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The Impact of Sleep Hygiene and Daytime Sleepiness on Academic Functioning Among Adolescents with ADHD

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Abstract

Adolescents with ADHD are likely to have poor sleep hygiene and experience heightened daytime sleepiness. Given that the combination of poor sleep hygiene and heightened daytime sleepiness is likely to result in functional impairment in school settings for healthy adolescents, it was hypothesized that adolescents with ADHD, who present with poor sleep hygiene and/or heightened daytime sleepiness, as well as educational difficulties, are an even more vulnerable population for experiencing academic impairment. The purpose of the current study was to better understand the role of daytime sleepiness in the association between sleep hygiene and academic functioning among high school students with ADHD. To that end, the following research question was examined: Is the relationship between sleep hygiene and academic functioning mediated by daytime sleepiness?

Participants included 163 high school students (Male = 77.3%; 80.4% Caucasian; 16.6% African American) who met diagnostic criteria for ADHD (Age range= 13.98-17.87 years of age; *M* = 15.33; *SD* = .84). Participants completed the Pediatric Daytime Sleepiness Scale (PDSS) and the Adolescent Sleep Hygiene Scale (ASHS). There were significant correlations between sleep hygiene and homework problems, daytime sleepiness and GPA, and daytime sleepiness and homework problems. Grade point average (GPA), WJ-Brief Achievement scores, and parent-reported Homework Problems Checklist (HPC) were used to represent academic functioning in three separate models. Structural equation modeling was utilized to test if the relationship between sleep hygiene and academic functioning is mediated by daytime sleepiness. Results indicated that the relationship between sleep hygiene and academic functioning was not mediated by daytime sleepiness.

Findings from the current study suggest that among adolescents with ADHD, excessive daytime sleepiness as opposed to poor sleep hygiene may impede academic functioning. This would indicate that addressing their daytime symptoms would yield better academic outcomes. In regards to academic functioning, intervening through improving sleep hygiene behavior alone may not be robust enough to impact their daytime functioning and subsequently improve overall academic functioning. However, these results also suggest that sleep environmental factors as well as physiological arousal may be important aspects of sleep hygiene to address among adolescents with ADHD when aiming to decrease homework difficulties.

Chapter I

Introduction

Adolescence is a critical developmental period between childhood and adulthood, involving dramatic physical, psychological, cognitive and social changes (Lerner & Steinberg, 2009). Various key transitional experiences occur that contribute to the movement toward social and economic independence, identity development, and the development of social-emotional skills necessary to carry out mature relationships. This transitional period is coupled with exploration and experimentation necessary for healthy psychosocial development. Therefore, adolescence presents a time of inevitable tension and ambivalence characterized by risk-taking that can promote learning and relationship building, as well as risk of harm.

One such developmental change evident during adolescence is within the biological regulation of sleep. The two-process model, proposed by Borbley (1982), has identified two separate biological mechanisms that interact and balance each other to produce the sleep-wake cycle. A daily circadian rhythm of sleep propensity and a sleep-wake homeostasis (pressure) system comprise the model. During adolescence, the circadian timing system that regulates the body's internal processes and alertness levels undergoes a phase delay (Carskadon, 2011). This phase delay results in the delay in the timing of sleep onset (i.e. "eveningness" preference). Additionally, the sleep-wake homeostatic pressure, which is generated by the accumulation of sleep-inducing substances in the brain (i.e. melatonin), begins to diminish during late adolescence. Therefore, the need for sleep increases (or remains the same) across adolescent development, while the circadian shift supports delaying sleep timing and slowing of sleep pressure.

As stated previously, the psychosocial changes that occur during adolescence inevitably influence the circadian phase delay as well as sleep quantity. Achieving independence is a main objective for adolescents. A way in which adolescents attempt to achieve autonomy is through exploration of limits and freedom, by setting their own bedtimes (Carskadon, 2011). In addition, an increase in social demands and engagement with peers, coupled with a rise in technology use, exacerbate the tension between sleep need and biological changes that occur during adolescence (Becker, Langberg, & Byars, 2015; Carskadon, 2011). Furthermore, complex school schedules, consisting of early school start times, homework, extracurricular activities, and night classes, contribute to inconsistent sleep patterns among this age group. Adolescents are likely to have to wake up earlier due to high school start times, yet continue to delay sleep onset. Taken together, the interaction of biological and psychosocial factors helps explain why many adolescents are at-risk for chronic sleep deprivation.

Sleep among Adolescents

Given these conflicting factors, it is not surprising that the majority of adolescents internationally are sleeping less than the recommended 9 hours per night (Carskadon, Wolfson, Acebo, Tzischinsky, & Seifer, 1998; Fredriksen, Rhodes, Reddy, & Way, 2004). The most recent US poll of sleep patterns in adolescents indicated that 87.5% of 9^{th} graders and 95% of 12^{th} graders sleep less than the recommended 9 hours per night (National Sleep Foundation, 2006). Moreover, adolescents tend to decrease their sleep duration on school nights by about an hour as they progress through high school (13-year-olds sleeping 8.5 hours vs. 17-year-olds sleeping 7.5 hours) (Maslowsky & Ozer, 2014).

This decline in sleep quantity among adolescents can be influenced by poor sleep hygiene. Sleep hygiene is defined as the behavioral and environmental factors that precede sleep

and have the potential to impact sleep quantity and quality (Noland, Price, Dake, & Telljohann, 2009). Sleep hygiene activities may be grouped into four categories: (a) environmental (e.g., temperature, noise level, ambient light); (b) scheduling (e.g., regular sleep/wake schedule); (c) sleep practices (e.g., bedtime routine); and (d) physiologic (e.g., exercise, timing of meals, caffeine use) (Jan et al., 2008). For example, good sleep hygiene behaviors can include avoiding late-afternoon naps and alcohol, tobacco, and caffeine before bedtime; following a bedtime routine; avoiding bedtime activities that are physiologically, cognitively, and emotionally activating; sleeping alone; not using the bed for activities other than sleep; sleeping in a comfortable, quiet, toxin-free environment; and maintaining a stable sleep schedule (Noland et al., 2009). Specifically, when assessing adolescents' perceptions of sleep, the most common barriers to good sleep were too much homework (46.5%), too much stress (42%), watching television (39.4%), and hanging out with friends (30.3%). Therefore, adolescents typically report watching television (46.2%), making the bedroom darker (45.2%), having a comfortable temperature in the bedroom (37.1%), and having a regular sleep/wake schedule (30.3%) as the most commonly used methods to get to sleep or stay asleep among 384 9th to 12th grade students. Collectively, various factors related to sleep hygiene can lead to an accumulation of sleep deprivation, which can have a substantial impact on one's daily functioning (Bryant & Gomez, 2015).

Sleep hygiene hasn't been explicitly studied in relation to academic impairment. The relationship between inadequate and insufficient sleep, which often results from poor sleep hygiene, has been studied. Reviews of the adolescent literature clearly document that inadequate sleep quality and quantity are causally linked various impairments impacting daytime functioning such as sleepiness, inattention, cognitive and behavioral deficits (Beebe, 2011;

Carskadon, 2011). For example, self-reports of adolescents indicate that insufficient sleep has effects such as increased daytime sleepiness (93.7%), having difficulty paying attention (83.6%), lower school grades (60.8%), heightened stress (59%), and difficulty getting along with others (57.7%) (Noland et al., 2009). Academic impairment has been consistently identified as a negative consequence of inadequate and insufficient sleep (Shochat, Cohen-Zion, & Tzischinsky, 2014; Wolfson & Carskadon, 2003). Cross-sectional studies have demonstrated a negative relation between restricted or lower sleep duration and academic functioning among adolescents. Experimental studies indicate that sleep restriction resulted in greater academic problems as reported by teachers (Fallone, Acebo, Seifer, & Carskadon, 2005) and in lower quiz grades among students in a simulated classroom environment (Beebe, Rose, & Amin, 2010). In addition, children and adolescents with later bedtimes on school nights, more irregular bedtimes, and lower sleep duration, experienced lower academic achievement when compared to children and adolescents with earlier, more regulated bedtimes, and longer sleep duration (Fallone, Owens, & Deane, 2002). Furthermore, naturalistic studies demonstrate similar effects. Among high school students, difficulties with class work and exam performance were found for students who sacrificed sleep to study the previous night (Gillen-O'Neel, Huynh, & Fuligni, 2013). In addition, students (ages 13 – 19) who described themselves as struggling or failing school (i.e., obtaining C's, D's/ F's) reported that they obtain less sleep, have later bed- times, and have more irregular sleep/wake schedules than students who report better grades (i.e., A's, B's) (Wolfson & Carskadon, 1998).

Although scarce, longitudinal research has also suggested that inadequate or insufficient sleep contributes to academic impairment among adolescents (Shochat et al., 2014). One study found that shorter weekday sleep duration was related to poorer grades and problems at school at

a one-year follow-up among youth between the ages of 11 and 17 (Roberts, Roberts, & Duong, 2009). Moreover, researchers have further elucidated the link between sleep difficulties and academic impairment among high school students (Warner, Murray, & Meyer, 2008). The relationship between sleep patterns and academic impairment, as measured by self-reported school grades, was moderated by circadian evening preference. Warner and colleagues speculate that morning preference may diminish the negative impact of sleep patterns and academic impairment. Specifically, morning-types are individuals who prefer to wake up and go to bed early and feel their "best" in the morning. In opposition, evening-types are those individuals who prefer later bedtimes and wake times, and become progressively more alert as the day goes on. Adolescents with later circadian evening preference are at heightened risk for academic impairment because of their sleep patterns (Becker, Langberg, & Byars, 2015).

Because the negative outcomes of poor sleep patterns are well documented among adolescents, the mechanisms that impact that relationship should be delineated. Various review articles indicate that sleep deprivation affected school performance, through lower grades, decreased alertness and concentration (Dewald et al., 2010). One possible mechanism by which sleep hygiene may influence academic impairment is through experiencing heightened daytime sleepiness. Because sleep is thought to impact cognitive, physical, and emotional functioning throughout the day, sufficient sleep is necessary to permit optimal daytime functioning (Dewald, Meijer, Oort, Kerkhof, & Bögels, 2010). Poor sleep hygiene and insufficient sleep among adolescents can directly affect levels of daytime sleepiness experienced. Previous research has consistently linked sleep hygiene and daytime sleepiness among otherwise healthy adolescent samples (Millman, 2005). For example, poor sleep hygiene scores were related to shorter sleep duration, more night-to-night variability in total sleep time, lower sleep efficiency, later

bedtimes, longer sleep onset latency, and heightened daytime sleepiness (Storfer−Isser, Lebourgeois, Harsh, Tompsett, & Redline, 2013).

Daytime sleepiness is characterized by persistent tiredness and lack of energy with a tendency to fall asleep during the day (Cortese, Faraone, Konofal, & Lecendreux, 2009). Approximately, 20-50% of children and adolescents report experiencing excessive daytime sleepiness (Pagel, Forister, & Kwiatkowki, 2007; Roehrs, Carskadon, Dement, & Roth, 2005). Heightened levels of daytime sleepiness have been found to impair cognitive functioning through reducing alertness and weakening regions of the brain responsible for daytime functioning (Dewald et al., 2010). Therefore, adolescents who are sleepy throughout the day may not be capable of working to their optimal potential when in school. Survey studies consistently demonstrate that adolescents experiencing daytime sleepiness have lower academic achievement than those who had fewer complaints of sleepiness (Fallone, Owens, & Deane, 2005). A meta-analysis examined the effect of various sleep variables (e.g., sleep quality, sleep duration, and sleepiness) on school performance (Dewald et al., 2010). Sleep quality, sleep duration, and sleepiness were related to school performance; however, the strongest association was between daytime sleepiness and school outcomes.

Sleep and ADHD among Adolescents

Sleep difficulties are significantly more common in youth with attention-deficit/hyperactivity disorder (ADHD) when compared to children and adolescents without ADHD (Owens, 2009). ADHD is the most frequently diagnosed pediatric neurodevelopmental disorder with prevalence rate of 3-12% (Willcutt, 2012). Various meta-analyses indicate that estimated prevalence rates for sleep disturbances in children and adolescents with ADHD range from 25% to 50% (Corkum, Tannock, Moldofsky, 1998; Cortese et al., 2009; Yoon, Jain, &

Shapiro, 2012). In comparison, approximately 25% of children in the general population experience some type of sleep difficulty, ranging from short-term problems (e.g. falling asleep) to primary sleep disorders (e.g. obstructive sleep apnea) (Owens, 2008). The symptoms associated with ADHD (i.e., hyperactivity-impulsivity, and inattention) present much overlap with various sleep disorders (Owens, 2008). Common sleep disorders with medical etiologies typically associated with ADHD among children and adolescents are obstructive sleep apnea (OSA), restless leg syndrome (RLS), and delayed sleep phase disorder (Owens, 2009). Those sleep difficulties related to behavioral or environmental etiologies among children and adolescents with ADHD include bedtime resistance, sleep onset delay, decreased sleep duration, daytime sleepiness, poor sleep quality, night wakenings, parasomnias, and problematic behaviors during bedtime routine.

Despite the recognition of higher than average prevalence rates of sleep difficulties among children and adolescents with ADHD, little research exists regarding sleep hygiene practices in this population. Sung, Hiscock, Sciberras, and Efron (2008) found that about 30% of school-aged children with ADHD had mild sleep problems and about 45% had moderate to severe sleep problems such as trouble falling asleep, bedtime resistance, difficulty getting up, night awakenings, restless sleep, breathing difficulty during sleep, and tiredness on waking. Other researchers have begun to examine the impact of a sleep hygiene intervention coupled with melatonin treatments for children and adolescents with initial insomnia and ADHD (e.g., Weiss et al., 2006). The combined treatments significantly decreased participants' sleep onset latency, from 91.7 minutes before treatment, to 70 minutes after sleep hygiene, and then 45 minutes after receiving melatonin. These favorable results demonstrate that behavioral aspects of ADHD do, in fact, play a role in sleep onset difficulties. Previous research among typically developing

adolescents suggests that poor sleep hygiene may impact daytime functioning and specifically, academic impairment (Dewald et al., 2010).

Therefore, because individuals with ADHD commonly experience struggles relating to academic, social, and emotional domains (Barkley, 2014; DuPaul & Stoner, 2014), it is expected that poor sleep hygiene among adolescents with ADHD impairs academic functioning. There seems to be initial evidence that sleep hygiene practices influence daytime functioning among children with ADHD. Specifically, among school-aged children with ADHD, those with severe sleep problems were more likely to experience poor quality of life and impaired daily functioning (Sung et al., 2008). In addition, children with sleep problems were more likely to miss or arrive late for school when compared to those without sleep problems. The relationship between sleep hygiene and academic impairment is unknown among adolescents with ADHD. Parsing out this relationship would aid clinicians and researchers in determining what sleep habits to target for intervention in this population.

Among otherwise healthy children, a possible mechanism by which sleep hygiene may impact academic impairment may be through heightened daytime sleepiness. A similar relationship among sleep hygiene, academic impairment, and daytime sleepiness may exist among adolescents with ADHD. Reviews of the literature indicate that heightened daytime sleepiness and more movements during sleep are commonly found in youth with ADHD when compared to controls (Cortese et al., 2006; Sadeh, Pergamin, & Bar-Haim, 2006). A meta-analytic review of objective studies utilizing polysomnographic recordings and subjective methods of assessment demonstrated that the average times to fall asleep were significantly lower in the children with ADHD and the latter were more likely to experience heightened daytime sleepiness than controls (Cortese et al., 2009). These findings indicate that children with

ADHD demonstrate a tendency to be sleepier during the day when compared to controls. It is evident that the relationship between sleep disturbance and ADHD is complex due to the significant overlap of symptoms. Children and adolescents with sleep difficulties that have a medical or behavioral etiology may present primarily with daytime sleepiness and neurobehavioral symptoms (Owens, 2009). Researchers have identified the Hyperarousal theory in an attempt to explain this complex relationship (Weinberg & Brumback, 1990). The theory postulates that children and adolescents with ADHD are likely to be sleepier than controls and may demonstrate motor hyperactivity and impulsivity as a strategy to stay awake and alert. Alternatively, this assumption counteracts the tendency of children with ADHD to experience excessive daytime sleepiness and the urge to fall asleep.

Although ADHD symptoms decline with increased age, ADHD-related impairments appear to increase during adolescence, often yielding negative outcomes relating to academics (Owens et al., 2013). To our knowledge, there are only two published studies examining the relationship between sleep and academic performance among adolescents with ADHD. First, Langberg, Dvorsky, Marshall, and Evans (2013) investigated the effects of daytime sleepiness on academic performance among middle school-aged children with ADHD. Daytime sleepiness was found to be negatively related to school grades. Self-reported daytime sleepiness was significantly related to unfavorable academic outcomes, while self-reported total time in bed was not. Furthermore, daytime sleepiness was a significant predictor, above and beyond ADHD symptoms, of both parent ratings of academic impairment and homework problems as well as teacher ratings of academic competence. Daytime sleepiness did not predict GPA or teacher ratings of academic impairment beyond symptoms of ADHD.

It is likely that the impact of daytime sleepiness would be more impairing among an older sample of adolescents, as the association between sleep and academic performance becomes stronger in adolescence (Becker, Langberg, & Byars, 2015; Beebe, Ris, Kramer, Long, & Amin, 2010). To evaluate this assertion, Langberg, Dvorsky, Becker, and Molitor (2014) conducted a longitudinal study of the impact of daytime sleepiness on school performance among college students with ADHD. Results indicated daytime sleepiness to be a significant predictor of academic and overall functional impairment. Specifically, self-reported daytime sleepiness at the beginning of the school year predicted self-report of school maladjustment and overall functional impairment at the end of the school year. Moreover, the relationship between sleep and academics was statistically significant even after controlling for gender, self- and parent-report of ADHD symptom severity and medication status. With regards to academic performance, daytime sleepiness did not predict overall GPA, but did predict the number of D and F grades students received.

Limitations of Extant Literature

Separate lines of research have demonstrated that adolescents with ADHD are likely to have poor sleep hygiene and heightened daytime sleepiness. Among otherwise healthy adolescents, the combination of poor sleep hygiene and heightened daytime sleepiness is likely to result in functional impairment. Therefore, adolescents with ADHD who present with poor sleep hygiene and/or daytime sleepiness are an even more vulnerable population for experiencing academic impairment. Despite high prevalence rates of sleep difficulties and academic impairment among youth with ADHD, no research has been carried out examining whether sleep hygiene predicts academic impairment among adolescents with ADHD. In addition, the relationship between sleep hygiene and daytime sleepiness has not been studied among children

and adolescents with ADHD. Furthermore, the research regarding daytime sleepiness and academic impairment among adolescents with ADHD is limited. It has been established that ADHD symptoms predict academic impairment among adolescents (DuPaul & Langberg, 2014); however, it is unknown whether sleep factors (i.e. daytime sleepiness and sleep hygiene practices) also contribute to the relationship. Investigating this relationship would aid clinicians and researchers in determining what sleep hygiene practices to target for intervention among adolescents with ADHD as part of efforts to ameliorate academic impairment.

Purpose and Aims of Proposed Study

The purpose of the current study was to better understand the role of daytime sleepiness in the association between sleep hygiene and academic impairment among high school students with ADHD. To that end, the following research questions were addressed:

1. Does sleep hygiene predict academic impairment among adolescents with ADHD?
    a. It was hypothesized that poor sleep hygiene predicts greater academic impairment (i.e., that there is a statistically significant relationship between sleep hygiene and academic achievement).
2. Does sleep hygiene predict daytime sleepiness among adolescents with ADHD?
    a. It was hypothesized that poor sleep hygiene predicts heightened daytime sleepiness (i.e., that there is a statistically significant inverse relationship between sleep hygiene and daytime sleepiness).
3. Does daytime sleepiness predict academic impairment among adolescents with ADHD?
    a. It was hypothesized heightened daytime sleepiness predicts greater academic impairment (i.e., that there is a statistically significant inverse relationship between daytime sleepiness and academic achievement).

4. Is the relationship between sleep hygiene and academic impairment mediated by daytime sleepiness?
    a. It was hypothesized that the relationship between sleep hygiene and academic impairment would be partially or fully accounted for when daytime sleepiness was included as a mediating variable.

CHAPTER II

Review of the Literature

Sleep difficulties are significantly more common in youth with ADHD when compared to children and adolescents without ADHD (Owens, 2009). Common sleep difficulties that have behavioral or environmental etiologies among children and adolescents with ADHD include bedtime resistance, sleep onset delay, decreased sleep duration, daytime sleepiness, poor sleep quality, night wakenings, parasomnias, and problematic behaviors during bedtime routine. Frequent reports among children and adolescents with ADHD and their parents indicate difficulty initiating and maintaining sleep as more of a problem than other difficulties. Youth with ADHD often complain that they experience difficulty with sleep onset because they "cannot turn their thoughts off," which may indicate that they don't possess the natural sleep pressure that induces sleep onset among otherwise healthy adolescents (Weiss, Wasdell, Bomben, Rea, & Freeman, 2006, p. 514). Parent reports have demonstrated that families and children with ADHD have poor sleep hygiene, specifically with regards to their environment, scheduling, and sleep patterns (Owens, 2009).

The purpose of this chapter is to review the existing literature regarding: (a) sleep hygiene and daytime sleepiness among adolescents with ADHD and (b) the relationship between sleep hygiene and academic impairment as well as between daytime sleepiness and academic impairment among adolescents with ADHD. The chapter concludes with a description of the proposed mediation model.

Sleep Hygiene among Adolescents with ADHD

Even though there is considerable research demonstrating the higher than average prevalence rates of sleep difficulties among children and adolescents with ADHD, little research

exists regarding sleep hygiene practices. In a cross-sectional survey of 216 school-aged children, Sung and colleagues (2008) found that about 30% of children with ADHD had mild sleep problems and about 45% had moderate to severe sleep problems. Among those with moderate or severe sleep problems, difficulties included trouble falling asleep (84%), bedtime resistance (68.2%), difficulty getting up in the morning (56%), waking up frequently during the night (36%), restless sleep (49%), and tiredness on waking (62%). Furthermore, additional cross-sectional research regarding sleep hygiene among 74 children, aged 6 – 12 years, with ADHD and chronic sleep onset insomnia provide results indicating similarities between children with ADHD, children with ADHD and chronic sleep onset insomnia, and otherwise healthy children (van der Heijden, Smits, & Gunning, 2006). Specifically, mean total scores on the Children's Sleep Hygiene Scale (CSHS; Easley, & LeBourgeois, 2002) were similar across groups of children with ADHD, children with ADHD and chronic sleep onset insomnia, and among otherwise healthy children from the US (LeBourgeois & Harsh, 2001). Notwithstanding, the children with ADHD rated sleep hygiene items related to bedtime schedule and problematic evening activities (e.g. "Does things that are alerting before bedtime," "Does things in bed that keeps him/her awake.") unfavorably. However, sleep hygiene was measured with the parent-reported CSHS, which has been normed with children between the ages of 2 and 8 years. This lack of age appropriateness may be one reason why sleep hygiene practices did not differ significantly among the various groups.

In addition, Weiss et al. (2006) examined the impact of a sleep hygiene intervention coupled with melatonin treatments for 27 children and adolescents with initial insomnia and ADHD who were between the ages of 6 and 14 years. Sleep hygiene procedures included a subjective baseline measure of sleep patterns to review with the parent and child. This served as

an educational technique to review maladaptive patterns related to sleep onset difficulties. Specific sleep hygiene recommendations were then given including following consistent bedtime and wakening schedules, discontinuing caffeine and naps, and setting realistic expectations of parents. The combined treatments significantly decreased participants' sleep onset latency from 91.7 minutes before treatment, to 70 minutes after sleep hygiene, and then 45 minutes after receiving melatonin. Furthermore, sleep hygiene recommendations significantly reduced the night-to-night variability in how long a child took to fall asleep. These favorable results demonstrate that behavioral aspects of ADHD do, in fact, play a role in sleep onset difficulties and can be ameliorated with favorable sleep hygiene practices.

Relation to academic impairment. ADHD is associated with significant adverse outcomes at school and throughout the life span (Barkley, Murphy, & Fisher, 2008; Biederman, Petty, Clarke, Lomedico & Faraone, 2011; Simon, Czobor, Balint, Meszaros, & Bitter, 2009). There seems to be initial evidence that sleep hygiene practices influence overall daytime functioning among children with ADHD. Specifically, among 216 school-aged children with ADHD between the ages of 5 and 18, those with severe sleep problems were more likely to experience poor quality of life and impaired daily functioning (Sung et al., 2008). In addition, children with moderate or severe sleep problems were more likely to miss (84%) or arrive late for school (54%), when compared to those without sleep problems (missed school = 51%; late for school = 35%). The relationship between sleep hygiene and academic impairment is unknown among adolescents with ADHD; however, these initial findings suggest that poor sleep hygiene may have an impact on academic impairment among adolescents with ADHD.

Daytime Sleepiness among Adolescents with ADHD

Reviews of the literature indicate that heightened daytime sleepiness and more movement during sleep are commonly found in youth with ADHD when compared to controls (Cortese et al., 2006; Sadeh, Pergamin, & Bar-Haim, 2006). From a meta-analytic review of subjective and objective studies, polysomnographic recordings demonstrated that the average times to fall asleep were significantly shorter in the children with ADHD than in controls (Cortese et al., 2009). These results suggest that children with ADHD demonstrate a tendency to be sleepier during the day when compared to controls. Studies using subjective methods to assess daytime sleepiness suggest that children with ADHD experienced significantly more daytime sleepiness than controls. As previously demonstrated, children and adolescents with sleep difficulties that have a medical or behavioral etiology may present primarily with daytime sleepiness and neurobehavioral symptoms (Owens, 2009).

Relation to academic impairment. Despite ADHD symptoms declining with increased age, ADHD-related impairments appear to increase during adolescence, often yielding negative school-related outcomes (Owens et al., 2013). To our knowledge, there are only three published studies examining the relationship between sleep and academic performance among children or adolescentsr with ADHD. First, Mayes and colleagues (2008) examined the predictive value of sleep, IQ, neuropsychological functioning, and ADHD symptoms in predicting academic achievement among 412 elementary aged children (i.e., 6 to 12 years of age). The researchers utilized standardized achievement scores and objective (i.e., one full night polysomnography; sleep latency, sleep efficiency, and night wakings) and subjective measures (i.e., ratings on the parent reported pediatric behavior scale; e.g. difficulty falling asleep, daytime sleepiness, and parasomnias) of sleep. There were no statistically significant differences in math and reading achievement scores between children with and without objectively and subjectively measured

sleep problems. Similarly, objective sleep scores did not differ significantly between children identified by their schools as having a learning disability versus not having a learning disability and between children with and without parent-reported academic problems. Lastly, results indicated that objective and subjective measures of sleep did not predict achievement standard scores once IQ and ADHD symptoms were included in the model. It is important to consider the age of the sample, because research has demonstrated that the link between sleep and academic performance becomes stronger as children get older (Beebe et al., 2010). Furthermore, the relationship between sleep and academic impairment may also be influenced by the way in which academic functioning is measured (e.g. GPA, achievement scores, teacher rated academic functioning). For instance, academic outcomes measured by standardized achievement tests in isolation may be less sensitive to sleep difficulties. This may be because standardized achievement tests are not subject to day-to day-variability in sleep effects on academic performance.

Secondly, Langberg, Dvorsky, Marshall, and Evans (2013) investigated the effects of daytime sleepiness on academic performance among 100 middle school-aged children with ADHD between the ages of 10 and 14. Subjective self-report measures of sleep (Pediatric Daytime Sleepiness Scale; Drake et al., 2003), report card grades, parent-rated homework problems (Homework Problems Checklist; Anesko, Schoiock, Ramirez, & Levine, 1987), and teacher-rated classroom problems (Classroom Problems Checklist; Brady et al., 2012), were utilized. Daytime sleepiness was negatively related to school grades. Additionally, daytime sleepiness was positively related to parent-rated academic impairment, parent-rated homework problems, teacher-rated academic impairment, and teacher-rated homework problems. Alternatively, subjective report of total hours slept was not related to any academic outcomes or

daytime sleepiness. Specifically, the mean total hours slept was 8.72, which is close to the recommended amount for adolescents; a finding that may have influenced that non-significant result. Furthermore, self-reported daytime sleepiness was a significant predictor, above and beyond ADHD symptoms, of both parent ratings of academic impairment and homework problems as well as teacher ratings of academic competence. Daytime sleepiness did not predict GPA or teacher ratings of academic impairment beyond symptoms of ADHD. It is likely that the impact of daytime sleepiness would be more impairing among an older sample of adolescents as the association between sleep and academics typically becomes stronger in adolescence (Becker, Langberg, & Byars, 2015; Beebe, Ris, Kramer, Long, & Amin, 2010).

In support of this possibility, Langberg, Dvorsky, Becker, and Molitor (2014) conducted a longitudinal study of the impact of daytime sleepiness on school performance among 62 college students with ADHD between the ages of 17 and 30. School performance was measured by spring semester GPA, self-reported school maladjustment, and psychosocial impairment. Subjective self-report measures of sleep (Pediatric Daytime Sleepiness Scale; Drake et al., 2003) were utilized. Results demonstrated daytime sleepiness to be a significant predictor of academic and overall functional impairment. Specifically, self-reported daytime sleepiness rated at the beginning of the school year predicted self-report of school maladjustment and overall functional impairment at the end of the school year. Moreover, the relationship between sleep and academics was statistically significant even after controlling for gender, self- and parent-report of ADHD symptom severity and medication status. With regards to academic performance, daytime sleepiness did not predict overall GPA, but did predict the number of D and F grades students received. The latter finding suggests that the relationship between daytime sleepiness and grades is stronger for those students with poorer grades when compared to those students

with higher GPAs. It is important to note that the Pediatric Daytime Sleepiness Scale was designed for younger adolescents (aged 11 – 15) and has not been evaluated in young adult samples such as this one. Further, it has been suggested to conduct additional studies among adolescent ADHD populations to elucidate the impact of sleep difficulties on subjective and objective measures of academic performance (Langberg et al., 2013).

Sleep Hygiene & Daytime Sleepiness among Adolescents with ADHD

Complaints of daytime sleepiness can be caused by a sleep debt due to delayed sleep onset or by the phase delay of the circadian rhythm (Millman, 2005). Delayed sleep onset and sleep debt can be also impacted by adolescents' sleep hygiene practices. Therefore, among otherwise healthy adolescents the relationship between sleep hygiene and daytime sleepiness is strong. Unfortunately, no research exists investigating sleep hygiene and daytime sleepiness among adolescents with ADHD. When validating the Adolescent Sleep Hygiene Scale (ASHS), Storfer−Isser et al. (2013) found that higher total sleep hygiene scores (i.e., indicative of good sleep hygiene) were related to longer sleep duration, less night-to-night variability in sleep duration, high sleep efficiency, earlier bedtimes, shorter sleep onset latency, and less daytime sleepiness. When compared to youth with poor sleep hygiene, those with good sleep hygiene slept longer, had an earlier bedtime and mid-sleep time, experienced shorter sleep onset latency, and exhibited less daytime sleepiness. Specifically, unfavorable sleep environmental factors (e.g. falling asleep while watching TV, sleeping in a room that is too hot or cold) were associated with lower sleep efficiency, more time awake after sleep onset, greater daytime sleepiness, more behavioral problems and lower school competency. These data are similar to the findings of Noland et al. (2009) regarding barriers to attaining sufficient sleep. Adolescents indicated

experiencing environmental factors that affected sleep such as watching television, improper bedroom temperature, and excessive noise.

During adolescence, a combination of biological and psychosocial factors produces a trend for increasingly shorter sleep duration across the adolescent years (Carskadon, 1990). Therefore, insufficient sleep, which may result from poor sleep hygiene, acts as an additive cost for adolescents. Poor sleep hygiene can exacerbate the sleep deficits already encountered by adolescents due to the normal maturation process. Excessive daytime sleepiness is one of the most common and direct effects of insufficient sleep and poor sleep hygiene. Separate lines of research have demonstrated that adolescents with ADHD are likely to have poor sleep hygiene and experience heightened daytime sleepiness. Among otherwise healthy adolescents, the combination of poor sleep hygiene and heightened daytime sleepiness is likely to result in functional impairment. Therefore, adolescents with ADHD, who present with poor sleep hygiene and/or daytime sleepiness, are an even more vulnerable population for experiencing academic impairment.

To explore the role of daytime sleepiness in the association between sleep hygiene and academic impairment, a model was tested in which daytime sleepiness is a mediator of the expected relationship between sleep hygiene and academic impairment. The mediation model examined the direct effect of sleep hygiene on academic impairment, and the indirect effect of sleep hygiene on academic impairment as mediated through daytime sleepiness (See Figure 1).

CHAPTER III

Method

Participants and Setting

Participants included 163 adolescents with ADHD between the ages of 14 and 17 who were enrolled in grades 9 through 11. Participants were recruited from a larger randomized control trial of a multi-component school-based treatment program for high school students with ADHD across two sites (Lehigh University and Ohio University). For the purposes of the current study, data collected at eligibility and baseline (pre-treatment) were utilized.

Public high schools were selected based upon proximity to the two sites, including both suburban and urban populations. Conducting the study at these two sites resulted in a diverse sample with respect to geographical location, race, gender, SES, type of high school (i.e., urban, suburban, and rural) and symptom severity. Additionally, all adolescents were required to meet full DSM-5 diagnostic criteria (APA, 2013) for ADHD on a parent semi-structured interview. Exclusionary criteria in the current study were as follows: (a) Full Scale IQ lower than 75, (b) typical attendance at school lower than 80% based on parent report during the phone screen, and (c) meets diagnostic criteria for bipolar disorder, obsessive-compulsive disorder, substance dependence, or psychotic disorder.

Measures

Demographics. The parents of all participants completed a brief form for collecting information on parents' employment status, parents' level of education, as well as family income, parent and child race/ethnicity, parents' marital status, and participants' use of ADHD medication. These data were used to describe the sample. In addition, school attendance and

tardiness data were collected from students' official school records for the academic year that the eligibility evaluation meeting occurred and are reported by the number of days absent or tardy.

ADHD diagnosis. ADHD diagnosis was determined by collecting ratings of student behavior from at least one parent using DSM-based ADHD symptom rating scales and a semi-structured parent interview (Children's Interview for Psychiatric Syndromes- Parent Version; P-CHIPS; Weller, Weller, Fristad, Rooney, & Schecter, 2000). Research team members at both sites were collectively trained on administration of the P-CHIPS. In order for a participant to meet the diagnostic criteria for ADHD, their parent needed to have endorsed at least six necessary symptoms for inattention (IA), hyperactivity-impulsivity (HI), or both. All ADHD presentations and common comorbid conditions not listed as exclusionary were assessed through the P-CHIPS and recorded.

ADHD Rating Scale 5 (ARS-5; DuPaul, Power, Anastopoulos, & Reid, 2016). The ARS-5 includes 18 symptom items that conform to DSM-5 criteria for ADHD. The participants' parents completed the ARS-5. On the parent ARS-5, the informant reported the frequency with which each child displays the 18 symptomatic behaviors of ADHD using the *ARS-5* Home adolescent versions. Parents indicated the frequency of each behavior over the previous 6 months on a four-point Likert scale including 0 (*never or rarely*), 1 (*sometimes*), 2 (*often*), and 3 (*very often*). In addition, parents reported the severity of ADHD symptom-related impairments in six domains: relationships with significant adults (family members on the home version), peer relationships, academic performance, behavioral functioning, homework performance, and self-esteem. Parents completed each set of six impairment items twice; first after rating the inattention symptom items and again after rating the hyperactivity-impulsivity items. For example, *"How much do the above behaviors cause problems for your child?"* Items were rated

on a four-point scale (*no*, *minor*, *moderate*, *severe* problem). A child's score on each impairment domain is the higher of the two ratings on items assessing impairment related to inattention and hyperactivity-impulsivity. The authors provided normative data and report adequate validity and reliability data in the manual (DuPaul, Power, Anastopoulos, & Reid, 2016). The separate summation of the nine IA items and nine HI comprise IA and HI factors, which were used to determine ADHD diagnosis for eligibility in the current study. Specifically, item ratings of a 2 (often) or 3 (very often) were considered endorsement of the presence of a symptom. Six or more endorsed symptoms constituted research criteria for ADHD diagnosis. Internal consistency for this measure was evaluated with the current sample ($\alpha = .92$).

School Grades. Research staff collected high school grades directly from the school offices at both sites for the whole school year prior to when the students were enrolled in the study. Grades were converted to a common scale (e.g., "A" = 4, "B" = 3, "C" = 2, "D" = 1, "F" = 0) and then averaged across the four core academic subject areas. The core academic subject areas included, mathematics, science, English, and social studies. The grades for these subjects were utilized because they are the most academically oriented classes students are taking in high school.

Homework Problems Checklist (HPC). Homework problems were assessed using the 20-item parent-completed HPC (Anesko et al., 1987: Langberg et al., 2010). For each item, parents rated the frequency of a specific homework problem on a four-point Likert scale (0 = *never*, 1 = *at times*, 2 = *often*, 3 = *very often*). Higher scores on the measure indicate more severe problems. The HPC total score was examined in the present study ($\alpha = .91$).

Woodcock Johnson IV (WJ-IV). The standard battery of the Woodcock-Johnson IV Tests of Achievement was utilized including six subtests: Letter-Word Identification, Applied

Problems, Spelling, Passage Comprehension, Calculation, and Writing Samples (Mather, & Wendling, 2015). Each broad area was designed to measure a hierarchy of abilities ranging from lower-order, less complex tasks, such as Spelling, to higher-level, more complex tasks, such as Applied problems, a measure of math problem-solving. The standard Battery has three forms (Forms A, B, and C) that provide alternate and equivalent tests to facilitate re-testing, therefore participants were randomized to a form for the various times the WJ-IV was administered. Brief achievement scores (Letter-Word Identification, Applied Problems, and Spelling) were utilized in the proposed model. Even though the WJ-IV is considered a narrow measure of achievement, it was included in this model due to its objectiveness as a measure of academic achievement. Grade standard scores compare children's performance to grade-level national norms and only approximate an equal-interval measurement scale. Extensive research has documented the reliability and construct validity of the WJ-IV and its predecessors (McGrew, LaForte, & Schrank, 2014). Specifically, the reliability of Brief achievement scores for ages 14 to 18 ranges from $\alpha = .95$ to $\alpha = .96$.

Pediatric Daytime Sleepiness Scale (PDSS). The PDSS (Drake et al., 2003) was developed and validated as a self-report measure to examine the relationship between daytime sleepiness and school-related outcomes. The PDSS is one of six sleep measures to meet criteria as well-established according to the American Psychological Association (APA) Division 54 evidence-based assessment criteria (Lewandowski, Toliver-Sokol, Palermo, 2011). The PDSS consists of eight items loading onto a single factor. Adolescents rated each item on a scale from 0 (*never*) to 4 (*always*) (e.g. "How often are you ever tired and grumpy during the day?"). Items are summed to produce a total score that can range from 0 to 32 (higher scores on all items reflect greater sleepiness). Internal consistency (Cronbach's alpha) for the 8-item scale was .80.

Internal consistency for this measure was evaluated with the current sample (α = .80).

Adolescent Sleep Hygiene Scale (ASHS). The Adolescent Sleep Hygiene Scale (ASHS; Storfer-Isser et al., 2013) was modified from the Children's Sleep Hygiene Scale (Easley, & LeBourgeois, 2002). The ASHS is a 33-item self-report measure that assesses sleep-facilitating and sleep-inhibiting practices in 12- to 18-year-old adolescents along six different conceptual domains: physiological (4 items), sleep stability (3 items), sleep environment (5 items), daytime sleep (2 items), cognitive-emotional (6 items), and behavioral arousal (3 items). Adolescents report how often sleep-related behaviors have occurred during the past month along a 6-point Likert scale ("always," "frequently-if not always," "quite often," "sometimes," "once in a while," and "never"). Mean domain scores were calculated for each domain and an overall sleep-hygiene score (ASHS total; mean of 6 domain scores) are available. Total sleep hygiene scores range from 1 (*very poor*) to 6 (*very good*). All scores range from 1 to 6, and higher scores are indicative of better sleep hygiene. Total ASHS scores were utilized in the proposed analyses. Additional items were included at the bottom of the scale that asked adolescents about bedtimes and wake times on weekdays and weekends. Total time in bed was calculated by subtracting their report of weekday bedtime from weekday wake time. Internal consistency reliability for the total ASHS is high (α = 0.84), and reliability on the ASHS subscales range from α = 0.60 (physiological) to α = 0.81 (Storfer-Isser et al., 2013). Internal consistency for total ASHS score for the current sample was adequate (α = 0.85).

Procedures

Parents/guardians of rising 8th, 9th, and 10th graders received flyers advertising the study. Interested parents/guardians who called research staff to express interest in the study were administered a telephone screen. During the telephone screen, parents indicated if their child has

a diagnosis of ADHD or endorse their child as currently exhibiting at least four of the nine DSM symptoms of inattention. If they endorsed those symptoms or have a previous diagnosis of ADHD, they were then scheduled for an eligibility evaluation. As part of the larger study, participants and their parents participated in an eligibility evaluation meeting to determine eligibility for the larger study. Participants met with research assistants trained as clinical or school psychologists to complete the assessments at students' high schools. During the eligibility evaluation, questionnaires were collected online via Redcap survey (Harris et al., 2009) as well as paper administration of the WJ-IV Achievement. At the eligibility evaluation, ADHD-5 ratings and WJ-IV Broad Achievement were collected.

After the eligibility meeting, 25% of the potentially eligible cases were reviewed by a panel of three ADHD experts (i.e. the three primary investigators). ADHD diagnosis was determined based on the presence of symptoms and impairment. Symptoms were considered present based on the "OR" rule. Specifically, symptoms were considered present if endorsed by parents (on the PChIPS) or 2 teachers endorsing the same symptom (on the ADHD-RS). Endorsed items are those that were rated as "yes" on the PChIPS and as "pretty much" or "very much" present on the ADHD Rating Scale. Although the "OR" rule was used to determine presence or absence of symptoms, participants only met criteria for one of the three presentations of ADHD (inattention or H/I) if the parent endorsed at least 6 symptoms. Impairment was considered present if the parent OR at least one teacher endorsed impairment in at least one domain on the PChIPS or the ADHD Rating Scale. For participating in evaluation evaluations, parents were compensated $100.

Once eligibility was determined, additional questionnaires were completed at baseline (approximately 2 to 5 months after the eligibility evaluation). Baseline assessment meetings

occurred prior to the start of the interventions described previously and were completed with research assistants trained as clinical or school psychologists. During this meeting, which took place at their respective high schools, the ASHS and PDSS were collected online via Redcap survey. For completing measures at baseline, parents were compensated $50. The Lehigh University IRB initially approved all procedures for the larger study and parents signed informed consent and youth provided written assent.

Research Design & Data Analysis

Demographic characteristics were examined using SPSS (version 21; IBM, 2012). Descriptive statistics for study measures were examined for normality. Preliminary analyses were conducted to examine group differences between those students who already have an IEP or 504 plan and those who do not on the academic functioning outcome variables (i.e. grades, WJ-IV Brief achievement scores, and HPC scores). It was expected that there are no differences between those groups on those variables. If there was a significant difference, presence of and IEP/504 plan would be controlled for in the mediation analyses. In addition, preliminary analyses were conducted to determine if total time in bed is related to academic functioning. If it was related, total time in bed would be controlled for in the mediation model.

To explore the role of daytime sleepiness in the association between sleep hygiene and academic functioning, we tested three models in which daytime sleepiness is a mediator of the expected relationship between sleep hygiene and academic functioning (see Figures 2, 3, and 4). Three separate models were tested utilizing the three academic outcomes as the dependent variables (grades, WJ-IV Brief achievement scores, and HPC scores). Additionally, multiple regressions analyses were used to determine whether mediation prerequisites and conditions were met (Hayes, 2009). All structural equation modeling analyses were conducted using Amos

(version 22; Arbuckle, 2006). The mediation model examined the direct effect of sleep hygiene on academic functioning, and the indirect effect of sleep hygiene on academic functioning through daytime sleepiness. Covariates for the mediation model were chosen based on previous research (Becker, Langberg, & Byars, 2015; Buckhalt, El-Sheikh, & Keller, 2007; Corkum, Moldofsky, Hogg-Johnson, Humphries, & Tannock, 1999; Marco, Wolfson, Sparling, & Azuaje, 2012; Sung et al., 2008) and include school attendance and school tardiness (collected from the students' school records), as well as ADHD medication use, parent education level, and parent income (obtained by parent report). It is possible that ADHD medication use could influence sleep onset latency and/or total sleep time among youth (Owens, 2009). Bootstrapping is a nonparametric, resampling approach that is robust to violations of normality and smaller sample sizes, thus improving power and decreasing the chance of Type I or II errors (Hayes, 2009). Missing item-level data were minimal due to the settings organized on Redcap requiring all items to be answered before moving on to each part of the survey.

An *a priori* power analysis was conducted for a multivariate multiple linear regression analysis with a specific focus on the relationship between sleep hygiene, daytime sleepiness, and academic functioning. The purpose was to determine the necessary sample size to test mediating effect of daytime sleepiness on the relationship between sleep hygiene and academic functioning. For an effect size of $f = 0.15$, $r^2 = .18$, and an α error probability of 0.05, the estimated required total sample size was 107 participants with an actual power of .95. Post-hoc power analyses were conducted for the whole mediation model to determine effect sizes and power of the current sample.

In the mediation models, sleep hygiene was the independent variable, daytime sleepiness was the mediator, and academic functioning (grades, WJ-IV Brief achievement scores, and HPC

scores) were the dependent variables. In contemporary analyses, total, direct, and indirect effects are reported and tested to determine mediation (Kenny, 2011) (See Figure 1). Path *a* denotes the effect of sleep hygiene on daytime sleepiness, path *b* demonstrates the effect of daytime sleepiness on academic functioning controlling for sleep hygiene, path *c* indicates the total effect of sleep hygiene on academic functioning, and path *c`* displays the direct effect of sleep hygiene on academic functioning controlling for daytime sleepiness. Finally, the indirect effect *a*b* is the effect of sleep hygiene on academic functioning through daytime sleepiness.

First, daytime sleepiness as a mediator of sleep hygiene and academic functioning was examined. Path coefficients were estimated and bootstrap confidence intervals (percentile method) were generated for the total, direct, and indirect effects. The indirect effects were examined with 5,000 bootstrap resamples (Preacher & Hayes, 2008). Mediation is indicated when 0 is not included in the bootstrap confidence intervals. Mediation is partial when the indirect/total ratio is less than .80 (Shrout & Bolger, 2002).

To evaluate the model fit, three indices were chosen: the Tucker-Lewis Index (*TLI*; Tucker & Lewis, 1973), the Comparative Fit Index (*CFI*; Bentler, 1990), and the root mean square error of approximation (*RMSEA*; Steiger, 1990). For TLI and CFI a value of ≥.95 indicates a good fit. For the current analysis, a value ≥.90 and ≤.949 was considered acceptable. For RMSEA a value ≤.05 was considered good and values ≥.06 and ≤.08 was considered acceptable (Hu & Bentler, 2009). If good fit is not found, modifications are permitted to increase fit (Browne & Cudeck, 1993). Additionally, to evaluate the model, effect sizes were determined using R^2.

CHAPTER IV

Results

Complete demographic information can be found in Table 1. Participants included 163 high school students (Male = 77.3%; 80.4% Caucasian; 16.6% African American) who met diagnostic criteria for ADHD (Age range = 13.98-17.87 years of age; *M* = 15.33; *SD* = .84). Values of sleep hygiene found in the current sample (total ASHS, *M* = 3.98, *SD* = .71) are comparable to otherwise healthy general populations samples (total ASHS, *M* = 4.0, *SD* = .61) and for the domain mean scores to range from 3.3 to 5.1 (LeBourgeois, Giannotti, Cortesi, Wolfson, & Harsh, 2005). It is not surprising that the lowest domain scores from the current sample are for sleep stability (*M* = 2.91, *SD* = 1.24) and behavioral arousal (*M* = 3.15, *SD* = 1.09), because adolescents are likely to have inconsistent sleep-wake schedules across the weekdays versus weekend and as well as sleep incompatible behaviors within the hour before bedtime, or while in bed (Storfer-Isser et al., 2013). However, all other domain means are above the poor sleep hygiene cut-off of $\leq$3.8 indicated by previous research. However, values of daytimes sleepiness found in the current sample (PDSS, *M* = 13.41, *SD* = 5.48) are lower than other samples (*M* = 15.3, *SD* = 6.2) of students 11 to 15 years of age (Drake et al., 2003).

An independent-sample *t*-test was conducted to compare grades for those students who had an IEP or 504 plan and those who did not. Students with an IEP or 504 plan obtained significantly higher grades (*M* = 2.17, *SD* = .87) than those without an IEP or 504 plan (*M* = 1.89, *SD* = .74; *t* (161) = -2.14, *p* = .03, two-tailed; Cohen's *d* = 0.02). Another independent-sample *t*-test was conducted to compare WJ-IV Brief achievement scores for those students with and without an IEP or 504 plan. Students with an IEP or 504 plan obtained a significantly lower WJ-IV achievement score (*M* = 89.81, *SD* = 12.77) relative to those without a plan (*M* = 97.38,

SD = 11.19; *t* (161) = 3.90, *p* < .001, two-tailed; Cohen's *d* = 0.09). The last independent-sample *t*-test was conducted to compare HPC scores for those students with and without an IEP or 504 plan. There was no significant difference in HPC score for those with an IEP or 504 plan (*M* = 56.35, *SD* = 11.06) and those without (*M* = 57.58, *SD* = 10.64; *t* (161) = .705, *p* = .482, two-tailed), Cohen's *d* = .003).

In order to evaluate whether total time in bed was related to academic functioning, Pearson correlations were obtained (see Table 2). Total time in bed was not related to grades (*r* = -.04, *p* = .588), WJ-IV Brief achievement scores (*r* = -.05, *p* =. 530), or HPC scores (*r* = -.04, *p* =. 607). Therefore, total time in bed was not controlled for in the mediation model. Alternatively, attendance, tardiness, medication status, IEP/504 status, and previous diagnosis of ADHD were all significantly correlated with GPA and thus were included as covariates in the mediation model. Pearson correlations were conducted to explore the relationships among all variables in the model. ASHS was significantly negatively correlated with HPC (*r* = -.21, *p* = .007), marginally significantly positively correlated with GPA (*r* = .15, *p* =. 054), but not significantly associated with WJ-IV (*r* = .07, *p* =. 398). Results also indicated that there was a significant relationship between daytime sleepiness and GPA (*r* = -.16, *p* = .048), as well as HPC scores (*r* = .25, *p* = .001), but not WJ-IV achievement scores (*r* = .05, *p* =. 491). These results are similar to previous research examining the link between daytime sleepiness and academic outcome among otherwise healthy adolescents (Dewald et al., 2010). Furthermore, GPA was significantly correlated with the daytime sleep subscale of the ASHS (*r* = .20, *p* = .012), while there was a significant relationship between the WJ-IV achievement scores and physiological (*r* = .25, *p* = .002), and behavioral arousal (*r* = -.16, *p* = .040) subscales of the ASHS. Lastly, HPC was significantly related to the physiological (*r* = -.19, *p* = .017), and sleep environment (*r* = -.26, *p* =

.001) subscales of the ASHS. In regards to the sleep variables, there was a significant negative relationship between PDSS and ASHS (r = -.56, p < .001), where poorer sleep hygiene was related to heightened daytime sleepiness.

Results of the measurement model are presented in Table 3. The three measurement models depict the pattern of observed variables for those latent constructs in the hypothesized models to be reliable measurements of the latent constructs. The three hypothesized models appear to be a good fit to the observed data, and therefore, post-hoc modifications were not conducted.

Structural equation modeling was utilized to test if the relationship between sleep hygiene and academic functioning (grades, WJ-IV Brief achievement scores, and HPC scores) was mediated by daytime sleepiness. Three separate mediation models were tested for each academic outcome. Direct and indirect effects of sleep hygiene on academic functioning are presented in Table 4. The first model with grades as the academic outcome variable was shown to have acceptable fit per the pre-determined fit criteria (X^2 (179) = 365.321, p < .001; CFI = .808; RFI = .608; TLI = .818; RMSEA = .080). Results indicated that daytime sleepiness did not significantly mediate the relationship between sleep hygiene and grades (p = .419, 95% CI = [-.164, .330]). The second model with WJ-IV Brief achievement scores as the academic outcome variable was shown to have acceptable fit per the pre-determined fit criteria (X^2 (179) = 373.068, p < .001; CFI = .803; RFI = .605; TLI = .750; RMSEA = .082). Results indicated that daytime sleepiness did not significantly mediate the relationship between sleep hygiene and WJ-IV Brief achievement scores (p = .309, 95% CI = [-.331, .105]). The third model with HPC scores as the academic outcome variable was shown to have acceptable fit per the pre-determined fit criteria (X^2 (179) = 363.938, p < .001; CFI = .804; RFI = .601; TLI = .748; RMSEA = .080). Results

indicated that daytime sleepiness did not significantly mediate the relationship between sleep hygiene and homework problems (p = .291, 95% CI = [-.367, .107]).

Given the acceptable level of fit, the regression weights for each variable in each of the analyzed models were evaluated. In the first model, ASHS did not significantly predict grades (b = -.057, p =.752), but ASHS did significantly predict PDSS (b = -.937, p < .001). In addition, PDSS did not significantly predict grades (b = -.168, p = .209). In the second model, ASHS did not significantly predict WJ-IV Brief achievement scores (b = 3.43, p = .215), but ASHS did significantly predict PDSS (b = .937, p < .001). In addition, PDSS did not significantly predict WJ-IV Brief achievement scores (b = 2.42, p = .226). In the third model, ASHS did not significantly predict HPC (b = -2.35, p = .358), but ASHS did significantly predict PDSS (b = -.926, p < .001). Further, PDSS did not significantly predict HPC (b = 2.43, p = .198).

CHAPTER V

Discussion

The current study aimed to investigate the potential role of daytime sleepiness in the association between sleep hygiene and academic functioning among high school students with ADHD. The literature in this area has focused on the individual impact of daytime sleepiness on academic functioning; while the relationship between sleep hygiene and academic functioning has not been studied among adolescents with ADHD. The current study fills a gap in the literature by investigating the role of sleep factors (i.e. daytime sleepiness and sleep hygiene practices) in contributing to academic functioning among adolescents with ADHD.

The first research question examined whether sleep hygiene predicts academic functioning. Contrary to what was hypothesized, sleep hygiene did not significantly predict grades, WJ-IV Brief achievement scores, or homework problems. However, there was a significant negative correlation between sleep hygiene and homework problems, indicating that more homework problems are related to poor sleep hygiene practices. These results suggest that poor sleep hygiene practices are related to academic functioning in the form of homework problems, rather then overall grades and achievement scores. Results indicating that total time in bed and sleep hygiene aren't related to GPA, while daytime sleepiness is, may point to presence of a potential comorbid sleep disorder such as obstructive sleep apnea (OSA), periodic limb movement disorder (PLMD), and/or restless leg syndrome (RLS). In clinical practice, the presence of heightened daytime sleepiness with adequate sleep quantity may indicate a comorbid sleep disorder mentioned previously, all of which are more prevalent among children and adolescents with ADHD (Owens, 2009). However, it is possible for adolescents to deny excessive daytime sleepiness and still have other risk factors indicative of a comorbid sleep

disorder (i.e., hypertension, obesity). Of note, mean PDSS scores from the current sample are below other samples reported in the literature (Drake et al., 2003). Previous research has consistently demonstrated that children with ADHD have significantly more homework difficulties than their classroom peers (Langberg et al., 2010). Children with ADHD are more likely than their peers to forget to bring materials from school to home and vice versa, to have homework assignments recorded inaccurately, to procrastinate when completing homework assignments, and to have left work incomplete. Furthermore, when completing homework, children with ADHD often have difficulties staying on-task, rush through their assignments and make careless mistakes (Epstein et al., 1993; Power, Karustis, & Habboushe, 2001). Therefore, it is not surprising that more homework difficulties are related to poor sleep hygiene.

When examining the individual relationships between the sleep hygiene subscales and homework problems, the sleep environment (e.g. falling asleep while watching TV; sleeping in a room that is too hot or cold) and physiological (e.g. very active during hour before bedtime; after 6:00 PM have drinks with caffeine; go to bed feeling hungry) subscales were negatively related to homework problems. These results suggest that sleep environmental factors as well as physiological arousal may be particularly important aspects of sleep hygiene to address among adolescents with ADHD, when aiming to decrease homework difficulties. It is also possible that homework difficulties (i.e., taking a long time to complete homework and/or heightened stress in regards to completing homework) could lead to poor sleep hygiene practices in the areas mentioned previously.

The current study also found that sleep hygiene was not related to grades or WJ-IV Brief achievement scores. Previous research has not explored the relationship between sleep hygiene and academic functioning (specifically grades and WJ-IV Brief achievement scores) among

adolescents with ADHD. However, among otherwise healthy children, lower scores on the sleep environment subscale were associated with lower sleep efficiency, more time awake after sleep onset, greater daytime sleepiness, more behavioral problems and lower school competency (Storfer-Isser et al., 2013). Consistent with the current study, Noland and colleagues (2009) found that high school students commonly reported environmental factors such as watching television, improper bedroom temperature and excessive noise as barriers to their getting adequate sleep.

The second research question examined whether sleep hygiene predicts daytime sleepiness. Consistent with what was hypothesized, sleep hygiene practices significantly predicted daytime sleepiness among adolescents with ADHD. In the current study, those who have poorer sleep hygiene experience more daytime sleepiness. No previous research exists investigating the relationship between sleep hygiene and daytime sleepiness among adolescents with ADHD. However, previous research has consistently linked sleep hygiene and daytime sleepiness among otherwise healthy adolescent samples (Millman, 2005). Poor sleep hygiene scores were related to shorter sleep duration, more night-to-night variability in total sleep time, lower sleep efficiency, later bedtimes, longer sleep onset latency, and heightened daytime sleepiness (Storfer−Isser et al., 2013). Similarly, among 361 school aged children (5 – 13 years old) with ADHD, poorer sleep hygiene was associated with increased bedtime resistance, increased daytime sleepiness, increased sleep duration problems, and increased delayed sleep onset (Sciberras, Song, Mulraney, Schuster, & Hiscock, 2017).

The third research question examined whether daytime sleepiness predicts academic functioning. Contrary to what was hypothesized for the mediation model, daytime sleepiness did not significantly predict homework problems, grades, or WJ-IV Brief achievement scores.

However, when examining bivariate correlation coefficients, daytime sleepiness was found to be negatively related to grades, where the more daytime sleepiness experienced, the lower the grades. Additionally, homework problems were positively related to daytime sleepiness, where more homework problems are related to heightened daytime sleepiness. In the current sample, WJ-IV Brief achievement scores were not found to be significantly related to daytime sleepiness. The findings from the current study are consistent with previous research among middle school students with ADHD demonstrating that daytime sleepiness was related to grades, homework problems, but didn't significantly predict grades (Langberg, Dvorsky, Marshall, & Evans 2013). Furthermore, the results from the current study are consistent with previous research among college students with ADHD indicating that daytime sleepiness did not predict overall GPA, but did predict the number of D and F grades students received (Langberg, Dvorsky, Marshall, & Evans, 2013). To our knowledge, this is the first study to examine the relationship between daytime sleepiness and academic functioning among adolescents with ADHD across various academic domains. Results from the current study indicate that daytime sleepiness impacts performance on a daily basis (as measured by GPA and parent reported homework problems), but not overall ability or knowledge (as measured by a standardized achievement test). However, it is important to note that mean PDSS scores from the current sample are below other samples reported in the literature (Drake et al., 2003).

The current study explored if the expected relationship between sleep hygiene and academic functioning was mediated by daytime sleepiness. Contrary to what was hypothesized, daytime sleepiness did not mediate the relationship between sleep hygiene and academic functioning in the forms of grades, homework problems, and WJ-IV Brief achievement scores. Among the current sample, sleep hygiene did not predict grades, homework problems, and WJ-

IV Brief achievement scores, therefore, a non-significant relationship cannot be mediated by another variable. It is possible that sleep hygiene is not a factor that truly influences global academic functioning, but does have an impact on homework problems. As previously stated, adolescents with ADHD have increased homework difficulty, which can influence how active they are prior to bedtime (Epstein et al., 1993; Lahey et al., 1994; Power, Werba, Watkins, Angelucci, & Eiraldi, 2006). Furthermore, in the current sample total hours slept on weekdays was close to the recommended amount for adolescents (M = 7.79 hours), and therefore it is possible that sleep hygiene didn't have an effect on global measures of academics (grades and WJ-IV Brief achievement scores). In the current study, total weekday sleep time was not related to grades, homework problems, WJ-IV Brief achievement scores, and daytime sleepiness, but was positively related to sleep hygiene. Similarly, previous research has demonstrated that subjective report of total hours slept was not related to academic outcomes or daytime sleepiness (Langberg, Dvorsky, Marshall, & Evans 2013). It is possible that these results point to the unique experience and overlap of excessive daytime sleepiness and ADHD symptoms. This study has various implications for assessment and treatment among this vulnerable population. Specifically, among adolescents with ADHD excessive daytime sleepiness as opposed to poor sleep hygiene may impede academic functioning and could be an indicator of a possible comorbid sleep disorder. Therefore, screening and assessing youth with ADHD for excessive daytime sleepiness by obtaining self-report as well as parent reported measures of daytime sleepiness, and information on symptoms of other possible comorbid sleep disorders such as obstructive sleep apnea, periodic limb movement sleep disorder, and restless leg syndrome are essential. Referral to a multidisciplinary sleep clinic would be ideal if a sleep disorder is suspected; however, that is often unrealistic due to various limiting factors (i.e., familial

resources to obtain a referral, geographic locations and availability of multidisciplinary sleep clinics). Therefore, with appropriate consultation, questions about sleep disruptions can easily be incorporated into a school psychologist's interview, and psychoeducation or brief behavioral interventions can be provided in the school setting (Meltzer & Mindell, 2006). In regards to academic functioning, intervening through improving sleep hygiene behavior alone may not be robust enough to impact students' daytime functioning and subsequently improve academic functioning. This would indicate that addressing their daytime symptoms could yield better academic outcomes. There are various methods that can be carried out in a school setting to maximize the development and appropriate use of organizational, time management and planning skills (e.g., management of materials, planning for short and long-term projects, use of organizational aides, time management) in students with ADHD. Developing and capitalizing on these skills can be carried out on an individual basis through academic coaching and/or in a group format where skills are taught and practiced in session with peers and generalized to other settings

Future Directions

The findings from the study highlight the importance of excessive daytime sleepiness and its effect on academic functioning. Furthermore, this study demonstrates that among adolescents with ADHD, aiming to improve sleep hygiene in isolation may not yield improvements in global academic functioning. Moreover, results suggest that sleep environmental factors as well as physiological arousal may be particularly important aspects of sleep hygiene to address among adolescents with ADHD when aiming to decrease homework difficulties. Because this is the first study to address sleep hygiene, daytime sleepiness, and academic functioning in this population, a multitude of future studies in this area are needed. Future studies should attempt to disentangle

the daytime symptoms associated with ADHD (e.g. inattention) and their experience of daytime sleepiness. In addition, further exploration of other potential mediators of the relationship between sleep hygiene and daytime sleepiness, as well as the relationship between daytime sleepiness and academic functioning are necessary. For example, it is possible that internalizing symptoms of anxiety or depression, and/or externalizing symptoms of aggression or mood disturbances play a role in these relationships. Additionally, future research should examine if the relationship between daytime sleepiness and academic functioning is mediated by sleep hygiene. Recent research has demonstrated that youth with ADHD are at increased risk for experiencing comorbid mental health problems including externalizing and internalizing symptoms (Becker, Langberg, & Evans, 2015). This emerging longitudinal evidence indicates that sleep problems predict comorbid externalizing and internalizing symptoms among young adolescents with ADHD. Specifically, above and beyond demographic characteristics, ADHD symptom severity, and initial levels of comorbidity, sleep problems significantly predicted greater ODD symptoms, general externalizing behavior problems, and depressive symptoms at 1 year follow up. However, limited research exists on this comorbid diagnostic profile, especially among high school students.

Longitudinal studies are needed to determine if sleep hygiene practices and/or heightened daytime sleepiness influence academic or vocational functioning over time among those with ADHD. Moreover, longitudinal research should aim to determine whether various sleep disorders (e.g. sleep disordered breathing, insomnia, circadian rhythm disorders) influence academic functioning among adolescents with ADHD. A recent systematic review of the literature on circadian function and chronotype in ADHD highlighted consistency in findings that delayed circadian phase and later chronotype/evening preference are associated with ADHD

(Coogan & McGowen, 2017). This consensus of findings suggest that chronotherapeutic approaches to correct underlying phase alterations with the goal to increase sleep quality and quantity could lead to improvement in daytime ADHD symptoms. However, research is needed to determine if this type of intervention is effective for adolescents with ADHD. More research has been conducted on the use of melatonin in ADHD, indicating that melatonin is effective in the reduction of sleep latency problems and reductions in sleep disruptions both for children not medicated and medicated with stimulant medication (Weiss, Craig, Davies, Schibuk, & Stein, 2015). This suggests that the use of melatonin with the goal to advance circadian phase should be utilized in smaller doses, while paying close attention to timing of administration, and tailoring to the underlying circadian phase misalignment (Coogan and McGowen (2017).

The current study highlights the need for future research to support the screening and assessment of potential co-occurring sleep difficulties and disorders among children and adolescents with ADHD. Daytime sleepiness may be a critical characteristic for screening and intervention aimed at improving daytime functioning. It is clear that evidence-based treatments that target sleep functioning are needed for children and adolescents with ADHD.

Limitations

Findings from the current study should be interpreted in light of its limitations. The cross-sectional data used in this study prevent a determination of causality, thus future longitudinal research is necessary. Additionally, the lack of variability in the PDSS and ASHS scores may have influenced the nonsignificant findings. Further, even though post-hoc power analyses were conducted for the whole mediation model to determine effect sizes and power of the current sample, it is possible that the sample size was not large enough to detect small effects due to the number of variables that were controlled for. In addition, conclusions based on this study are

limited by the use of subjective sleep measures (as opposed to objective measures of youths' sleep such as polysomnography or actigraphy). Additionally, sleep was measured after academic variables. A multi-time point assessment may have provided more confidence or further details about the nature of the sleep hygiene and sleepiness problems. However, it is not likely that the timing influenced the outcomes because the difference in data collection points was only 2 to 5 months. Moreover, baseline levels of academic functioning, ADHD symptom severity, and possible comorbid sleep disorders were not controlled for in the models and would be important variables to consider in future studies. Similarly, even though parent education level and income were controlled for in the models, it is possible that other extrinsic cultural practices and norms (e.g., bed sharing, access to electronics, emphasis on academic achievement) specifically related to sleep environment/routines, sleep hygiene, and academic functioning play a role in these relationships. Additionally, the way in which academic functioning was measured (e.g., GPA, achievement scores, parent reported homework problems) may have influenced the outcomes. Specifically, academic outcomes measured by standardized achievement tests in isolation may be less sensitive to sleep factors that are likely to vary in effects on day-to-day scholastic performance. Furthermore, homework problems were parent reported, while the sleep measures were adolescent self-report. It is possible that self-reported homework problems would be highly correlated to the self-reported sleep measures. Lastly, the models in the current study didn't include teacher-reported measures as an index of academic functioning. Incorporating teacher-reported measures of academic functioning could be more sensitive to change due to daytime sleepiness.

Conclusions

Evidence-based treatments that target sleep functioning are needed for children and

adolescents with ADHD. Previous research has demonstrated that adolescents with ADHD are likely to have poor sleep hygiene (Sung, Hiscock, Sciberras, & Efron, 2008), experience heightened daytime sleepiness (Cortese et al., 2006; Sadeh, Pergamin, & Bar-Haim, 2006), while also daytime impairment. It is important to consider psychosocial and contextual factors that can advance our understanding of sleep in children and adolescents with ADHD, a population of youth at heightened risk for experiencing significant sleep difficulties. Findings from the current study suggest that among adolescents with ADHD, excessive daytime sleepiness as opposed to poor sleep hygiene may impede academic functioning. This would indicate that addressing their daytime symptoms would yield better academic outcomes. In regards to academic functioning, intervening through improving sleep hygiene behavior alone may not be robust enough to impact their daytime functioning and subsequently improve overall academic functioning. However, these results also suggest that sleep environmental factors as well as physiological arousal may be important aspects of sleep hygiene to address among adolescents with ADHD when aiming to decrease homework difficulties. Despite progress in the diagnosis, assessment, and treatment of adolescents with ADHD, numerous research questions remain unaddressed regarding the complex relationship between ADHD and sleep in adolescents with ADHD.

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Table 1. *Descriptive characteristics of the sample*

Categorical demographic variables	n (%)
Male	126 (77.3%)
Caucasian	131 (80.4%)
African American	27 (16.6%)
Presence of IEP/504	97 (59.5%)
Existing diagnosis of ADHD	105 (64.4%)
ADHD Medication	69 (42.3%)
Primary caregiver employment status	
Full time	107 (65.6%)
Part time	26 (15.9%)
Not employed	30 (18.4%)
Highest degree completed of primary caregiver	
High school diploma	30 (18.4%)
Partial college (no degree)	37 (22.7%)
Associates Degree	32 (19.6%)
Bachelors degree	33 (20.2%)
Masters/Doctoral	20 (12.3%)
Household income of primary residence	
Up to $10,000	8 (4.9%)
$10,000-14,999	5 (3.1%)
$15,000-24,999	10 (6.1%)
$25,000-49,999	37 (22.7%)
$50,000-74,999	31 (19.1%)
$75,000-99,999	34 (20.9%)
$100,000-149,999	24 (14.7%)
$150,000-199,999	9 (5.5%)
$200,000 or more	5 (3.1%)
Continuous demographic variables	**Mean (SD)**
Age	15.33 (.84)
Absences(# of days missed)	12.07 (14.26)
Tardiness (# of days late)	11.45 (13.77)
GPA	2.05 (.83)
WJ-IV Achievement	92.88 (12.67)
HPC	56.84 (10.88)
Total time in bed (weekday)	7.79 (.99)
PDSS	13.41 (5.48)
ASHS (total)	3.98 (.71)
Physiological	4.09 (.86)
Behavioral arousal	3.15 (1.09)
Cognitive-emotional	4.48 (1.02)
Daytime sleep	4.53 (1.28)
Sleep environment	4.71 (1.01)
Sleep stability	2.91 (1.24)

Table 2. *Pearson correlations for variables in model*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1.GPA	-																		
2.WJ	.07	-																	
3.HPC	-.24**	.12	-																
4.PDSS	-.16*	.05	.25**	-															
5.ASHS	.15	.07	-.21**	-.56**	-														
6.ASHS1	.07	.25**	-.19*	-.26**	.64**	-													
7.ASHS2	.05	-.16*	-.13	-.30**	.66**	.32**	-												
8.ASHS3	.04	.07	-.03	-.34**	.68**	.35**	.38**	-											
9.ASHS4	.20*	.13	-.09	-.28**	.61**	.30**	.22**	.28**	-										
10.ASHS5	.12	.17*	-.26**	-.56**	.76**	.53**	.30**	.50**	.39**	-									
11.ASHS6	.10	-.12	-.14	-.44**	.62**	.20**	.39**	.26**	.15	.37**	-								
12.Dx	.25**	.11	-.04	-.07	.08	.06	-.02	.02	.10	.11	.05	-							
13.IEP/504	.17*	-.29**	-.05	-.14	.03	-.05	.11	-.00	.03	-.03	.05	.43**	-						
14.TST	-.04	-.05	-.04	-.11	.23**	.06	.16*	.22**	.23*	.07	.16*	-.08	-.01	-					
15.Meds	.25**	.05	-.05	-.17*	.05	.07	.02	-.05	.02	.11	.04	.61**	.32**	.00	-				
16.Atten	-.20**	-.20*	.09	.18*	-.16*	-.08	.02	-.13	-.19*	-.19*	-.03	-.08	-.07	-.07	-.14	-			
17.Tardy	-.34**	-.14	-.13	-.08	-.05	-.05	.04	.04	-.25**	.03	.05	-.04	-.12	.01	-.09	.15	-		
18.Employ	-.21**	-.08	.04	.09	-.13	-.12	-.12	.00	-.15	-.10	-.00	-.10	-.10	-.08	-.22**	.04	.16*	-	
19.Educ	.21**	.15	.03	-.09	.07	.10	-.01	-.02	.15	.12	-.05	.14	.15	.01	.06	.02	-.18*	-.40**	-
20.Income	.26**	.27**	-.10	-.01	.14	.18*	.00	-.05	.23**	.22**	-.01	.13	.07	.05	.19*	-.13	-.17*	-.41**	.53**

Note. GPA = grade point average; WJ = Woodcock Johnson achievement scores; HPS = Homework problems checklist total score; PDSS = Pediatric Daytime Sleepiness Scale total score; ASHS = Adolescent Sleep Hygiene Scale total score; ASHS1 = Physiological subscale of the ASHS; ASHS2 = Behavioral Arousal subscale of the ASHS; ASHS3 = Cognitive-Emotional subscale of the ASHS; ASHS4 = Daytime Sleepiness subscale of the ASHS; ASHS5 = Sleep Environment subscale of the ASHS; ASHS6 = Sleep Stability subscale of the ASHS; Dx = Previous diagnosis of ADHD; IEP/504 = Presence or absence of and IEP or 504 plan; TST = total time in bed; Meds = Medication status; Atten = Attendance; Tardy = Tardiness; Employ = Primary caregiver employment status; Educ = Primary caregiver's highest level of education; Income = Primary caregiver's household income.

* $p < .05$. ** $p < .01$

Table 3. *Standardized Regression Weights, Standard Errors, Critical Ratio, and p Values of the Measurement Model*

	Estimate	**S.E.**	**C.R.**	***p***
GPA Model				
pdss_1 ←PDSS	1.00			
pdss_2 ←PDSS	1.02	.133	7.71	<.001
pdss_3 ←PDSS	.211	.106	1.99	.046
pdss_4 ←PDSS	.765	.108	7.09	<.001
pdss_5 ←PDSS	1.12	.147	7.63	<.001
pdss_6 ←PDSS	1.18	.150	7.86	<.001
pdss_7 ←PDSS	.896	.160	5.59	<.001
pdss_8 ←PDSS	1.03	.145	7.14	<.001
Sleep stability subscale ←ASHS	1.00			
Daytime subscale ←ASHS	.997	.228	4.38	<.001
Sleep environment subscale ←ASHS	1.44	.247	5.80	<.001
Cognitive Emotional subscale ←ASHS	1.00	.200	5.04	<.001
Behavior subscale ←ASHS	.837	.193	4.34	<.001
Physiological subscale ←ASHS	.850	.169	5.04	<.001
WJ Model				
pdss_1 ←PDSS	1.00			
pdss_2 ←PDSS	1.02	.135	7.58	<.001
pdss_3 ←PDSS	.210	.107	1.96	.050
pdss_4 ←PDSS	.776	.110	7.06	<.001
pdss_5 ←PDSS	1.14	.150	7.61	<.001
pdss_6 ←PDSS	1.19	.153	7.83	<.001
pdss_7 ←PDSS	.912	.162	5.61	<.001
pdss_8 ←PDSS	1.04	.147	7.08	<.001
Sleep stability subscale ←ASHS	1.00			
Daytime subscale ←ASHS	1.01	.232	4.35	<.001
Sleep environment subscale ←ASHS	1.46	.254	5.74	<.001
Cognitive Emotional subscale ←ASHS	1.02	.204	4.99	<.001
Behavior subscale ←ASHS	.836	.196	4.27	<.001
Physiological subscale ←ASHS	.868	.173	5.01	<.001
HPC Model				
pdss_1 ←PDSS	1.00			
pdss_2 ←PDSS	1.02	.136	7.55	<.001
pdss_3 ←PDSS	.208	.107	1.94	.052
pdss_4 ←PDSS	.773	.110	7.01	<.001
pdss_5 ←PDSS	1.15	.151	7.60	<.001
pdss_6 ←PDSS	1.20	.153	7.84	<.001
pdss_7 ←PDSS	.919	.163	5.63	<.001
pdss_8 ←PDSS	1.05	.148	7.10	<.001
Sleep stability subscale ←ASHS	1.00			
Daytime subscale ←ASHS	.999	.228	4.37	<.001

Sleep environment subscale ←ASHS	1.44	.249	5.80	<.001
Cognitive Emotional subscale ←ASHS	.999	.199	5.08	<.001
Behavior subscale ←ASHS	.836	.193	4.37	<.001
Physiological subscale ←ASHS	.856	.170	5.04	<.001

Note. PDSS = Pediatric Daytime Sleepiness Scale; pdss_1-8 = individual items from the PDSS
ASHS = Adolescent Sleep Hygiene Scale.

Table 4. *Bootstrapped estimates of standardized direct and indirect effects*

			Lower Bound (95%)		Upper Bound (95%)	
			PDSS	ASHS	PDSS	ASHS
GPA Model	Direct	GPA	-.450	-.330	.220	.332
		PDSS		-.847**		-.544**
	Indirect	GPA		-.164		.330
WJ Model	Direct	WJ	-.138	-.152	.440	.452
		PDSS		-.845**		-.452**
	Indirect	WJ		-.331		.105
HPC Model	Direct	HPC	-.149	-.445	.398	.496
		PDSS		.847**		.832**
	Indirect	HPC		-.367		.295

Note. PDSS = Pediatric Daytime Sleepiness Scale; ASHS = Adolescent Sleep Hygiene Scale; GPA = Grade point average; WJ = WJ-IV Brief achievement scores.

**p<.01; *p<.05

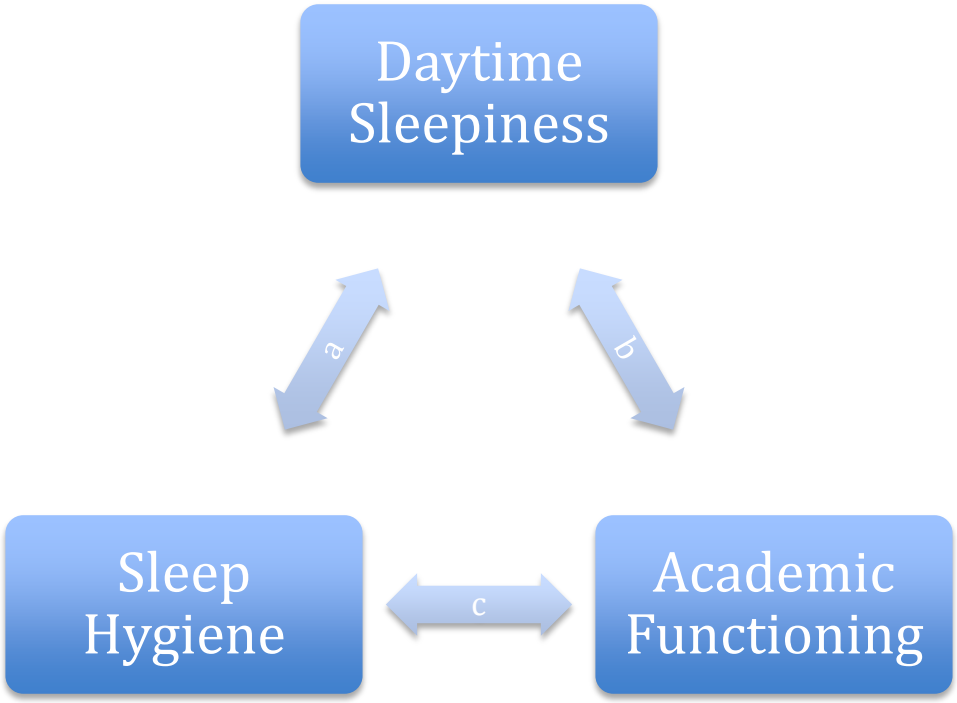

Figure 1. Proposed Mediation Model

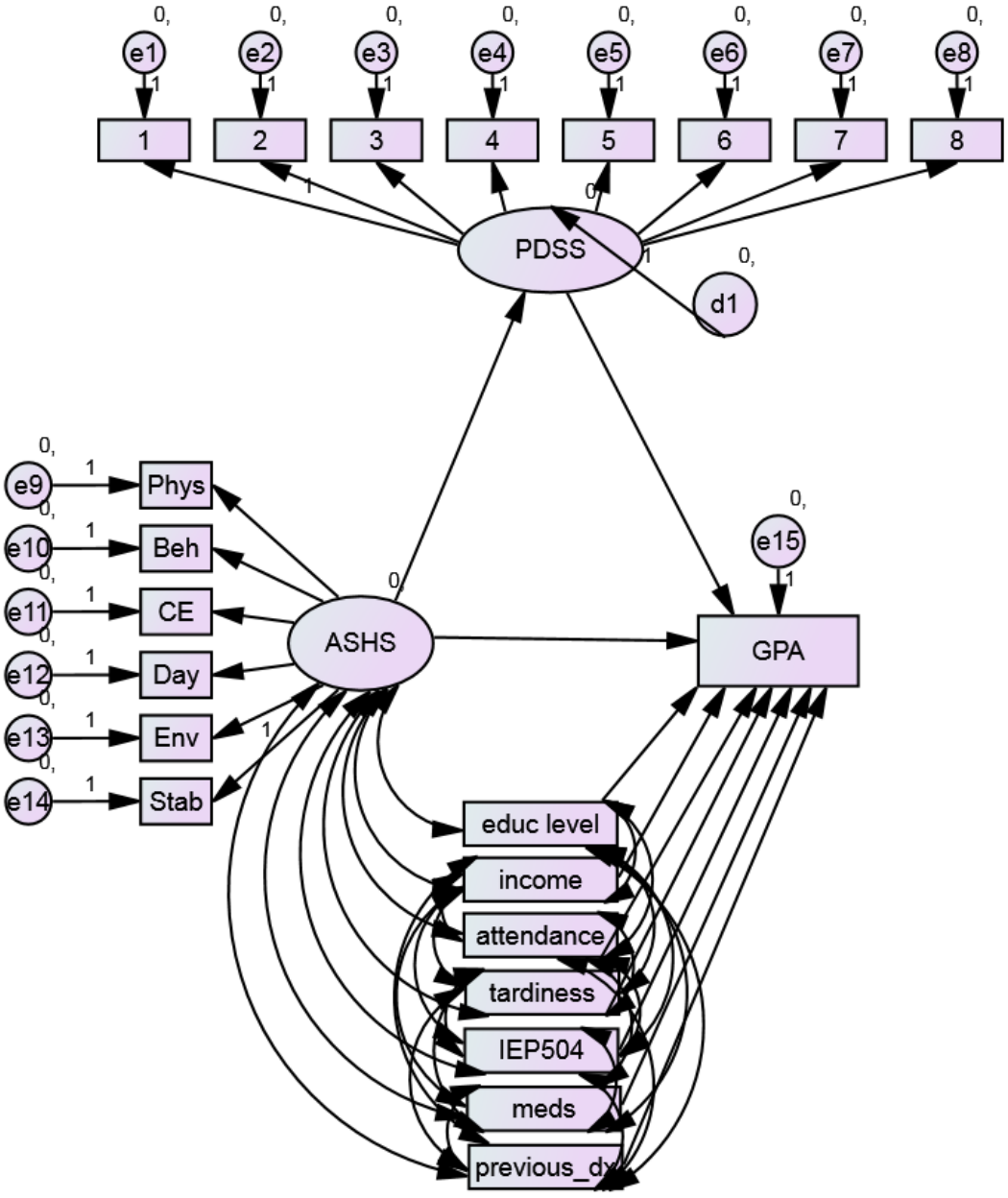

Figure 2. Model 1 with GPA as the outcome measure

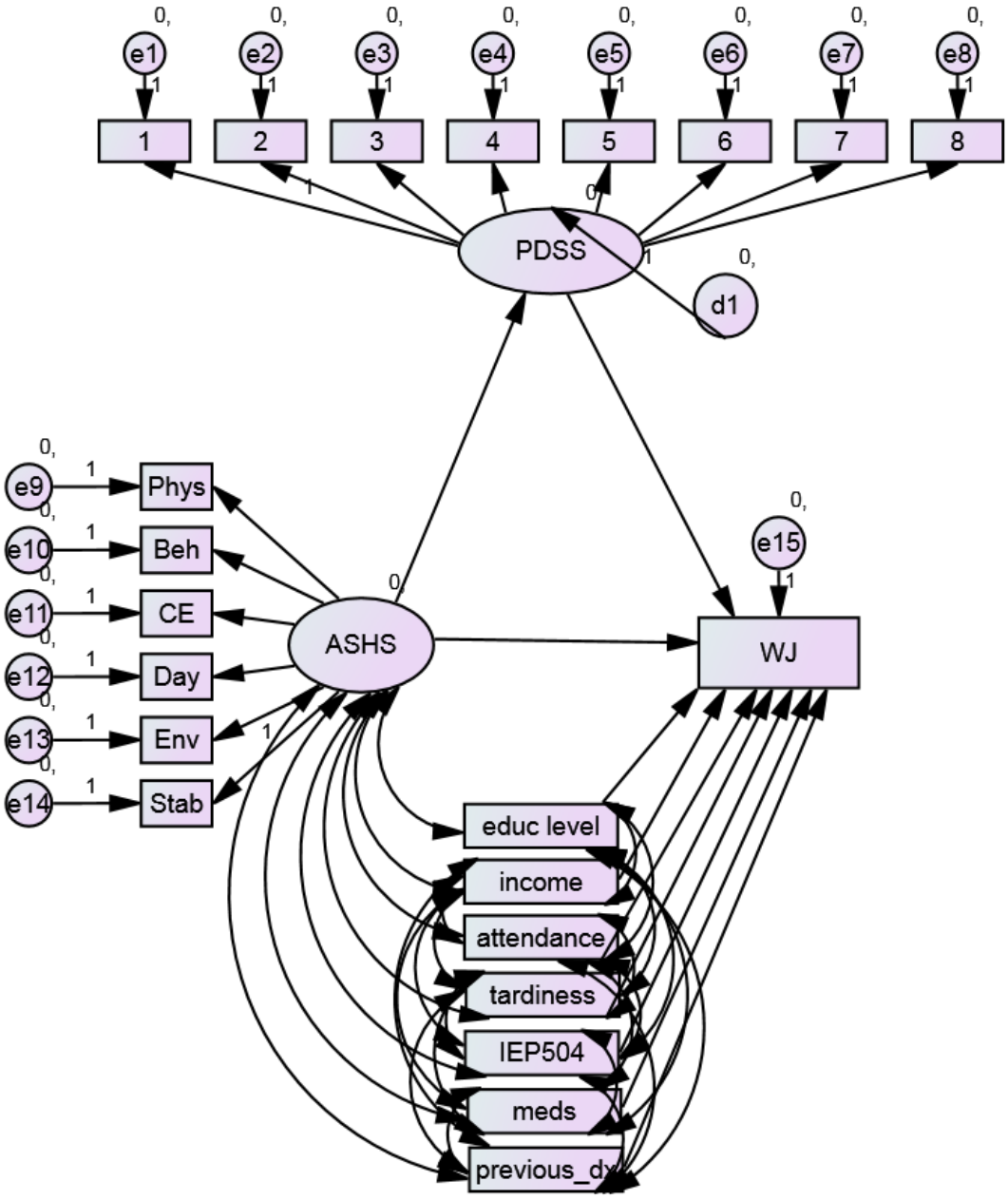

Figure 3. Model 2 with WJ-Achievement as the outcome measure

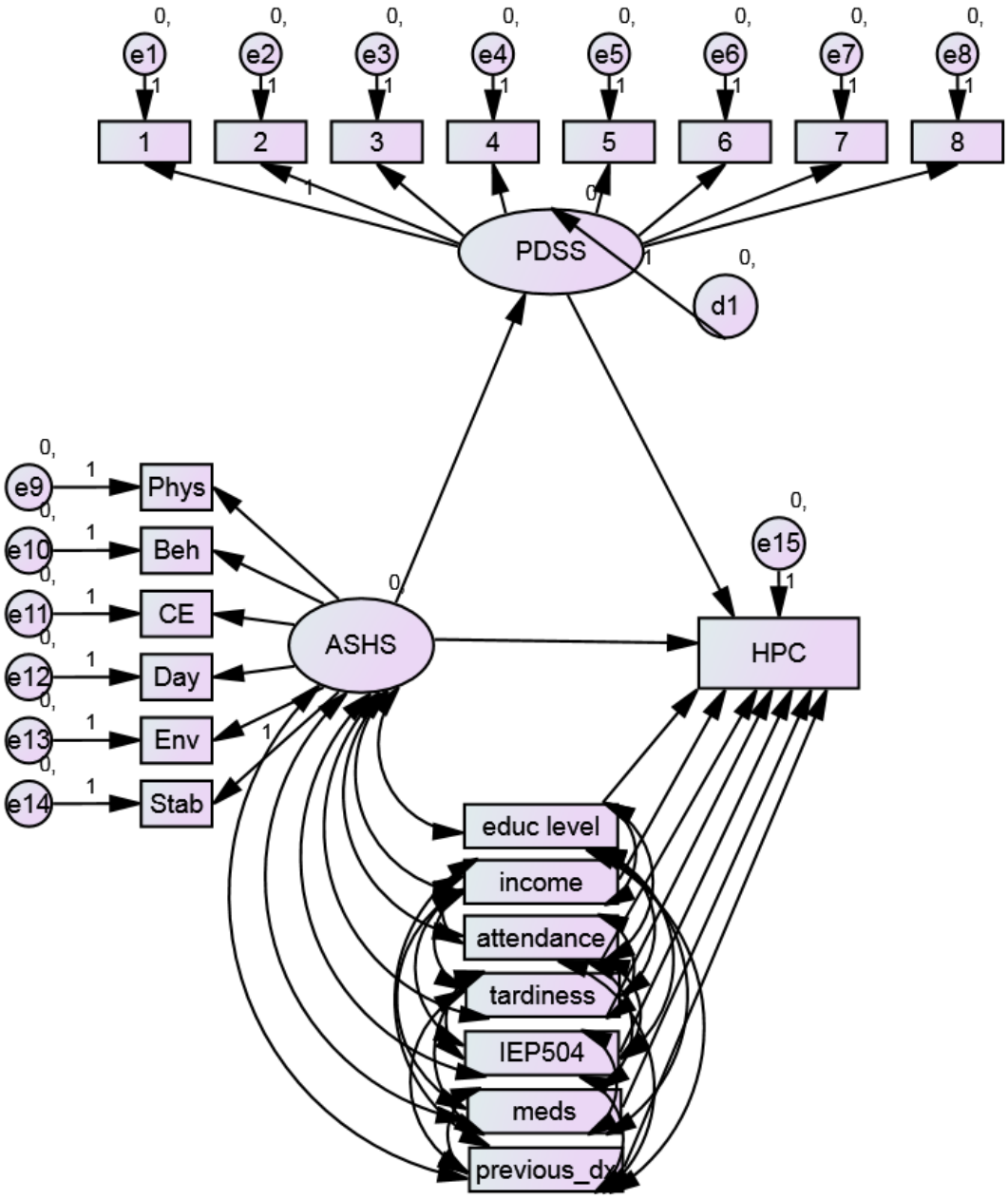

Figure 4. Model 3 with HPC as the outcome measure

KRISTINA PUZINO

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EDUCATION

August 2013-May 2018	**Lehigh University**, Bethlehem, PA Doctoral Candidate in School Psychology, GPA: 3.85 Dissertation Title: *The Impact of Sleep Hygiene and Daytime Sleepiness on Academic Functioning Among Adolescents with ADHD*
June 2017-July 2018	**Penn State Hershey Medical Center**, Hershey PA Psychology Pre-doctoral Internship
August 2011-August 2013	**Saint Joseph's University**, Philadelphia, PA M.S. in Experimental Psychology, GPA: 3.71 Thesis Title: *Presleep cognitive arousal among adolescents and young adults with chronic pain*
August 2007-May 2011	**Siena College**, Loudonville, NY B.A. in Psychology, *Cum Laude*, GPA: 3.69

PEER REVIEWED PUBLICATIONS

Puzino, K., Guite, J. W., Moore, M., Lewen, M., & Williamson, A. (2017). The relationship between parental responses to pain, pain catastrophizing, and adolescent sleep in adolescents with chronic pain. *Children's Health Care*, (accepted).

Moore, J. A., & **Puzino, K.** (2017). What I wish I knew before being a trainee in integrated primary care. *Society of Pediatric Psychology, Integrated Primary Care SIG Newsletter*, March, 3.

Ingram, D. G., Mindell, J. A., **Puzino, K.**, & Walters, R. M. (2016). A survey of practicing sleep coaches. *Behavioral Sleep Medicine*, 1-12.

Winston, F. K., **Puzino, K.**, & Romer, D. (2016). Precision prevention: time to move beyond universal interventions. *Injury prevention*, *22*(2), 87-91.

Gormley, M. J., Pinho, T., Pollack, B., **Puzino, K.**, Franklin, M. K., Busch, C., DuPaul, G. J., Anastopoulos, A. D., & Weyandt, L. L. (2015). Impact of study skills and parent education on first-year GPA among college students with and without ADHD a moderated mediation model. *Journal of attention disorders*.

Puzino, K., & Mindell, J. (2015). Sleep disturbances in pediatric chronic pain patients: The role of cognitions. *Translational Issues in Psychological Science*, *1*(1), 6-15.

Mindell, J. A., Leichman, E. S., **Puzino, K.**, Walters, R., & Bhullar, B. (2015). Parental concerns about infant and toddler sleep assessed by a mobile app. *Behavioral sleep medicine*, *13*(5), 359-374.

Prashad, P., Marcus, C., Cornaglia, M., Bradford, R., Costa, P., **Puzino, K**., Xanthopoulos, M., Maggs, J., Moore, M., Barg, F. (2013). Investigating reasons for CPAP adherence in adolescents: A qualitative approach. *Journal of clinical sleep medicine: JCSM: official publication of the American Academy of Sleep Medicine*, *9*(12), 1303-1313.

BOOK CHAPTERS

DuPaul, G.J., Belk, G., & **Puzino, K.** (2016). Interventions for attention-deficit/hyperactivity disorder. In L. A. Theodore (Ed.), *The handbook of applied interventions for children and adolescents.* New York: Springer Publishing Company.

MANUSCRIPTS UNDER REVIEW

Power, T., DuPaul, G. J., Gormely, M. L., Pollack, B., **Puzino, K.,** Bassano, T., Anastopoulos, A. D., & Reid, R. (in submission). Unique associations between symptom dimensions of ADHD and domains of impairment: A multi-method assessment.

TREATMENT MANUALS

DuPaul, G.J., Evans, S.W., Owens, J.S., **Puzino, K.,** & Petca, A.R. (2014). *Bridges to Educational Success for Teens (BEST): Individual Academic Sessions Manual.* Lehigh University and Ohio University.

DuPaul, G.J., Evans, S.W., Owens, J.S., **Puzino, K.,** & Petca, A.R. (2014). *Bridges to Educational Success for Teens (BEST): Parent Manual.* Lehigh University and Ohio University.

DuPaul, G.J., Evans, S.W., Owens, J.S., **Puzino, K.,** & Petca, A.R. (2014). *Bridges to Educational Success for Teens (BEST): Social Skills Group Manual*. Lehigh University and Ohio University.

ORAL PRESENTATIONS

Puzino, K., Frye, S.S., LaGrotte, C., Vgontzas, A.N., Fernandez-Mendoza, J. *Clinical significance of pre-sleep somatic arousal in young adults with insomnia: hyperarousal vs. anxiety.* Paper accepted for presentation at the Associated Professional Sleep Societies Annual Meeting, Baltimore, MD.

Puzino, K., Frye, S.S., LaGrotte, C., Vgontzas, A.N., Fernandez-Mendoza, J. *Arousability as a predisposition to insomnia: clinical dimensions and cut-offs to identify insomnia risk.* Paper accepted for presentation at the Associated Professional Sleep Societies Annual Meeting, Baltimore, MD.

DuPaul, G.J., **Puzino, K.,** Evans, S.W., Petca, A.R., & Owens, J.S. (February, 2018). *High school teacher ratings: Development of the school functioning scale.* Paper presented

presentation at the National Association for School Psychology Annual Conference, Chicago, IL.

Levine, M.E., **Puzino, K.**, & Crovello, N.J. (May, 2017). *Sit back and relax: The effects of progressive muscle relaxation on motion-induced nausea and gastric dysrhythmia*. Paper presented at the annual meeting of the Eastern Psychological Association, Boston, MA.

Puzino, K., Hoff, M.E., Hetrick, A.A., Kipperman, K.L., Andryc, M., Harrington, J., & DuPaul, G.J. (February, 2017). *Predictors of school functioning among adolescents with ADHD.* Paper presented at the National Association for School Psychology Annual Conference, San Antonio, TX.

Puzino, K. & Cunningham, T. (June, 2016). *First time SLEEP attendees welcome breakfast*. Presentation for the Trainee Development Suite during the Associated Professional Sleep Societies Annual Meeting, Denver, CO.

Hostutler, C., Laracy, S., **Puzino, K**., & Mindell, J. (February, 2016). *Sleep 101: How to effectively assess, treat, and refer.* Paper presented at the National Association for School Psychology Annual Conference, New Orleans, LA.

DuPaul, G.J., Power, T.J., Gormley, M. J., Bassano, T., Reid., R., Anastopoulos, A. D., & **Puzino, K**. (February, 2016). *ADHD symptom and impairment ratings: Screening, assessment, and treatment evaluation.* Paper presented at the National Association for School Psychology Annual Conference, New Orleans, LA.

Evans, S.W., DuPaul, G.J., Petca, A.R., **Puzino, K.** & Owens, J.S. (December, 2015). Bridges to education success in teens. In J. Buckley & E. Doolittle (Chairs), *Supporting students in early and late adolescence with Attention Deficit Hyperactivity Disorder: Developmental challenges and opportunities in service provision.* Symposium presented at the annual meeting of the Institute for Education Sciences – PI meeting, Washington DC.

Gormley, M. J., Pinho, T., Pollack, B., Laracy, S. D., Busch, C., Franklin, M., **Puzino, K**., Hollingsworth, K., & DuPaul, G. J. (August, 2014). *First-year GPA for college students with and without ADHD: A moderated mediation model. In A. D. Anastopoulos (Chair), Longitudinal outcome of college students with ADHD: Initial findings from two studies.* Symposium presented at the annual convention of the American Psychological Association, Washington, D.C.

DuPaul, G. J., **Puzino, K**., Evans, S. W., Petca, R. (September, 2014). *Multisite study of school-based treatment approaches for adolescents with ADHD.* Symposium presented at the School Mental Health Research Summit, Pittsburgh, PA.

Puzino K., & Levine M. E. (May, 2014). *Music helps but shadowing doesn't: The effects of emotional and cognitive distraction on motion-induced nausea and gastric dysrhythmia*. Paper presented at the annual meeting of the Eastern Psychological Association, Boston, MA.

POSTER PRESENTATIONS

Puzino, K., Ray, R., Owens, J. S., DuPaul, G.J., & Evans, S.W. (August, 2017). *Sleep and Internalizing Symptoms among Adolescents with ADHD.* Poster presented at the annual convention of the American Psychological Association, Washington, D.C.

Bunford, N., DuPaul, G.J, Owens, J.S., Evans, S.W., **Puzino, K.,** & Ray, R., (June, 2017). *Validation of a parent-report rating scale of emotion dysregulation in adolescents.* Poster presented at the 18th annual meeting of the International Society for Research in Child & Adolescent Psychopathology, Amsterdam, North Holland, Netherlands.

Ingram, D.G., Mindell, J., **Puzino, K**., Walters, R., & West, K. (June, 2016). *A Survey of practicing sleep coaches.* Poster presented at the Associated Professional Sleep Societies Annual Meeting, Denver, CO.

Puzino, K., Mindell, J., Moore, M., & Guite, J. W. (November, 2015). *Functional disability in adolescents with chronic pain: It's all about sleep and cognitions*. Poster presented at the 8th Bi-Annual Conference on Pediatric Sleep Medicine, Amelai Island, FL.

Levine, M., **Puzino, K.,** & Crovello, N. J. (May, 2015). *Sit back and relax: The effects of progressive muscle relaxation on motion-induced nausea and gastric dysrhythmia.* Poster presented at the 27th Annual Association for Psychological Science Convention, New York, NY.

Lockyer, J., Xanthopoulos, M., **Puzino, K**., Scheiman, M., Gallaway, M., Master, S., Master, C. (March, 2015). *Concussions in Children and Adolescents: The prevalence and impact of mental health conditions prior to injury.* Poster presented at the Society of Pediatric Psychology Annual Conference, San Diego, CA.

Busch, C., DuPaul, G. J., Gormley, M. J., & **Puzino, K**. (February, 2015). *Substance use patterns in college students with ADHD*. Poster presented at the National Association for School Psychology Annual Conference, Orlando, FL.

Pollack, B., Gormley, M. J., Pinho, T., DuPaul, G. J., Oster, D., **Puzino, K.,** Weyandt, L. L., & Anastopoulos, A. D. (February, 2015). *Service utilization among college students with ADHD and Learning Disorders.* Poster presented at the National Association for School Psychology Annual Conference, Orlando, FL.

Puzino, K., Mindell, J., Moore, M., & Guite, J. W. (March, 2014). *Presleep cognitive arousal and functional disability in chronic pain patients*. Poster presented at the Society of Pediatric Psychology Annual Conference, Philadelphia, PA.

Mindell, J., Leichman, E., **Puzino, K.**, Walters, R., & Bhullar, B. (March, 2014). *An iPhone application for young children's sleep: Caregivers' concerns and sleep consolidation.* Poster presented at the Society of Pediatric Psychology Annual Conference, Philadelphia, PA.

Puzino, K., Mindell, J., Moore, M., & Guite, J. W. (November, 2013). *Presleep cognitive arousal among adolescents and young adults with chronic pain.* Poster presented at the 7th Bi-Annual Conference on Pediatric Sleep Medicine, Amelia Island, FL.

Mindell, J., Leichman, E., **Puzino, K.**, Walters, R., & Bhullar, B. (November, 2013). *Parent questions submitted to an iPhone application for infant and toddler sleep.* Poster presented at the 7th Bi-Annual Conference on Pediatric Sleep Medicine, Amelia Island, FL.

Mindell, J., Leichman, E., **Puzino, K**., Walters, R., & Bhullar, B. (October, 2013). *Parent questions submitted to an iPhone application for infant and toddler sleep.* Poster presented at the 2013 American Academy of Pediatrics (AAP) National Conference and Exhibition, Orlando, FL.

Puzino K., & Levine M. E. (October, 2013). *Music helps but shadowing doesn't: The effects of emotional and cognitive distraction on motion-induced nausea and gastric dysrhythmia*. Poster presented at the Biology and Control of Nausea and Vomiting meeting, Pittsburgh, PA.

Puzino, K., Mindell, J., Moore, M., & Guite, J. W. (June, 2013). *Presleep cognitive arousal among adolescents and young adults with chronic pain.* Poster presented at the Associated Professional Sleep Societies Annual Meeting, Baltimore, MD.

Puzino, K., Mindell, J., Moore, M., & Guite, J. W. (2013, April). *Presleep cognitive arousal among adolescents and young adults with chronic pain.* Poster presented at the Saint Joseph's Sigma Xi Poster Symposium, Philadelphia, PA.

Puzino, K., Mindell, J., Moore, M., & Guite, J. W. (2013, April). *Presleep cognitive arousal among adolescents and young adults with chronic pain.* Poster presented at the Philadelphia Area Psi Chi Research Day, Philadelphia, PA.

Corregano, L., **Puzino, K.,** & Mirman, J. (April, 2013). *Parents' perceptions of common problems teens face when learning to drive.* Poster presented at the Lifesavers National Conference on Highway Safety Priorities, Denver, CO.

Puzino, K. & Levine, M. (March, 2013). *Music helps but shadowing doesn't: The effects of emotional and cognitive distraction on motion-induced nausea and gastric dysrhythmia.* Poster presented at the 71st Annual Scientific Meeting of American Psychosomatic Society, Miami, FL.

Puzino, K., Moore, M., Guite, J., W., Mindell, J., & Olsen, M. (March, 2013). *Parental responses to pain, pain catastrophizing, and adolescent sleep in adolescents with chronic pain.* Poster presented at the 84th Eastern Psychological Association Annual Meeting, New York, NY.

Moore, M., Guite, J. W., **Puzino, K.**, Mindell, J., & Olsen, M. (2012, June). *Parental responses to pain, pain catastrophizing, and adolescent sleep in adolescents with chronic pain.*

Poster presented at the Associated Professional Sleep Societies Annual Meeting, Boston, MA.

Prashad, P., Marcus, C., Cornaglia, M., Bradford, R., Costa, P., **Puzino, K**., Xanthopoulos, M., Maggs, J., Moore, M., Barg, F. (2012, June). *Investigating reasons for suboptimal CPAP adherence in adolescents*. Poster presented at the Associated Professional Sleep Societies Annual Meeting, Boston, MA.

Levine, M., **Puzino, K**., & Koch, K. (2012, May). *Anticipatory nausea in cancer chemotherapy: predicting its incidence and severity to facilitate the development of effective interventions.* Poster presented at the 24th Annual Association for Psychological Science Convention, Chicago, IL.

Puzino, K. M. (2012, April). *The effects of introversion, extraversion and distraction on social performance.* Poster presented at the Saint Joseph's Sigma Xi Poster Symposium, Philadelphia, PA.

Puzino, K. M. (2012, March). *The effects of introversion, extraversion and distraction on social performance*. Poster presented at the Philadelphia Area Psi Chi Research Day, Philadelphia, PA.

Puzino, K. & Levine, M. (2011, May). *Music helps but shadowing doesn't: The effects of emotional and cognitive distraction on motion-induced nausea and gastric dysrhythmia*. Poster presented at the Siena College Academic Celebration, Loudonville, NY.

Puzino, K. & Levine, M. (2011, May). *Music helps but shadowing doesn't: The effects of emotional and cognitive distraction on motion-induced nausea and gastric dysrhythmia.* Poster presented at the 23rd Annual Association for Psychological Science Convention, Washington, DC.

Levine, M., **Puzino, K**., & Koch, K. (2011, March). *Anticipatory nausea in cancer chemotherapy: Predicting its incidence and severity to facilitate the development of effective interventions.* Poster presented at the 69th Annual Scientific Meeting of American Psychosomatic Society, San Antonio, TX.

Puzino, K. M. (2010, May). *The effects of introversion, extraversion and distraction on social performance*. Poster presented at the 10th Annual Stanford Undergraduate Psychology Conference, Stanford, CA.

Puzino, K. M. (2010, May). *The effects of introversion, extraversion and distraction on social performance*. Poster presented at the Siena College Academic Celebration, Loudonville, NY.

CLINICAL EXPERIENCE & TRAINING

Penn State Hershey Medical Center (07/17 to Present)
Sleep Research & Treatment Center
Psychology Intern
Supervisor: Julio Fernandez-Mendoza, PhD

The psychology intern works with an interdisciplinary team from pulmonary, neurology, psychiatry and psychology to assess, diagnose, and treat physical and behavioral sleep disorders, with an emphasis on Insomnia Disorders, Hypersomnia Disorders, Parasomnias, Circadian Disorders, Movement Disorders and Sleep Disordered Breathing Disorders, as well as providing review and patient care correlates for sleep behavior, neurobiology, and physiology. In addition, the psychology intern compiles clinical patient notes, which are comprised of self-report sleep measures, semi-structured interviews, clinical impressions, and treatment plans.

Penn State Hershey Medical Center (07/17 to 01/18)
Child Diagnostic Clinic
Psychology Intern
Supervisor: Susan Mayes, PhD

The psychology intern works with children 0-5 years of age referred for a diagnostic evaluation for autism, ADHD, behavior problems, anxiety, or other mental health problems. The evaluation includes analyses of parent and teacher rating scales (completed prior to the appointment), administration of psychological tests (IQ, academic, attention, graphomotor, language, and self-care), and a diagnostic interview with the parents. Immediately following the evaluation, the results of the evaluation and recommendations are shared with the parents.

Penn State Hershey Medical Center (07/17 to 01/18)
Chronic Illness/CBT Clinic
Psychology Intern
Supervisor: Timothy Zeiger, PsyD

The psychology intern works with children 5-18 years of age referred for a diagnostic evaluation and treatment for mood and anxiety disorders, psychological comorbidities with chronic illnesses, or other mental health problems. Comprehensive evidence based assessments and treatment strategies such as cognitive-behavioral therapy, exposure, and response prevention are utilized. Additionally, the psychology intern leads the delivery of evidence based treatments for children and adolescents with anxiety disorder as well as chronic illnesses in a group format.

The Children's Hospital of Philadelphia (07/16 to 05/17)
Pediatric Feeding and Swallowing Center
Psychology Extern
Supervisor: Nancy Silverman, PhD

The psychology extern works with a consultative, interdisciplinary team comprised of psychology, medicine, nutrition, speech therapy and occupational therapy to evaluate feeding disorders, develop and implement treatment plans. In addition the psychology extern participates in consultation services to youth ages 0-18 with a variety of feeding problems and discussed initial recommendations with caregivers.

The Children's Hospital of Philadelphia (07/16 to 05/17)
The Center for Management of ADHD

Psychology Extern
Supervisor: Jenelle Nissley-Tsiopinis, PhD

The psychology extern participates in the delivery of multi-family group sessions using program manuals. Additionally, the psychology extern facilitates parent group interventions (ADHD Bootcamp, Family School Success) and organizational skills training group intervention for middle and early high school students. Furthermore, the psychology extern responds to family needs via between-session phone contacts and provides school consultation services over the phone with teachers.

The Center for Promoting Research to Practice, Lehigh University (9/15 to 05/17)
Group Facilitator
Supervisor: George DuPaul, PhD

The Group Facilitator participates in the delivery of multi-family group sessions using program manuals at local high schools in the Lehigh Valley as part of a multisite research project. Group sessions include parent group ADHD interventions and Interpersonal Skills Group sessions for adolescents with ADHD.

The Children's Hospital of Philadelphia, Sleep Center (07/15 to 7/16)
Psychology Extern
Supervisor: Jodi Mindell, PhD & Melisa Moore, PhD

The psychology extern works with an interdisciplinary team from pulmonary, neurology, psychiatry and psychology to diagnose and treat physical and behavioral sleep disorders, with a special emphasis on the behavioral treatment of bedtime problems and night wakings. In addition, the psychology extern participates in ongoing telephone follow-ups with families as well as compiling clinical patient notes.

Upper Darby School District, Hillcrest Elementary School (08/15 to 07/16)
Practicum Student
Supervisor: Glen Shankman, MEd

The practicum student at Hillcrest Elementary School conducts multimethod psycho-educational assessments, writing reports, consulting with parents and teachers, and participating in Individualized Education Program (IEP) meetings.

Bethlehem Area School District, Fountain Hill Elementary (09/14 to 6/15)
Practicum Student
Supervisor: Mrs. Alyssa Barasch, School Counselor

Served as a practicum student at an elementary school. Responsibilities included conducting comprehensive psychoeducational and diagnostic assessment of children, writing comprehensive reports, and providing feedback to families. Additionally, services utilizing Response to Intervention (RtI) model were provided, including administration of DIBELS and AIMSweb literacy and numeracy progress monitoring and assessment systems.

Bethlehem Area School District, William Penn Elementary (09/13 to 09/14)
Practicum Student
Supervisor: Mr. Jonathan DeRaymond, Guidance Counselor

Served as a practicum student at an elementary school. Activities included conducting multimethod behavioral assessments, parent and child semi-structured interviews, designing interventions, performing brief counseling with students, and advising parents and teachers on strategies for improving child behavior.

Elywn Inc. (08/11 to 4/12)
Applied Behavioral Specialist
Supervisor: Lindsey Dunn

ABS provides intensive behavioral assessment/treatment services consumers on the Autism spectrum living in a residential setting. The ABS is responsible for participating in the continued behavioral assessment across settings, as well as the application of treatment strategies derived from an applied behavioral analysis (ABA) model by the clinical team. Interventions are developed based on results of systematic behavioral assessments including functional behavioral assessments, analysis of parent-child interactions, and reinforcer assessments. The ABS works closely with the clinical team to provide individually designed behavior plans to decrease problem behavior while increasing adaptive responses.

Parson's Child and Family Center (01/10 to 05/10)
Psychology Intern
Supervisor: Michael Clarkson-Hendrix, Licensed Clinical Social Worker

The Centralized Intake Unit Intern communicated with caregivers and/or clinicians of the client to plan an intake. Responsibilities included performing weekly intake interviews with children and their families. In addition to conducting utilization reviews post interview to ensure that the client was still a fit for his or her program. This position provided opportunity to further develop interpersonal skills and a better sense of the clinical decision-making process.

New York Presbyterian Hospital (05/09 to 09/09)
Pediatric Emergency Department Volunteer

The main objective of a volunteer was to gain valuable experience in a clinically related field. Primary interests included providing a personal dimension of emotional support to the patients and their families in the waiting room. Volunteers act as a liaison between patients, families and clinical staff, and are trained in various methods of interaction with children.

PROFESSIONAL LEADERSHIP ACTIVITIES

2016-Present	Internship Program Student Representative, *Penn State Hershey Medical Center*
2016-Present	Vice Chair, Pipeline Development Committee, *Sleep Research Society*

2016-Present	Student Leader, Integrated Primary Care Special Interest Group, *American Psychological Association*
2015-2016	Trainee Representative, Program Committee, *Pediatric Sleep Medicine*
2014-2016	Trainee Member at Large, *Sleep Research Society*
2014-2015	Doctoral Program Student Representative, *Lehigh University*
2013- 2016	Project Coordinator, The Center for Promoting Research to Practice, *Lehigh University*
2013-2014	Lehigh University Student Representative, *National Association of School Psychologists*
2012-2013	Trainee Symposia Series Subcommittee Member, *Associated Professional Sleep Societies Annual Meeting*

EDITORIAL EXPERIENCE

Ad Hoc Reviewer	School Mental Health
	Children's Health Care
	Journal of Health Psychology
Mentored Reviewer	Journal of Sleep
	Journal of Clinical Psychiatry
	Journal of Sleep Research
	Sleep Health: Journal of the National Sleep Foundation

PROFESSIONAL MEMBERSHIPS

2013-Present	National Association of School Psychologists
2012-Present	Sleep Research Society
2009-Present	American Psychological Association

SUPERVISORY EXPERIENCE

Lehigh University, Upper Darby School District
School Psychology Interns (September 2015 – June 2016)

AWARDS & HONORS

2016	Distinguished Service Award, Sleep Research Society
2013-2015	Lehigh University Travel Grant
2011-2013	Saint Joseph's University Travel Award
2011	Alpha Kappa Alpha Honor Society
2009	Psi Chi – National Honor Society in Psychology
2009	Siena College Student Leadership Fellow
2007	Presidential Scholarship award winner