether parents became over involved because of an executive functioning deficit or due to personality and parenting factors. However, this finding is consistent with recent research showing that students with over-involved parents demonstrated higher levels of anxiety and depression and lower levels of self-efficacy, which led to poorer college adjustment, including lower grade point average (Darlow et al., 2017).

## **Strengths, Limitations, and Contextual Considerations**

The results of this study contribute to the literature on the role of executive functioning and provide further clarity on the role of executive functioning within the relationship between sleep and academic performance among college students. Results of the regression analysis demonstrate the key role executive functioning plays in the implementation of healthy sleep hygiene and provide support for the application of the Temporal Self-Regulation Theory (TST; Hall & Fong, 2013; 2015) in sleep behaviors. These results underscore the importance of executive functioning skills, particularly emotion regulation, on the sleep health and academic outcomes within this population. This finding also supports the idea that individual differences in executive functioning may explain the inconsistent efficacy of sleep hygiene education interventions.

Results of the moderation analyses provide further clarity about the risk factors associated with executive dysfunction, specifically, that students with below average executive functioning abilities demonstrate increased risk of poor academic outcomes within the context of sleep disturbance. This finding underscores the importance of identifying at-risk students who are most likely to benefit from effective interventions.

However, there are contextual factors and study limitations that warrant consideration. First, this study used a convenience sample of college undergraduate students, which may limit the generalizability of study results. Most participants were white, non-Hispanic, and female. More than half were psychology majors and two-thirds were freshmen or sophomores (mean age =  $19.21 \pm 1.23$ ). This is important because growing research has shown racial and ethnic disparities in sleep duration and sleep quality (e.g., Johnson et al., 2019). Further, some studies have shown upperclassmen have

higher levels of depression, anxiety, and stress when compared with underclassman (Beiter et al., 2015). Overall, a more diverse sample would enhance the external validity of the study.

Second, self-report measures were used to assess sleep hygiene, sleep quality, and executive functioning skills. Self-report measures can be biased, as students may under report, over report, or inaccurately recall details about their sleep, behaviors, and executive functioning skills. Large scale objective data collection for sleep quality and executive functioning among college students would demand significant resources and was not feasible for the current study, though it is an important avenue for future research. For instance, objective neuropsychological tests would provide important information about the influence of cognitive skills, rather than reported behavior, on the relationship between sleep quality and academic outcomes.

Regarding executive functioning skills specifically, some research has raised questions about the extent to which self-report measures tap into measurable executive dysfunction (Buchanan, 2016). Further, the relationship between objective sleep variables and perception of sleep quality is unclear, as objective measures of sleep and experiences of “quality” sleep are not always closely related (Cudney et al., 2022). Further, it is possible that students were not willing to share sensitive information that may have impacted results of the study, such as medication use, substance use, or psychiatric symptomology.

Third, using survey measures to evaluate executive functioning may lead to response bias, as it is possible students with lower levels of executive functioning may

demonstrate difficulty persisting through the survey. This may lead to a sample that underrepresents executive dysfunction.

Fourth, non-standardized questions were used to assess respondent's prior behaviors. Asking respondents to recall their cognitive and behavioral functioning from years prior might yield unreliable results and therefore should be interpreted with appropriate caution.

Fifth, the present study did not assess psychiatric symptomology directly. As prior research has shown poor sleep is associated with increased risk of depression, anxiety, and other mood disorders, affective distress among college students is an important factor to consider when studying these relationships. However, the Emotional Regulation scale on the CEFI-A offers some information as to the mood functioning among participants. This subscale was validated with clinical populations including individuals diagnosed with generalized anxiety disorder as well as those with a mood disorder (Naglieri & Goldstein, 2017).

Finally, it is also important to discuss the context in which the present study was conducted. Data was collected in New York from September 2021 to December 2021, during the COVID-19 pandemic. While participants were not asked about the impact of COVID-19 or the subsequent public health policies (i.e., social distancing requirements) on their individual circumstances, it is likely these factors played a significant role in some way. For instance, emerging research has shown a significant impact on students, including increased alcohol and tobacco use (Romero-Blanco et al., 2020), heightened symptoms of depression and anxiety (López-Castro et al., 2021), increases in screen time, and diminished sleep quality (Ellakany et al., 2022).

## **Future Directions**

Given the limitations and implications of the present study, several future directions for research are suggested. As mentioned in the prior section, additional studies are needed to replicate these results using objective measures of executive functioning, such as neuropsychological tests of inhibition, planning, self-monitoring, and cognitive flexibility. Similarly, a valuable extension of this line of research would include objective measures of sleep quality, such as actigraphy monitoring and polysomnography. Not only would this research potentially replicate the results of the present study and add ecological validity, but it would also help clarify the relationship between self-report and objective measurements of these variables.

Additionally, these findings should be researched in diverse populations to better understand how these relationships are influenced by other demographic variables. For instance, socioeconomic status in childhood is associated with diminished executive skills in adulthood (Evans et al., 2021), as childhood exposure to poverty is a significant contributing factor to impairments in the hippocampus, amygdala and prefrontal cortex (e.g., Lipina & Posner 2012; Noble et al., 2012). Further, evidence shows that disparities in sleep duration and sleep quality are related to race and ethnicity (e.g., Johnson et al., 2019).

While the present study helped to identify the role of emotional regulation in the implementation of healthy sleep, discrete measures of affective distress were not incorporated in the present study. Given that psychiatric symptoms, such as anxiety and depression, have a substantial impact on academic performance, cognitive functioning,

behavioral regulation, and overall health status, incorporating standardized mood measures would provide important information as to how the outcome variables interact.

An unexpected finding in the present study was that individuals with above average executive functioning skills demonstrated high academic achievement despite poor sleep hygiene behaviors. Going forward, perhaps interviews with students who fall into this category, would be helpful in better understanding the specific habits and behaviors that contribute to this academic success.

Finally, the results of this study provide information about a single point in time and therefore cannot account for many potentially confounding variables, such as prior behaviors. For instance, a longitudinal study might be able to compare the differential contributions of prior behaviors versus executive abilities in predicting future sleep hygiene.



## Chapter VII

### **IMPLICATIONS FOR THE PROFESSION OF SCHOOL PSYCHOLOGY**

The college years provide emerging adults with many opportunities for academic, social, emotional, and occupational growth. That said, the significant, often life-changing, financial investment required to pursue higher education in the United States makes it imperative these years be as efficacious as possible. Research shows that sleep disturbance represents a significant threat to the efficacy and productivity of the college experience. Sleep problems are widespread among undergraduates and have a downstream, adverse impact on students' cognitive, behavioral, and emotional functioning (ACHA, 2019; Becker et al., 2018; Wilckens et al., 2014).

Given the significant deficit in sleep hygiene knowledge, as well as the seriousness and prevalence of maladaptive sleep behaviors among college students, several educational sleep hygiene interventions have been developed for this population (e.g., Hershner & O'Brien, 2018; Levenson et al., 2016). However, sleep knowledge does not reliably predict healthy sleep behaviors or sleep quality (e.g., Kloss et al., 2016; Peach et al., 2018). The present study suggests that executive functioning, especially emotion regulation, may be the critical domain to target in promoting healthy sleep.

Results of the present study can help inform sleep intervention in two key ways. First, students with executive dysfunction demonstrate an increased risk for sleep disturbance and poorer academic outcomes. An effective screening measure may be an important tool in aiding clinicians working with this population in the identification of at-risk students. Given the findings of the present study, administrators and clinicians might

consider screening undergraduate students for executive functioning abilities, with a particular emphasis on emotion regulation skills.

Second, given the predictive role of executive functioning in sleep hygiene observed in the present study, interventions targeted at the remediation of sleep disturbance may demonstrate improved efficacy with the implementation of executive skills supports. In other words, it may not be enough to teach students *why* they should go to sleep on time, but rather how to manage their responsibilities so they *can* go to sleep on time.

This study demonstrated the important role of all executive domains assessed in predicting sleep hygiene. As such, findings support including planning, organization, initiation, inhibitory control, and self-monitoring strategies to bolster healthy sleep hygiene. However, the emotional regulation domain emerged as the most important executive skill in predicting sleep hygiene behaviors in the present study. As such, emotional regulation skills may be the most important ingredient in an effective sleep hygiene intervention. Not only is emotional regulation important in sleep hygiene, research shows emotion regulation skills also impact total sleep quality, duration, latency, and fragmentation (Fairholme & Manber, 2015).

Limited resources mean administrators must be discerning in the interventions they implement for students to support their success. The present study may help elucidate the key factors in effective remediation of sleep disturbance among college students. Specifically, the present study provides support for the inclusion of executive skills supports, particularly emotion regulation, in sleep hygiene interventions among college students.

**Table 1***Demographic Characteristics for Undergraduate Student Sample*

Characteristic	<i>n</i>	%
Gender		
Female	184	81.1%
Male	37	16.3%
Transgender/Gender Queer	5	2.2%
Race		
Black/African American	38	16.7%
White/Caucasian	120	52.4%
Asian American	31	13.7%
Middle Eastern	2	0.9%
Native American	1	0.4%
Multiracial	13	5.7%
Other	20	8.8%
Ethnicity		
Hispanic/Latino	56	24.7%
Non-Hispanic	169	74.4%
Age (years)		
18	74	32.6%
19	76	33.5%
20	47	20.7%
21	24	10.5%
≥22	6	3.0%
College Year		
1 <sup>st</sup> year	70	30.8%
2 <sup>nd</sup> year	78	34.4%
3 <sup>rd</sup> year	55	24.2%
4 <sup>th</sup> year	23	10.1%
5 <sup>th</sup> year	1	0.4%
Student Housing Status		
On Campus Housing	52	22.9%
Off Campus Housing	31	13.7%
With Family/Commuting	144	63.4%
Living Arrangement		
Living alone	8	3.5%
Shared bedroom	60	26.4%
Private bedroom, shared living space	150	66.1%
Shared bed	9	4.0%
Academic Major		
Accounting	1	0.4%
Art History	1	0.4%
Biology	29	12.7%

Biomedical Sciences	4	1.8%
Childhood Education	10	4.4%
Computer Science	3	1.3%
Criminal Justice	4	1.7%
English	2	0.9%
Finance	1	0.4%
Graphic Design	1	0.4%
Homeland Security	3	1.3%
Hospitality Management	1	0.4%
Journalism	1	0.4%
Legal Studies	2	0.9%
Liberal Studies	1	0.4%
Marketing	2	0.9%
Pharmacy PharmD	2	0.9%
Psychology	135	59.5%
Sociology	2	0.9%
Speech Pathology & Audiology	15	6.6%
Undecided	7	3.1%

---

**Table 2***Descriptive Statistics for Study Variables*

Variable	<i>n</i>	<i>M</i>	<i>SD</i>
PSQI			
Global score	227	7.19	3.09
SHI			
Total score	226	23.58	6.88
SBS			
Total score	225	11.44	3.92
CEFI-A			
Attention	227	95.27	15.40
Emotion Regulation	227	96.20	15.25
Flexibility	227	102.73	12.78
Inhibitory Control	227	104.86	13.35
Initiation	227	103.28	15.45
Organization	227	102.70	15.12
Planning	227	100.45	13.68
Self-Monitoring	227	100.75	12.52
Working Memory	227	102.05	15.31
Full Scale	227	101.07	13.50
Academic Achievement			
Grade Point Average	227	3.54	0.46

*Note.* PSQI = Pittsburgh Sleep Quality Index; Global PSQI score >5 indicate poor sleep quality; SHI = Sleep Hygiene Index; Total SHI score >16 indicate poor sleep hygiene; SBS = Sleep Beliefs Scale; CEFI-A = Comprehensive Executive Function Inventory-Adult. CEFI-A scores are standardized ( $M=100$ ;  $SD=15$ ).

**Table 3***Pearson Correlations for Primary Study Variables*

	Global PSQI	SHI Total	SBS Total	GPA
PSQI Total	-----			
SHI Total	.47***	-----		
SBS Total	-.06	.02	-----	
Grade Point Average	-.18**	-.08	.29**	-----
CEFI-A Attention	-.31***	-.33***	-.03	.096
CEFI-A Emotion Regulation	-.34***	-.43***	-.08	.002
CEFI-A Flexibility	-.18**	-.23**	-.05	.13*
CEFI-A Inhibitory Control	-.21**	-.28***	.07	.19**
CEFI-A Initiation	-.35***	-.31***	.07	.24***
CEFI-A Organization	-.36***	-.35***	-.01	.28***
CEFI-A Planning	-.37***	-.38***	.04	.16*
CEFI-A Self-Monitoring	-.27***	-.32***	.03	.17**
CEFI-A Working Memory	-.43***	-.34***	.07	.24***
CEFI-A Full Scale	-.38***	-.41***	-.01	.22**

*Note.* PSQI = Pittsburgh Sleep Quality Index; SHI = Sleep Hygiene Index; SBS = Sleep Beliefs Scale; CEFI-A = Comprehensive Executive Function Inventory-Adult.

\*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

**Table 4***Regression of Independent Variables' Prediction of Sleep Hygiene*

---

Model		Unstandardized Coefficients		Standardized Coefficients	<i>t</i>	<i>p</i>
		<i>B</i>	<i>SE</i>	$\beta$		
1	(Constant)	44.71	3.19		14.002	<.001
	CEFI-A Full Scale	-0.21	0.03	-0.407	-6.67	<.001

---

*Note.* Model 1:  $R^2 = .166$ , Adjusted  $R^2 = .162$ .

CEFI-A = Comprehensive Executive Function Inventory-Adult.

**Table 5***Hierarchical Regression of Independent Variables' Prediction of Sleep Hygiene*

Model		Unstandardized Coefficients		Standardized Coefficients	<i>t</i>	<i>p</i>
		<i>B</i>	<i>SE</i>	$\beta$		
1	(Constant)	41.483	2.685		15.451	<.001
	CEFI-A Emotion Regulation	-.186	.028	-0.413	-6.764	<.001
2	(Constant)	43.865	3.775		11.619	<.001
	CEFI-A Emotion Regulation	-.163	.036	-.361	-4.522	<.001
	CEFI-A Attention	-.039	.042	-.089	-.936	.35
	CEFI-A Flexibility	.141	.053	.267	2.683	.008
	CEFI-A Inhibitory Control	.019	.045	.037	.426	.671
	CEFI-A Initiation	-.001	.045	-.003	-.028	.977
	CEFI-A Organization	-.031	.051	-.067	-.6	.549
	CEFI-A Planning	-.102	.059	-.204	-1.732	.085
	CEFI-A Self-Monitoring	-.012	.058	-.021	-.2	.841
	CEFI-A Working Memory	-.027	.048	-.059	-.55	.583

*Note.* Model 1:  $R^2 = .171$ , Adjusted  $R^2 = .167$

Model 2:  $R^2 = .235$ , Adjusted  $R^2 = .203$ ,  $R^2$  change = .064

CEFI-A = Comprehensive Executive Function Inventory-Adult.



**Table 6***Executive Functioning Moderates the Association Between Sleep Quality and**Academic Performance*

Variables	<i>B (95% CI)</i>	<i>SE B</i>	<i>t</i>	<i>p</i>
Constant	4.04 (2.96, 5.13)	.55	7.33	<.001
Sleep Quality (Global PSQI)	-.14 (-.27, -.02)	.06	-2.27	.02
Executive Functioning (CEFI-A Full Scale)	.00 (-.01, .01)	.01	-.71	.48
PSQI x CEFI-A	.00 (.00, .00)	.00	2.04	.04

*Note.*  $R = .27$ ,  $R^2 = .07$ ,  $F(3,223) = 6.02$ ,  $p = .006$ 

PSQI = Pittsburgh Sleep Quality Index; CEFI-A = Comprehensive Executive Function

Inventory-Adult

**Table 7**

*Executive Functioning Moderates the Relationship Between Sleep Hygiene and Academic Performance*

Variables	<i>B</i> (95% <i>CI</i> )	<i>SE B</i>	<i>t</i>	<i>p</i>
Constant	4.38 (2.99, 5.76)	.70	6.25	<.001
Sleep Hygiene (SHI Total Score)	-.06 (-.12, -.01)	.03	-2.47	.01
Executive Functioning (CEFI-A Full Scale)	-.01 (-.02, .00)	.01	-1.23	.22
SHI x CEFI-A	.00 (.00, .00)	<.00	2.54	.01

*Note.*  $R = .269$ ,  $R^2 = .072$ ,  $F(3, 22) = 5.50$ ,  $p = .001$

SHI = Sleep Hygiene Index; CEFI-A = Comprehensive Executive Function Inventory-Adult.

**Table 8***Correlations for Prior Functioning Variables*

	HS-SH	HS-SQ	HS-EF	HS-ST	HS-GPA	HS-PI
HS-SH	-	-	-	-	-	-
HS-SQ	.535**	-	-	-	-	-
HS-EF	-.288**	-.337**	-	-	-	-
HS-GPA	-.233**	-.133*	.248**	-	-	-
HS-ST	-.14	-.136	.033	.162*	-	-
HS-PI	.109	.117	-.093	-.062	-.022	-

*Note.* HS-SH = High School Sleep Hygiene, HS-EF = High School Executive

Functioning, HS-SQ = High School Sleep Quality, HS-ST = High School

Standardized Testing, HS-GPA = High School Grade Point Average, HS-PI =

High School Parent Involvement

\*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

**Table 9***Correlations for Primary Variables and Prior Functioning Variables*

	Global PSQI	SHI Total	CEFI-A Full Scale	GPA
HS-SH	.226**	.410**	-.254**	-.207**
HS-SQ	.245**	.345**	-.266**	-0.117
HS-EF	-.156*	-.178**	.678**	.259**
HS-GPA	0.091	-.102	.206**	.424**
HI-PI	.140*	.161*	-0.09	-.162*

*Note.* HS-SH = High School Sleep Hygiene, HS-EF = High School Executive

Functioning, HS-SQ = High School Sleep Quality, HS-ST = High School

Standardized Testing, HS-GPA = High School Grade Point Average, HS-PI =

High School Parent Involvement, PSQI = Pittsburg Sleep Quality Index, SHI

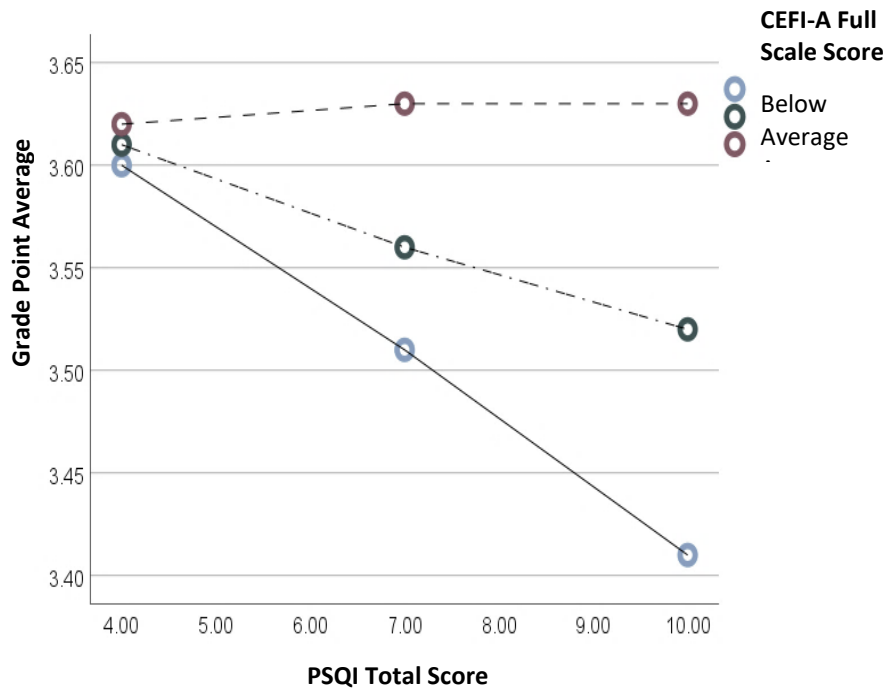
= Sleep Hygiene Index, CEFI-A = Comprehensive Executive Function

Inventory-Adult, GPA = Undergraduate Grade Point Average.

\*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

**Figure 1**

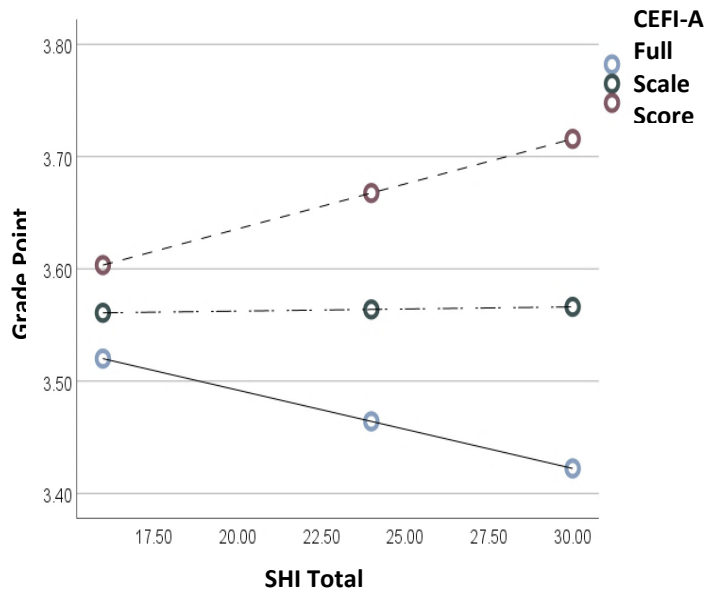
*Moderating Effects of Executive Functioning on the Relationship Between Sleep Quality and Academic Achievement*



*Note.* PSQI = Pittsburg Sleep Quality Index, CEFI-A = Comprehensive Executive Function Inventory-Adult, GPA = Undergraduate Grade Point Average; Above Average = CEFI-A Full Scale  $\geq$  84<sup>th</sup> percentile; Average = 83<sup>rd</sup> percentile > CEFI-A Full Scale > 17<sup>th</sup> percentile; Below Average = CEFI-A Full Scale  $\leq$  16<sup>th</sup> percentile

**Figure 2**

*Moderating Effects of Executive Functioning on the Relationship Between Sleep Hygiene and Academic Achievement*



*Note.* SHI = Sleep Hygiene Index, CEFI-A = Comprehensive Executive Function Inventory-Adult, GPA = Undergraduate Grade Point Average; Above Average = CEFI-A Full Scale  $\geq$  84<sup>th</sup> percentile; Average = 83<sup>rd</sup> percentile > CEFI-A Full Scale >17<sup>th</sup> percentile; Below Average = CEFI-A Full Scale  $\leq$  16<sup>th</sup> percentile.

## Appendix A

### Student Recruitment Email

Hello,

You are being asked to participate in a research study conducted by Christine O'Brien under the supervision of Dr. Mark Terjesen, of St. John's University. The purpose of this research is to better understand the role of executive functioning abilities in college students' sleep quality, sleep hygiene practices, and academic outcomes.

Participation in this study is optional and includes the completion of a survey questionnaire, which may take up to 60-minutes to complete. Participants will receive an opportunity to enter a raffle to win one of two \$50 gift cards. Please note that an e-mail address will need to be provided for this incentive, however it will not be tied to your responses in any way and is optional.

St. John's University students will be asked to provide their X-number so that academic records, including GPA can be included.

Your participation in this study completely voluntary. You may choose not to complete the questionnaire, and you can stop participation at any time. The link below includes more information regarding the study and participant involvement as well as access to the online questionnaire.

If you have any questions regarding this research study please contact either Christine O'Brien at [christine.obrien17@stjohns.edu](mailto:christine.obrien17@stjohns.edu) or Dr. Mark Terjesen at [terjesem@stjohns.edu](mailto:terjesem@stjohns.edu).

Your participation in this study is much appreciated and will help advance scientific knowledge about the role of executive functioning in sleep and academic functioning among college students.

Weblink:

[https://stjohns.az1.qualtrics.com/jfe/form/SV\\_bCWlbyXoo1uGGou?id=%SURVEY\\_CODE%](https://stjohns.az1.qualtrics.com/jfe/form/SV_bCWlbyXoo1uGGou?id=%SURVEY_CODE%)

I appreciate your consideration.

Kind Regards,

Christine O'Brien  
St. John's University, Psy.D. 2023  
[christine.obrien17@stjohns.edu](mailto:christine.obrien17@stjohns.edu)

## Appendix B

### Faculty Recruitment Email

Good afternoon –

My name is Christine O'Brien, and I am a fourth-year student in St. John's School Psychology Psy.D. program. In order to better understand the role of executive functioning in sleep and academic performance among college students, I have created a survey meant for current undergraduate students. Under the direction of my faculty advisor, Mark D. Terjesen, PhD, I intend to use the data collected in my doctoral dissertation.

I am writing to ask if you would consider disseminating information about the study and survey to your undergraduate students.

For more information, please click the link below, which will direct you to the consent form, a demographics form and survey.

Weblink:

[https://stjohns.az1.qualtrics.com/jfe/form/SV\\_bCWlbYXoo1uGGou?id=%SURVEY\\_CODE%](https://stjohns.az1.qualtrics.com/jfe/form/SV_bCWlbYXoo1uGGou?id=%SURVEY_CODE%)

If you have any questions regarding this research study, please contact Christine O'Brien at [christine.obrien17@stjohns.edu](mailto:christine.obrien17@stjohns.edu) or Dr. Mark Terjesen at [terjesem@stjohns.edu](mailto:terjesem@stjohns.edu).

Thanks very much for your consideration,

Christine O'Brien



## Appendix C

### Consent Form



#### **Introduction:**

You are invited to participate in a research study to learn more about the role of executive functioning abilities in college students' sleep quality, sleep hygiene practices, and academic outcomes. This study is conducted by Christine O'Brien under the supervision of Mark Terjesen, Ph.D. of St. John's University, Department of Psychology. Christine O'Brien is a student in the School Psychology PsyD program, and the data collected will be used to complete her doctoral dissertation.

#### **Procedures:**

You must be at least 18-years of age to participate in this study. Participation in this study is optional and includes the completion of a survey questionnaire, which may take up to 50-minutes to complete. Should you choose to participate, you will be asked to do the following:

1. Complete a questionnaire about your background (e.g. age, gender).
2. Complete a questionnaire about your executive functioning abilities.
3. Complete questionnaires about your sleep quality and sleep hygiene practices.
4. Complete a questionnaire about your prior sleep and executive skills.
5. Provide your St. John's University X-number so that your academic record, including your high school GPA, available standardized test scores (SAT, ACT), SJU GPA, major GPA, academic major, and the number of credits in which you're enrolled, can be included in the data collection.

Following completion of the surveys, participants will be invited to provide an email address for entry into a raffle drawing to receive one of two \$50 gift cards. While an e-mail address will be needed to enter the raffle, it will not be tied to your responses in any way and is optional.

#### **Benefits:**

There are no direct benefits to you for your participation in this study. However, the information obtained from this study will further advance the knowledge and understanding of the role of executive functioning skills in sleep and academic performance.

**Risks, Inconvenience, Discomfort:**

There are no known risks associated with your participation in this research beyond those of everyday life.

**Confidentiality:**

All information from this study will be kept strictly confidential and only seen by the researchers. If any publications result from this study, you will not be identified. Any data from this study will be reported in aggregate form only; individual data responses will not be reported. Data will be transferred in a HIPAA-compliant manner and will be kept in de-identified, password-protected files. The academic records released to the researchers will be reviewed only by the researchers and will be used for comparison purposes only.

**Alternatives:**

Participation in this study is voluntary. You may refuse to participate or withdraw at any time without penalty. For questionnaires or surveys, you have the right to skip or not answer any questions you prefer not to answer.

**Questions:**

If there is anything about the study or your participation that is unclear or that you do not understand, if you have questions or wish to report a research-related problem, you may contact Christine O'Brien at [christine.obrien17@stjohns.edu](mailto:christine.obrien17@stjohns.edu), or her faculty mentor, Dr. Mark Terjesen at [terjesem@stjohns.edu](mailto:terjesem@stjohns.edu).

For questions about your rights as a research participant, you may contact the University's Institutional Review Board, St. John's University, Dr. Raymond DiGiuseppe, Chair [digiuser@stjohns.edu](mailto:digiuser@stjohns.edu), 718-990-1955, or Marie Nitopi, IRB Coordinator, [nitopim@stjohns.edu](mailto:nitopim@stjohns.edu), 718-990-1440.

**Agreement to Participate**

Thank you very much for your consideration. If you agree to participate, please consent by pressing the button below. Please print a copy of this form for your records.

- I am at least 18 years of age and I voluntarily give my consent to participate in this research study. I understand that my pressing this button indicates that I have read and understood the information provided here. I understand that my participation is completely voluntary, and that my name will not be tied to the information I am providing. If at any time I do not wish to further participate, I have the right to withdraw my participation.
  - I voluntarily give my consent to the release of my academic records. My SJU X-number is: \_\_\_\_\_
- I do not wish to participate in the study.

## Appendix D

### Demographic Form

Are you currently enrolled in full time or part time study?

- Part time student
- Full time student

How many credits are you taking this semester? \_\_\_\_\_

What is your major? \_\_\_\_\_

What is your gender identity?

- Male
- Female
- Trans male/Trans man
- Trans female/Trans woman
- Gender queer/gender non-conforming

Age: \_\_\_\_\_

Race [check all that apply]:

- Black/African American
- White/Caucasian
- Asian
- Middle Eastern
- Native American
- Pacific Islander
- Other, please specify: \_\_\_\_\_

Ethnicity:

- Hispanic/Latino
- Not Hispanic/Latino

Academic standing:

- First-year Undergraduate
- Second-year Undergraduate
- Third-year Undergraduate
- Fourth-year Undergraduate
- Fifth-year Undergraduate

Select the statement that best describes your current living situation.

- I live in on-campus housing.
  - o I live alone
  - o I share a room with a roommate(s)

- I have my own room and share common spaces with roommate(s)
- I share a bed.
- I live off campus away from my family/caregivers.
  - I live alone
  - I have my own room and share common spaces with roommate(s)
  - I share a bedroom
  - I share a bed.
- I live off campus with my family/caregivers (i.e. parents, grandparents).
  - I have my own room and share common spaces with family members
  - I share a bedroom
  - I share a bed.

Including yourself, how many adults 18-years or older reside in your household?

\_\_\_\_\_

How many children under 18-years reside in your household? \_\_\_\_\_

Are you a parent or primary caregiver of a child under 18 years?    Yes    No

If yes, how old are the children you are currently caring for?

Age:  
Age:  
Age:  
Age:

How often do you use alcohol within 4 hours of going to bed?

- Never
- Rarely
- Sometimes
- Frequently
- Always

How often do you use tobacco or nicotine within 4 hours of going to bed?

- Never
- Rarely
- Sometimes
- Frequently
- Always

How often do you consume caffeine within 4 hours of going to bed?

- Never
- Rarely
- Sometimes
- Frequently
- Always

During the past month, when have you usually gone to bed on weekend nights?

\_\_\_\_\_

During the past month, when have you usually gone to bed on weekday nights?

\_\_\_\_\_

Please provide the last 5-digits of you SJU X Number: \_\_\_\_\_

Please provide your 5-digit SONA ID number: \_\_\_\_\_

Appendix E

**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 the 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 taken you to fall asleep each night?

**number of minutes** \_\_\_\_\_

3. During the past month, when have you usually got 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	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(b) Wake up in the middle of the night or early morning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(c) Have to get up to use the bathroom	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(d) Cannot breathe comfortably	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(e) Cough or snore loudly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(f) Feel too cold	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

(g) Feel too hot	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(h) Had bad dreams	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(i) Have pain	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(j) Other Reason(s), please describe: <hr/> <hr/> <hr/>				
(k) How often during the past month have you had trouble sleeping because of this?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

6. During the past month, how would you rate your sleep quality overall?	Very Good	Fairly Good	Fairly Bad	Very Bad
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

7. During the past month, how often have you taken medicine (prescribed or “over the counter”) to help you sleep?	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

8. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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 problem at all	Only a very slight problem	Somewhat of a problem	A very big problem
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

10. Do you have a bed partner or roommate?

- No bed partner or roommate \_\_\_\_\_  
 Partner/roommate in other room \_\_\_\_\_  
 Partner in same room, but not same bed \_\_\_\_\_  
 Partner in same bed \_\_\_\_\_

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	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Long pauses between breaths while asleep	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. Legs twitching or jerking while you sleep	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. Episodes of disorientation or confusion during sleep	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. Other restlessness while you sleep; please describe: _____ _____				
How often has this occurred?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Buysse, D., Reynolds, C., Monk, T., Berman, S., & Kupfer, D. (1989). The Pittsburgh sleep quality index: A new instrument for psychiatric practice and research. *Psychiatry Research*, 28(2), 193-213. doi:10.1016/0165-1781(89)90047-4



## Appendix F

### Sleep Hygiene Index (SHI)

**Instructions:** Below you will find a list of statements. Please rate how true each statement is for you by circling a number next to it. Use the scale to make your choice.

	Never 0	Rarely 1	Sometimes 2	Frequent 3	Always 4
1. I take daytime naps lasting two or more hours.	0	1	2	3	4
2. I go to bed at different times from day to day.	0	1	2	3	4
3. I get out of bed at different times from day to day.	0	1	2	3	4
4. I exercise to the point of sweating within 1 hour of going to bed.	0	1	2	3	4
5. I stay in bed longer than I should two or three times a week.	0	1	2	3	4
6. I use alcohol, tobacco, or caffeine within 4 hours of going to bed or after going to bed.	0	1	2	3	4
7. I do something that may wake me up before bedtime (for example: play video games, use the internet, or clean).	0	1	2	3	4
8. I go to bed feeling stressed, angry, upset, or nervous.	0	1	2	3	4
9. I use my bed for things other than sleeping or sex (for example: watch television, read, eat, or study)	0	1	2	3	4
10. I sleep on an uncomfortable bed (for example: poor mattress or pillow, too much or not enough blankets).	0	1	2	3	4

11. I sleep in an uncomfortable bedroom (for example: too bright, too stuffy, too hot, too cold, or too noisy).	0	1	2	3	4
12. I do important work before bedtime (for example: pay bills, schedule, or study).	0	1	2	3	4
13. I think, plan, or worry when I am in bed.	0	1	2	3	4

Mastin, D. F., Bryson, J., & Corwyn, R. (2006). Assessment of sleep hygiene using the sleep hygiene index. *Journal of Behavioral Medicine*, 29(3), 223–7. <https://doi-org.jerome.stjohns.edu/10.1007/s10865-006-9047-6>

## Appendix G

### Sleep Belief Scale (SBS)

**Instructions:** For the following list of behaviors, please indicate whether you believe they produce a “positive” effect, a “negative” effect, or “neither” effect on sleep. Please do not make reference to how they influence your sleep in particular, but to the affects you think these behaviors have on people in general. Please answer ALL the statements by checking the appropriate box, even if you are not completely sure of the answer.

	Positive Effect	Negative Effect	Neither Effect
1. Drinking alcohol in the evening	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Drinking coffee or other substances with caffeine after dinner	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Doing intense physical exercise before going to bed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Taking a long nap during the day	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Going to bed and waking up always at the same hour	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Thinking about one’s engagements for the next day before falling asleep	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Using sleep medication regularly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Smoking before falling asleep	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Diverting one’s attention and relaxing before bedtime	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Going to bed 2 h later than the habitual hour	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Going to bed with an empty stomach	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Using the bed for eating, calling on the phone, studying and other non-sleeping activities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

- |   |                          |                          |                          |
|---|--------------------------|--------------------------|--------------------------|
| 13. Trying to fall asleep<br>without having a sleep<br>sensation        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 14. Studying or working<br>intensely until late night                   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 15. Getting up when it is<br>difficult to fall asleep                   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 16. Going to bed 2 h earlier<br>than the habitual hour                  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 17. Going to bed<br>immediately after eating                            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 18. Being worried about the<br>impossibility of getting<br>enough sleep | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 19. Sleeping in a quiet and<br>dark room                                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 20. Recovering lost sleep by<br>sleeping for a long time                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Adan, A., Fabbri, M., Natale, V, & Prat, G. (2006). Sleep beliefs scale (SBS) and circadian typology. *Journal of Sleep Research*, 15(2), 125–132. <https://doi-org.jerome.stjohns.edu/10.1111/j.1365-2869.2006.00509.x>

## Appendix H

### Comprehensive Executive Function Inventory Adult (CEFI-A)

**Instructions:** Read each statement that follows the phrase, “During the past four weeks, how often did you...,” then circle the letter under the word that tells how often it happened. Read each question carefully, then mark how often it happened in the past four weeks. Answer every question without skipping any.

<i>During the past four weeks, how often did you...</i>	Never	Rarely	Sometimes	Often	Very Often	Always
1. Show self-control?	N	R	S	O	V	A
2. Have trouble finding things?	N	R	S	O	V	A
3. Maintain self-control?	N	R	S	O	V	A
4. Plan ahead?	N	R	S	O	V	A
5. Remember many things at one time?	N	R	S	O	V	A
6. Know when a task was completed?	N	R	S	O	V	A
7. Come up with different ways to solve problems?	N	R	S	O	V	A
8. Pay attention for a long time?	N	R	S	O	V	A
9. Have trouble solving problems?	N	R	S	O	V	A
10. Start tasks easily?	N	R	S	O	V	A
11. Get upset?	N	R	S	O	V	A
12. Get things done efficiently?	N	R	S	O	V	A
13. Think of the consequences before acting?	N	R	S	O	V	A
14. Pay attention during a boring task?	N	R	S	O	V	A
15. Forget to do things?	N	R	S	O	V	A
16. Know what to do first?	N	R	S	O	V	A
17. Stay calm when handling small problems?	N	R	S	O	V	A
18. Like everyone you met?	N	R	S	O	V	A
19. Accept a different way of doing things?	N	R	S	O	V	A

20. Need others to tell you to get started on things?	N	R	S	O	V	A
21. Work neatly?	N	R	S	O	V	A
22. Have trouble listening to instructions?	N	R	S	O	V	A
23. Keep all your commitments?	N	R	S	O	V	A
24. Remember instructions with many steps?	N	R	S	O	V	A
25. Keep track of time?	N	R	S	O	V	A
26. Prepare for upcoming events?	N	R	S	O	V	A
27. find it hard to control your emotions?	N	R	S	O	V	A
28. get things done on time?	N	R	S	O	V	A
29. respond thoughtfully?	N	R	S	O	V	A
30. fail to put plans into action?	N	R	S	O	V	A
31. work well in a noisy environment?	N	R	S	O	V	A
32. hold several ideas in memory?	N	R	S	O	V	A
33. have trouble judging how long it takes to do something?	N	R	S	O	V	A
34. react with the right level of emotion?	N	R	S	O	V	A
35. start something without being asked?	N	R	S	O	V	A
36. pay attention to details?	N	R	S	O	V	A
37. have good thoughts about everyone?	N	R	S	O	V	A
38. notice your mistakes?	N	R	S	O	V	A
39. think through your decisions?	N	R	S	O	V	A
40. manage frustration?	N	R	S	O	V	A
41. change your behavior as needed?	N	R	S	O	V	A
42. need others to tell you to do things?	N	R	S	O	V	A
43. manage time effectively?	N	R	S	O	V	A

44. have trouble waiting your turn?	N	R	S	O	V	A
45. concentrate while reading?	N	R	S	O	V	A
46. get bothered by something?	N	R	S	O	V	A
47. follow instructions well?	N	R	S	O	V	A
48. learn from past mistakes?	N	R	S	O	V	A
49. solve problems creatively?	N	R	S	O	V	A
50. become upset in new situations?	N	R	S	O	V	A
51. compromise when needed?	N	R	S	O	V	A
52. appear motivated?	N	R	S	O	V	A
53. organize your thoughts well?	N	R	S	O	V	A
54. have trouble waiting to get what you wanted?	N	R	S	O	V	A
55. notice how your actions affected others?	N	R	S	O	V	A
56. make a mistake?	N	R	S	O	V	A
57. remember important things?	N	R	S	O	V	A
58. respond calmly to delays?	N	R	S	O	V	A
59. consider other points of view?	N	R	S	O	V	A
60. get distracted?	N	R	S	O	V	A
61. organize tasks well?	N	R	S	O	V	A
62. have a bad day?	N	R	S	O	V	A
63. ask for help when needed?	N	R	S	O	V	A
64. resist change?	N	R	S	O	V	A
65. think before acting?	N	R	S	O	V	A
66. stay on topic when talking?	N	R	S	O	V	A
67. keep goals in mind when making decisions?	N	R	S	O	V	A
68. make careless errors?	N	R	S	O	V	A
69. come up with a new way to reach a goal?	N	R	S	O	V	A
70. get upset when plans were changed?	N	R	S	O	V	A
71. start a task without help?	N	R	S	O	V	A

72. appear disorganized?	N	R	S	O	V	A
73. think before speaking?	N	R	S	O	V	A
74. tell a fib?	N	R	S	O	V	A
75. fix your mistakes?	N	R	S	O	V	A
76. forget where you put things?	N	R	S	O	V	A
77. make good decisions?	N	R	S	O	V	A
78. control emotions when under stress?	N	R	S	O	V	A
79. react well to new demands?	N	R	S	O	V	A
80. take initiative?	N	R	S	O	V	A



Appendix I

**Comparison Questions**

**Sleep Quality Comparison Questions**

1. As a senior in high school, when did you typically go to bed at night?  
**usual bedtime** \_\_\_\_\_
  
2. As a senior in high school, how long (in minutes) did it usually take you to fall asleep each night?  
**number of minutes** \_\_\_\_\_
  
3. As a senior in high school, what time did you typically get up in the morning?  
**usual getting up time** \_\_\_\_\_
  
4. During your senior year of high school, how many hours of *actual* sleep did you get at night? (This may be different than the number of hours you spent in bed).  
**Hours of sleep per night** \_\_\_\_\_

- |   | Very Good                | Fairly Good              | Fairly Bad               | Very Bad                 |
|---|--------------------------|--------------------------|--------------------------|--------------------------|
| 5. During your senior year of high school, how would you rate your sleep quality overall? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

**Sleep Hygiene Comparison Questions**

	Never 0	Rarely 1	Sometimes 2	Frequent 3	Always 4
1. As a senior in high school, I took naps lasting two or more hours.	0	1	2	3	4
2. As a senior in high school, I went to bed at different times from day to day.	0	1	2	3	4
3. As a senior in high school, I got out of bed at different times from day to day.	0	1	2	3	4

### Executive Functioning Comparison Questions

**Instructions:** Read each statement that follows the phrase, “As a high school senior, how often did you...,” then circle the letter under the word that tells how often it happened. Read each question carefully, then mark how often it happened during your last year of high school. Answer every question without skipping any.

<i>As a high school senior, how often did you...</i>	Never	Rarely	Sometimes	Often	Very Often	Always
1. pay attention to details?	N	R	S	O	V	A
2. organize your thoughts well?	N	R	S	O	V	A
3. react well to new demands?	N	R	S	O	V	A
4. solve problems creatively?	N	R	S	O	V	A
5. know what to do first?	N	R	S	O	V	A
6. think through your decisions?	N	R	S	O	V	A
7. keep track of time?	N	R	S	O	V	A
8. learn from past mistakes?	N	R	S	O	V	A
9. start tasks easily?	N	R	S	O	V	A
10. take initiative?	N	R	S	O	V	A
11. remember important things?	N	R	S	O	V	A
12. keep goals in mind when making decisions?	N	R	S	O	V	A
13. follow instructions well?	N	R	S	O	V	A
14. organize tasks well?	N	R	S	O	V	A
15. get things done on time?	N	R	S	O	V	A

### HS-Parent Involvement Questions

Read the following statements and rate how true each statement was for you *during your senior year of high school*.

- |  |                          |                          |                          |                          |
|--|--------------------------|--------------------------|--------------------------|--------------------------|
|  | N                        | S                        | O                        | A                        |
| 1. My parent(s) set my bedtime.            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. My parent(s) woke me up in the morning. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

- |  |                          |                          |                          |                          |
|--|--------------------------|--------------------------|--------------------------|--------------------------|
| 3. My parent had to remind me to do assignments. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. My parent(s) reminded me to study for tests.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. My parent(s) helped me manage my assignments. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

## REFERENCES

- Adan, A., Fabbri, M., Natale, V., & Prat, G. (2006). Sleep beliefs scale (SBS) and circadian typology. *Journal of Sleep Research, 15*(2), 125–132. <https://doi-org.jerome.stjohns.edu/10.1111/j.1365-2869.2006.00509.x>
- Afandi, O., Et. Al. (2013). "Sleep Quality Among University Students: Evaluating the Impact of Smoking, Social Media Use, and Energy Drink Consumption on Sleep Quality and Anxiety." *Inquiries Journal/Student Pulse, 5*(06). Retrieved from <http://www.inquiriesjournal.com/a?id=738>
- Allan, J. L., McMinn, D., & Daly, M. (2016). A Bidirectional Relationship between Executive Function and Health Behavior: Evidence, Implications, and Future Directions. *Frontiers in neuroscience, 10*, 386. <https://doi.org/10.3389/fnins.2016.00386>
- Almojali, A. I., Almalki, S. A., Alothman, A. S., Masuadi, E. M., & Alaqeel, M. K. (2017). The prevalence and association of stress with sleep quality among medical students. *Journal of epidemiology and global health, 7*(3), 169–174. <https://doi.org/10.1016/j.jegh.2017.04.005>
- American Academy of Sleep Medicine. (2014). *International classification of sleep disorders: Diagnostic and coding manual*. 3rd ed. Darien, IL: American Academy of Sleep Medicine.
- American College Health Association (2019). American College Health Association: National College Health Assessment II: Reference Group Executive Summary Spring 2019. Silver Spring, MD: American College Health Association; 2019.

- American College Health Association (2020). American College Health Association: National College Health Assessment II: Undergraduate Student Reference Group Data Report Fall 2019. Silver Spring, MD: American College Health Association; 2020.
- American Sleep Disorders Association (1990). *International Classification of Sleep Disorders: Diagnostic and Coding Manual*. Rochester, NY: American Sleep Disorders Association
- Armbruster, D. J. N., Ueltzhöffer Kai, Basten, U., & Fiebach, C. J. (2012). Prefrontal cortical mechanisms underlying individual differences in cognitive flexibility and stability. *Journal of Cognitive Neuroscience*, 24(12), 2385–2385.
- Arnett, J. J. (2000). Emerging adulthood: A theory of development from the late teens through the twenties. *American Psychologist*, 55(5), 469–480. <https://doi.org/10.1037/0003-066X.55.5.469>
- Arnett, J. J. (2015). *Emerging Adulthood: The Winding Road From the Late Teens Through the Twenties: Vol. Second edition*. Oxford University Press.
- Baars, M. A. E., Nije Bijvank, M., Tonnaer, G. H., & Jolles, J. (2015). Self-report measures of executive functioning are a determinant of academic performance in first-year students at a university of applied sciences. *Frontiers in Psychology*, 6, 1131–1131. <https://doi.org/10.3389/fpsyg.2015.01131>
- Beauvalet, J. C., Quiles, C. L., de Oliveira, M. A. B., Ilgenfritz, C. A. V., Hidalgo, M. P. L., & Tonon, A. C. (2017). Social jetlag in health and behavioral research: A systematic review. *ChronoPhysiology and Therapy*, 7, 19-31.  
Doi:10.2147/cpt.s108750

- Becker, S., Dvorsky, M., Holdaway, A., & Luebbe, A. (2018). Sleep problems and suicidal behaviors in college students. *Journal of Psychiatric Research, 99*, 122-128. [doi:10.1016/j.jpsychires.2018.01.009](https://doi.org/10.1016/j.jpsychires.2018.01.009)
- Beiter R, Nash R, McCrady M, Rhoades D, Linscomb M, Clarahan M, Sammut S. The prevalence and correlates of depression, anxiety, and stress in a sample of college students. *J Affect Disord.* 2015 Mar 1;173:90-6. doi: 10.1016/j.jad.2014.10.054.
- Berkman, E. T., Falk, E. B., & Lieberman, M. D. (2011). In the trenches of real-world self-control: neural correlates of breaking the link between craving and smoking. *Psychological Science, 22*(4), 498–498. Doi: 10.1177/0956797611400918
- Blunden, S. L., Chapman, J., & Rigney, G. A. (2012). Are sleep education programs successful? the case for improved and consistent research efforts. *Sleep Medicine Reviews, 16*(4), 355–70. <https://doi-org.jerome.stjohns.edu/10.1016/j.smr.2011.08.002>
- Bolden, J., Gilmore-Kern, J. E., & Fillauer, J. P. (2019). Associations among sleep problems, executive dysfunctions, and attention-deficit/hyperactivity disorder symptom domains in college students. *Journal of American college health : J of ACH, 67*(4), 320–327. <https://doi.org/10.1080/07448481.2018.1481070>
- Borisenkov, M. F., Perminova, E. V., & Kosova, A. L. (2010). Chronotype, sleep length, and school achievement of 11- to 23-year-old students in northern European Russia. *Chronobiology International, 27*(6), 1259–1270. <https://doi-org.jerome.stjohns.edu/10.3109/07420528.2010.487624>
- Buchanan T. (2016). Self-report measures of executive function problems correlate with personality, not performance-based executive function measures, in nonclinical

samples. *Psychological assessment*, 28(4), 372–385.

<https://doi.org/10.1037/pas0000192>

Buysse, D., Reynolds, C., Monk, T., Berman, S., & Kupfer, D. (1989). The Pittsburgh sleep quality index: A new instrument for psychiatric practice and research. *Psychiatry Research*, 28(2), 193-213. doi:10.1016/0165-1781(89)90047-4

Carrión-Pantoja, S., Prados, G., Chouchou, F., Holguín, M., Mendoza-Vinces, Á., Expósito-Ruiz, M., & Fernández-Puerta, L. (2022). Insomnia Symptoms, Sleep Hygiene, Mental Health, and Academic Performance in Spanish University Students: A Cross-Sectional Study. *Journal of clinical medicine*, 11(7), 1989. <https://doi.org/10.3390/jcm11071989>

Cifre, A. B., Walters, K. S., & Budnick, C. J. (2020). College student sleep and executive functioning: An examination of potential moderators. *Translational Issues in Psychological Science*, 6(4), 412-427. <https://doi-org.jerome.stjohns.edu/10.1037/tps0000258>

Darlow, V., Norvilitis, J. M., & Schuetze, P. (2017). The relationship between helicopter parenting and adjustment to college. *Journal of Child and Family Studies*, 26(8), 2291–2298. <https://doi-org.jerome.stjohns.edu/10.1007/s10826-017-0751-3>

Diamond, A. (2013). Executive functions. *Annual Review of Psychology*, 64(1), 135–168. <https://doi.org/10.1146/annurev-psych-113011-143750>

Dietrich, S. K., Francis-Jimenez, C. M., Knibbs, M. D., Umali, I. L., & Truglio-Londrigan, M. (2016). Effectiveness of sleep education programs to improve

sleep hygiene and/or sleep quality in college students: a systematic review.

*Database of Systematic Reviews and Implementation Reports*, 14(9), 108–134.

Ellakany P, Zuñiga RAA, El Tantawi M, Brown B, Aly NM, Ezechi O. (2022). Impact of the COVID-19 pandemic on student' sleep patterns, sexual activity, screen use, and food intake: A global survey. *PLoS One*, 17(1): e0262617.

<https://doi.org/10.1371/journal.pone.0262617>

Fernie, G., Peeters, M., Gullo, M. J., Christiansen, P., Cole, J. C., Sumnall, H., & Field, M. (2013). Multiple behavioural impulsivity tasks predict prospective alcohol involvement in adolescents. *Addiction (Abingdon, England)*, 108(11), 1916–1923.

<https://doi.org/10.1111/add.12283>

Ferraro, F. R., Holfeld, B., Frankl, S., Frye, N., & Halvorson, N. (2015). Texting/ipod dependence, executive function and sleep quality in college students. *Computers in Human Behavior*, 49, 44–49. <https://doi.org/10.1016/j.chb.2015.02.043>

Friedrich, A., & Schlarb, A. A. (2018). Let's talk about sleep: a systematic review of psychological interventions to improve sleep in college students. *Journal of Sleep Research*, 27(1), 4–22. DOI: 10.1111/jsr.12568

Gilbert, S. P., & Weaver, C. C. (2010). Sleep quality and academic performance in university students: a wake-up call for college psychologists. *Journal of College Student Psychotherapy*, 24(4), 295–306. [https://doi-](https://doi-org.jerome.stjohns.edu/10.1080/87568225.2010.509245)

[org.jerome.stjohns.edu/10.1080/87568225.2010.509245](https://doi-org.jerome.stjohns.edu/10.1080/87568225.2010.509245)

Gilmore, C., Attridge, N., Clayton, S., Cragg, L., Johnson, S., Marlow, N., Simms, V., Inglis, M., Chambers, C. (2013). Individual differences in inhibitory control, not



- non-verbal number acuity, correlate with mathematics achievement. *PLOS One*, 8(6), 67374. <https://doi-org.jerome.stjohns.edu/10.1371/journal.pone.0067374>
- Gomes, A. A., Tavares José, & de Azevedo, M. H. P. (2011). Sleep and academic performance in undergraduates: a multi-measure, multi-predictor approach. *Chronobiology International*, 28(9), 786–801. <https://doi-org.jerome.stjohns.edu/10.3109/07420528.2011.606518>
- Gruber, R., & Cassoff, J. (2014). The interplay between sleep and emotion regulation: conceptual framework empirical evidence and future directions. *Current Psychiatry Reports*, 16(11), 500–500. <https://doi.org/10.1007/s11920-014-0500-x>
- Guarnieri, S., Smorti, M., & Tani, F. (2015). Attachment Relationships and Life Satisfaction During Emerging Adulthood. *Social Indicators Research*, 121(3), 833-847. <http://dx.doi.org.jerome.stjohns.edu:81/10.1007/s11205-014-0655-1>
- Hall, P. A., & Fong, G. T. (2013). Temporal self-regulation theory: integrating biological, psychological and ecological determinants of health behavior performance. In *Social Neuroscience and Public Health*, ed. P. A. Hall. New York, NY: Springer, p. 35-53.
- Hall, P. A., & Fong, G. T. (2015). Temporal self-regulation theory: a neurobiologically informed model for physical activity behavior. *Frontiers in human neuroscience*, 9, 117. <https://doi.org/10.3389/fnhum.2015.00117>
- Hall, P. A., & Marteau, T. M. (2014). Executive function in the context of chronic disease prevention: theory, research and practice. *Preventative Medicine*, 68, 44-0. <https://doi-org.jerome.stjohns.edu/10.1016/j.ypm.2014.07.008>

- Hall, P. A., Fong, G. T., Epp, L. J., & Elias, L. J., (2008). Executive function moderates the intention-behavior link for physical activity and dietary behavior. *Psychology & Health, 23*(3), <http://doi-org.jerome.stjohns.edu/10.1080/14768320701212099>
- Hauri, P. (1977). *The Sleep Disorders: Current concepts*. Kalamazoo: Scope Publications, The Upjohn Company.
- Hayley, A., Sivertsen, B., Hysing, M., Vedaa, Ø, & Øverland, S. (2017). Sleep difficulties and academic performance in Norwegian higher education students. *British Journal of Educational Psychology, 87*(4), 722-737. doi:10.1111/bjep.12180
- Hershner, S. D., & Chervin, R. D. (2014). Causes and consequences of sleepiness among college students. *Nature and science of sleep, 6*, 73–84.  
<https://doi.org/10.2147/NSS.S62907>
- Hershner, S. D., & O'Brien, L. M. (2018). The impact of a randomized sleep education intervention for college students. *Journal of Clinical Sleep Medicine, 14*(3), 337-347. <https://doi.org/10.5664/jcsm.6974>
- Hofmann, W., Baumeister, R. F., Förster, G., & Vohs, K. D. (2012). Everyday temptations: An experience sampling study of desire, conflict, and self-control. *Journal of Personality and Social Psychology, 102*(6), 1318–1335.  
<https://doi.org/10.1037/a0026545>
- Honn, K. A., Hinson, J. M., Whitney, P., & Van Dongen, H. (2019). Cognitive flexibility: A distinct element of performance impairment due to sleep deprivation. *Accident; analysis and prevention, 126*, 191–197. <https://doi.org/10.1016/j.aap.2018.02.013>

- Huang, Z., & Kämpfen, F. (2021). The association between depressive symptoms and self-reported sleep difficulties among college students: Truth or reporting bias? *PLoS ONE*, 16(2), 1–22. <https://doi-org.jerome.stjohns.edu/10.1371/journal.pone.0246370>
- Irish, L. A., Kline, C. E., Gunn, H. E., Buysse, D. J., & Hall, M. H. (2015). The role of sleep hygiene in promoting public health: a review of empirical evidence. *Sleep Medicine Reviews*, 22, 23–36. <https://doi-org.jerome.stjohns.edu/10.1016/j.smr.2014.10.001>
- Job, V., Friese, M., & Bernecker, K. (2015). Effects of practicing self-control on academic performance. *Motivation Science*, 1(4), 219–232. <https://doi.org/10.1037/mot0000024>
- Johnson, D. A., Jackson, C. L., Williams, N. J., & Alcántara, C. (2019). Are sleep patterns influenced by race/ethnicity - a marker of relative advantage or disadvantage? Evidence to date. *Nature and science of sleep*, 11, 79–95. <https://doi.org/10.2147/NSS.S169312>
- Johnston, L. D., Miech, R. A., O'Malley, P. M., Bachman, J. G., Schulenberg, J. E., & Patrick, M. E. (2019). *Monitoring the Future national survey results on drug use 1975-2018: Overview, key findings on adolescent drug use*. Ann Arbor: Institute for Social Research, University of Michigan. Web site: [http://www.isr.umich.edu](http://www.isr.umich.edu;); WorldCat.org.
- Kercood, S., Lineweaver, T. T., Frank, C. C., & Fromm, E. D. (2017). Cognitive flexibility and its relationship to academic achievement and career choice of college students with and without attention deficit hyperactivity disorder. *Journal of Postsecondary Education and Disability*, 30(4), 329–344.

- Kloss, J. D., Nash, C. O., Walsh, C. M., Culnan, E., Horsey, S., & Sexton-Radek, K. (2016). A "sleep 101" program for college students improves sleep hygiene knowledge and reduces maladaptive beliefs about sleep. *Behavioral Medicine*, 42(1), 48–56. <https://doi-org.jerome.stjohns.edu/10.1080/08964289.2014.969186>
- Knouse, L. E., Blevins, E. J., & Feldman, G. (2014). Executive functioning difficulties as predictors of academic performance: examining the role of grade goals. *Learning and Individual Differences*, 36, 19–26. <https://doi.org/10.1016/j.lindif.2014.07.001>
- Komarraju, M., & Nadler, D. (2013). Self-efficacy and academic achievement: why do implicit beliefs, goals, and effort regulation matter? *Learning and Individual Differences*, 25, 67–72. <https://doi.org/10.1016/j.lindif.2013.01.005>
- Kor, K., & Mullan, B. A. (2011). Sleep hygiene behaviours: an application of the theory of planned behaviour and the investigation of perceived autonomy support, past behaviour and response inhibition. *Psychology and Health*, 26(9), 1208–1224. <https://doi.org/10.1080/08870446.2010.551210>
- Lacks, P., & Rotert, M. (1986). Knowledge and practice of sleep hygiene techniques in insomniacs and good sleepers. *Behaviour research and therapy*, 24(3), 365–368. [https://doi.org/10.1016/0005-7967\(86\)90197-x](https://doi.org/10.1016/0005-7967(86)90197-x)
- Levenson, J. C., Miller, E., Hafer, B., Reidell, M. F., Buysse, D. J., & Franzen, P. L. (2016). Pilot Study of a Sleep Health Promotion Program for College Students. *Sleep health*, 2(2), 167–174. doi:10.1016/j.sleh.2016.03.006
- López-Castro T, Brandt L, Anthonipillai NJ, Espinosa A, Melara R (2021) Experiences, impacts and mental health functioning during a COVID-19 outbreak and

- lockdown: Data from a diverse New York City sample of college students. *PLoS One*, 16(4): e0249768. <https://doi.org/10.1371/journal.pone.0249768>
- Lund, H., B.A., Reider, B., B.A., Whiting, A., R.N., & Prichard, J. (2010). Sleep patterns and predictors of disturbed sleep in a large population of college students. *Journal of Adolescent Health*, 46(2), 124-132. doi:10.1016/j.jadohealth.2009.06.016
- Mahoney, C. R., Giles, G. E., Marriott, B. P., Judelson, D. A., Glickman, E. L., Geiselman, P. J., & Lieberman, H. R. (2019). Intake of caffeine from all sources and reasons for use by college students. *Clinical Nutrition*, 38(2), 668–675.
- Mastin, D., Bryson, J., & Corwyn, R. (2006). Assessment of sleep hygiene using the sleep hygiene index. *Journal of Behavioral Medicine*, 29(3), 223-7. doi:10.1007/s10865-006-9047-6
- McAuley, E., Mullen, S. P., Szabo, A. N., White, S. M., Wójcicki, T. R., Mailey, E. L., Gothe, N. P., Olson, E. A., Voss, M., Erickson, K., Prakash, R., & Kramer, A. F. (2011). Self-regulatory processes and exercise adherence in older adults: executive function and self-efficacy effects. *American journal of preventive medicine*, 41(3), 284–290. <https://doi.org/10.1016/j.amepre.2011.04.014>
- Medic, G., Wille, M., & Hemels, M. E. (2017). Short- and long-term health consequences of sleep disruption. *Nature and science of sleep*, 9, 151–161. <https://doi.org/10.2147/NSS.S134864>
- Mega, C., Ronconi, L., & De Beni, R. (2014). What makes a good student? how emotions, self-regulated learning, and motivation contribute to academic achievement. *Journal of Educational Psychology*, 106(1), 121–121.

- Miyake, A., & Friedman, N. P. (2012). The nature and organization of individual differences in executive functions: four general conclusions. *Current Directions in Psychological Science*, 21(1), 8–8. <https://doi-org.jerome.stjohns.edu/10.1177/0963721411429458>
- Moulin, K. L., & Chung, C.J. (2016). Technology trumping sleep: impact of electronic media and sleep in late adolescent students. *Journal of Education and Learning*, 6(1), 294–294. <https://doi.org/10.5539/jel.v6n1p294>
- Naglieri, J. A., & Goldstein, S. (2017). Comprehensive executive function inventory adult (CEFI-A). Multi-Health Systems.
- National Sleep Foundation. (2011). 2011 *Sleep in America Poll: Communications Technology in the Bedroom: Summary of findings*. National Sleep Foundation. Retrieved from: [http://sleepfoundation.org/sites/default/files/sleepinamericapoll/SIAP\\_2011\\_Summary\\_of\\_Findings.pdf](http://sleepfoundation.org/sites/default/files/sleepinamericapoll/SIAP_2011_Summary_of_Findings.pdf).
- National Sleep Foundation. (2019). *Sleep in America Poll: Sleep Health & Scheduling Summary of Findings*. Retrieved from: [https://www.sleepfoundation.org/wp-content/uploads/2019/02/SIA\\_2019\\_Sleep\\_Health\\_and\\_Scheduling.pdf?x57153](https://www.sleepfoundation.org/wp-content/uploads/2019/02/SIA_2019_Sleep_Health_and_Scheduling.pdf?x57153)
- National Sleep Foundation's Updated Sleep Duration Recommendations: Final Report (2015). *Sleep Health: Journal of the National Sleep Foundation*, 1(4) 233–243.
- Nota, J. A., & Coles, M. E. (2015). Duration and timing of sleep are associated with repetitive negative thinking. *Cognitive Therapy and Research*, 39(2), 253–261. <https://doi-org.jerome.stjohns.edu/10.1007/s10608-014-9651-7>

- Okano, K., Kaczmarzyk, J. R., Dave, N., Gabrieli, J., & Grossman, J. C. (2019). Sleep quality, duration, and consistency are associated with better academic performance in college students. *NPJ science of learning*, 4, 16. <https://doi.org/10.1038/s41539-019-0055-z>
- Orzech, K., Salafsky, D., & Hamilton, L. (2011). The state of sleep among college students at a large public university. *Journal of American College Health*, 59(7), 612-612. doi:10.1080/07448481.2010.520051
- Panos, S. E., Del Re, A. C., Thames, A. D., Arentsen, T. J., Patel, S. M., Castellon, S. A., Singer, E. J., & Hinkin, C. H. (2014). The impact of neurobehavioral features on medication adherence in HIV: evidence from longitudinal models. *AIDS care*, 26(1), 79–86. <https://doi.org/10.1080/09540121.2013.802275>
- Peach, H. D., Gaultney, J. F., & Ruggiero, A. R. (2018). Direct and indirect associations of sleep knowledge and attitudes with objective and subjective sleep duration and quality via sleep hygiene. *Journal of Primary Prevention*, 39(6), 555–570. <https://doi-org.jerome.stjohns.edu/10.1007/s10935-018-0526-7>
- Peeters, M., Janssen, T., Monshouwer, K., Boendermaker, W., Pronk, T., Wiers, R., & Vollebergh, W. (2015). Weaknesses in executive functioning predict the initiating of adolescents' alcohol use. *Developmental cognitive neuroscience*, 16, 139–146. <https://doi.org/10.1016/j.dcn.2015.04.003>
- Peltzer, K., Pengpid, S. (2015). Nocturnal sleep problems among university students from 26 countries. *Sleep Breath* 19, 499–508. <https://doi.org/10.1007/s11325-014-1036-3>

- Petersen, R., Lavelle, E., & Guarino, A. J. (2006). The relationship between college students' executive functioning and study strategies. *Journal of College Reading and Learning, 36*(2), 59–67.
- Philip, P., Sagaspe, P., Prague, M., Tassi, P., Capelli, A., Bioulac, B., Commenges, D., & Taillard, J. (2012). Acute versus chronic partial sleep deprivation in middle-aged people: differential effect on performance and sleepiness. *Sleep, 35*(7), 997–1002. <https://doi.org/10.5665/sleep.1968>
- Pickens, S., Ostwald, S. K., Murphy-Pace, K., & Bergstrom, N. (2010). Systematic review of current executive function measures in adults with and without cognitive impairments. *International Journal of Evidence-Based Healthcare, 8*(3), 110–25. <https://doi-org.jerome.stjohns.edu/10.1111/j.1744-1609.2010.00170.x>
- Rabin, L. A., Fogel, J., & Nutter-Upham, K. E. (2011). Academic procrastination in college students: the role of self-reported executive function. *Journal of Clinical and Experimental Neuropsychology, 33*(3), 344–57. <https://doi-org.jerome.stjohns.edu/10.1080/13803395.2010.518597>
- Regestein, Q., Natarajan, V., Pavlova, M., Kawasaki, S., Gleason, R., & Koff, E. (2010). Sleep debt and depression in female college students. *Psychiatry Research, 176*(1), 34–39. [doi:10.1016/j.psychres.2008.11.006](https://doi.org/10.1016/j.psychres.2008.11.006)
- Reimann, Z., Miller, J. R., Dahle, K. M., Hooper, A. P., Young, A. M., Goates, M. C., Magnusson, B. M., & Crandall, A. A. (2020). Executive functions and health behaviors associated with the leading causes of death in the United States: a systematic review. *Journal of Health Psychology, 25*(2), 186–196. <https://doi.org/10.1177/1359105318800829>



- Sandru, C., & Voinescu, B. I. (2014). The relationship between emotion regulation, dysfunctional beliefs about sleep and sleep quality - an exploratory study. *Journal of Evidence - Based Psychotherapies*, 14(2), 249–257. Retrieved from <https://search-proquest-com.jerome.stjohns.edu/docview/1619888419?accountid=14068>
- Schlarb, A. A., Friedrich, A., & Claßen, M. (2017). Sleep problems in university students - an intervention. *Neuropsychiatric disease and treatment*, 13, 1989–2001. <https://doi.org/10.2147/NDT.S142067>
- Semrud-Clikeman, M., & Harder, L. (2011). Neuropsychological Correlates of Written Expression in College Students With ADHD. *Journal of Attention Disorders*, 15(3), 215–223. <https://doi.org/10.1177/1087054709359169>
- Seun-Fadipe, C. T., Aloba, O. O., Oginni, O. A., & Mosaku, K. S. (2018). Sleep Hygiene Index: Psychometric Characteristics and Usefulness as a Screening Tool in a Sample of Nigerian Undergraduate Students. *Journal of clinical sleep medicine: JCSM: official publication of the American Academy of Sleep Medicine*, 14(8), 1285–1292. <https://doi.org/10.5664/jcsm.7256>
- Sheehan, W. A., & Iarocci, G. (2019). Executive Functioning Predicts Academic But Not Social Adjustment to University. *Journal of Attention Disorders*, 23(14), 1792–1800. <https://doi.org/10.1177/1087054715612258>
- Sheeran, P., Godin, G., Conner, M., & Germain, M. (2017). Paradoxical effects of experience: past behavior both strengthens and weakens the intention-behavior relationship. *Journal of the Association for Consumer Research*, 2(3), 309–318. <https://doi.org/10.1086/691216>

- Taheri, M., & Arabameri, E. (2012). The effect of sleep deprivation on choice reaction time and anaerobic power of college student athletes. *Asian journal of sports medicine*, 3(1), 15–20. <https://doi.org/10.5812/asjasm.34719>
- Taylor, D. J., Bramoweth, A. D., Grieser, E. A., Tatum, J. I., & Roane, B. M. (2013). Epidemiology of insomnia in college students: relationship with mental health, quality of life, and substance use difficulties. *Behavior therapy*, 44(3), 339–348. <https://doi.org/10.1016/j.beth.2012.12.001>
- Taylor, D., Vathauer, K., Bramoweth, A., Ruggero, C., & Roane, B. (2013). The role of sleep in predicting college academic performance: Is it a unique predictor? *Behavioral Sleep Medicine*, 11(3), 159-159. [doi:10.1080/15402002.2011.602776](https://doi.org/10.1080/15402002.2011.602776)
- Todd, J., & Mullan, B. (2013). The role of self-regulation in predicting sleep hygiene in university students. *Psychology, Health & Medicine*, 18(3), 275–288. <https://doi.org/10.1080/13548506.2012.701756>
- Todd, J., & Mullan, B. (2014). The role of self-monitoring and response inhibition in improving sleep behaviours. *International Journal of Behavioral Medicine: Official Journal of the International Society of Behavioral Medicine*, 21(3), 470–477. <https://doi.org/10.1007/s12529-013-9328-8>
- U.S. Department of Education, National Center for Education Statistics. (2019). *The Condition of Education 2019* (2019-144), [Immediate College Enrollment Rate](https://nces.ed.gov/ipeds/data/ipedsdatatools/indicators/coe/cpa/cpa_2019_05.pdf). Retrieved from: [https://nces.ed.gov/programs/coe/pdf/Indicator\\_CPA/coe\\_cpa\\_2019\\_05.pdf](https://nces.ed.gov/programs/coe/pdf/Indicator_CPA/coe_cpa_2019_05.pdf)

- Vadnais, S. A., Kibby, M. Y., Anastasiou, D., Cashel, M. L., Dollinger, S., & Fehr, K. (2018). Executive functioning as a predictor of college student writing ability. ProQuest Dissertations and Theses (2018)
- Voinescu, B. I., & Szentagotai-Tatar, A. (2015). Sleep hygiene awareness: its relation to sleep quality and diurnal preference. *Journal of molecular psychiatry*, 3(1), 1. <https://doi.org/10.1186/s40303-015-0008-2>
- Whitney, P., Hinson, J. M., Jackson, M. L., & Van, D. H. P. (2015). Feedback blunting: total sleep deprivation impairs decision making that requires updating based on feedback. *Sleep*, 38(5), 745–54. <https://doi-org.jerome.stjohns.edu/10.5665/sleep.4668>
- Wilckens, K. A., Woo, S. G., Kirk, A. R., Erickson, K. I., & Wheeler, M. E. (2014). Role of sleep continuity and total sleep time in executive function across the adult lifespan. *Psychology and aging*, 29(3), 658–665. doi:10.1037/a0037234
- Wittmann, M., Dinich, J., Mellow, M., & Roenneberg, T. (2006). Social jetlag: misalignment of biological and social time. *Chronobiology international*, 23(1-2), 497–509. <https://doi.org/10.1080/07420520500545979>
- Wong, M. L., Lau, E. Y. Y., Wan, J. H. Y., Cheung, S. F., Hui, C. H., & MOK, D. S. Y. (2013). The interplay between sleep and mood in predicting academic functioning, physical health and psychological health: a longitudinal study. *Journal of Psychosomatic Research*, 74(4), 271–277. <https://doi.org/10.1016/j.jpsychores.2012.08.014>

Zhou Y, Bo S, Ruan S, Dai Q, Tian Y, Shi X. (2022). Deteriorated sleep quality and influencing factors among undergraduates in northern Guizhou, China.

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