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Health and Behavioral Problems Associated with Symptoms of Pediatric Sleep Disorders

by

Rachel B. French

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
Department of Psychological and Social Foundations
College of Education
University of South Florida

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Health and Behavioral Problems Associated with
Symptoms of Pediatric Sleep Disorders

Rachel French

ABSTRACT

The purpose of this study was to examine prevalence rates of symptoms of several sleep disorders in young children, and the relationship between symptoms of pediatric sleep disorders and other childhood problems. Two-hundred-seventy-six children aged 2 to 5 years were studied through examination of a pre-existing database. Children rated as high risk for having a sleep disorder displayed significantly more aggressive behavior and attention problems, as compared to children whose sleep was rated in the normal range. However, no relationship was found between symptoms of sleep disorders and body mass index, asthma, or allergies. In addition, no relationship was found between symptoms of sleep disorders and social skills. Twenty-six percent of children in this sample were at high risk for having at least one type of sleep disorder. Results are discussed with regard to implications for prevention and early identification of students who are at-risk for developing sleep disorders, as well as direct interventions for those students who have a diagnosed sleep disorder.

Chapter 1

Introduction

Statement of the Problem

It is estimated that 43% of children ages 2 to 14 years may suffer from a significant sleep disturbance (Archbold, Pituch, Panahi, & Chervin, 2002). Research has shown that 18% of children performing in the bottom 10% of their class have a sleep disorder (Gozal, 1998), and 33% of children with Attention-Deficit/Hyperactivity Disorder (ADHD) suffer from habitual snoring, a known risk factor for sleep problems (Chervin, Dillon, Bassetti, Ganoczy, & Pituch, 1997). Therefore, it is vital that pediatric sleep disorders are identified and treated at the earliest possible age in order to prevent the negative academic and behavioral outcomes associated with them.

The area of pediatric sleep medicine only recently began to receive attention from researchers. Although the field of adult sleep medicine has been widely explored, there are still many unknowns about sleep disorders in children. While childhood sleep disorders are among the most common complaints in pediatricians' offices (Halborow & Marcus, 2003), the exact prevalence of sleep disorders is vague, especially relating to children of a specific age. Many studies of pediatric sleep disorders have aggregated children of wide age ranges together into one sample instead of separating data into smaller age groups. Misdiagnosis and under-identification of sleep disorders in young children also contribute to vague prevalence rates (Wiggs & Stores, 1996). Thus, there is

a need for research to be conducted to establish the prevalence rates of specific sleep disorders in young children.

In addition, there is a need to further explore the relationship between sleep disorders and other health and behavioral concerns in young children. Just as incidence rates in young children are unknown, the complete behavioral and health impact of sleep disorders at this early age also is unknown. Although many studies have suggested a link between sleep disorders, health factors, and behavior, the age at which individuals with sleep disorders begin to experience related difficulties has yet to be discovered. Additional research is needed to determine which age groups are particularly vulnerable to these problems, and the optimal time for treatment to prevent later educational and health problems (Halborow & Marcus, 2003).

Similarly this research is needed in order to raise awareness in pediatricians and educators of the consequences of these disorders in young children (BaHammam, 2000; Wiggs & Stores, 1996). Therefore, additional research is needed in the area of pediatric sleep disorders in order to raise awareness of the consequences of these disorders in young children.

Three Types of Pediatric Sleep Disorders Impacting Children

Although there are over 80 sleep disorder classifications, not all sleep disorders have been found to occur in children. Additionally, some childhood sleep disorders occur commonly, but do not have any lasting negative effects (i.e. bruxism, somnambulism). The sleep disorders of Periodic Limb Movement Disorder (PLMD), Delayed Sleep Phase Syndrome (DSPS), and Obstructive Sleep Apnea Syndrome (OSAS) are all found in children and have been associated with long-term negative consequences that impact

children's functioning (Coccagna, 1990; Hla, 1994; Wise, 1998) The following paragraphs will discuss the characteristics of each of these disorders.

Periodic Limb Movement Disorder (PLMD), initially known as nocturnal myoclonus (Coleman, 1982), is a broad term that refers to periodic movements of the legs and/or arms during sleep (Coccagna, 1990). In order to receive a diagnosis of PLMD, these movements must occur at least five times for every hour of sleep, and must interfere with sleep (Picchiette, England, Walters, Willis, & Verico, 1998). In addition, patients must reach the criteria of a minimum number of 4 leg contractions lasting between 0.5 to 5.0 seconds each, recurring every 4 to 90 seconds (Hening, Allen, Earley, Kushida, Picchietti, & Silber, 1999). All of these criteria must be fulfilled during a state of sleep. Overnight sleep monitoring of those with PLMD reveal that these patients generally experience increased stage 1 and 2 NREM (non-rapid eye movement) sleep, and decreased stage 3 and 4 NREM sleep and REM (rapid eye movement) sleep (Trenkwalder, Walders, & Hening, 1996), with limb movements primarily during NREM sleep, resulting in increased arousals.

Delayed Sleep Phase Syndrome (DSPS) involves a persistent inability for at least 6 months to fall asleep and rise at normal times (Roehrs & Roth, 1994). Those with DSPS tend to go to sleep early in the morning and rise in the early afternoon. However, if morning activities are scheduled or the individual is a student, dramatic loss of sleep may occur. DSPS is a disorder linked to the circadian rhythm cycle, and may be caused by periods of sleep deprivation, poor sleep hygiene, or irregularities in sleep (Anders & Eiben, 1997). Several studies have shown the adverse effects of DSPS on mental health and cognition/academics (Wolfson & Carskadon, 1998). Very young children with

similar symptoms may actually be suffering from a condition called Behavioral Insomnia of Childhood, which primarily results from poor sleep hygiene habits as opposed to changes in the circadian rhythm cycle. These young children do not undergo the lengthening of their circadian sleep-wake cycle as older adolescents with DSPS experience (Luginbuehl, Bradley-Klug, Ferron, McDowell, & Benbadis, 2008).

Obstructive Sleep Apnea Syndrome (OSAS) is defined as "the cessation of airflow at the nose and mouth despite respiratory efforts, stemming from airway obstruction" (Ward, Sally & Marcus, 1996, p. 199). OSAS is primarily caused by physical abnormalities of the airway structure, including tonsils, adenoids, tongue, palatal size and position, and jaw (Bower & Buckmiller, 2001). In children, the enlargement of the tonsils and adenoids is the most likely cause of airway obstruction (Bower & Buckmiller, 2001). The most pertinent symptom of OSAS is loud snoring, with periods of silence caused by complete airway closure (Gaultier, 1992). Morning lethargy and headaches, poor school performance and behavior, failure to thrive, and personality changes, are important daytime symptoms (Butt, Robertson & Phelan, 1985). Untreated OSAS has powerful consequences in several different domains; OSAS may inhibit growth (Goldstein et al., 1987), lead to cognitive impairment (Shepard, 1994), and have adverse effects on the cardiovascular system (Aljadeff et al., 1996).

Externalizing Behaviors

Externalizing Disorders have been shown to co-occur with pediatric sleep disorders. For example, research shows an overlap between symptoms of Attention-Deficit/Hyperactivity Disorder (ADHD) and the behavioral symptoms of sleep disorders. Chervin et al. (1997) showed a relationship between characteristics of ADHD and

characteristics of disordered sleep for children and adolescents ages 2-18 years. They found that there was a high incidence of cases of ADHD among children with symptoms of snoring, restless legs, and sleepiness. Picchietti et al. (1998) also found a high incidence rate of PLMD within a sample of children 2-15 years of age diagnosed with ADHD, showing once again that there is an overlap between symptoms of ADHD and this particular sleep disorder. More generally, Wiggs and Stores (1996) demonstrated that children 5-16 years of age with sleep disturbances tended to have larger numbers of challenging behaviors such as irritability and hyperactivity as compared to controls. Several recent studies found that in children between the ages of 2 and 5 years, symptoms of pediatric sleep disorders were related to increases in externalizing behavior problems (Popkave, 2007; Witte, 2006). However, these studies did not explore which specific components of externalizing behaviors were related specifically to symptoms of pediatric sleep disorders.

Conduct disorders have also been implicated with sleep disorders. While conduct disorders are found in 8% of the population between the ages of 4 and 16 years, children with sleep disordered breathing or PLMD are 2 to 4 times more likely to be diagnosed with a conduct disorder (Chervin et al., 2001). Although the literature seems to be clear that there is a relationship between pediatric sleep disorders and diagnoses of psychological disorders such as Conduct Disorder and ADHD, more research is needed to look at the relationship between specific symptoms of externalizing disorders and sleep in young children, particularly in children under the age of 5 years.

It is known that children with externalizing behaviors also tend to display deficits in social skills (Stein, Szumoski, Blondis, & Roizen, 1996). However, there is very little

research concerning the relationship between social skills and pediatric sleep disorders. There are several studies which have determined that those with sleep disorders tend to experience social problems (Uema, Vargas, Vidal, Fujita, Moreira, Shizue, & Pignatari, 2006; Broughton, Ghanem, Hishikawa, Sugita, Nevsimalova & Roth, 1981; Hood & Harbord, 2002). However, there is only one known study which specifically addresses social skills and symptoms of pediatric sleep disorders (Witte, 2006). This study determined that those children ages 3 to 5 years who were rated by their parents to have symptoms of sleep disorders were also rated to have more deficits in social skills, as compared to those children not displaying symptoms of sleep disorders. Because this is the only known study in this area, it is clear that more research is necessary to explore the relationship between sleep and social skills.

Pediatric Overweight

Research linking pediatric overweight to pediatric sleep disorders is equivocal. The majority of available research suggests that obesity is a risk factor for sleep disorders such as OSAS, and that children who are obese or overweight are at an increased risk for sleep-disordered breathing (Tauman & Gozal, 2006). Several large-scale studies revealed that 45-55% of those children referred for sleep-disordered breathing are obese (Tauman & Gozal, 2006). However, other studies have not found a link between pediatric overweight and symptoms of sleep disordes. For example, Sardon and colleagues found no differences between body mass index (BMI) and OSAS in children between the ages of 2 and 14 years (Sardon, Gonzalex, Aldasoro, Bordoy, Mintegui, & Emparanza, 2006). Therefore, additional research is needed to determine conclusively whether or not pediatric overweight increases the risk for sleep disorders in children.

Asthma and Allergies

Individuals with sleep disorders also have a greater tendency to suffer from asthma and allergies. For example, one study found that in children between the ages of 6 and 14 years, those with wheezing (a symptom of asthma) were more likely to report disturbed sleep (Baiardini, Braido, Cauglia, & Canonica, 2006). Another study determined that children with allergic rhinitis report difficulties falling asleep and waking up at night (Nathan, 2007). Additional research is needed to more fully explore the relationship between sleep disorders, asthma, and allergies. The majority of existing research focuses on adults and older children; there are very few studies examining this relationship in young children.

Summary

In summary, PLMD, DSPS, and OSAS are pediatric sleep disorders that significantly impact children's functioning and well-being. Although there is some research to suggest that sleep disorders are associated with an increase in body weight, asthma, and allergies, additional research is needed to further explore these relationships in young children.

Purpose of the Study

The purpose of this study was to investigate the relationship between young children who demonstrate symptoms of sleep disorders, and those who demonstrate aggressive behavior, attention problems, and deficits in social skills. This study also examined the relationship between children who are at risk for sleep disorders and those who have asthma and/or allergies, and those with elevated BMIs for their ages. The prevalence of pre-kindergarten children who display symptoms indicative of sleep

disorders, using the Sleep Disorders Inventory for Students – Children's version (SDIS-C) also was reported. The SDIS-C is a screening instrument used to assess symptoms of several different pediatric sleep disorders. An archived database of pre-kindergarten children from a local child development clinic served as the sample in this study. Examining these issues contributed to the empirical literature concerning sleep disorders in young children.

Research Questions

This research study examined the relationship between sleep disorders and aggression, attention, social skills, asthma/allergies, and pediatric overweight. Also, this study investigated the prevalence rates of sleep disorders in an at-risk pre-kindergarten population. The following questions were addressed:

Question #1: What is the prevalence of symptoms of sleep disorders, as measured by the SDIS-C, in children visiting a Child Development Clinic?

Hypothesis #1: Approximately 30% of children will score in the cautionary or high risk range of the SDIS-C, indicating symptoms of sleep disorders.

Question #2: What is the relationship between children who are found to have symptoms of sleep disorders as measured by the SDIS-C and children who demonstrate attention problems as measured by the Child Behavior Checklist?

Hypothesis #2: Children who display greater levels of sleep problems as measured by the SDIS-C will also display more attention problems as measured by the CBCL.

Question #3: What is the relationship between children who are found to have symptoms of sleep disorders as measured by the SDIS-C and children who demonstrate aggressive behavior as measured by the Child Behavior Checklist?

Hypothesis #3: Children who display greater levels of sleep problems as measured by the SDIS-C will also display more aggressive behavior as measured by the CBCL.

Question #4: What is the relationship between children who are found to have symptoms of sleep disorders as measured by the SDIS-C and children who have deficits in social skills, as measured by the Adaptive Behavior Assessment System (ABAS)?

Hypothesis #4: Children who display greater levels of sleep problems as measured by the SDIS-C will also display more deficits in social skills as measured by the ABAS.

Question #5: What is the relationship between children who are found to have symptoms of sleep disorders as measured by the SDIS-C and children who are overweight, as measured by their Body Mass Index (BMI)?

Hypothesis #5: Children who display greater levels of sleep problems as measured by the SDIS-C will also display higher Body Mass Indexes.

Question #6: What is the relationship between children who are found to have symptoms of sleep disorders as measured by the SDIS-C and children who have asthma/allergies?

Hypothesis #6: Children who display greater levels of sleep problems as measured by the SDIS-C will also have an increased incidence of asthma and allergies.

Chapter 2

Review of the Literature

Introduction

This literature review presents general information on sleep, specifically describes common types of pediatric sleep disorders, discusses externalizing problems related to sleep disorders, and reviews health factors associated with sleep disorders. This chapter is organized into several different areas. First, general information about normal sleep is discussed, after which an overview of sleep disorders in pediatric populations is given. Next, definitions and general information on Periodic Limb Movement Disorder, Delayed Sleep Phase Syndrome, and Obstructive Sleep Apnea Syndrome are presented. Research is then presented focusing on the relationship between sleep disorders and externalizing behavior. Finally, literature is reviewed concerning the relationship between sleep disorders and pediatric overweight, asthma, and allergies.

It is important to note that there is a lack of information regarding some sleep disorders in childhood populations. Therefore, some of the research reviewed refers to adults. This lack of available research supports the need to further explore and expand the research concerning sleep disorders of children.

General Information about Normal Sleep

Sleep is an extremely important regenerative process for people of all ages. We spend approximately one third of our life in this vulnerable state called sleeping. Before

discussing disordered sleep, the importance of sleep and the characteristics of normal sleep in children must be recognized.

There are several different theories regarding the purpose of sleep. The most widely accepted theory is that sleep is a "forced time out" and is a part of the biological rhythms that control many physiological processes. Another theory is that sleep is necessary to conserve energy (Dotto, 1990). Although there is still much that is unknown regarding sleep's effect on the developing brain, most researchers agree that there is a relationship between sleep and brain development (Bertelle, Sevestre, Laou-Hap, Nagahapitiye, & Sizun, 2007). In fact, most new theories about the purpose of sleep define sleep as an extremely active process. Rapid Eye Movement (REM) sleep is thought to facilitate protein synthesis, memory function, and cardiovascular function (Morrison, 2004), while Non-Rapid Eye Movement (NREM) sleep is thought to have developmental effects in terms of growth (Sarzarulo & Fagioloi, 1995).

Normal sleep progresses through well-defined, ordered stages, consisting of REM, or rapid eye movement sleep, and NREM, or non-rapid eye movement sleep. NREM, also known as "quiet sleep," normally occurs at sleep onset, and can be further divided into substages. NREM sleep, according to Morrison (2004) begins with stage 1, which involves a transition from wakefulness into sleep. It usually lasts about 5-15 minutes, and includes short dreams and myoclonic jerks (sudden muscle twitches without any rhythm or pattern). Stage 2 is considered to be the first stage of actual sleep, and lasts slightly longer than stage 1, about 15-20 minutes. A person in this state is not aware of his or her surroundings but is easily awakened. Stages 3 and 4 are deep, slow wave sleep. A person in stage 3 or 4 is difficult to awaken and generally does not display many body

movements. The onset of REM sleep occurs after the end of the NREM cycle for increasingly longer periods of time over sleep cycles. REM occurs in infants, children, and adults of all ages and is defined by a low-voltage, fast, desynchronized electroencephalogram (EEG) pattern; rapid eye movements under closed lids; rapid and irregular heart rate and respiratory patterns; and muscle paralysis (Anders, Sadeh & Appareddy, 1995). This progression through the 4 sleep stages, from NREM sleep to REM sleep, repeats itself many times throughout one night of sleep.

Sleep Across the Lifespan

Maturational changes of the systems involved in sleep occur during the first two decades of life, altering the sleep-wake cycle throughout infancy and childhood. During infancy, sleep becomes increasingly organized. According to Carskadon, Anders and Hole (1968), a major task of the newborn is to organize the behaviors of wake, NREM, and REM, into discrete states. It is not until several weeks that infants are able to operate within a circadian rhythm framework. By 6 weeks of age, infants have a clear diurnal/nocturnal pattern of sleep (Anders & Keener, 1985); by 3 months, EEG sleep stages are clearly present (Hoppenbrouwers, 1987); and by 6-9 months most children have a well-established pattern of nocturnal sleep (Moore & Ucko, 1957).

Kahn et al. (1973) showed that there are several differences in sleep structure between 2-year-old and 5-year-old children. One difference is that the REM-NREM cycle lengths of 2-year olds are shorter than the cycles in 5-year-olds. In addition, during the night, 5-year-olds have longer sustained stage 3-4 NREM periods, while 2-year-olds have longer sustained periods of REM sleep. This provides evidence that during early childhood, the sleep cycle is undergoing several changes. It is important to note that there

is a lack of research regarding the sleep of preschool aged children, and thus physiologically there is much that remains unknown.

Sleep disorders such as Obstructive Sleep Apnea Syndrome, Periodic Limb Movement Disorder and Delayed Sleep Phase Syndrome can have serious effects on those of all ages. Approximately one third of the United States population claims to suffer from a lack of sleep (Benbadis, 1998). Sleep problems can impact cognitive and academic performance, mood and behavior, and physical development of several bodily systems such as the nervous, endocrine, cardiovascular, and endocrine systems (Morrison, 2004). A survey sent to physicians specializing in a variety of different fields revealed that the prevalence of sleep disorders in the pediatric population of children ages 2 to 14 years was generally higher than the rate of sleep disorders in adult populations; 11% of children had symptoms of Sleep-Disordered Breathing, 41% of the children had Insomnia, and 14% of children suffered from Excessive Daytime Sleepiness (Bixler, Kales, Scharf, Kales & Leo, 2000). Other evidence suggests that up to 43% of children ages 2 through 14 may suffer from significant sleep disturbance (Archbold, Pituch, Panahi, & Chervin, 2002). The combination of high reported prevalence rates and proven negative effects of sleep disorders highlight the need for further research and education in this area.

Pediatric Sleep Disorders

Pediatric sleep disorders can be divided into four broad categories: Primary Sleep Disorders, including dyssomnias and parasomnias; sleep disorders related to another mental disorder; sleep disorders due to a general medical condition; and substance-induced sleep disorders (Anders & Eiben, 1997). This literature review will focus on

Primary Sleep Disorders because of the daytime effects caused solely by these types of sleep disorders. Periodic Limb Movement Disorder, Delayed Sleep Phase Syndrome, and Obstructive Sleep Apnea Syndrome, are three pediatric sleep disorders that affect not only nighttime activity, but daytime performance of children as well. The following subsections will provide information on these three sleep disorders.

Periodic Limb Movement Disorder

Periodic Limb Movement Disorder or PLMD is one primary sleep disorder for which there are effects on daytime functioning. The term noctural myoclonus was first introduced by Charles Symonds in 1953 to refer to involuntary clonic movements of the lower extremities during sleep (Coleman, 1982). While this condition was first thought to be an epileptic variant, nocturnal myoclonos, now known as PLMD, is a condition with distinct features separating itself from other movement disorders. PLMD is broadly applied to both periodic leg movements and periodic arm movements during sleep (Coccagna, 1990). PLMD involves stereotyped, periodic jerking movements of one or both legs that usually reoccurs approximately every 30 minutes (Coleman, 1979), during periods of light or non-REM sleep (Coccagna, 1990).

The International Restless Legs Syndrome group recently developed criteria for the diagnosis of PLMD in children. These criteria include the presence of at least 5 periodic limb movements during sleep, clinical sleep disturbance (sleep onset problems, sleep maintenance problems, or excessive daytime sleepiness), and leg movements that cannot be accounted for by medication or another sleep disorder. Typically the sleep profile of PLMD consists of increased stage 1 and 2 NREM sleep, decreased stage 3 and 4 NREM sleep and REM sleep, and frequent arousals resulting in an increased amount of

wake time (Trenkwalder et al., 1996). Case studies of children diagnosed with PLMD suggest that children may slap their feet on the mattress, have an extended sleep latency period, and may demonstrate improved behaviors if caffeine and chocolate are restricted (Walters, Picchietti, Ehrenberg, & Wagner, 1994).

Several hypotheses exist regarding the cause of PLMD, most dealing with dysfunctions within bodily systems. One hypothesis is that PLMD results from a sleep-related problem of a descending inhibitory drive in the central nervous system. Another hypothesis suggests PLMD is related to the subcortical or reticular oscillator, an area which also controls blood pressure, respiration, and EEG arousal activity. In addition, results of medication studies suggest there may be a link between PLMD and an overactive sympathetic nervous system (Trenkwalder et al. 1996). More recent research has determined that a link may exist between abnormal metabolism of iron, or deficiencies in iron storage, and PLMD in pediatric populations (Hayes, 2007).

In the last 20 years, substantial gains have been made in determining treatment options for adults with PLMD. There are six commonly prescribed treatment options, including dopaminergic, opioid, benzodiazepine, and/or anticonvulsant medications, medications drawn from other classes, and nonpharmacological therapy including accommodative strategies and sleep hygiene improvement, behavioral and stimulation therapies, invasive therapies, and nutritional considerations (Hening, 1999). Benzodiazepine medication is the treatment of choice, especially for patients with mild cases or for young patients (Montplaisir, 1994). However, there are few studies investigating treatments for PLMD for those under the age of 18 years, especially in terms of the long-term consequences of medication. In fact, the Standard of Practice

Committee of the American Academy of Sleep Medicine states that no specific recommendations can be made regarding treatment of children with PLMD (Simakajorboon, 2006).

A study of 18,980 individuals, ages 15-100 years, in 5 European countries revealed that 3.9% of people met the criteria for PLMD (Ohayan & Roth, 2002). Demographic data regarding the number of young children who suffer from PLMD is vague, and PLMD was only recently recognized as an important sleep disorder in children because of its apparent relationship to Attention-Deficit/Hyperactivity Disorder. One study found that of children ages 2-5 years, 8% of children from a clinic-referred sample and 11% of children from a community sample were diagnosed with PLMD (Crabtree, Ivanenko, O'Brien, & Gozal, 2003).

Delayed Sleep Phase Syndrome (Circadian Rhythm Disorder)

Delayed Sleep Phase Syndome (DSPS) is characterized by sleep-onset insomnia and difficulty awakening in the morning (Czeisler et al., 1981). It involves a persistent inability to fall asleep and rise at normal times that has lasted longer than 6 months (Roehrs & Roth, 1994), and is usually caused by long periods of sleep deprivation or consistent irregularities in sleep routine (Anders & Eiben, 1997). Sleep onset usually does not occur until the early morning hours, and the person often does not wake until early afternoon.

While the occurrence of DSPS in adolescence is common and is thought to be caused by biological changes in circadian rhythm during puberty, in the case of younger children, DSPS is more commonly related to poor sleep hygiene. In other words, DSPS in preschoolers is often caused by parents neglecting to promote good sleep habits in their

children. This problem is more commonly referred to as Behavioral Insomnia of Childhood (BIOC). These young children do not undergo the lengthening of their circadian sleep-wake cycle as older adolescents with DSPS experience (Luginbuehl, et al., 2008). Therefore, the physiology of this disorder is slightly different in young children as opposed to adolescents with DSPS. Because of the lack of available literature addressing BIOC, there is a great need to further explore this sleep disorder.

Promoting sleep hygiene is important for children and adolescents of all ages, especially for those with insomnia. One study found that improving sleep hygiene reduced initial insomnia in children with ADHD taking stimulant medication. Initial insomnia was reduced in a sample of 27 children between the ages of 6 to 14 years from over 60 minutes to less than 1 hour in 5 cases. The overall effect size was .67, and the average sleep latency was reduced from 92 minutes to 69 minutes. This reduction in sleep latency was even greater for those children with combined sleep hygiene and melatonin treatment (Weiss, Wasdell, Bomben, Rea, & Freeman, 2006). However, one limitation of this study is that specific sleep hygiene techniques were not discussed by the authors. Therefore, it is difficult to determine exactly which components of sleep hygiene resulted in the positive effects that were measured in this study.

Surprisingly, there is little research examining the prevalence rates of DSPS, or BIOC. Although research suggests that approximately 17% of adolescents suffer from unrestorative sleep, the exact prevalence rate of DSPS is not known (Goll & Shapiro, 2006). Preliminary research suggests that the incidence rate of DSPS/BIOC in at-risk children between the ages of 3 and 5 years is as high as 29% (Witte, 2006).

Obstructive Sleep Apnea Syndrome

Obstructive Sleep Apnea Syndrome (OSAS) can be found in the literature dating back to Charles Dickens' "The Pickwick Papers." However, it was not until 1973 that sleep apnea was first described as a syndrome by Guilleminault et al. (1973). Apnea, or the cessation of breath, can be either central or obstructive. OSAS is defined as "the cessation of airflow at the nose and mouth despite respiratory efforts, stemming from airway obstruction" (Ward, Sally, & Carole, 1996, p.199).

There are both nocturnal and diurnal symptoms of OSAS. Nocturnal symptoms include heavy snoring, difficulty breathing, respiratory pauses, restless sleep and abnormal movements, profuse nocturnal sweating, special sleeping positions and enuresis (Gaultier, 1992). The main nocturnal symptom is loud snoring, interrupted by silence caused by complete airway closure, although it is important to note that habitual snoring occurs in 7-12% of children and not all snoring children have sleep apnea (Rosen, 1999). Another characteristic symptom of OSAS is the collapse of the upper airway during inspiration while a person is sleeping, resulting from negative pressure and the inability of the walls of the upper airway to resist collapse (Sher, 1990). Diurnal symptoms consist of morning lethargy and headaches, poor school performance, abnormal behavior, failure to thrive, and personality changes (Butt, Robertson, & Phelan, 1985). High school students and college students with OSAS have reported falling asleep in class and having difficulty engaging in educational activities (Kales, Caldwell, Cadieux, Vela-Bueno, Ruch, & Mayes, 1985).

Using Guilleminault's criteria for diagnosing OSAS in adults (1976), there must be at least 30 apneic periods of a duration greater than 10 seconds, during a seven-hour

period of sleep. An overnight polysomnogram measuring both respiratory and non-respiratory variables is recommended for diagnosing OSAS. Although apneas of >5 or more events/hour is an often-used cutoff for the diagnosis for OSAS in adults, children generally experience fewer apneic episodes per hour, but suffer significantly impaired oxygen saturation levels (Kuppersmith, 1996).

OSAS is the most common airway problem (Mark & Brooks, 1984), accounting for 50% of cases of sleep disorders (Benbadis, 1998). It can occur in people of all ages, including infants, children, and adults. The true prevalence of OSAS in children as a whole is unknown, although the lower bound limits have been estimated to be 2.9% (Wang, Elkins, Keech, Eauguier, & Hubbard, 1998) in those between 6 months and 6 years old. Other sources report the prevalence of OSAS among the pediatric population to be between 0.5% and 3% (Kuppersmith, 1996) and 1.6% to 3.4% (Gaulter, 1992). Among the preschool population, OSAS is purported to affect 1% to 3% of children (Marcus, 1997).

OSAS is often caused by physical abnormalities of the airway. The obstruction usually occurs in the upper airway between the caudal region of the soft palate and the epiglottis (Chervin & Guilleminault, 1996). The most common cause of obstruction in children is the enlargement of the tonsils and adenoids (Bower & Buckmiller, 2001). However, there is no relationship between tonsil and adenoid size and the severity of OSAS (Marcus, 1996). Tongue and palatal size and position, and craniofacial malformations related to the jaw also may be attributed to the development of OSAS (Bower & Buckmiller, 2001).

OSAS can be associated with serious health consequences. First, sleep apnea can cause hypoxemia. Hypoxemia, or a lack of oxygen resulting from apneic episodes disrupts the central nervous system (Findley, 1986), and can result in cognitive impairment to the degree that hypoxemia is present. While oxygen consumption and carbon dioxide production decreases from 10% to 25% normally during sleep, those with sleep apnea experience abnormally low levels of oxygen in the bloodstream (Shepard, 1994). Also importantly, repeated periods of hypoxemia are hypothesized to ultimately result in hypertension (Zwillich, 2000).

Hla et al. (1994) studied 147 adults aged 30 to 60 years and found after controlling for obesity, age, and sex, sleep apnea was significantly associated with hypertension, as compared to those without sleep apnea. OSAS has also been shown to have an effect on heart rate variability. Another large cross-sectional study of 6,132 subjects greater than age 40 years corroborated the idea that sleep related breathing disorders are associated with hypertension (Nieto et al., 2000). Aljadeff et al. (1996) took six hour polysomnographic recordings of seven children with OSAS (mean age 4.5 years) and seven children with a history of primary snoring (mean age 4.7 years) and found that OSAS altered beat-to-beat variation at all heart rates, especially for children with slower heart rates. These findings suggest that OSAS has a cardiovascular impact on children as well as adults.

Children suffering from OSAS have several different treatment options. Adenotonsillectomy, or the removal of the tonsils and adenoids, has been the treatment most recommended by physicians (Gaultier, 1992). This procedure has been shown to be effective in resolving OSAS. One clinic reported that 94% of patients undergoing

adenotonsillectomy for OSAS experienced a clinical resolution of OSAS after surgery, although the age range that this finding pertains to is not reported (Marcus, 1997). Studies examining the effects of adenotonsillectomy on children with OSAS have shown very positive results, although additional randomized controlled trials examining this area are needed (Bower & Buckmiller, 2001). Another treatment that is used less commonly for children is CPAP, or continuous positive airway pressure. CPAP may be recommended to supplement other treatment methods, especially for children with craniofacial abnormalities or neuromuscular disease (Marcus, 1997).

Summary of Pediatric Sleep Disorders

In summary, PLMD, DSPS, and OSAS are all pediatric sleep disorders which have serious consequences on daytime behavior. These sleep disorders have been associated with multiple other problems. Specifically, the next sections will discuss the relationship between pediatric sleep disorders and other factors, including externalizing behaviors and health.

Sleep Disorders and Externalizing Behavior

Many children with sleep disorders also tend to receive a diagnosis of ADHD, particularly those with RLS, PLMD, OSAS, and Narcolepsy (Chervin, 1997; Picchietti, England, Walters, Willis, & Verrico, 1998; Wiggs & Stores, 1996).. Sleep problems may actually contribute to or exacerbate the behavioral manifestations of disorders such as ADHD (Marcotte et al., 1998). However, there is much less research examining the relationship between sleep and specific externalizing symptoms, especially in very young children.

Chervin et al. (1997) assessed the relationship between sleep disorders (RLS and PLMD), inattention, and hyperactivity. The sample included 77 boys and 66 girls ages 2-18 years (mean 9.0, SD 4.7 years). These children were recruited from the Child and Adolescent Psychiatry Clinic and the General Pediatrics Clinic at the University of Michigan Medical Center. Parents of the children completed two self-administered questionnaires: the Pediatric Sleep Questionnaire (PSQ), which assessed snoring, restless legs at night, and sleepiness, and an 18-item Likert-scale questionnaire designed by researchers to assess DSM-IV (Diagnostic and Statistical Manual of Mental Disorders – fourth edition) symptoms of ADHD.

The group reporting symptoms indicative of ADHD was compared to both the general pediatric population as well as the psychiatric population without characteristics of ADHD. Habitual snoring was found to be more common in children with symptoms of ADHD (33%) then among the psychiatric population without a diagnosis of ADHD (11%), and the general pediatric subjects (9%). In addition, among children with symptoms of ADHD, the snoring score was significantly associated with the Inattention/Hyperactivity Score (IHS), as measured by the scale developed with DSM-IV criteria for ADHD. The IHS score was associated with the snoring score in multiple regressions that controlled for age, sex, and the use of stimulant medication. IHS also was associated with the sleepiness score when comparing the ADHD symptoms sample to the general pediatrics sample, but not when compared to the non-ADHD psychiatric population.

This study shows that there are links between symptoms of ADHD and snoring, restless legs, and sleepiness. As the authors point out, while leg restlessness may be an

effect of hyperactivity and sleepiness may be the result of disruptive behavior either during the day or before bedtime, snoring is one factor that is more difficult to attribute to hyperactivity (Chervin et al., 1997). One limitation of this study is the assumption made that none of the children in the control group had a Sleep Related Breathing Disorder (SRBD). Researchers acknowledged that this may have resulted in a misclassification of a small percentage of children (less than 10%), and a weakening of subsequent tests of validity. Another limitation of this study concerns the age range. The authors used a very wide range of ages in the sample (ages 2 through 15 years), which limits knowledge concerning children within more narrow age ranges.

Picchietti, England, Walters, Willis, and Verrico (1998) also studied the relationship between PLMD and RLS in children with ADHD. Twenty-seven children (ages 2 to 15 years; mean 8.7 years) with ADHD scoring high on PLMD questions were given overnight polysomnographies, eighteen of which fulfilled the criteria for PLMD. An age and sex matched group of children referred to a sleep laboratory for sleep complaints but without a diagnosis of ADHD had only a 5% rate of periodic limb movements in sleep. This shows a high incidence rate of PLMD in children with ADHD. Eighty-three percent of the patients with both ADHD and PLMD and 60% of the controls reported sleep onset problems of a minimum of 15 minutes at least twice a week. Seventy-eight percent of children with ADHD were reported to sleep restlessly as compared with 44% of controls. However, sleep maintenance problems were reported to be fewer in the combined ADHD/PLMD group (67%) as compared with the control group (73%). This study also supported a familial basis of RLS. Because ADHD has a hereditary component, one can hypothesize that these disorders may be linked genetically. Interestingly, 10 (56%) of the

18 children with ADHD and PLMD also had at least one parent who met the criteria for RLS.

Wiggs and Stores (1996) looked at a variety of challenging behaviors in children with severe sleep disturbances. Subjects were 486 children with severe learning disabilities aged 5-16 years attending 13 schools for those with learning disabilities in Oxfordshire and Berkshire, England. Parents were sent a questionnaire designed to assess demographic and medical information, children's sleep patterns, general daytime behavior and challenging behavior. Questionnaires were completed by the parents of 209 children.

Forty-four percent of these parents reported current severe sleep problems most nights or every night, while 56% reported no problems or infrequent problems. The daytime behaviors section of the questionnaire revealed that children showing each form of challenging behavior (irritability, lethargy, stereotypies, hyperactivity) were significantly more likely to have a sleep problem. Specifically, children with sleep problems had a mean of 2.7 challenging behaviors, while children without sleep problems had a mean of 1.62 problem behaviors. These results show that children with sleep problems are more likely to exhibit irritability, lethargy, stereotypies, and hyperactivity, and often have multiple challenging behaviors. This study also shows a high rate of sleep problems (44%) in this population of children with learning disabilities.

There are many unknowns regarding the relationship between pediatric sleep disorders and externalizing behaviors. The mechanisms by which sleep disordered breathing and OSAS are related to hyperactivity and inattention are still unclear. One hypothesis is that sleep fragmentation and periodic hypoxia related to OSAS causes

dysfunction in the prefrontal cortex (Tauman & Gozal, 2006). This hypothesis is consistent with the findings that both children and adults who snore have been found to have impaired executive functioning. However, additional research is needed to further explore these relationships. In addition, more reseach is needed concerning the relationship between sleep disorders and other specific externalizing problems (i.e. aggression, attention problems), particularly within more narrow age ranges.

Sleep Disorders and Social Skills

The relationship between pediatric sleep disorders and social skill deficits is unclear. Although there is evidence that ADHD and broad-band externalizing problems are related to pediatric sleep disorders, there are very few studies that have looked into the relationship between pediatric sleep and social skills.

Narcolepsy specifically has been found to be associated with several negative social consequences. Children suffering from Narcolepsy report experiences of stigmatization that are similar to adults (Hood & Harbord, 2002). In addition, children with Narcolepsy are often perceived as lazy or unmotivated by their teachers (Wise, 1998), are socially isolated from their peers, and are more likely to be bullied by peers (Broughton, Ghanem, Hishikawa, Sugita, Nevsimalova & Roth, 1981).

One study examined the behavior of children ages 4 to 18 years diagnosed with OSAS (Uema, Vargas, Vidal, Fujita, Moreira, Shizue et al., 2006). Parents of the children participating in the study completed the Child Behavior Checklist (CBCL). Researchers determined that the most affected individual scales on the CBCL were total competency (20%), somatic complaints (10%), social problems (10%), and aggressive behavior (10%). The authors admit that the limitations of this study include a small sample size of

20 children and a lack of a control group of children who did not have any sleep problems. The absence of a control group makes it difficult to determine the extent to which social problems is related to the presence of OSAS. Also, it is important to note that this study assessed social problems, which is a slightly different and broader construct than social skills.

There is only one known study that assessed social skills specifically and their relationship to sleep in young children (Witte, 2006). It was determined that children ages 3 to 5 years who were rated by their parents in the high risk range of sleep disorders symptoms, as measured by the Sleep Disorders Inventory for Students – Children's version (Lugibuehl, 2004), displayed more poorly developed social skills as compared to children whose scores indicated that they were not at risk for having a sleep disorder. Similarly, children who had moderate levels of sleep disorders risk factors also had inferior social skills, as measured by the Preschool and Kindergarten Behavior Scales-2nd edition (Merrell, 2004), when compared to those children who were rated as having normal sleep. Because this is the only known study that examined the relationship between social skills and pediatric sleep, it is clear that there is a great need for further investigation.

Sleep Disorders and Pediatric Overweight

The relationship between weight and pediatric sleep disorders is another research area that has just recently begun to emerge. Childhood overweight is defined as a Body Mass Index equal to or greater than the 95th percentile for age and gender, whereas risk of overweight is defined as a Body Mass Index (BMI; weight divided by height) between the 85th and 95th percentiles (www.cdc.gov). Although the term "childhood obesity" is

used commonly, the CDC instead refers to this condition as “overweight”. Prevalence rates of childhood overweight have varied in the literature, from a low of 8.1% to a high of 55% (Mason et al., 2006). A recent study examined the prevalence rate of overweight in children between the ages of 3 and 5 years in Chicago, and found the overall prevalence rate of overweight to be 24% (Mason et al., 2006). The rate of pediatric obesity is increasing dramatically along with the obesity-related morbidities, such as Type 2 diabetes, hypertension, atherosclerosis, depression, and impaired quality of life (Tauman & Gozal, 2006).

The majority of researchers have determined that obesity/pediatric overweight also is a risk factor for sleep disorders such as OSAS. Children who are obese are proportionally at an increased risk for developing sleep-disordered breathing (Tauman & Gozal, 2006). A polysomnography study revealed that 66% of obese children had partial airway obstruction, and 59% of obese children had complete airway obstruction (Mallory, 1989). Several large-scale studies revealed that 45-55% of children referred for sleep-disordered breathing also are obese (Tauman & Gozal, 2006). The reported rates of sleep disorders vary between 27% and 46% in obese children (Tauman & Gozal, 2006). Another study found that for every 1 kg/m2 increase in BMI beyond the mean BMI, the risk for OSAS increased by 12% (Redline, Tishler, Shluchter, Aylor, Clark, & Graham, 1999).

Although the majority of research indicates that there is a relationship between childhood obesity and sleep-disordered breathing, there is some research that is at odds with this finding. For example, researchers examined a cohort of 400 children between the ages of 2 and 14 years (mean age 5 years), and found no relationship between BMI

and OSAS (Sardon, Gonzalex, Aldasoro, Bordoy, Mintegui, & Emparanza, 2006). The authors concluded that additional research is needed to further examine these variable findings in the literature. Another study of sleep disordered breathing in children concluded that there was no association with obesity (Leach, Olson, & Hermann, 1992), and a study of 3,671 obese Singaporean children aged 6 to 18 years reported a prevalence rate of sleep disordered breathing that was only .71% (Chay, Goh, & Abjsheganaden, 2000). However, these results may have been affected by the low sensitivity of the questionnaires used in this research. In other words, the questionnaire that was developed by the researchers of this study to assess sleep-disordered breathing may have not correctly identified all of the patients who actually did have sleep-disordered breathing.

There are several hypotheses that may explain the relationship between pediatric overweight and sleep disorders. Adenotonsillar enlargement, fatty infiltration of the upper airway passages, fat deposits in the anterior neck region, mass loading of the respiratory system, increased fat tissue in the abdominal wall and cavity as well as the surrounding thorax, all may contribute to sleep-disordered breathing (Tauman & Gozal, 2006). All of these problems result in decreased lung volumes and oxygen reserve, and increase the effort needed to breathe while sleeping. One of the leading hypotheses suggests that excess fat tissue adjacent to the pharyngeal airway along with adenotonsillar hypertrophy obstructs the airway (O'Brien, Sitha, Baur, & Waters, 2006).

Researchers are discovering that excess body fat may mediate the relationship between sleep disorders and other medical conditions. For example, one study determined that diabetes is related to sleep apnea, but this relationship is explained by obesity, which is common to both disorders (Sanders & Givelber, 2003). Using a study

population of over 5000 subjects, researchers found that after confounding factors were controlled, there was no difference between diabetic and non-diabetic subjects in terms of periodic breathing. However, even after controlling for confounding factors, there was a greater occurrence of periodic breathing events among diabetic patients. The authors concluded that obesity likely explains the common risk factors for these disorders.

Obesity in children with sleep-disordered breathing is problematic because it can have an effect on treatment. One study evaluated the impact of obesity on treatment outcomes of children with OSAS (O'Brien, Sitha, Baur, & Waters, 2006). Two groups of children with a mean age of 7 years before treatment (range of 2.9 years to 11.3 years) were compared. One group of children was classified as obese (BMI z-score of greater than 2), and the other group of children was classified as normal weight. Both the obese and non-obese children had similar respiratory disturbance indices before treatment. However, after adenotonsillectomy, the obese children had a significantly higher respiratory disturbance index as compared to those children who were of average weight. Resolution of OSAS occurred in 77.5% of normal-weight subjects, as compared to only 45% of obese children. This study indicates that obesity is a major risk factor for the persistence of OSAS, even after treatment. This finding is true regardless of the severity of the condition initially. This study found the rate of resolution among obese children to be significantly lower than previous findings which indicated that adenotonsillectomy resolved 80% of OSAS cases in children (Lipton & Gozal, 2003).

A different study found additional troubling results for the treatment of obese children with OSAS. Soultan, Wadowski, Rau, and Kravath (1999) examined children with a mean age of 4.9 years (+/-2.4 years) who underwent tonsillectomy and/or

adenoidectomy. At the time of surgery, 25 children were of normal weight, 3 were underweight, 7 were obese, and 10 were morbidly obese (defined as those who weighed more than 150% of their ideal body weight). After the surgery, 31 children (including 10 of the 17 who were obese or morbidly obese) had a substantial increase in weight. Therefore, these authors concluded that the treatment of OSAS is actually related to an increase gain in height, weight, and BMI, even among those children who are initially obese or morbidly obese.

Researchers predict that an increase in OSAS will accompany the increased prevalence of obesity in young children (Tauman & Gozal, 2006). The high prevalence rates of sleep disorders and obesity stress the importance of increasing the public awareness of these conditions, so that both conditions are prioritized with the emphasis that they deserve.

Sleep Disorders and Asthma and Allergies

Research has shown that symptoms of sleep disorders also are related to other health factors in addition to obesity and overweight, such as asthma and allergic rhinitis. The majority of research in the relationship between asthma, allergies, and sleep has been conducted in adults and older children (Marshall, Almqvist, Grunstein, & Marks, 2007). There is little information on the nature of this relationship in young children.

Asthma is an expensive and chronic syndrome which affects at least 5% of the population (Kasasbeh, Kasasbeh, & Krishnaswamy, 2006); in children between the ages of 0 and 17 years, the prevalence rate of asthma is 8.9%. Pediatric asthma has been found to be directly related to a loss of academic time for children and is responsible for 12.8 million school absences in the United States (Centers for Disease Control and Prevention,

2006). One survey found that 26% of students with asthma were absent from school for at least 1 day during the school year due to asthma, and 64% of students with asthma visited the nurse's office at least once during the school year due to asthma symptoms associated with this disease (Kielb, Lin, & Hwang, 2007).

Asthma is a complex disease with multiple different phenotypes. The major symptoms of asthma include airflow obstruction, bronchial hyperresponsiveness, and airway inflammation. Asthma frequently is comorbid with allergic rhinitis, chronic sinusitis, gastroesophageal reflux disease, obesity, and psychopathology such as anxiety, depression, and panic disorders (Ekici, Ekici, Kurtipek, Keles, Kara, Tunckol et al., 2005), all found to be associated with daytime sleepiness. In addition, asthma medications often have stimulating, anxiety-provoking, or mood-depressing properties that may interfere with the quality of sleep or worsen daytime sleepiness symptoms (Ekici et al., 2005).

The association between OSAS and asthma is complication for several different reasons, and has not been systematically studied (Kasasbeh, Kasabeh, & Krishanaswamy, 2006). The symptoms of these two conditions, including airway obstruction and inflammation, overlap. Also, there has been a collateral rise in both OSAS and asthma in the past few years. Obesity, which is also a common risk factor for both conditions, is a rising epidemic. Although there are several hypotheses attempting to explain the link between sleep apnea and asthma, such as obesity, activation of inflammatory pathways, esophageal disease, and cardiac pathology, more research is needed in order to further examine the validity of these hypotheses (Kasasbeh, Kasabeh, & Krishanaswamy, 2006).

One study explored the association of asthma-related symptoms with snoring and apnea, and their effects on health-related quality of life (Ekici et al., 2005). These researchers distributed questionnaires to a total of 10,224 parents and grandparents who had children attending one of 14 randomly selected primary schools in Kirikkale, Turkey. The surveys contained questions to assess asthma-related symptoms (Respiratory Questionnaire, 1999), snoring and apnea (Modified Sleep and Health Questionnaire, 1999), and health-related quality of life (HRQOL; Short Form-12 Health Survey, 1996). Analysis showed that snoring and apnea were more prevalent in children with asthma-related symptoms. Also, children with asthma-related symptoms, as well as snoring and apnea, had poorer HRQOL scores, even after adjusting for other relevant factors, as compared to children without asthma symptoms. This study, while providing preliminary evidence regarding the relationship between sleep disorders and asthma, has several limitations. First, snoring and apnea were measured by only two questions. Additionally, no information was provided by the researchers concerning the age range of the children who were included in the study.

Research has also examined daytime sleepiness in patients with asthma. One study examined a sample of 115 adults with asthma in order to explore possible explanations for daytime sleepiness (Teodorescu et al., 2006). These adults were administered the Epworth Sleepiness Scale (Johns, 1991) to assess subjective sleepiness and the Sleep Apnea scale within the Sleep Disorders Questionnaire (Douglas et al., 1994). They also were assessed for perceived daytime sleepiness (one-item indicator), asthma severity, relevant comorbid conditions, and current asthma medications. It was determined that excessive daytime sleepiness was independently associated with

obstructive sleep apnea risk, but not with asthma severity. Therefore, researchers determined that although sleepiness is common in those with asthma, this may be the result of sleep apnea instead of the effects of asthma alone. Because this study included only adults as participants, there is limited generalizability of the results to children.

Allergic diseases also are a global health problem, affecting up to 15% of the population (Baiardini, Braido, Cauglia, & Canonica, 2006) and being labeled as a major epidemic of the 21st century. Compared with matched controls, patients with allergic rhinitis have approximately twice as many medication costs and 1.8 times the number of health care visits (Nathan, 2007). On a given day, it is estimated that approximately 10,000 children are absent from school because of allergic rhinitis (Nathan, 2007). Also, children with allergic rhinitis may experience isolation because of the presence of allergens that prevents them from engaging in certain activities such as camping and picnics. It has been hypothesized that sleep problems associated with allergies may exacerbate the burden of the illness and diminish quality of life. In fact, about half of patients with allergic rhinitis report difficulties falling asleep and waking up at night. Similarly to asthma, the relationship between sleep and allergies has not been systematically studied in young children, and the hypothesized causes leading to sleep disturbance in patients with allergies are numerous.

Some researchers have suggested that perennial allergic rhinitis (e.g., hayfever) is an independent risk factor for sleep disturbance in asthmatics (Hellgren, Omenaas, Gislason, Jogi, Franklin, Lindberg et. Al., 2006). In this study, a questionnaire was distributed to a random population sample of 16,191 adults from Denmark, Estonia, Iceland, Norway and Sweden (aged 30-54 years). A total of 17% of the subjects with

asthma also reported perennial non-infectious rhinitis, which was associated with difficulties maintaining sleep, early morning wakings, and daytime sleepiness. This study, while providing vital information concerning the relationship between asthma and sleep disturbance, did not include children in its sample. In addition, it is important to note that sleep disturbances were measured, not specific sleep disorders.

Recent research has attempted to explore the potential causes of sleep disturbance in those with allergies. Bairardino, Braido, Cauglia, and Canonica (2006) performed a literature review in order to discern the causes of sleep problems in allergic patients. They suggest that an allergy by itself can disrupt sleep, even when controlling for other factors. In addition, due to their effects on the central nervous system, anti-allergic medications can also alter sleep patterns, making research in this area more complex. The authors state that allergic rhinitis can interfere with restful sleep through symptoms and underlying pathology, and nasal congestion caused by the allergy itself. For example, in a population-based study of 4927 patients who completed a questionnaire on nasal congestion and sleep problems, those with rhinitis symptoms occurring at least five nights per month were significantly more likely to report habitual snoring, daytime somnolence, and nonrestorative sleep (Young, Finn, & Kim, 1997). One limitation of this literature review is that it mainly refers to adults with allergies. As a result, the relationship between childhood allergies and sleep is even less clear, due to the fact that there is very limited research in this population.

There have been several other studies suggesting that there is a possible relationship between sleep and allergies in children. Previous research shows that children between the ages of 6 years and 14 years who experienced wheezing were more

likely to have difficulty falling asleep, restless sleep, and snoring, as compared to those subjects who did not have wheezing symptoms (Ersi, 2004). Several researchers also investigated the predictors for snoring in children with rhinitis at age five (Marshall, Almqvist, Grunstein, & Marks, 2007). Children in this study who suffered from asthma had a 26.3% snoring rate, which is much higher than the rate of snoring in the general population (10-15% of children within this age range). Interestingly, body mass index at age 4.5 years was not found to be related to snoring, indicating that allergic disease may be a more important risk factor as compared to BMI in this young population. Another study prospectively evaluated 39 children with chronic snoring. Of those children involved in the study, 36% were sensitive to allergens. This rate is approximately three times the prevalence rate of allergen sensitivity in the general population (McColley, Carroll, Curtis, & Loughlin, 1997).

There is one meta-analysis of the literature examining the role of allergic rhinitis in obstructive sleep apnea syndrome in a pediatric population (Nq, Chan, Hwang, Chow, & Kwok, 2006). The authors conducted a PubMed literature search, and reviewed articles that reached a pre-determined inclusion criteria. They determined that allergic rhinitis affected an average of 40% of children across studies, while OSAS occurred in an average of 2% of children. They also concluded that allergic rhinitis is a risk factor for apnea because it is associated with nasal obstruction, tonsil and adenoid enlargement, and an elongated face, which are also risk factors for obstructive apnea. Therefore, treatment of allergies is necessary to decrease the occurrence and severity of OSAS.

Summary

This literature review introduced several different areas related to pediatric sleep disorders. First of all, general information regarding sleep and sleep disorders in school-age populations was included. While researchers have shown that sleep serves a vital biological function (Morrison, 2004), Americans regularly do not get adequate sleep. Research demonstrates that the prevalence rate of pediatric sleep disorders is disturbingly high (Bixler et al., 2000), although there is a lack of empirical research concerning childhood sleep and it is evident that children with sleep disorders are often misdiagnosed. It has been reported that the rate of sleep disorders in children is higher than that of adults (Bixler et al., 2000), and may occur in as many as 43% of children ages 2 through 14 years of age (Archbold, Pituch, Panahi, & Chervin, et al., 2002). Five types of Primary Sleep Disorders affecting children's daytime performance are PLMD, DSPS, and OSAS.

Children with sleep disorders tend to experience externalizing behavior problems, especially if they are suffering from untreated sleep disorders. In addition, there appears to be a relationship between sleep disorders and multiple types of health risks. In order to prevent negative outcomes, it is imperative that research is conducted to explore the prevalence of sleep disorders in young children and the relationship of sleep problems to other specific externalizing behaviors, and health factors such as pediatric overweight, asthma, and allergies.

Chapter 3

Method

Introduction

The purpose of this study was to explore the relationship between symptoms of pediatric sleep disorders, externalizing behaviors, and health-related factors such as pediatric overweight, asthma, and allergies. In addition, this study reported the prevalence rates of symptoms of sleep disorders in a pediatric population. This chapter presents information regarding the participants in this study, the procedures used to collect the data, and the analyses that were conducted.

Participant Characteristics

Two hundred seventy-six children ages 2-5 years from west central Florida served as participants in this study. Data from the children were accessed through a pre-existing database located at the University of South Florida (USF) Child Development Clinic. All subjects in the database included children who have received services at the clinic, either through traditional clinic visits or through participation in a parent training program. The sample was 78% male and 22% female. The race/ethnicity of the children was 51% Caucasian, 29% Hispanic, 12% African-American, and 8% other races. The children's ages ranged from 2 years to 5 years with a mean of 3 years. The majority of the families reported having private insurance (61%). See Table 1 for participant characteristics

Children were served through this clinic for a variety of psychological, behavioral, developmental, and academic concerns. Children within the sample were referred from a variety of sources such as their pediatrician or social worker/service coordinator. Reasons for referral include problems such as academic underachievement, developmental delay, autism spectrum disorder symptoms, and challenging behavior. Children undergoing traditional clinic visits typically received triage appointments, relevant assessments, and intervention-planning. Parents of children attending clinic visits also completed behavioral, sleep, and adaptive behavior rating scales. These data were included in the existing database. It should be emphasized that these children do not represent the general population; rather, this is a unique, high-risk sample.

Table 1

Participant Characteristics

Race/Ethnicity	N	Percentage
African-American	33	11.87%
Caucasian	143	51.44%
Hispanic	80	28.78%
Other	22	7.90%
Sex		
Male	216	77.70%
Female	62	22.30%
Age		
2 years	72	26.09%
3 years	72	26.09%
4 years	80	28.99%
5 years	53	18.845
SES		
Private Insurance	168	60.65%
Medicaid	109	39.35%

Sleep Disorders Inventory for Students

The Sleep Disorders Inventory for Students (SDIS; Luginbuehl et al., 2008) was developed in order to respond to the need for a school-based screening instrument to recognize the symptoms of several sleep disorders, including OSAS, Excessive Daytime

Sleepiness, PLMD, RLS, and DSPS. There are two forms of the SDIS, the SDIS-C, which was normed on children ages 2–10 years, and the SDIS-A, which was normed on adolescents ages 11–18 years. The SDIS-C screens for OSAS, RLS, DSPS, and Excessive Daytime Sleepiness, while the SDIS-A screens for OSAS, PLMD, DSPS, Excessive Daytime Sleepiness, and Narcolepsy. The SDIS-C was used for this study.

The SDIS is available in both English and Spanish and takes approximately 8-15 minutes to complete. There are 30 behavioral questions (i.e., child rolls or moves around the bed when sleeping) answered on a likert scale of 1-7, and 11 questions which require a 'yes' or 'no' response (i.e., Is your child overweight now?). Parents are asked to complete the SDIS to the best of their abilities, based on their child's sleep behavior during the past 6 to 12 months. If parents are unsure how to answer any of the questions, they are instructed to observe their child sleep on 2 different nights for 2 hours, a few hours after the onset of sleep and then again at 4:00 to 5:00 in the morning, preferably on a night during which the child is not taking any medication. This tool was chosen because of its specific design for children of this age and its technical properties.

The responses of the SDIS were evaluated through a computerized scoring program which provides a range of normal, cautionary, or high risk on each of the sleep disorders for which this tool screens. In addition, Excessive Daytime Sleepiness (the primary predictor of Narcolepsy in this tool), and a Total Sleep Disturbance Index is provided. These results are displayed through a bar graph with standard scores for each of the sleep disorders and for the Total Sleep Disturbance Index. Also, an interpretive report provides parents with additional information about pediatric sleep disorders. This study used the T score of the sleep disturbance index for all analyses.

The SDIS-C was normed on a national sample of 412 children from four major geographical regions of the United States. The demographics of this sample included were similar to the 2000 U.S. census. The exploratory factor analysis, including 188 children, showed that the SDIS-C has high predictive validity (93% using discriminate function analysis), criterion-related validity (OSAS: 33% agreement as compared with Polysomnography and Respiratory Distress Index; EDS: 83% agreement as compare to the Multiple Sleep Latency Test; information is unavailable for the other disorders), internal consistency (0.91), content validity (94% agreement on items as determined by an expert test review panel), and test-retest reliability (0.97). Exploratory and Confirmatory Factor Analysis found four sleep factors on the SDIS-C, including OSAS, Excessive Daytime Sleepiness (EDS), PLMD, and DSPS. Narcolepsy at this age was best predicted by the EDS subscale. In addition, five parasomnias (bruxism or teeth grinding, somnabulism or sleep walking, somniloquy or sleep talking, eneuresis or bed wetting, and night terrors) are detected in order to provide parents with some practical tips in order to deal with these conditions (Luginbuehl, et al., 2008).

Child Behavior Checklist

The Child Behavior Checklist (CBCL; Achenbach, 1991) was designed to screen for a variety of types of behavior problems. The CBCL assesses for several core syndromes, including emotionally reactive, withdrawn, attention problems, sleep problems, anxious/depressed, somatic complaints, and aggressive behavior. These narrow-band syndromes can be classified under 2 broad-band syndromes, including externalizing problems and internalizing problems. A total problems score may also be calculated to give an overall impression of the seriousness of the problem behaviors the

child is exhibiting. Several DSM-IV syndromes are also assessed, including affective problems, anxiety problems, pervasive developmental problems, ADHD, and oppositional defiant problems. This study used the narrow-band externalizing problems subscales, including aggressive behavior and attention problems, for analyses.

The CBCL takes approximately 15 minutes to administer. There are 99 items which assess behavior or emotional problems. Also, a language development survey exists for parents of young children, and several survey, short-answer questions (i.e. What concerns you most about your child?). There are several different versions of the CBCL, including a Teacher Report Form (TRF), Youth Self-Report (YSR), and CBCL for parents of children to complete. There are both English and Spanish versions of all Achenbach scales. All responses assessing behavior/emotional problems require the respondent to circle a response that corresponds to how true the behavior is to their child (never true, sometimes/somewhat true, almost always true). These responses are entered and scored through a computerized scoring program. This computerized scoring program produces a print-out containing bar graphs that classify each narrow-band and broad-band problem into one of three categories: normal, borderline clinically significant, and clinically significant.

The CBCL was normed on approximately 1,700 sites in 40 states. A variety of cultural groups were included in the norming sample. Researchers found that the CBCL has excellent technical properties. The test-retest reliability ranged from .95 to 1.0, inter-rater reliability was between .93 and .96, and the internal consistency ranged from .78 to .97.

The test-retest reliability of the aggressive behavior subscale was r=.91 for both boys and girls. Test-retest reliability of the attention problems subscale was slightly lower, however (r=.69).

Adaptive Behavior Assessment System – 2nd Edition (ABAS-II)

The Adaptive Behavior Assessment System, 2nd edition (ABAS-II) is an instrument designed to assess all 10 specific adaptive skills areas as outlined in the Diagnostic and Statistical Manual of Mental Disorders. The purpose of the ABAS-II is to provide a valid, comprehensive, norm-based measure of adaptive behavior skills for both children and adults up to 89 years old. The ABAS-II is used with children in order to determine how they are responding to everyday demands, develop goals for treatment and training, determine eligibility for Social Security benefits, and assess individuals with intellectual or learning disabilities, ADHD, or other impairments.

The ABAS-II contains 10 separate skill area scores, including communication, community use, functional academics, health and safety, home/school living, leisure, self care, self direction, social, and work skills. These areas constitute the four domain composite scores of conceptual skills, social skills, practical skills, and a general adaptive composite score (GAC). Communication, functional academics, and self-direction comprise the conceptual domain, social and leisure skills constitute the social domain, and self care, home/school living, community use, health and safety, and work make up the practical domain.

There are five available versions of the ABAS-II based on the rater and the age of the child, including a teacher rating scale for ages 2 to 5 years, and 5 to 21 years. Parent rating scales exist for children between the ages of 0 and 5, and for children between the

ages of 5 and 21 years. In addition, there is one available scales for adult clients between 16 and 89 years old. Items are scored based on a 4-point Likert scale (not able, never or almost never when needed, sometimes when needed, and always or almost always when needed). There are between 193 and 241 items used to calculate the general composite score, depending on the version used. This study will use the parent rating scale for children between the ages of 0 and 5 years. The social skills score was used for analyses.

The ABAS-II has shown a high degree of reliability. For example, the majority of measured skill areas have internal consistency coefficients of .90 or higher. Three studies evaluating the test-retest reliability examined the relationship between raters' scores between a 2 week time interval. GAC correlations were near or above .90 for all ABAS-II versions, showing additional evidence of adequate reliability of scores. There is also evidence of adequate validity of the ABAS-II. Factor analysis provided in the ABAS-II manual supports the three-factor model and the GAC factor. In addition, intercorrelations among skills areas, domains, and GAC provides evidence for construct validity of the ABAS-II. Studies comparing the ABAS-II to other adaptive behavior measures such as the Vineland demonstrate concurrent validity, with correlations ranging between .70 and .84 (Rust & Wallace, 2004).

The social scale of the parent/primary caregiver forms of the ABAS-II was used for the purposes of this study. The scores from this scale have demonstrated good reliability and validity. The reliability coefficients for the social scale range from .86 and .90 for the ages that will be included in this study. The test-retest reliability coefficient for the social subscale was .92. The results of clinical validity studies suggest that the ABAS-II shows high levels of sensitivity between differentiating between clinical and

nonclinical samples. For example, a significant difference was found in the social skill area between matched controls and those with Mental Retardation, Developmental Delay, Pervasive Developmental Disorder Not Otherwise Specified, and language disorders.

Health-Related Factors

In addition to measuring behavior and symptoms of sleep disorders, data on several health-related factors are maintained in the database. Specifically, height and weight were used in order to calculate body mass index (BMI). BMI is a calculation that is used by researchers and those in the medical community to estimate adiposity, or fatness, in both children and adults. Higher BMI ratings indicate increased levels of adiposity, while lower levels indicate decreasing amounts of adiposity.

Obesity is defined as the presence of excess body fat (Wickramasighe et al., 2005). Various anthropometric measures such as skin fold thickness and body mass index (BMI) are used in order to measure obesity. BMI is a formula that is used to compare weight and height of those who are the same age and sex. It has a clear relationship with both adulthood and childhood body fat mass, and is a convenient measure to use in a variety of clinical and research settings (Wickramasinghe et al., 2005). Strictly speaking, obesity is a measure of adiposity. However, BMI is used as an appropriate substitute to measure adiposity when this information is not available.

There is no one agreed-upon method of measuring pediatric overweight in children, and there is still much debate in the field, particularly in measuring obesity and overweight among various ethnic groups. BMI percentiles are the most commonly used method to determine the size and growth patterns of children in the United States, and are available according to age and sex. The Center for Disease Control (CDC) defines

healthy weight as a BMI between the 5th percentile and the 85th percentile for age and sex. At-risk-of-overweight is defined as a BMI between the 85th percentile and the 95th percentile. Overweight is defined as a BMI that is equal to or greater than the 95th percentile (www.cdc.gov). This study will use the CDC criteria for determining healthy weight, at risk of overweight, and overweight. It should be noted that although some studies use the term “obese," the CDC instead defines this as “overweight."

The database also included information regarding the presence or absence of asthma and allergies for each subject. These categorical data were obtained for the purposes of this study. The presence of asthma and/or allergies was included based on a traditional medical questionnaire that parents completed during the initial triage visit. These data were used to determine whether or not symptoms of sleep disorders are related to asthma and/or allergies.

Chapter 4

Results

Sleep Disorders Inventory for Students – Children's version (SDIS-C)

Data from the Sleep Disorders Inventory for Students – Children's version (SDIS-C) were accessed from the database at the USF Child Development Clinic in order to provide information regarding whether or not the subjects had any level of risk for one or more pediatric sleep disorders. In this study, the reliability estimate for the overall total sleep disturbance scale of the SDIS-C was .89. Reliability estimates were calculated for all scales that were used in order to determine the extent to which each of the items within a scale measured a similar construct.

Child Behavior Checklist (CBCL)

Data from the Child Behavior Checklist was also were accessed from the database in order to determine whether or not the subjects demonstrated externalizing behaviors (attention problems and aggressive behavior). Results showed that the reliability estimate for the CBCL was .92 for the aggressive behavior scale and .72 for the attention problems scale.

Adaptive Behavior Assessment System – 2nd Edition (ABAS-II)

Results from the social subscale of the ABAS-II were also obtained from the database in order to gain more information regarding the social skill development of the

subjects, as rated by their parents. The reliability estimate of the social skills subscale of the ABAS-II was .91.

Descriptive Statistics

Upon examination of the sleep scores on the SDIS-C, it was found that the mean scores for all of the sleep disorders scales (OSAS, PLMD, DSPS, and Excessive Daytime Sleepiness) were in the low to mid 50s, with standard deviations ranging from 9.40 to 12.45 points (see Table 2). The means and standard deviations were as follows: 63.13 and 12.55 for the aggressive behavior subscale, 63.02 and 9.19 for the attention problems subscale, and 6.37 and 3.15 for the social subscale (see Tables 4 and 5). The sleep disorders, aggressive behavior, and attention problems scales were reported as T-scores, which have a mean of 50 and a standard deviation of 10. The social subscale was reported as a scaled score, which has a mean of 10 and a standard deviation of 3.

Information was gathered from the database regarding each child's height and weight in order to calculate body mass index. Table 6 shows that the mean body mass index was 16.63 and the standard deviation was 2.03. Examination of BMI percentiles revealed that 65% of the sample had a normal body weight, 17% were at risk of being overweight, and 18% of children were overweight. A review of the asthma and allergy data from the database indicate that 23% of the sample reported having allergies, and 20% reported having asthma (see table 7).

A large number of subjects were missing BMI data because their heights and weights were not measured during visits to the clinic and therefore this information was not recorded in the database. Because a significant number, 97 (35%), of the subjects had missing body mass index (BMI) data, descriptive statistics were run to determine if there

was a difference in the sleep disorders index, aggressive behavior, attention problems, or social skills between those subjects with and without BMI data. Significant differences were not found between the two groups based on any of these variables (see Table 3).

Table 2

SDIS-C Descriptive Statistics

	n	Mean	Standard deviation	Med.	Mode	Skew-ness	Kurtosis	Min	Max
OSAS	276	53.94	9.72	52.0	51.0	.95	.71	39	88
PLMD	276	54.51	9.54	53.0	49.0	.44	-.44	36	80
DSPS	276	53.70	12.45	49.5	41.0	1.05	.20	41	90
EDS	276	51.77	9.40	49.0	48.0	.93	.88	39	90
SDI Index	276	55.51	9.82	54.0	52.0	0.80	0.42	39	89

Table 3

Present and Missing BMI Descriptive Statistics and Significance Tests

	Sleep Risk		Aggressive Bx		Attention Problems		Social Skills	
	BMI Present	BMI Absent	BMI Present	BMI Absent	BMI Present	BMI Absent	BMI Present	BMI Absent
n	181	95	178	95	178	95	155	75
M	.73	.51	63.77	61.94	64.73	62.82	6.99	7.15
SD	.90	.81	13.01	11.62	8.91	8.91	2.97	3.34
t	2.04		1.15		1.68		.35	
p	.04		.25		.09		.73	

Table 4

CBCL Descriptive Statistics

	n	Mean	Standard Dev.	Med.	Mode	Skew-ness	Kurt-osis	Min	Max
Aggressive Behavior	273	63.13	12.55	60.0	50.0	.95	.07	50	98
Attention Problems	273	63.02	9.19	62.0	57.0	.04	-1.3	50	82

Table 5

ABAS-II Descriptive Statistics

	n	Mean	Standard Dev.	Median	Mode	Skew-Ness	Kurtosis	Min	Max
Social	230	6.37	3.15	6.0	5.0	.16	-.54	1	15

Table 6

Body Mass Index Descriptive Statistics

	n	Mean	Standard Dev.	Median	Mode	Skew-Ness	Kurtosis	Min	Max
BMI	181	16.63	2.03	16.30	15.80	1.89	8.22	13.4	29.3

Table 7

Allergies and Asthma Descriptive Statistics

	Presence		Absence	
	Frequency	Percentage	Frequency	Percentage
Allergies	56	23%	183	77%
Asthma	48	20%	190	80%

Prevalence of Sleep Disorders

The first research question sought to determine the prevalence rates of symptoms of sleep disorders in the study population. According to the overall index of sleep disorders (SDI), 70.29% of children scored in the normal range of sleep. However, 12.68% of children received sleep scores in the cautionary range, and 17.03% scored in the high-risk range. Frequencies for the specific types of sleep disorders can be found in Table 8.

Table 8

Prevalence of Sleep Disorders as Measured by the SDIS-C

	Level 1: Normal		Level 2: Caution		Level 3: High Risk	
	Frequency	Percentage 95% C.I.	Frequency	Percentage 95% C.I.	Frequency	Percentage 95% C.I.
OSAS	217	78.62 73.11-82.89	19	6.88 3.83-9.77	40	14.49 9.91-18.09
PLMD	196	71.01 65.65-76.35	39	14.13 9.91-18.09	41	14.85 10.79-19.21
EDS	224	81.16 23.65-34.35	27	9.78 6.21-13.19	25	9.06 5.62-12.38
DSPS	206	74.64 68.83-79.17	21	7.61 4.47-10.73	49	17.75 13.47-22.53
SDI	194	70.29 64.59-75.41	35	12.68 8.17-15.83	47	17.03 12.57-21.43

The Sleep Disorders Index can be an under-representation of overall sleep disorders risk because more than one subscale typically needs to be elevated for the Sleep

Disorders Index to be elevated as well. In other words, if only one subscale is high-risk, the Sleep Disorders Index may be in the Normal range. Therefore, individual subscales for each subject were examined in order to ensure that the overall measure of risk was reported accurately. When individual subscales were examined subject-by-subject, it was found that 61.23% of the children scored in the normal range across all sleep disorders areas, including Obstructive Sleep Apnea Syndrome, Periodic Limb Movement, Delayed Sleep Phase Syndrome/Behavioral Insomnia of Childhood, and Excessive Daytime Sleepiness (see Table 9). Further analysis revealed that 12.32% of the sample had a score of caution in at least one sleep disorder subscale. The remainder of the children, 26.45%, scored in the high risk range in at least one sleep disorder subscale.

Table 9

SDIS-C Subscale Percentages

	Overall	
	n	Percentage 95% C.I.
Normal	169	61.23 52.25-66.75
Caution	34	12.32 8.78-15.22
High Risk	73	26.45 21.66-30.34

Examination of Continuous Variables

A Box's M test was conducted to test the equivalency of the covariance matrices and determine whether or not this assumption was passed. The results indicated that the Chi-Square value was 23.105, with 20 degrees of freedom and a p-value of .284. Because the p-value was greater than .05, this shows that no evidence exists indicating that the

assumption was violated. Normality for each of the variables was also examined. Skewness and kurtosis values can be found in tables 10, 11, and 12.

A multivariate analysis of variance (MANOVA) was conducted to determine whether or not a difference existed between the category of sleep risk (normal, caution, or high risk) and any of the continuous variables, including attention problems, aggressive behavior, social skills, and body mass index. Because missing observations were present in some of the participants, only those 153 subjects with complete data were included in the MANOVA analysis. The results of the test indicated that there was a difference between the different categories of sleep risk and at least one of the variables (Lamda=.830, $F(8,153) = 3.60$, $p=.005$).

Because the MANOVA yielded significant results, follow-up Analyses of Variances were conducted in order to determine which of the variables varied based on the degree of sleep disorder risk. All subjects were included in the ANOVA analyses if they had the necessary data for performing that analysis. In other words, subjects were not excluded from the analysis because they had missing data in other areas that were not involved in the analysis being performed.

The following sections will discuss the analyses related to symptoms of sleep disorders and each specific continuous variable. Analyses involving aggressive behavior, attention problems, social skills, and Body Mass Index will be examined. For each variable, the relevant assumptions, Analysis of Variance, and follow-up Tukey tests will be discussed.

Aggressive Behavior and Sleep Disorders

The distribution for each of the three groups can be seen in Appendix A, Figure 1. The means and standard deviations for each group on the aggressive behavior subscale are displayed in Table 9. Two-hundred seventy one observations were included in the aggressive behavior analyses.

Table 10

Aggressive Behavior Means and Standard Deviations by Sleep Score

	N	Mean	Standard Deviation	Skewness	Kurtosis
Normal	167	59.19	9.81	1.296	1.553
Caution	32	68.34	13.26	.585	-.515
High Risk	72	70.08	14.21	.280	-1.085

Several assumptions were checked in order to ensure that an Analysis of Variance (ANOVA) was an appropriate test to use. Specifically, independence, normality, and homogeneity were tested. Since all subjects were separate individuals who completed both measures independently and without the ability to interact with each other, it was ensured that the assumption of independence was not violated. Scores on the aggressive behavior subscale of the CBCL had a small positive skew overall (0.95), and kurtosis was normal (0.07), indicating that the assumption of normality was passed. Boxplots of each condition reveal that the normal category of sleep disorder risk had the least variability in score distribution.

After checking all assumptions, a one-way ANOVA was conducted in order to determine whether or not difference existed between scores on the aggressive behavior subscale of the CBCL, based on the category of sleep disorder. Two-hundred seventy one observations were used to perform this analysis. The level of overall sleep disorder risk (normal, caution, and high risk) served as the categorical variable, while the score on the aggressive behavior subscale of the CBCL served as the continuous variable. There was a statistically significant difference among the three groups ($F(2,268)=25.97$, $p<.0001$). This indicates that because the ANOVA was significant at the .0125 level, there was a difference in parent-reported aggressive behavior based on the overall level of sleep disorder.

A Tukey test was conducted in order to determine for which levels of overall sleep disorders risk (normal, cautionary, and high risk) there was a difference in aggressive behavior scores. The Tukey test indicated a difference between the normal level and high risk level of sleep disorders, and between the normal level and caution risk level of sleep disorders, at a .0125 confidence level (error degrees of freedom=268). When the comparison between the high risk and normal level of sleep were examined, the difference between sample means was 10.886, with a 95% chance that the difference between population means was between 6.220 and 15.551. When the comparison between the normal sleep group and the caution group were examined, the difference between the sample means was 9.146, with a 95% chance that the difference between the population means was between 2.760 and 15.532. No differences were found between the caution level and the high risk level of sleep disorders. Overall, this indicates that children who were rated as high risk for a sleep disorder received significantly higher

scores on the aggressive behavior subscale of the CBCL as compared to children who scored in the normal sleep range. Similarly, those in the caution risk group also received higher aggressive behavior scores as compared to children with sleep risk rated in the normal range.

Attention Problems and Sleep Disorders

The distribution of internalizing problems for each of the three groups can be seen in Appendix A, Figure 2. The means and standard deviations for each sleep disorders risk classification on the internalizing problems scale are displayed in Table 11. Two-hundred seventy-one observations were used to study attention problems.

Table 11

Attention Problems Means and Standard Deviations by Sleep Score

	n	Mean	Standard Deviation	Skewness	Kurtosis
Normal	167	60.63	8.72	.373	-1.158
Caution	32	66.56	8.78	-.541	-.839
High Risk	72	67.06	8.60	-.503	-.680

The same methods were used to test the three assumptions of independence, normality, and homogeneity. The same data collection procedures and participants ensured that the assumption of independence was passed for the same reasons that this assumption was passed for aggressive behavior. Scores on the attention problems subscale of the CBCL had normal skewness overall (0.04), and the distribution was

slightly platykurtic (-1.3). Standard deviations of each condition revealed that all 3 levels of sleep disorder risk had similar variability in scores.

After checking all assumptions, an ANOVA was conducted in order to determine whether or not a difference existed between scores on the attention problems subscale of the CBCL, based on the category of sleep disorder. The level of overall sleep disorder risk was used as the categorical variable, while the score on the attention problems subscale of the CBCL served as the continuous variable. Results of the ANOVA revealed that a significant difference existed between the three groups ($F(2,268)=16.72$, $p<.0001$). This indicates that at the .0125 level of significance, there is a difference in parent-reported attention problems based on the overall level of sleep disorder.

A Tukey test was conducted in order to determine for which levels of overall sleep disorders risk there was a difference in attention problems. The Tukey test showed a difference between the normal level and high risk level of sleep disorders, and between the normal level and caution level of sleep disorders, at a .0125 confidence level. This indicates that children with high risk factors for sleep disorders had significantly more attention problems, as compared to children with no risk factors for sleep disorders. Similarly, those with sleep risk in the caution range also were rated by their parents to have more attention problems as compared to children whose sleep was rated in the normal range. When the high risk group was compared to the normal group, the difference between sample means was 6.427, with a 95% chance that the difference between population means was between 2.915 and 9.939. When the caution group was compared to the normal group, the difference between sample means was 5.934, with a 95% chance that the difference between population means was between 1.127 and

10.741. No significant differences in attention problems were found between the caution risk level and the high risk level of sleep disorders.

Social Skills and Sleep Disorders

The distribution of social skills for each of the three groups can be seen in Figure 3 of Appendix A. In addition, the means and standard deviations for each sleep disorders risk classification on the social skills scale of the ABAS-II are displayed in Table 12.

Table 12

Social Skills Means and Standard Deviations by Sleep Score

	n	Mean	Standard Deviation	Skewness	Kurtosis
Normal	138	6.41	3.19	.179	-.532
Caution	29	5.86	2.84	-.334	-.700
High Risk	62	6.50	3.26	.238	-.661

The same assumptions of independence, normality, and homogeneity were checked again in reference to the total social skills scale of the ABAS-2 to ensure that an ANOVA was an appropriate test to use. Again, it was ensured that the assumption of independence was not violated because of the nature of the data-collecting process. Scores on the social skills subscale of the ABAS-2 overall had an approximately normal level of skewness (-.16), and the distribution was slightly platykurtic (-.54). Boxplots of each condition reveal that the caution sleep disorder category had slightly less variability in scores as compared to the normal and high risk groups.

After checking all assumptions, an ANOVA was conducted in order to determine whether or not a difference existed between scores on the total social skills scale of the ABAS-2, based on the category of sleep disorder. Two-hundred twenty-nine observations were used to conduct this analysis. Again, the level of overall sleep disorder risk was used as the categorical variable, while the score on the total social skills subscale of the ABAS-2 served as the continuous variable. The results of the ANOVA did not show a significant difference between the three groups of sleep disorders risk ($F(2,226)=0.44$, $p=.646$), meaning that there was no difference found in parent-reported social skills based on the overall risk level of sleep disorder.

Body Mass Index and Sleep Disorders

The distribution of body mass indices for each of the 3 groups can be seen in Figure A4. The means and standard deviations of the body mass indices for each sleep disorders risk category are found in Table 13.

Table 13

Body Mass Index Means and Standard Deviations by Sleep Score

	n	Mean	Standard Deviation	Skewness	Kurtosis
Normal	103	16.59	1.84	.353	-.347
Caution	24	16.86	2.11	1.988	4.495
High Risk	54	16.62	2.34	3.339	15.918

The assumptions of independence, normality, and homogeneity were again tested to make certain that an ANOVA was a valid test to use. Because each child arrived at the

clinic with a specific height and weight, it is logical that the assumption of independence is passed. BMI scores overall had a positive skew (1.89), and the distribution was platykurtic (8.22). Visual inspection of the boxplots of each condition showed that the high risk condition of sleep disorder risk had slightly less variability of scores than the caution or normal ranges of sleep disorder risk.

After checking all assumptions, an ANOVA was conducted in order to determine whether or not a difference exists between BMI based on the category of sleep disorder. Although this variable was found to be somewhat non-normal, the ANOVA is a test that is robust enough to be used even if the data were not totally normal. One-hundred eighty-one observations were used to conduct this analysis. Again, the level of overall sleep disorder risk was used as the categorical variable, while BMI scores served as the continuous variable. The results of the ANOVA did not show a significant difference between the three groups of sleep disorders risk ($F(2,178)=0.18$, $p=.834$), meaning that there is no difference in body mass indices on the overall risk level of sleep disorder.

Because there was no relationship found between BMI and overall sleep disorders symptoms, a follow-up ANOVA was conducted in order to determine whether any relationship existed between OSAS and BMI. One-hundred-eighty-one observations were used in this additional analysis, with the level of risk for OSAS serving as the categorical variable, and BMI serving as the continuous variable. The results of this ANOVA did not show a significant difference in BMI for the different classifications of OSAS risk ($F(2,178)=0.48$, $p=.621$). This indicates that there is no difference in body mass indices either by overall level of risk for sleep disorders, or by risk for OSAS specifically.

Allergy and Asthma Incidence by Sleep Score

The frequency of the incidence of asthma and allergies for each sleep disorder risk category are found in Table 14. Four different groups are displayed in the table: (a) those with neither asthma nor allergies, (b) those with asthma but not allergies, (c) those with allergies but not asthma, and (d) those with both asthma and allergies. A category combining both asthma and allergies was analyzed due to the fact that a moderate number of subjects endorsed both of these conditions. A total of 238 observations were used to conduct the analysis of allergies and asthma.

Table 14

Prevalence of Asthma and Allergies by Sleep Score

	Neither Asthma nor Allergies		Asthma only		Allergies only		Asthma and Allergies	
	n	% 95% C.I.	n	% 95% C.I.	n	% 95% C.I.	n	% 95% C.I.
Normal	95	39.92 32.8-45.2	11	4.62 1.94-7.26	15	6.30 3.21-9.39	17	7.14 3.84-10.36
Caution	19	7.98 4.47-11.33	4	1.68 0.01-3.19	4	1.68 0.01-3.19	3	1.26 0.00-2.58
High Risk	48	20.17 15.73-24.27	5	2.10 0.28-3.92	9	3.78 1.3-6.1	8	3.36 1.03-5.57

A chi-square test was performed to determine whether or not the incidence of allergies and asthma was related to the level of sleep disorder risk. The chi-square equaled 1.49, and the probability of obtaining a chi-square this large or larger by chance alone is .959. This indicates that there is an extremely high likelihood that a chi-square of this number was obtained by chance. Therefore, it does not appear that the incidence of allergies or asthma is related to the degree of risk for sleep disorders.

Summary

The present findings demonstrate significantly high prevalence rates of sleep disorders in an at-risk population of young children. In this sample, while the majority of children appeared to have normal sleep as rated by their parents or guardians (61%), 26% of children were found to be at high-risk for having at least one type of sleep disorder. Additionally, 12% were in the cautionary range, a lower yet still significant risk category for having a sleep disorder. A large percentage of children, 38%, were reportedly experiencing significant sleep problems.

Several different problem behaviors also were associated with symptoms of sleep disorders. Specifically, a positive relationship was found between sleep and both attention problems and aggressive behavior. Children who experienced more behavior problems in both of these areas also tended to have an increased risk of having a sleep disorder. However, a relationship was not found between symptoms of sleep disorders and social skills. This indicates that in this sample, the level of social skills does not seem to vary based on the level of sleep disorder risk.

This study also examined the relationship between sleep disorder risk and various health concerns such as pediatric overweight, asthma, and allergies. A significant relationship was not found between sleep and any of these other health problems. In this sample, neither BMI, asthma, or allergies varied based on the level of sleep disorder risk.

Chapter 5

Discussion

The increasing emphasis on school accountability for educational standards clearly demonstrates the significance of investigating relationships between students' health and educational outcomes. There are major benefits to investigating these relationships such as educating school personnel on the impact of various pediatric health disorders on academic, behavioral, and social-emotional outcomes of children; improving prevention, early identification, and intervention efforts for children with health concerns; and enhancing overall educational outcomes for these children. By increasing the knowledge that school personnel have about pediatric sleep disorders, and implementing more effective practices concerning prevention, early identification, and intervention, the potential negative consequences associated with sleep disorders may be significantly reduced.

The purpose of this study was to examine the prevalence of symptoms of pediatric sleep disorders in an at-risk population of pre-kindergarten children, and to analyze the relationship between sleep disorders risk and other common childhood behavioral and health problems. This is the fourth study incorporating the use of the SDIS-C to measure symptoms of pediatric sleep disorders, and examine the relationship between symptoms of pediatric sleep disorders and a variety of other factors (Ax, 2006; Popkave, 2007; Witte, 2006). Specifically, the relationships between symptoms of sleep disorder and specific types of externalizing behaviors (including aggressive behavior, attention

problems, and social skill deficits), and between symptoms of sleep disorders and health, were examined. The health factors examined were asthma, allergies, and pediatric overweight. This chapter will provide an overview of the results of this study with respect to each research question. The results will then be interpreted in light of the proposed hypotheses and current empirical literature. Implications of the research findings on the practice of school psychology and directions for future research will be discussed.

Interpretation of Results

Research Question 1

What is the prevalence of symptoms of sleep disorders, as measured by the SDIS-C, in children visiting a Child Development Clinic?

Results of this study indicated that 26% of children in this sample received a score of high risk in at least one category of sleep disorders. This finding supports previous research studies that have found high rates of pediatric sleep disorders, especially in populations of children who are considered to be at-risk (Archbold, Pituch, Panahi, & Chervin, 2002; Gozal, 1998; Witte, 2006). In this sample, particularly high rates of sleep disorders risk were found in the areas of Delayed Sleep Phase Syndrome/Behavioral Insomnia of Childhood (18% high risk), Obstructive Sleep Apnea Syndrome (14% high risk), and Periodic Limb Movement Disorder (15% high risk). Excessive Daytime Sleepiness was not quite as prevalent as the other types of sleep disorders, but still occurred in a relatively high percentage of the sample (9% high risk). Large prevalence rates of high risk and moderate risk in each individual category led to high scores in the sleep disturbance index (17% high risk). When individual subscales were examined, it was found that 61% of the participants scored normal across all areas, 12% scored in the

moderate risk range for at least one type of sleep disorder, and 26% scored in the high risk range in at least one area of sleep.

Previous research has been relatively vague in determining prevalence rates in young children, and overall rates vary widely based on the age of the children studied and the criteria used to diagnose pediatric sleep disorders. In addition, many prior studies grouped wide age ranges together instead of examining rates in specific age ranges of pre-kindergarten children. The prevalence rates of symptoms of sleep disorders in this sample were higher than the rates expected based on the majority of previous research. For example, 14% of this sample demonstrated some risk for OSAS, while previous research has estimated that the rate of OSAS in preschool populations is between 1% and 3% (Marcus, 1997). However, the prevalence rates in this study refer to general population rates and not specifically to high-risk populations. The results of this study are similar to previous research with the SDIS-C. Ax (2006), who evaluated prevalence rates of sleep disorder risk in 216 second- and third-grade general education students, determined that 20% of the sample was at risk for a sleep disorder. Witte (2006) found that 32% of a sample of 86 at-risk preschool children was at high-risk for at least one type of sleep disorder, and Popkave (2007) determined that 31% of preschool-age children had a high risk for at least one type of sleep disorder.

The reported higher rates of sleep disorder risk in research using the SDIS-C, as compared to previous studies using other screening measures, may be attributed to the fact that the SDIS-C has good predictive power and is able to detect a potential un-diagnosed sleep disorder. In other words, prevalence rates of sleep disorders in previous research may be misleadingly low due to undetected symptoms of sleep disorders. In

addition, higher rates of symptoms of sleep disorders in this study may be due to the fact that the sample is at-risk, and not reflective of the typical preschool population. It is important to emphasize that these data reflect rates of risk for sleep disorders, and not diagnoses. Nevertheless, the SDIS-C has been shown to be a highly effective predictive tool.

Research Question 2

What is the relationship between children who are found to have symptoms of sleep disorders as measured by the SDIS-C and children who demonstrate attention problems as measured by the Child Behavior Checklist?

School psychologists are called upon to consult with teachers and parents dealing with children who have disruptive or otherwise concerning behaviors. Appropriate behavior is often considered to be a prerequisite to learning in young children, and previous research has made the link between behavior and educational outcomes clear at all ages (Dally, 2006). Therefore, it is important to recognize the relationships involved between sleep and these challenging behaviors. While there is empirical research available indicating that children with sleep disorders are more likely to have a diagnosis of ADHD and experience externalizing problems, there is little information existing regarding the specific types of externalizing symptoms that are related to sleep disorders, particularly in this young population. The results of this study show a significant relationship between attention problems and sleep; those children who were at high-risk or cautionary risk for a sleep disorder had more parent-reported attention problems as compared to those children whose sleep was rated in the normal range.

Although it is evident that a difference exists between children who have normal sleep and those who were rated as high-risk or cautionary risk for having a sleep disorder, significant discrepancies in attention problems were not apparent between cautionary and high risk sleep. This indicates that similar degrees of attention problems were observed regardless of the severity of symptoms of sleep disorders. In addition, even children with mildly impaired sleep were rated as having difficulties with attention problems.

This study is unique because it compared types of behavior between children in 3 different categories of risk for a sleep disorder. The results of this study are aligned with previous research that determined a relationship between sleep disorders and externalizing behavior problems (Ax, 2006; Picchietti, England, Walters, Willis, & Verrico, 1998; Popkave, 2007; Witte, 2006). Ax (2006), Popkave (2007), and Witte (2006) all determined that children with high-risk ratings on the SDIS-C tended to have more externalizing behavioral problems. This study expands the research by examining attention problems specifically instead of simply looking at generalized externalizing problems.

Research Question 3

What is the relationship between children who are found to have symptoms of sleep disorders as measured by the SDIS-C and children who demonstrate aggressive behavior as measured by the Child Behavior Checklist?

Aggression is another characteristic of externalizing behavior that has minimal empirical support in terms of the relationship with symptoms of pediatric sleep disorders. This is especially true in young children, as much of the previous research has examined older children or children between wide ranges of ages (i.e. samples including children

ages 2 to 18). Therefore, the literature has been less clear on when these behavior problems begin to occur. In this study, there was a significant relationship between sleep and aggressive behavior; children who were rated by their parents as having symptoms of sleep disorders displayed high levels of aggressive behavior symptoms.

Analyses comparing all three levels of sleep disorders risk (normal, caution, and high risk) revealed significant differences between the normal sleep category and both the caution and high risk categories. In other words, in this sample, even for children whose sleep problems were rated as less severe, aggressive behavior problems were present when compared with children whose parents rated their child's sleep as normal. Similarly to the attention problems results, no differences were found between caution risk and high risk sleep, indicating that the degree of aggressive behavior was not related to these two levels of sleep disorder severity.

Importantly, this study shows that symptoms of sleep disorders are related to the development of aggressive behavior even before children reach school-age. Although previous research has examined the relationship between externalizing behaviors and sleep disorder risk on the SDIS-C (Ax, 2006; Popkave, 2007; Witte, 2006), this is the first study to specifically examine the relationship between aggressive behavior and sleep disorder risk on the SDIS-C. These results are consistent with previous research which has shown that sleep disorders are related to aggressive behaviors in older children and adults (Booth, Federoff, Curry, & Douglass, 2006; Mulvaney et al., 2006).

Research Question 4

What is the relationship between children who are found to have symptoms of sleep disorders as measured by the SDIS-C and children who have deficits in social skills, as measured by the Adaptive Behavior Assessment System (ABAS)?

Previous research has made it clear that there is a relationship between social skill development and externalizing behavior problems (Merrell &Wolfe, 1998). However, there is little research available examining whether or not there is a relationship between social skills and pediatric sleep disorders. The data gathered in this study did not produce a significant relationship between symptoms of sleep disorders and social skills.

There are several potential explanations as to why no relationship was found between symptoms of sleep disorders and social skills. It is likely that the age of the sample may have impacted the results. The young age of the sample may have created problems in the ability to validly examine social skills development. Since the children have not yet reached school-age, they may not have been exposed to as wide of a range of social experiences as older children. In addition, the measurement of social skills relied on parent-report. A more direct method of measuring these behaviors, such as direct observation, may have yielded different results.

This research represents one of the only studies that examining the relationship between symptoms of sleep disorders and social skill development in pre-kindergarten children. The only other known study determined that a relationship did exist between parent-reported social skill development and symptoms of sleep disorders (Witte, 2006), which is inconsistent with the results of the current study. It is possible that the different samples of participants may account for the discrepant results; the previous study

examined children between the ages of three and five years of age, while the current study included children between the ages of two and five years old. It is clear that additional research is needed in this area in order to clarify the relationship between sleep and social skills in young children, and whether or not age plays a significant role in this relationship.

Research Question 5

What is the relationship between children who are found to have symptoms of sleep disorders as measured by the SDIS-C and children who are overweight, as measured by their Body Mass Index (BMI)?

The rising prevalence rates of pediatric overweight and related health problems demonstrate the importance of research in this area investigating the potential relationship between these variables. Previous research examining the relationship between pediatric sleep disorders and Body Mass Index has been mixed. Although most studies have concluded that there is a relationship between the two (Redline, 1999; Tauman & Gozal, 2006), other studies have not found a link between sleep and BMI (Leach, Olson, & Hermann, 1992; Sardon et al., 2006). In addition, there is very little information on this topic related to young children below the age of 5 years. The results of this study indicated no difference in the BMI scores of the children who had normal, caution, or high-risk sleep disorder symptoms. Similarly, a follow-up analysis indicated that no relationship was found between BMI scores and level of risk for OSAS.

There are several potential hypotheses that may explain why no differences were found. At least one recent study has suggested that age may play a significant role in the interaction between sleep disorders and pediatric overweight, and this relationship may

not fully occur until late childhood or adolescence (Lumeng et al., 2007). Another study found that sleep problems in young children may be associated with weight gain in the future more so than children's weight status early in life (Lumeng et al., 2008). Future research needs to investigate the role that chronological age plays in the interaction between sleep disorders and pediatric overweight. Also, the lack of variability found in the BMIs of the sample may have also impacted the results. There were far more children who were normal weight than overweight. The relatively small sample size may also have contributed the lack of significance that was found in the analyses.

Although a relationship between BMI and sleep disorder symptoms was not found in this sample, previous research (Redline, 1999; Tauman & Gozal, 2006) has clearly demonstrated this relationship with adolescents and adults. Obesity is associated with a variety of very serious health concerns and even morbidity. However, because this same relationship with sleep concerns was not observed in the young children in this sample, it may offer hope that with early identification and early intervention, these children may not have to endure the same consequences as adults with similar symptoms.

Research Question 6

What is the relationship between children who are found to have symptoms of sleep disorders as measured by the SDIS-C and children who have asthma/allergies?

Just as the incidence rate of pediatric overweight has risen significantly over the past decade, the rates of both asthma and allergies in children have also risen, and impact school functioning in multiple ways (Baiardini, Braido, Cauglia, & Canonica, 2006; Kasasbeh, Kasasbeh, & Krishnaswamy, 2006). Existing research with adults and older children has indicated that those with sleep disorders have an increased likelihood of

having asthma and/or allergies (Ekici et al., 2005; Hellgren et al., 2006). However, there are no known studies examining this relationship specifically in young children under the age of 5 years.

The results of this study found that there was no relationship between symptoms of sleep disorders and asthma or allergies. Similarly to the examination of BMI, the young age of this sample may have played a role in the finding that no relationship exists between sleep and these health concerns. In other words, the relationship between sleep, allergies, and asthma may not surface until later in childhood or adolescence (Marshall et al., 2007). In addition, the lack of available information in the database concerning the severity of asthma or allergy symptoms may have led to an inability to determine any relationship. Again, because no relationship was found between asthma or allergies and sleep in this young sample, it provides hope that with early identification and intervention, children with symptoms of sleep disorders may be able to receive care in order to prevent these associated health outcomes from occurring later in life.

Implications for Practitioners: Early Identification

In this study, 39% of at-risk children were either moderate or high risk for having at least one type of sleep disorder. In order to establish appropriate interventions and improve the quality of life for children with sleep disorders, identification is the first step. Prevention and intervention of sleep disorders in educational settings has been limited by a lack of sleep disorder assessment tools. While it is true that sleep disorders can only be diagnosed by a medical doctor, school professionals can still play a role in identifying children who may be at risk for or demonstrate symptoms of a sleep disorder.

Although more than one third of children in this study had symptoms of a sleep disorder, previous research has shown that many children with sleep disorders are undiagnosed. Therefore, in a school setting, school psychologists should consider sleep problems/disorders as a possible hypothesis for children who are presenting with behavioral and/or academic skills problems. In order to explore this hypothesis, the school psychologist may request additional information from the parent regarding their child's sleep patterns and nocturnal behaviors. Consistent, thorough, and universal screening is the only way to ensure that all children who may be at risk for sleep disorders are appropriately identified (Ward, Rankin, & Lee, 2007).

School psychologists may also play a role in educating other practitioners regarding the high prevalence rates and negative implications associated with symptoms of pediatric sleep disorders. Previous research suggests that there is very little teaching and training in both the medical and educational community (BaHammam, 2000). By informing colleagues of the importance of accurate identification of pediatric sleep disorders, and providing critical professional development, school psychologists may work towards ameliorating the problem of under-diagnosis of pediatric sleep disorders.

School psychologists can also serve children suffering from sleep disorders by acting as liaisons between the school and the medical community to facilitate an appropriate diagnosis. Through developing partnerships with sleep specialists in the community, school psychologists can make referrals to well-respected pediatric sleep specialists who suit the needs of individual families. For instance, the child can be referred to a sleep specialist who is familiar with the type of sleep disorder which the screening instrument predicts in that particular child. In addition, as a knowledgeable

liaison, school psychologists can ensure that families see sleep specialists who use child criteria to diagnose sleep disorders in children as opposed to adult criteria which may be mistakenly used by some sleep specialists (Rosen, D'Andrea, & Haddad, 1993).

Implications for Practitioners: Intervention

Screening for sleep disorders in a school setting should lead to more accurate assessment and intervention processes. A focus on prevention and early identification is crucial in order to prevent the behavior and academic problems that are typically associated with sleep disorders from pervading and escalating throughout childhood. If assessments indicate that a child does have a sleep disorder, the medical intervention would be based on the specific type of sleep disorder that the sleep specialist determines. For a school psychologist, knowledge that a child has a sleep disorder logically leads to improvements in the problem-solving process, as sleep problems may be a hypothesis generated as part of the problem identification/analysis stage.

This study found that young children with symptoms of sleep disorders were more likely to display aggressive behavior and attention problems. Without accurate problem identification, these behavioral problems may be misidentified as externalizing behavioral disorders, leading to inappropriate interventions (Chervin, 1997). For example, children with attention problems related to sleep disorders may be mistakenly diagnosed with ADHD, and therefore receive interventions geared towards children with ADHD instead of receiving the help that they need in correcting the sleep disorder (Marcotte et al., 1998). Similarly, in this sample, a significant relationship was found between symptoms of sleep disorders and aggressive behavior and attention problems. Therefore, these results demonstrate the importance of considering the role that sleep

may play for children identified with these behavior concerns. Identification of a sleep disorder in children displaying these concerns may lead to interventions geared towards healthy sleep, therefore targeting the root of the problem and not solely the symptoms. In order to guard against inaccurate problem identification, a thorough knowledge of a child's typical sleep patterns, bedtime and waketime, quality of sleep, and movements or sounds made during sleep can improve the problem-solving process and lead to appropriate and comprehensive support plans.

Twenty-five percent of children in this sample were rated as having symptoms of DSPS, or BIOC, which are disorders that are influenced by behavior and sleep hygiene. In many children, there is a behavioral component to their sleep problems (Bharti, Malhi, & Kashyap, 2005). School psychologists have experience and background in behavioral techniques as well as consultation skills with parents. These two skill areas should be combined in order to work with parents to establish healthy bedtime routines and create positive behavior intervention plans geared towards improving the sleep hygiene of young children. Utilizing behavioral principles particularly in children with Behavioral Insomnia of Childhood can lead to positive outcomes without more invasive medical interventions, and sleep hygiene has been found to be positively related to sleep quality in children (LeBourgeois, Giannotti, Cortesi, Wolfson, & Harsh, 2005).

Provision of Systems-Level Services

It is also possible to provide prevention and intervention services to children on a universal scale. Although the treatment of sleep disorders often requires medical intervention, this does not absolve school personnel from responsibility. One of the most effective interventions that educators and other school personnel can provide to children

with sleep problems or disorders is broad-based education. Educational campaigns geared toward receptive audiences such as elementary school children and their families can be an efficient and cost-effective way to identify and intervene in the area of sleep disorders. Several studies have examined the effects of such educational programs and found positive results (Simore, Crassard, Rechatin, and Locard, 1987).

School psychologists can also serve children suffering from sleep disorders by acting as liasons between the school and the medical community. Through developing partnerships with sleep specialists in the community, school psychologists can make referrals to well-respected pediatric sleep specialists who suit the needs of individual families. For instance, the child can be referred to a sleep specialist who is familiar with the type of sleep disorder which the screening instrument predicts in that particular child. In addition, as a knowledgeable liaison, the school psychologists can ensure that families see sleep specialists who use child criteria to diagnose sleep disorders in children as opposed to adult criteria which may be mistakenly used by some sleep specialists (Rosen, D'Andrea, & Haddad, 1993).

Limitations and Implications for Future Research

This study examined the prevalence and correlates of sleep disorders on a small scale. A sample of fewer than 300 children was studied. Because this sample is relatively small, there is greater room for error in estimating the prevalence rates in the population. Future research should focus on using larger samples in order to gain a more accurate picture of prevalence rates in this population. In addition, larger samples would more precisely determine the differences that exist between the three categories of risk for a sleep disorder: normal risk, moderate risk, and high risk.

Additional research should be conducted in order to learn more about the prevalence rates in the general population. Because this study used an at-risk sample, it should not be considered reflective of the prevalence rates in the general population. This sample contained a fairly large proportion of children with asthma and/or allergies, even higher than previous research has determined in the general population. In addition, the average BMI of this sample was higher than previous research has shown in children of this same age range. The children also had higher levels of parent-reported aggressive behavior and attention problems, and lower levels of social skills, than the general population. However, this sample is similar to those children who are struggling in the school system and referred to school psychologists for a variety of concerns. Additional studies exploring similar questions of the relationship between sleep, behavior, and health, should be explored with narrow age brackets of children. By performing additional research in this area, the prevalence of sleep disorders across developmental age ranges of children may be examined and refined.

This study used a screening tool in order to gain a picture of the behaviors associated with sleep disorders. No children involved in this study received a diagnosis of a sleep disorder during the course of the study. The results of the individual sleep scales should also be interpreted with caution, because high scores on one subscale can result in misleadingly high scores on other subscales. In other words, if a child has many symptoms of OSAS, they also may score excessively high on the PLMD subscale as a result of the sleep apnea symptoms. The SDIS-C it is not intended for diagnostic purposes and there is no available information as to whether or not those children who scored in the high risk category of sleep disorders actually have a medically diagnosable

sleep disorder. However, it is important to note that the SDIS-C has been shown to have a high degree of accuracy. A validation study showed that the scale was very accurate in predicting the presence (.83) or absence (.91) of a potential sleep disorder (Luginbuehl et al., 2008). Studies that examine the differences between children who have had a sleep disorder diagnosed by a medical professional (i.e., the child has undergone a polysomnography test), and children who do not have a sleep disorder would yield more reliable estimates as compared to using a screening tool. However, although the SDIS-C is a screening tool, it has demonstrated very high predictive validity rates of 93% for students who have at least one type of sleep disorder measured by the SDIS-C (Luginbuehl et al., 2008).

Although this study explored the relationship between sleep and various other problems, causal factors were not explored. In other words, it is impossible to judge solely from this study whether sleep problems caused other behavioral concerns, or whether these concerns contributed at least partly to the child's disturbed sleep. Previous research has suggested that the former is more likely. After the sleep disorder is corrected, behavior tends to improve as compared to controls who did not receive any sleep disorder intervention (Hansen & Vandenberg, 2001). This could be confirmed in this sample through conducting a follow-up study with those children who were at high-risk for having a sleep disorder. A comparison of those families who sought treatment and those who did not receive treatment could be made in order to see if there are any differences between these two groups in terms of the variables under investigation in this study.

Additional research is also needed to more fully explore the impact of sleep disorders which are corrected through medical intervention. Previous research suggests that children whose sleep disorders are corrected through procedures such as surgery or medication experience other positive effects such as improvements in behavior and performance in school (i.e., grades, performance on intelligence tests), compared to controls. Further research with this sample could include following the progress of those children who have corrected sleep disorders compared to children for whom a sleep disorder is diagnosed but not corrected.

Conclusion

The results of this study show that a very high percentage of the participants, 39%, are at high risk for having at least one type of sleep disorder. High rates of symptoms of sleep disorders were observed across all disorder categories, particularly in Delayed Sleep Phase Syndrome/Behavioral Insomnia of Childhood and Obstructive Sleep Apnea Syndrome. This indicates that the symptoms of sleep disorders are already apparent even at this young age of two to five years old. In addition, a significant relationship was found between symptoms of sleep disorders and externalizing problem areas including aggressive behavior and attention problems. However, a significant relationship was not found between sleep and BMI, asthma, or allergies. Therefore, this offers hope that with early identification and intervention, these children may be able to escape the serious health implications that are apparent with older children and adults.

It is apparent that sleep disorders are commonly associated with other significant problems in young children. Although children with sleep disorders most commonly receive interventions through sleep specialists, school psychologists can intervene

through appropriate identification of the problem in the problem-solving process, educating students and educators about the prevalence and negative effects associated with sleep disorders, and working with parents to improve sleep hygiene. With these factors in place, school psychologists may play a pivotal role in improving the quality of life for children with sleep disorders.

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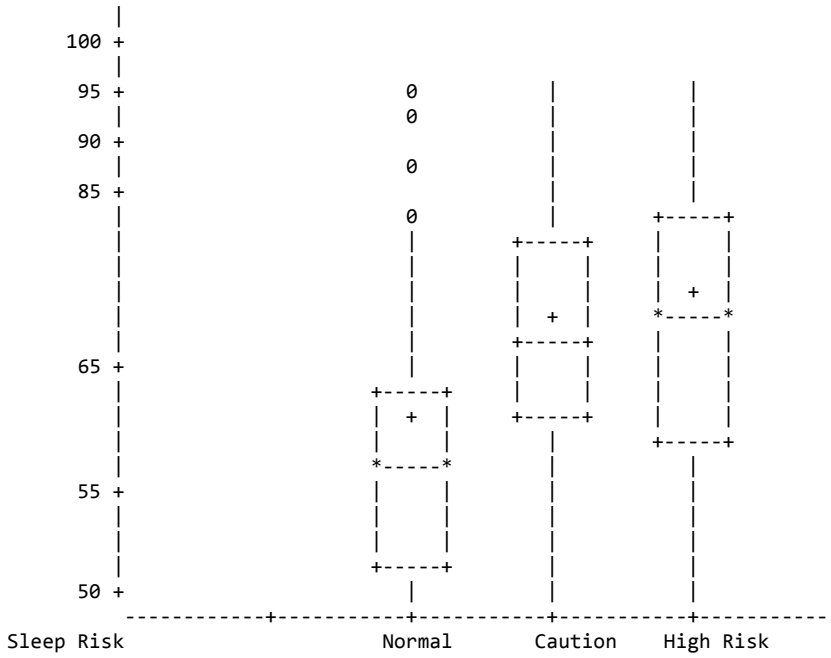
Appendices

Appendix A

Figure 1

Aggressive Behavior Schematic Plots



Appendix A (Continued)

Figure 2

Attention Problems Schematic Plots

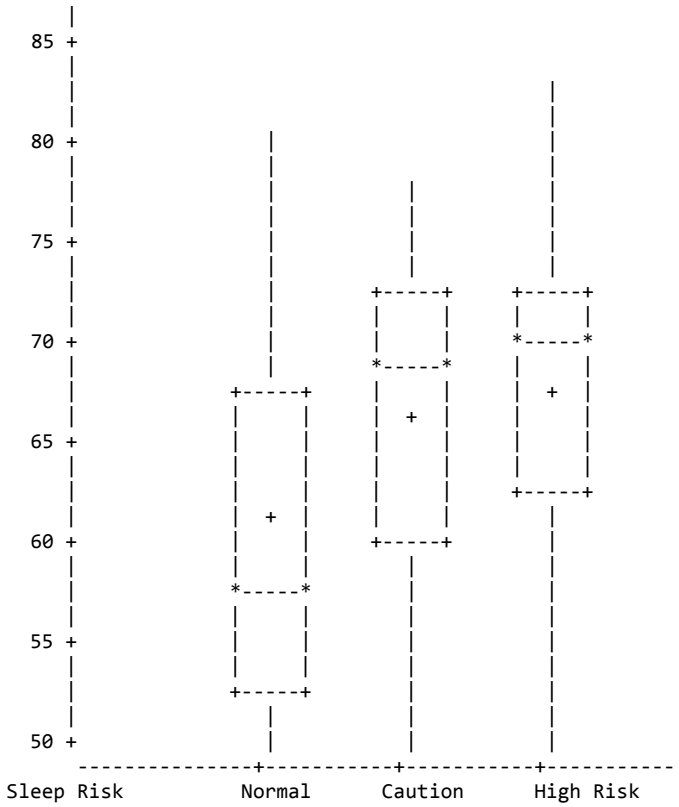


Figure 3

Social Skills Schematic Plots

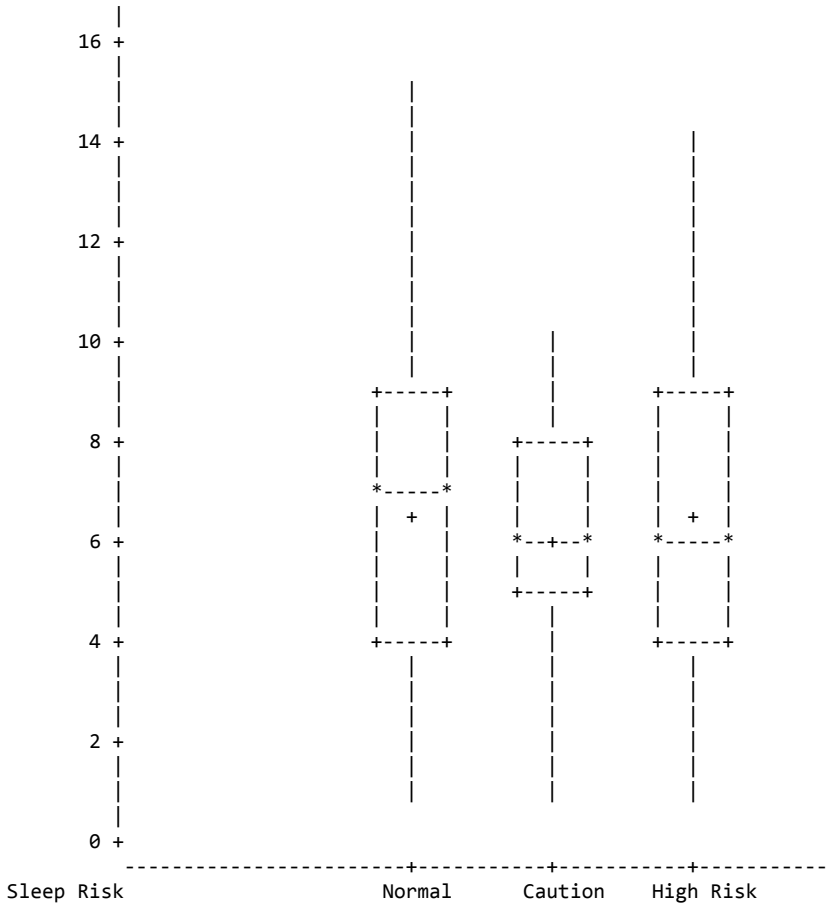
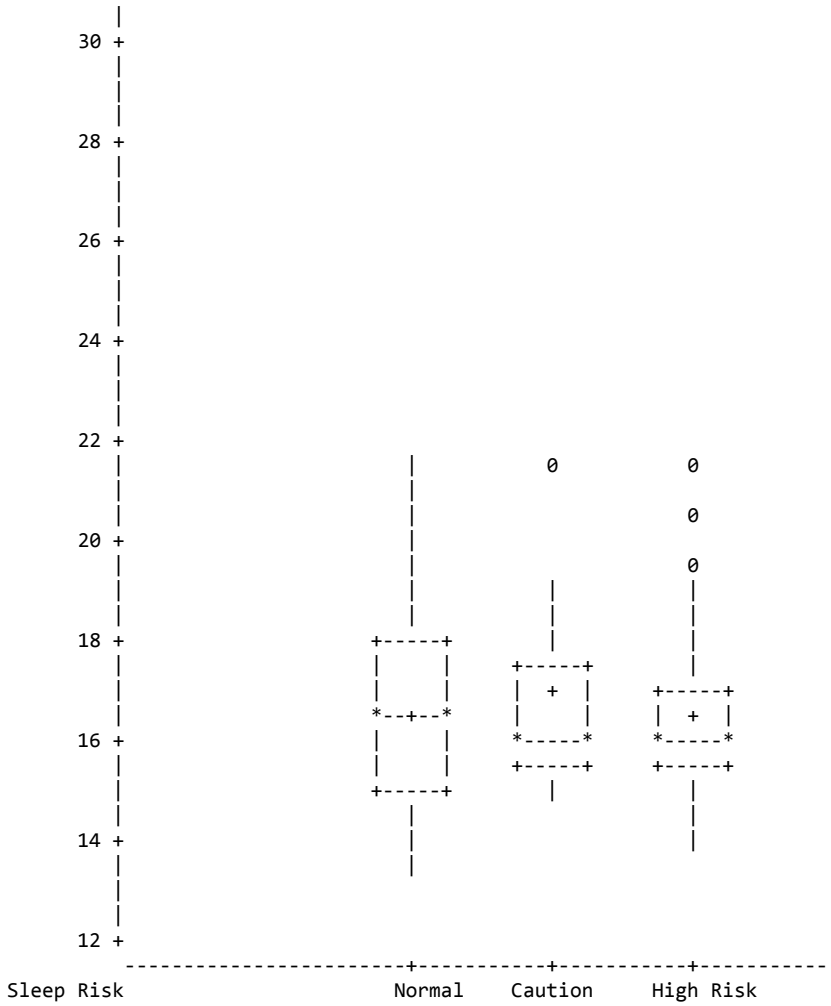


Figure 4

BMI Schematic Plots



About the Author

Rachel French is a first year school psychologist in the Indianapolis Public School District. She holds a Masters and Educational Specialist degree in School Psychology from the University of South Florida. Her area of concentration for her doctoral work is Pediatric School Psychology. She has presented previous research at state and national conferences in the field of pediatric sleep disorders research, and is passionate about educating others in this very important area. When not working, she enjoys spending time with her husband, friends and family, exercising, and being outdoors. She would like to thank her committee for their support and energy that was devoted to the creation of this dissertation.