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The relationship between sleep, behavior, and pre-academic skills in pre-kindergarteners

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The Relationship Between Sleep, Behavior, and Pre-Academic Skills

In Pre-Kindergarteners

by

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A thesis submitted in partial fulfillment
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The Relationship between Sleep Disorders, Behaviors,

and Pre-academic Skills in Pre-Kindergarteners

Rachel Witte

ABSTRACT

The purpose of this study was to examine prevalence rates of several sleep disorders symptoms in young children, and the relationship between symptoms of pediatric sleep disorders and other childhood problems. Eighty-six children aged 3 to 5 years were studied through parent report and academic assessment. Children rated as high risk for having a sleep disorder displayed more externalizing and internalizing problems, less developed social skills, and lower scores on a measure of pre-academic skills, as compared to children whose sleep was rated in the normal range. It was found that 33% of children were at high risk for having at least one type of sleep disorder. Early identification and intervention is crucial in order to assist children suffering from sleep disorders.

Chapter 1

Introduction

Statement of the Problem

Since 1968, the federal government has played an active role in establishing and

implementing early intervention and preschool services for young children (Bailey, 2000).

Research shows that it is important for schools and mental health professionals to be proactive in

focusing on preventative interventions (Bierman, 2003). An effective prevention and early

intervention program should not wait until children begin school, but should focus on preschool

programs such as Head Start (Forness, Serna, & Nielsen, 2000). With a focus on prevention and

intervention it is critical to identify early those children who may be at risk for educational

concerns, including children who have sleep disorders. Evidence suggests that up to 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 in the bottom 10% of their

class have a sleep disorder (Gozal, 1998), and 33% of children with Attention-

Deficit/Hyperactivity Disorder (ADHD) also suffer from habitual snoring, a known risk factor

for sleep problems (Chervin, Dillon, Bassetti, Ganoczy, & Pituch, 1997). Therefore, it is vital

that these 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 determine the nature of the relationship between sleep disorders and other cognitive and behavioral concerns in young children. Just as incidence rates in young children are unknown, much about the behavioral and cognitive impact of sleep disorders at this early age is also unknown. Although many studies have suggested a link between sleep disorders, cognition, 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 ages for which reversibility of cognitive and behavioral difficulties is a possibility (Halborow & Marcus, 2003).

Although research indicates that sleep disorders have effects on behavior and cognition, many pediatricians, professionals working in the schools, and parents are unaware of these negative effects. Current knowledge and expertise about sleep disorders is limited by a lack of appropriate teaching and training (Wiggs & Stores, 1996). A study of 156 pediatric residency programs found that pediatricians receive a mean of 4.8 hours of training in the area of pediatric sleep disorders (Mindell, Moline, Zendell, Brown & Fry, 1994). Another study surveyed 209

physicians and found that only 57% considered sleep disorders a distinct medical specialty, and only 40% reported that sleep disorders were common in their practice (BaHammam, 2000). However, it was found that the 15% of doctors who had attended lectures about sleep disorders referred significantly more patients to sleep clinics as compared to those who did not have any post-graduate training. Researchers have found that one fourth of children in sleep clinics were either referred by their parents, or referred by less common sources such as school psychologists (Mindell, Moline, Zendell, Brown & Fry, 1994). Because pediatricians, school personnel, and parents all refer children to sleep clinics, it is important that all of these groups receive training and are knowledgeable about sleep disorders. However, research indicates that this is not necessarily the case (Wiggs & Stores, 1996). Although there is limited information regarding training and knowledge of sleep disorders among educators in the schools, it is suspected that they receive little or no training on this topic during their pre-service education. With a heightened knowledge that sleep disorders are found commonly in children, and have negative effects across several domains, pediatricians, parents, and school personnel may be more cognizant of the signs and symptoms of sleep disorders.

Five 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. However, the sleep disorders of Periodic Limb Movement Disorder (PLMD), Restless Legs Syndrome (RLS), Delayed Sleep Phase Syndrome (DSPS), Narcolepsy, 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 both in school and outside of school (Wise, 1998; Hla, 1994; Coccagna, 1990). 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, 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.

Restless Legs Syndrome (RLS) shares some common characteristics with PLMD and may co-occur with PLMD. Those with RLS experience uncomfortable sensations in both legs that result in a strong urge to move the legs and to keep them moving. As a result, patients with RLS often get out of bed several times at night, and may hop or walk around the room (Coccagna, 1990). Diagnosis of RLS involves the experience of uncomfortable sensations in the legs along with temporary relief caused by movement (American Sleep Disorders Association, 1997). Because of the variable expressivity of RLS symptoms, it is not uncommon for doctors to misdiagnose this condition, particularly in childhood (Walters, Picchietti, Whrenberg & Wagner, 1994).

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).

Narcolepsy is a chronic neurological disorder characterized by excessive daytime sleepiness, cataplexy, and premature onset of rapid eye movement sleep that occurs at the beginning of the sleep cycle (Aldrich, 1992). Daytime symptoms of narcolepsy include excessive daytime sleepiness, cataplexy, sleep paralysis, and hypnagogic hallucinations, although because all symptoms are often not experienced in pediatric cases of narcolepsy, diagnosis can be difficult (Aldrich, 1992). The state of cataplexy is characterized by a sudden, reversible decrease in muscle tone and frequently is evoked by the experience of emotions such as anger, laughter, surprise, or strain (Guilleminault, Mignot, & Partinen, 1994). Sleep paralysis involves an inability to move the extremities, speak, or open the eyes although being fully aware of the surroundings. Sleep paralysis is often accompanied by hypnagogic hallucinations, which include both visual and auditory disturbances (Guilleminault, Mignot, & Partinen, 1994). Not surprisingly, these symptoms can result in tremendous social and educational consequences.

Obstructive Sleep Apnea Syndrome (OSAS) is defined by Ward, Sally, and Carole (1996) 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).

Links of Sleep Disorders to Cognition and Behavior

It is vital that sleep disorders are identified as early as possible, especially because of the suggested negative consequences of sleep disorders academically and behaviorally. More specifically, Hansen and Vandenberg (2001) showed that children aged 7-16 years suffering from narcolepsy and OSAS performed more poorly than expected in the domains of attention and memory. However, after the children with OSAS received treatment, they showed significant cognitive improvement. This study demonstrates that while the occurrence of a sleep disorder may have negative consequences cognitively, treatment shows encouraging positive results. Steenari et al. (2003) studied a group of children aged 6-13 years and found that poor sleep quality and quantity were associated with poor performance on a task measuring working memory. While this study did not specifically address children with a specific sleep disorder, it provides information suggesting that there is a link between poor sleep and impaired cognitive skills. A study of university students in England found that sleep deprivation can lead to diminished creative thinking abilities as well (Engelhardt & Walsh, 1994). Another study found

that first graders with OSAS tended to earn lower grades in school as compared to controls, a finding that is not surprising on the basis of what is known about the relationship of sleep disorders to school-related cognitive tasks (Gozal, 1998). In general, it is known that sleep deprivation alone limits overall cognitive efficiency (Mitru, Millrood, & Mateika, 2002).

A relationship exists not only between sleep disorders and cognition, but also between sleep disorders and behavior. 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, England, Walters, Willis and Verrico (1998) also showed 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, Stores and Wiggs (1998) 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. 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).

In summary, PLMD, RLS, DSPS, Narcolepsy, and OSAS are sleep disorders that have significant nighttime and daytime impacts. Research has shown that these sleep disorders may have long-term consequences negatively affecting academic performance in school and behavioral adjustment at school and in the home. More specifically, a relationship has been

found between sleep disorders and symptoms of ADHD as well as cognition. Policy makers recognize the importance of prevention and early intervention. A national focus of prevention and early intervention demonstrates the importance of accurate identification and treatment of sleep disorders in order to give children the best opportunity for school and social success.

Purpose of the Study

The primary purpose of this study was to assess the prevalence of pre-kindergarten children who display symptoms indicative of sleep disorders, using the Sleep Disorders Inventory for Students (SDIS). The SDIS is a screening instrument developed to identify students with Obstructive Sleep Apnea Syndrome (OSAS), Narcolepsy (as measured by an Excessive Daytime Sleepiness Scale), Periodic Limb Movement Disorder (PLMD), and Delayed Sleep Phase Syndrome (DSPS). A secondary purpose was to find out if there is a relationship between children who score high on the SDIS, demonstrating symptoms of sleep disorders, and those who score high on the Preschool and Kindergarten Behavior Scales (Merrell, 1994), indicating problems in social skills and problem behavior. Another goal of this study was to determine whether there is a relationship between children who are at risk for sleep disorders as measured by the SDIS and those who score low on the Developmental Indicators for the Assessment of Learning – R (Czudnowski & Goldenberg, 1990), indicating problems in pre-academic skills. A convenience sample of pre-kindergarten children from a local educational screening program will serve as participants in this study. Examining these issues helped to remedy the lack of information available concerning sleep disorders in pre-kindergarten children. More specifically, it added to the literature regarding the prevalence rate of OSAS, Narcolepsy, PLMD, and DSPS, as well as the extent to which children of this age are already beginning to experience problems that may be associated with a sleep disorder.

Research Questions

This research study investigated the prevalence rates of sleep disorders in an at-risk pre-kindergarten population, and examine the relationship between sleep disorders, academic skills, and problem behaviors. Therefore, the following questions were addressed:

Question #1: What is the prevalence of sleep disorders symptoms, as measured by the Sleep Disorders Inventory for Students Children's version (SDIS-C), in pre-kindergarten children participating in an at-risk screening program?

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: How does the level of social skills deficits, as measured by the PKBS-2, compare between students who have sleep disorders symptoms in the normal, cautionary, and high risk range, as measured by the SDIS-C?

Hypothesis #2: Children who display greater levels of sleep problems as measured by the SDIS-C will also display more social skills deficits as measured by the PKBS-2.

Question #3: How does the level of externalizing problems, as measured by the PKBS-2, compare between students who have sleep disorders symptoms in a normal, cautionary, and high risk range, as measured by the SDIS-C?

Hypothesis #3: Children who display greater levels of sleep problems as measured by the SDIS-C will also display more externalizing problems as measured by the PKBS-2.

Question #4: How does the level of pre-academic skill problems, as measured by the DIAL-R, compare between students who have sleep disorders symptoms in the normal, cautionary, and high risk range, as measured by the SDIS-C?

Hypothesis #4: Children who display greater levels of sleep problems as measured by the

SDIS-C will also display more pre-academic skill deficits as measured by the DIAL-R.

Chapter 2

Review of the Literature

Introduction

This literature review presents the research on pediatric sleep, five different common types of pediatric sleep disorders, and the negative impact of sleep disorders on academic performance and behavior. This chapter is organized into 4 areas. First, general information about normal sleep is discussed, after which an overview of sleep disorders in school-age populations is given. Second, this literature review provides definitions and general information regarding the sleep disorders of Periodic Limb Movement Disorder, Restless Legs Syndrome, Delayed Sleep Phase Syndrome, Narcolepsy, and Obstructive Sleep Apnea Syndrome. Research is presented dealing with the negative impact of sleep disorders on cognition and academics. Finally, the negative impact of sleep disorders on behavior is discussed. It is important to note that there is a lack of information regarding sleep disorders in pre-kindergarten population age groups. Much of the research reviewed refers to children of older ages or to adults. The lack of available research supports the need to further explore these concerns in young children and to expand the body of available research concerning sleep disorders of pre-kindergarten 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 acknowledged.

There are several different theories regarding the purpose of sleep, although most fall into two broad categories. One is that sleep is a "forced time out" and is a part of the biological rhythms that control many biological processes (Dotto, 1990). Also within this category is the theory that sleep is necessary to conserve energy. 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. 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 stages 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; bilaterally synchronous rapid eye movements under closed lids; rapid and irregular heart rate and respiratory patterns; and muscle atonia (Anders, Sadeh & Appareddy, 1995).

Sleep Across the Lifespan

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, nonrapid eye movement, and rapid eye movement, 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 children and 5-year-old children. One difference is that the REM-NREM cycle lengths of 2-year olds were shorter than cycles in 5-year-olds. In addition, during the night, 5-year-olds had longer sustained stage 3-4 NREM periods, while 2-year-olds had 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 disturbance can have serious effects on those of all ages. The impact on both physical health and mental health are widespread, and have become a nationwide problem. Approximately one third of the United States populations 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 was generally higher than the rate of sleep disorders in adult populations (Bixler, Kales, Scharf, Kales & Leo, 2000). The combination of high prevalence rates and proven negative effects of sleep disorders highlight the need for further research and education in this area. There is evidence suggesting that up to 43% of children ages 2 through 14 may suffer from significant sleep disturbance (Archbold, Pituch, Panahi, & Chervin, 2002).

Pediatric Sleep Disorders

Pediatric sleep disorders can be divided into four broad categories: Primary Sleep Disorders, including dyssomnias and parasomnias; sleep disorder related to another mental disorder; sleep disorder 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, Restless Legs Sydrome, Delayed Sleep Phase Syndrome, Narcolepsy, and Obstructive Sleep Apnea Syndrome, are five pediatric sleep disorders that affect not only nighttime activity, but daytime performance as well. The following subsections will provide information on these five sleep disorders.

Periodic Limb Movement Disorder

Periodic Limb Movement Disorder 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, it is now known that Periodic Limb Movement Disorder (PLMD), initially known as nocturnal

myoclonos, 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 which usually reoccurs approximately every 30 minutes (Coleman, 1979), during periods of light or non-REM sleep (Coccagna, 1990). The movements usually consist of dorsiflexion of the foot, extension of the big toe, and often flexion of the lower leg at the knee and hip, lasting between 1.5 and 2.5 seconds (Coleman, 1979).

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). 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 have improved behaviors if caffeine and chocolate are restricted (Walters, Picchietti, Ehrenberg, & Wagner, 1994).

Polysomnography for diagnosis of PLMD includes electroencephalography (EEG; electrical recording of the brain), electro-oculography (interpretation of EEGs made by movements of the eyes), submental EMG (recording of the electrical activity of muscles under the chin), and bilateral EMG of the anterior tibialis muscles (recording of the electrical activity of muscles in the lower leg; Montplaisir 1994). Bilateral electromyography (EMG) is a direct recording of the patient's movements which measures both anterior tibial muscles during

polysomnography (Hening, 1999). Recently, actigraphy, or activity recording, has been used as well (Hening, 1999). In order to obtain a diagnosis of PLMD, patients must reach the criteria of EMG burst length (leg contractions must last between 0.5 to 5.0 seconds), period (contractions must recur every 4 to 90 seconds), minimal train length (leg movements must occur at least 4 times), and behavioral state (the patient must be sleeping) (Hening, 1999). Diagnostic criteria are usually met when there are at least 5 movements every hour of sleep that interfere with sleep (Picchietti & Walters, 1999). 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 (Trendwalder et al., 1996).

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). Overall, however, researchers are unsure regarding the exact cause of PLMD and more research is needed in this area.

In the last 20 years, substantial gains have been made in determining treatment options for those 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

for most doctors, especially for patients with mild cases or for young patients (Montplaisir, 1994). However, there are unfortunately few studies on treatment for those under the age of 18 years, especially in terms of the long-term consequences of medication.

Restless Legs Syndrome

Restless Legs Syndrome (RLS) involves leg restlessness accompanied by uncomfortable sensations in both legs and motor restlessness. These symptoms occur after long periods of fatigue or being seated, especially in the evening or nighttime, and are temporarily relieved by activity (Coccagna, 1990). The sensations which occur are primarily localized in the legs and result in a strong urge to move the legs and keep them in motion. The person with restless legs will often get out of bed several times during the night to walk or hop around the room (Coccagna). RLS is commonly associated with PLMD, and may occur either alone or comorbidly with PLMD (Coleman, 1982). Children with RLS experience symptoms that are sometimes described as growing pains. They also may explain that their feet just want to move (Walters, Picchetti, Ehrenberg & Wagner, 1994).

A study of 18,980 European subjects found that the prevalence rate for RLS was 5.5% among those between the ages of 15 and100 years (Ohayan & Roth, 2002). RLS is more common in the elderly population at a rate of 2% to 9% (Trentwalder, Wetter, Stiasny, & Clarenbach, 2001). Diagnosis of RLS in children is rare, and incidence rates in the literature are vague. Case reports have shown that children with RLS may display characteristics such as complaining of leg pain, wanting to play "chase" at night, and wiggling or rubbing feet together (Walters, Picchietti, Ehrenberg & Wagner, 1994). Bedtime struggles and signs of motor restlessness may also occur. Inattentive and hyperactive behaviors associated with RLS may lead to a misdiagnoses of ADHD (Walters, Picchietti, Ehrenberg, & Eagner, 1994).

In 1996 the International Restless Legs Syndrome Study Group developed 4 minimum criteria for the diagnosis of RLS. In order to be diagnosed with this disorder, the patient must experience uncomfortable sensations in the legs at night or trouble falling asleep. These sensations are felt in the calves, occurring most often late in the day and are especially strong at bedtime, and are relieved by the movement of the legs (American Sleep Disorder Association, 1997). Other symptoms of RLS are muscular weakness, headaches, and daytime somnolence (Coccagna, 1990). Walters, Picchietti, Hening and Lezzarini (1990) analyzed case studies and found that there can be variable expressivity of the clinical features in RLS, and that because it is possible to have non-restless patients who still exhibit RLS, it is not uncommon for doctors to misdiagnose RLS.

Although there are several hypotheses regarding the cause of RLS, the exact etiology remains unknown. Analysis of the patient's family history reveals that an autosomal dominant family history is present in about one-third of patients, supporting the hypothesis that RLS may be partially genetically based (Walters, Picchietti, Ehrenberg & Wagner, 1994). Because of the way RLS symptoms follow a circadian cycle, it has also been suggested that there may be a link between RLS and circadian rhythm; another hypothesis proposes that low levels of iron in the body may be related to RLS (Hening, Allen, Earley, Kushida, Picchietti & Sibler, 1999).

In order to deal with the link between RLS and possible lack of iron storages, medical professionals recommend that a proper diet be a part of a treatment for RLS. In addition to diet, it is advised that patients establish better sleep hygiene habits. Pharmacological interventions including the use of dopaminergic agents, benzodiazepines, opiods, and anticonvulsants may also be necessary (Paulson, 2000). Electrical stimulation of the feet before bedtime has also been implicated in relieving the nighttime symptoms of RLS (Trenkwalker, 1996).

Pelletier, Lorrain, and Montplaisir (1992) studied two hypotheses regarding whether sensory features are the primary cause of limb movements, or the result of motor movements. They looked at ten patients (4 male and 6 female) with a mean age of 53.4 years (age range was unspecified) and a history of RLS. The patients underwent a Forced Immobilization Test (F.I.T.), in which they remained in bed for 60 minutes with their legs immobilized. EMG was recorded, and participants were instructed to press a hand switch when they began to feel uncomfortable sensations in their legs. Researchers found that only 49% of movements were associated with the report of uncomfortable sensations, while 95.7% of sensory events occurred 5 seconds before or after leg movements. These results do not confirm the hypothesis that sensations, or dysesthesias, are the result of the muscle contraction. The hypothesis that sensory disturbances are the primary feature of RLS is also not supported. The authors propose an explanation that sensory and motor components of RLS are independent expressions of the neurological dysfunction. However, one limitation of this study was that the participants were adults and therefore it is unclear regarding whether or not this finding applies to children.

Survey data of 138 adults with RLS showed that 18% of individuals reported onset during the first ten years of their lives (Picchietti, 1998). In another retrospective survey of 107 adults, 19.6% had an age of onset between 0 and 10 years (Walters, Picchietti, Ehrenberg & Wagner, 1994). Those with an age of onset before 20 years of age did not receive medical attention until they reached an average age of 32 years, and were often misdiagnosed in childhood. These data reinforce the need for early identification and treatment.

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 p.139), and is usually caused by long periods of sleep deprivation or consistent irregularities in sleep hygiene (Anders & Eiben, 1997). Sleep onset usually does not occur until the early morning, and the person often does not wake until early afternoon. While most of the literature on DSPS focuses on adolescents, research is needed to confirm the existence of DSPS in younger school-age children

Thorpy, Korman, Spielman, and Glovinsky (1988) studied twenty-two adolescents aged 10-19 years (20 males, 2 females) with the primary complaint of difficulty fallings asleep at night or waking in the morning. During polysomnography testing, researchers found that subjects spent a greater percentage but not amount of sleep in stage 4 sleep. The subjects also completed a psychological evaluation which showed that 64% had features of depression and 23% expressed suicidal ideation. However, only 14 out of 22 subjects completed this evaluation. The other subjects were either unwilling to take the test or were not within the recommended age range. Other research has shown that students who report going to bed later are more likely to recieve C and D grades, as compared to students who report earlier bedtimes and receive grades of B or better (Wolfson & Carskadon, 1998). These studies demonstrate the potential negative effects of DSPS on mental health and academics.

DSPS is thought to be caused as a result of a faulty circadian rhythm cycle. Circadian rhythms are thought to time sleeping and sleepiness, subjective alertness, and the REM phases of sleep during the sleep cycle (Caskadon, Wolfson, Acebo, Tzischinsky & Seifer, 1998). One treatment of DSPS is chronotherapy, a sleep rescheduling treatment that does not require medication and seeks to reset the patient's circadian rhythm. Since the normal human sleep-wake cycle is actually 25 hours in free-running conditions, chronotherapy usually involves advancing

the patient's biological clock by an average of 1 –3 hours each day (Czeisler et al., 1981). In other words, if a subject's normal bedtime is 4am, chronotherapy would involve imposing a bedtime later and later until the bedtime reached a normal hour. Exposure to bright light has also been shown to be effective in certain populations, and although the clinical utility has not been clearly established yet, exposure to bright light in the morning and avoidance of bright light in the evening may theoretically be helpful (Roehrs & Roth, 1994).

Narcolepsy

Narcolepsy, which comes from the Greek word meaning "seized by somnolence" (Bassetti & Aldrich, 1996), is a chronic neurological disorder associated with excessive daytime sleepiness, cataplexy (sudden decrease in muscle tone), and premature onset of rapid eye movement sleep (Aldrich, 1992). Whereas people do not normally experience REM sleep until the end of their sleep cycle, those with narcolepsy experience attacks of REM sleep at unusual times (Kales et al., 1982). Dreaming and muscle cataplexy, the normal accompaniments of REM sleep, occur separately and during wakefulness in narcoleptic patients (Parkes, London & Lock, 1986).

Although narcolepsy has been found to occur in between 1 in 1,000 and 1 in 2,000 adults in the general population (Siegel, 2000), the exact incidence of pediatric narcolepsy is unknown based on the lack of research and the retrospective nature of the majority of studies examining prevalence rates (Wise, 1998). While narcolepsy usually occurs after puberty, making the diagnosis of narcolepsy in children rare, retrospective studies suggest that the first symptoms of narcolepsy may occur in early childhood, prior to 5 years of age (Challame, Mazzola, Nevsimalova, Cannard, Louis, & Revol, 1994). The peak age of onset for symptoms of narcolepsy is reported to be between 15 and 25 years (Guilleminault, 1994).

The approach to diagnosing narcolepsy in children is the same as the approach used for adults and includes clinical history, Multiple Sleep Latency Testing (MSLT), and overnight polysomnography, although there is a lack of research that specifically addresses the validity of this diagnostic strategy (Wise, 1998). Because symptoms of narcolepsy are often not entirely present in childhood, it is important to gather as much diagnostic data as possible. In addition to other measures, human leukocyte antigen (HLA) testing should also be performed on children who have symptoms of narcolepsy (Anders, Sadeh & Appareddy, 1995). Positive HLA testing provides support for other tests indicating narcolepsy. There are multiple problems involving the diagnosis of pediatric narcolepsy. In children, many of the classic symptoms of narcolepsy are often absent. In fact, all four symptoms of excessive daytime sleepiness, cataplexy, hypnagogic hallucinations, and sleep paralysis are often not present at onset in childhood cases of narcolepsy. Children with narcolepsy are often unable or unwilling to talk about their symptoms, making diagnosis more challenging (Wise, 1998). Children with narcolepsy are commonly misdiagnosed as having a psychiatric disorder such as a psychosis (Dahl, Holttum & Trubnick, 1994).

Daytime symptoms for narcolepsy include excessive daytime sleepiness, cataplexy, sleep paralysis, and hypnagogic hallucinations, although not all people with narcolepsy experience all of these symptoms. In addition, many features of narcolepsy overlap with those of other disorders such as idiopathic hypersomnia, a condition in which the patient sleeps more than normal for no known reason (Aldrich, 1992). Excessive daytime sleepiness is usually enhanced in the afternoon hours, in situations of boredom or limited physical activity, after large meals, and in warm environments (Bassetti & Aldrich, 1996). Patients with narcolepsy also experience irresistible or involuntary naps, which can occur during everyday activities such as walking,

driving, eating, talking, or standing. Age of onset for excessive daytime sleepiness has been reported to vary from 5 to 63 years (Billiard, Besset, & Cadilhac, 1983).

The word cataplexy comes from the Latin word meaning "to strike down with fear" (Bassetti & Aldrich, 1992). In fact, early psychiatric literature categorized cataplexy as a hysterical disorder because it often occurs during times when the patient is experiencing high emotional tension (Zarconi & Fuchs, 1976). Cataplexy involves a sudden, reversible decrease in muscle tone which is most often caused by emotions such as anger, laughter, surprise, or strain (Guilleminaut, 1994). The severity and extent of these attacks vary. Age of onset for cataplexy has been reported to vary from 9 to 68 years (Billiard, Besset, & Cadilhac, 1983).

A person experiencing an episode of sleep paralysis is unable to move the extremities, to speak, or to open the eyes although he or she is fully aware of the circumstances (Guilleminault, 1994). Sleep paralysis usually occurs in the period between wakefulness and sleep, usually when the patient is falling asleep (Kales et al., 1982). Hypnagogic hallucinations may accompany an episode of sleep paralysis. These hallucinations often include both visual disturbances, such as simple forms, animals or people, and auditory disturbances, such as collections of sounds, melodies, or even threatening sentences (Guilleminault, 1994). Age of onset for sleep paralysis has been reported to vary from 10 to 58 years (Billiard, Besset & Cadilhac, 1983), and hypnogogic hallucinations have been reported to vary from 9 to 65 years (Billiard, Besset & Cadilhac, 1983).

Evidence supports the hypothesis that narcolepsy could be partially caused by genetic factors. Honda, Asaka, Tanimura, and Furusho (1983) reported that of the narcoleptic Japanese patients that they studied, 100% presented with the same antigen (DR2). However, one limitation of this study is that the authors did not report a specific age range for which this finding may be

applied. Other hypotheses have been made that narcolepsy is an immune related disease. This is supported by the sudden onset of narcolepsy, sometimes after a febrile or viral illness, the association with multiple sclerosis, and the tendency for the narcoleptic to have minor abnormalities in cerebrospinal fluid (Parkes, Langdon & Lock, 1986). Recent studies have suggested that environmental factors acting on a specific gene background may be the actual cause of narcolepsy (Mignot, 1998).

Researchers have recently discovered a gene in dogs that corresponds to narcolepsy in humans (McClintock, 2000). Scientists hope that this discovery may lead to improvements in treatment for narcolepsy. So far, treatments only deal with the narcoleptic symptoms. Amphetamines and other stimulants, as well as antidepressants, have been used to treat the symptoms of narcolepsy. In 2002, the FDA approved the drug Xyrem for use in treating narcolepsy, and cataplexy specifically (FDA Consumer, 2002). However, because of the serious side effects of this drug, its distribution and use are monitored carefully by doctors.

Children suffering from narcolepsy report experiences of stigmatization that are similar to adults (Hood & Harbord, 2002). Narcolepsy can contribute to multiple problems in school, including academic deterioration during the later phases of the disorder, inattentiveness, and emotional lability. In addition, children with narcolepsy are often perceived as lazy or unmotivated by their teachers (Wise, 1998), are socially isolated from their peers, and may become the recipient of bullying (Broughton, Ghanem, Hishikawa, Sugita, Nevsimalova & Roth, 1981).

Obstructive Sleep Apnea Syndrome

Sleep Apnea Syndrome 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. Obstructive apnea syndrome (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). Central apnea, on the other hand, is also characterized by the cessation of airflow but in this case it is not accompanied by respiratory effort, and is caused by a failure of the central neurological mechanisms to initiate respiratory efforts (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 obstructive sleep apnea 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 should also be assessed when diagnosing OSAS (Bower & Buckmiller, 2001).

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).

By 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).

Obstructive sleep apnea can cause hypoxemia. Hypoxemia, or a lack of oxygen resulting from apneic episodes, actually disrupts the biochemical and hemodynamic state of 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 abnormal levels of arterial

oxyhemoglobin desaturation (Shepard, 1994). Also importantly, repeated periods of hypoxemia are hypothesized to stimulate arterial chemoreceptors, which signal central sympathetic outflow and 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 alters beat-to-beat variation at all heart rates, especially for children with slower heart rates. These findings shows that OSAS has a cardiovascular impact on children as well as adults.

Another physical impact of OSAS is in the area of growth. OSAS may cause disordered sleep architecture and affect the slow wave sleep which is associated to the release of growth hormones (Goldstein et al., 1987). In fact, Goldstein et al. demonstrated that prior to therapeutic tracheostomy, a surgical procedure to insert a tube into the trachea in order to make breathing easier, a 9 year old boy with obstructive sleep apnea and growth failure experienced absent slow wave sleep and abnormally low growth hormone secretion during sleep; however, after treatment the boy had normal levels of slow wave sleep and growth hormone secretion, leading to a normal growth rate. However, these findings should be interpreted cautiously because other variables in addition to the tracheostomy may have been implicated in the results.

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). Potsic, Pasquariello, Baranak, Marsh and Miller (1986) studied 100 children of mean age 5.8 years with adenotonsillar obstruction, but without severe sleep apnea, and found that compared to controls, the experimental group who underwent adenotonsillectomies had significant improvements in sleep sonography, which is an analysis of sleep sounds, and in a parent questionnaire measuring specific indices of airway obstruction and other areas of concern such as appetite and behavior. Another treatment that is used less commonly is CPAP, or continuous positive airway pressure, and is often used to supplement other treatment methods, especially for children with craniofacial abnormalities or neuromuscular disease (Marcus, 1997).

Sleep Disorders and Cognition

The presence of sleep disorders and the relationship with cognitive performance has been of recent interest to researchers. This section will address studies looking at the relationship between sleep problems and cognition, and will be organized by type of sleep problem, with the first study addressing sleep apnea and narcolepsy, the second study looking at sleep quantity and quality, and the third study addressing sleep associated gas exchange abnormalities.

There is evidence that children with OSAS often experience cognitive problems including impaired attention and memory (Blunden, Lushington & Kenndy, 2000). Hansen and Vandenberg (2001) studied the effects of sleep apnea and narcolepsy on cognitive performance, particularly in the areas of attention and memory. Fourteen children were included in this study (10 male and 4 female). Seven of the 14 children were diagnosed with sleep apnea, and seven were diagnosed with narcolepsy. The mean age of subjects was 10.7 years, with a range of 7 to 16 years. Ten children were Caucasian and four children were African-American.

Subjects completed polysomnographic tests, as well as neuropsychological assessments. The polysomnograph (PSG) measured respiratory effort, air flow, oxygen saturation, and sleep stage. An obstructive respiratory event was characterized as a 10 second of more cessation of breathing, resulting in a drop of blood oxygen saturation below 90%, or airflow that was decreased by at least half of normal range (Hansen & Vandenbuerg, 2001). Criteria for apnea was more than 5 respiratory episodes per hour. Patients displaying narcolepsy symptoms were subsequently evaluated with a Multiple-Sleep Latency Test (MSLT) the next day, in which four daytime naps were monitored. Children were considered to have narcolepsy on the basis of sleep latency with REM sleep, and other symptoms of narcolepsy including daytime somnolescence, cataplexy, sleep paralysis, and hypnogogic hallicuncations (Hansen & Vandenberg, 2000).

Neuropsychological measures included the WISC-R Digit Span measuring auditory attention and the WRAML Finger Window measuring visual attention. The WISC-R Digit Span test requires the subject to attend to and repeat a series of unrelated number sequences, both forward and backward, immediately after the series is spoken by the examiner. Subjects taking the WRAML Finger Windows test must visually attend to a plastic board with holes spaced randomly as the examiner points to certain holes. The subject must then repeat this pattern in the

same order. Completion of these measures occurred approximately two hours before beginning the PSG, and cessation of all medications occurred at least two weeks prior to testing.

Because of the small sample size, frequency plots, descriptive statistics, measures of skewness, and the Shapiro-Wilks test of normality were used to show that the data were normally distributed. Z-test analyses revealed that children with sleep disorders performed significantly below the norms on all of the measures. More specifically, poor performance of those with sleep disorders were found on the tasks of Digit Span, Finger Windows, and general memory. When subjects were split up into those with sleep apnea versus those with narcolepsy, Digit Span was significant for the sleep apnea group and the narcolepsy group, while Finger Window was significant for only the narcolepsy group. Results indicated that the sleep-disordered subjects' general memory performance improved after undergoing treatment. Performance on the visual attention measure approached statistical significance, while the measure of verbal attention did not show noticeable improvement.

This study found that performance on these measures was significantly below the norms for the age groups of the participants, indicating that childhood sleep disorders are associated with impaired cognitive functioning. After treatment of OSAS, memory performance improved significantly, providing evidence that OSAS may inhibit memory functioning in children. One limitation of this study was the small sample size, which limits the statistical power. In addition, the majority of children in this study suffered from mild cases of apnea, which may limit the cognitive results. Other studies have noted more pronounced cognitive delays with more severe levels of sleep apnea (Rhodes et. al, 1995).

Steenari et al. (2003) examined how performance on a task measuring working memory is associated with sleep quality and quantity. Working memory stores and manipulates relevant

information, and the uses it jointly with information in long-term memory storage. Working memory is considered to be necessary in order to perform behaviors such as learning, reasoning, comprehending language, and learning how to read (Baddeley, 1992), all tasks necessary for school success. In this study, 68 children ages 6-13 years (including 34 girls and 34 boys) in general education regular classes in three different schools responded to a school advertisement for inclusion in this study. Subjects were then screened for psychiatric symptoms using the Child Behavior Checklist (CBCL) (Achenbach, 1991), Teacher's Report Form (TRF) (Achenbach, 1991), and Children's Depression Inventory (CDI) (Kovacs, 1985). Eight children were then excluded, one for symptoms of dysphasia, one because of a lack of cooperation, and 6 because of technical problems with the activity measurement. Therefore, the final sample included 60 children (31 boys and 29 girls). Most of the parents of the participants were in an SES class that included those with academic degrees, business managers, and professionals.

Researchers measured the children's sleep quantity and quality through wrist-worn ambulatory activity monitors (Basic Mini Motionlogger, Ambulatory Monitoring, Inc., New York), which were worn for 72 uninterrupted hours. All data were taken from days which the children were in school. Parents recorded the time of their children's bedtimes and waking times. Computer-based n-back working memory tasks, commonly used in human neuroimaging and psychophysical studies, were administered by either a hospital psychologist or a school psychologist, and coincided with the activity monitor measurement. The assessment consisted of audio and visuospatial tasks, which were varied by increasing the number of items that had to be remembered while keeping other features of the task constant. The percentage of incorrect, skipped, and multiple responses, and the reaction times, were recorded for each memory task.

Analyses of the data showed that sleep efficiency and sleep latency had a significant effect on mean performance in auditory working memory tasks. Performance on both auditory tasks and visual working memory tasks were shown to be dependent on sleep, and performance was also found to be associated significantly with sleep latency. These results indicate that poor sleep quality is linked to a reduced ability to remember both auditory and visual information. However, because the setting of this experiment was confined to a laboratory setting, it would be beneficial to test whether or not these results can apply to school settings as well.

Because of research showing a greater incidence of cognitive impairments among those with sleep problems, it follows that school performance of these children may be hindered as well. Gozal (1998) has linked sleep-associated gas exchange abnormalities (SAGEA) to the grades received by 1st graders. Out of a sample of 297 first-grade children in the lowest 10th percentile of their class, SAGEA was identified in 54 children based on an OSAS screening questionnaire and overnight sleep recording. Twenty-four (18.1%) of these children underwent surgical tonsillectomy and adenoidectomy. Of the remaining 30 children, parents decided not to pursue treatment. One year and 3 months after parents were notified of the likely presence of a sleep-disorder in their children, parents completed a follow-up survey. Grades were obtained from the school for the school year preceding and the school year following the overnight sleep recording. Researchers found that overall mean grades increased from a mean of 2.43 +/- 0.17 during first grade to a mean of 2.87 +/- 0.19 during second grade in the treatment group, while there were no significant changes in grades for the group that were diagnosed with a SAGEA but did not receive treatment. The mean score of the follow-up questionnaire was 10.4 in the non-treatment group and 1.7 in the treatment group, indicating that parents of those children in the

non-treatment group reported more positive school-related behaviors as compared to the parents of those in the treatment group.

This study reveals several different important findings. First of all, SAGEA is common among first-grade children who are experiencing academic difficulty. Also, treatment of SAGEA was associated with higher academic performance as compared to those who did not undergo treatment. However, one limitation of this study is that formal sleep studies were not performed on these children, and thus researchers may have missed important information regarding these childrens' overnight sleep behavior.

Sleep Disorders and Behavior

Interestingly, deficits in working memory function have been also been found in children with Attention-Deficit/Hyperactivity Disorder (ADHD). There is much evidence that indicates an association between ADHD and sleep disorders (Chervin, 1997; Picchietti, England, Walters, Willis, & Verrico, 1998; Wiggs & Stores, 1996). It has been found that children with sleep disorders also tend to receive a diagnosis of ADHD, particularly those with RLS, PLMS, OSAS, and Narcolepsy. For example, one study of 88 adults with Narcolepsy found that 13% had also been given a diagnosis of ADHD (Navelet, Anders & Guilleminault, 1976). Sleep problems may actually contribute to or exacerbate the behavioral manifestations of disorders such as ADHD (Marcotte et al., 1998).

Chervin et al. (1997) also assessed the relationship between sleep disorders (particularly Restless Legs and Periodic Limb Movement Disorder), inattention, and hyperactivity, both symptoms of ADHD. 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. It was found that habitual snoring was more common in children with ADHD (33%) then among the psychiatry clinic subjects without a diagnosis of ADHD (11%), and the general pediatric subjects (9%). The attributable risk percent was 81%, which indicates that assuming habitual snoring causes ADHD, if we could treat the habitual snoring then we could eliminate 81% of the ADHD cases of those with comorbid diagnoses. In addition, among children with 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 still associated with the snoring score in multiple regressions that controlled for age, sex, and the use of stimulant medication. IHS was also associated with the sleepiness score when comparing the ADHD sample to the general pediatrics sample, but not when compared to the non-ADHD psychiatric population.

This study shows that there are links between characteristics 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. 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), 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 periodic limb movement disorder 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 did not have 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 at least 15 minutes of sleep latency at least twice a week. Seventy-eight percent of children were reported to sleep restlessly as compared with 44% of controls. However, sleep maintenance problems were reported to be fewer in the combined ADHD/RLS group (67%) as compared with the control group (73%). This study also supported a familial basis of RLS. Because ADHD also has a hereditary component, one can hypothesize that these disorders may be linked genetically. Interestingly, 10 (56%) of the 18 children with ADHD and periodic limb movement disorder also had at least one parent who met the criteria for RLS. Also, due to the fact that none of these subjects were taking medication, it is unlikely that stimulant medication is a viable explanation for RLS amongst children with ADHD.

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. Completed questionnaires were completed by the parents of 209 children.

Of those 209 children, 44% reported current severe sleep problems most nights or every night, while 56% had 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. Inappropriate or repetitive speech was not significantly different between those with and without sleep problems. Children with sleep disturbances were more likely to have more types of challenging behavior. 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 report multiple challenging behaviors. This study also shows a high rate of sleep problems (44%) in this population of children with learning disabilities.

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 many

children with sleep disorders tend to receive misdiagnoses. 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, 2002). Five types of Primary Sleep Disorders affecting children's daytime performance are PLMD, RLD, DSPS, Narcolepsy, and OSAS.

Children with sleep disorders tend to experience deficits in working memory, lower grades in school, and behavior problems, especially if they are suffering from untreated sleep disorders. In order to prevent these 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 academic and behavioral concerns.

Chapter 3

Methods

Introduction

The purpose of this study was to explore the relationship between sleep disorders,

academics performance, and behaviors in pre-kindergarteners. In addition, this study sought to

determine the prevalence of sleep disorder symptoms in a sample of pre-kindergarteners. This

chapter presents information regarding participants who were involved in this study, the method

through which the data were collected, and the analyses that were conducted.

Participant Characteristics

A convenience sample was used for this study in that participants were selected

from children referred to the Florida Diagnostic and Learning Resources System (FDLRS) -

Gulfcoast, a diagnostic and instructional support system which provides assessments for at-risk

pre-kindergarten children ages 3 through 5 displaying academic, behavior, or language

deficiencies. The purpose of FDLRS is to screen children for a variety of concerns; children who

display deficiencies during the screening process are then referred for a more thorough

evaluation in the area(s) of weakness. Children typically undergo FDLRS screening as a result of

a recommendation by a pediatrician, daycare provider, or early educator, who may have

observed delays in one of more areas of development. FDLRS is located in a rural school district

in West Central Florida, and is affiliated with Head Start. Twenty-one percent of students in this

district are eligible for free or reduced lunch. Fifty-two percent of Pasco County's Head

Start/Early Intervention population parents are single parents, and 43% of Head Start children are

on medicaid (Research and Evaluation Demographics, n.d.) In 2001, out of the 52,684 students in this district (pre-k through grade 12), 85.8% were white, 7.7% were Hispanic, 3.7% were black, and 2.8% were Asian/Pacific Islander (Research and Evaluation Demographics, n.d.).

A sample of 86 children ages 3 – 5 years, and their parents, served as participants in this study. The sample was 77% male and 23% female. The race/ethnicity of the children was 81% Caucasian, 8% mixed race, 5% Hispanic, 3% African-American, and 2% Asian. The ethnic breakdown of this sample is similar to the ethnicity of the county as a whole. The children's ages ranged from 3 years to 5 years with a mean of 4.0 years. The majority of the parents who completed rating scales for their children were mothers (85%), while fathers (12%) and other relatives or friends of the family (3%) also made up a proportion of the sample. Eighty-nine percent of the parents who were eligible agreed to participate in the study. The demographics of this sample are similar to the expected demographics; therefore, no response bias was apparent in this sample. See Table 1 for participant characteristics.

Table 1

Participant Characteristics

Race/Ethnicity	N	Percentage
African-American	3	3.48%
Caucasian	70	81.40%
Hispanic	4	4.65%
Mixed Race	7	8.14%
Asian	2	2.32%
Sex		
Male	66	76.74%
Female	20	23.26%
Language		
English	79	91.86%
Spanish	4	4.65%
Other	3	3.49%
Person completing form		
Mother	73	84.88%
Father	10	11.63%
Other friend or relative	3	3.49%

Instrumentation

   Demographics Form. The Demographics Form (see Appendix A) was developed by the

researcher in order to collect additional information about the participants in this study. This

form includes four questions which ask the rater to indicate their relationship to the child, the child's sex and race, and the language spoken in the child's home.

Sleep Disorders Inventory for Students. The Sleep Disorders Inventory for Students (SDIS; Luginbuehl, Batsche, Bradley-Klug, & Anderson, 2003) was developed in order to respond to the need for a school-based screening instrument to recognize the sleep disorders of OSAS, Narcolepsy, 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. This study used the SDIS-C for data collection.

The SDIS-C 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-C 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-C 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 were provided. These results were 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 provided parents with additional information about pediatric sleep disorders. This study used the Total Sleep Disturbance Index to determine the relationship between incidence of sleep disorders symptoms and academic and behavioral concerns.

The SDIS-C was normed on a national sample of 821 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 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) were detected in order to provide parents with some practical tips in order to deal with these conditions (Luginbuehl et al., 2003).

Developmental Indicators for the Assessment of Learning – Revised. The Developmental Indicators for the Assessment of Learning – Revised (DIAL-R; Mardell-Czudnowski & Goldenberg, 1990; See Appendix B), is an individually administered screening test which is given in order to identify children who are in need of further assessment and intervention. It is not an intelligence test but an estimate of the level of development of intellectual skills needed to be successful in preschool and kindergarten. The DIAL-R takes approximately 20-30 minutes to

complete, and is separated into 3 subtests, including motor functioning, conceptual knowledge, and language skills. There are eight items in each of the three subtests, and 24 items total. Each subtest score is combined into a total score that is used to assess overall kindergarten readiness. The overall score was used for analysis in this study.

The children taking this test rotated between motor, language, and conceptual knowledge stations, each of which is administered by a different FDLRS team member or operator. Each operator has received training in the administration of the DIAL-R and holds a masters or specialists degree in a field such as school psychology. The required responses consist of oral responses such as saying one's age, motor responses such as pointing to different body parts, and written responses such as copying a drawing. Standard scores on the subtests are converted into a total score and interpreted using a cutoff based on standard deviations. Children are grouped into three categories: 'Potential Problem' (score below 1.5 standard deviations of the mean), 'OK' (score within 1.5 standard deviations of the mean), and 'Potential Advanced' (score above 1.5 standard deviations of the mean). Children who score in the 'Potential Problem' range are referred for further evaluations which include IQ tests.

Test-Retest reliability reportedly ranges from 0.76 to 0.90 on the subtests of the DIAL-R, with a total test-retest reliability of 0.87. Internal consistency, estimated using Chronbach's coefficient alpha, ranges from 0.45 to 0.87, with the median correlation being 0.86 for the DIAL-R total. Mardell and Goldenberg (1975) examined inter-rater reliability of the DIAL, and reported that the percentage of agreement between the operators ranged from 81 to 99%. Because the DIAL-R has items that are similar to the original DIAL, the authors hypothesize that a study of inter-rater agreement using the DIAL-R would produce similar results. Suen, Mardell-

Czudnowski, and Goldenberg (1989) found that the classification reliability was high across all age groups. Chronbachs alphas for the total scores across the 3 subtests range from 0.81 to 0.91.

In addition, the predictive validity of the DIAL is adequate for a screening instrument (Vacc, Vacc, & Sawyer, 1987). The DIAL was administered to 245 children four months before beginning kindergarten, and was determined to effectively predict the subjects' first grade performance as measured by the California Achievement Test (CAT; r=.67). The Concepts subtest was found to have a substantially larger loading (r=.72) on the canonical variate than did the other DIAL subtests. However, it should be pointed out that these findings are based on the previous DIAL and not the later version used in this study. No predictive validity data are reported for the DIAL-R.

Content validity information is only reported for the DIAL. A panel of eight child development experts reviewed the test design, construction, instructions, and scoring criteria, and determined unanimously that the DIAL displayed content validity for screening children ages 2-6 through 5-6 (Mardell-Gzudnowski & Goldenberg, 1990). Construct validity was also assessed through comparing the mean values, standard deviations, and the three area scaled score totals, through the progression of age. A study using a sample that was representative of the 1990 census found that there is a nearly steady increase in the total scores as age increases for the entire age range across all areas (Czudnowski & Goldenberg, 1990). A correlation of 0.98 was found between the DIAL-R Total score and age. A second means of determining construct validity was through the comparison with the Learning Accomplishment Profile-Diagnostic (LAP-D; Sanford & Zelman, 1981), using the multitrait-multimethod model (Barnett, Faust, & Sarmir, 1988). Researchers found correlations of 0.79 between scores on the LAP-D and DIAL-

R motor sections, 0.86 between LAP-D cognitive and DIAL-R concepts, and 0.74 between scores on the language sections.

Criterion-related validity was found through comparing the results of the DIAL-R to subsequent Stanford-Binet Intelligence Scale (Terman & Merrill, 1973) scores, based on the fact that at that time most DIAL-R at-risk scores were followed up by Stanford-Binet testing. An 88.6% agreement was found between the DIAL-R and the Stanford- Binet. This agreement was determined by comparing decisions based on the DIAL-R to decisions based on the results of the Stanford-Binet (Czudnowski & Goldenberg, 1990).

The Twelfth Mental Measurements Yearbook (Sabers, 1995) reviewed the DIAL-R and pointed out several strengths and weaknesses of this instrument. First, predictive validity was measured by the test developers with the criteria of test scores, which is not the most accurate method of calculating predictive validity. Other weaknesses include a poorly defined minority sample in the normative group and exact cutoff test scores that do not take into account the standard error of measurement. However, strengths of the DIAL-R include attractive stimuli used during testing and examiner materials which allow accurate checks of progress towards mastery of the test. In addition, the DIAL-R has been determined to meet most of the psychometric criteria of normative adequacy, validity. The criterion of predictive validity was not met because the authors did not note the levels of significance that were used, and the interexaminer reliability criterion was not met because no studies examining this were reported in the test manual.

Preschool and Kindergarten Behavior Scales. The Preschool and Kindergarten Behavior Scales-2nd edition (PKBS-2; Merrell, 2004) is a norm-referenced, standardized behavior rating scale which is designed to assess social skills and problem behaviors in children ages 3-6 years.

The PKBS-2 takes 10-12 minutes to administer and contains 76 items that are completed by the parent or guardian of a child. Items are classified into either the Social Skills scale or Problem Behaviors scale. The Social Skills Scale consists of 34 items in three subscales, Social Cooperation, Social Interaction, and Social Independence. The Problem Behaviors scale includes 42 items in two subscales, Externalizing Problems and Internalizing Problems. In order to score these responses, the administrator calculates raw scores for the subscales and the total score, which are then converted into standard scores, percentile rankings, and functional levels using a conversion table provided in the manual.

The answers are reported through a likert scale, with the parent or guardian circling a number which corresponds to 'never', 'rarely', 'sometimes', or 'often'. Also, there is an open-ended question which requests that the rater provide additional information about the child that he or she feels would be useful. In the case of this study, the parent or guardian accompanying the child to the screening will complete the PKBS-2. If the parent is more proficient in Spanish than in English, the Spanish version of the PKBS-2 will be given. Because the PKBS-2 is a recently revised version of the original PKBS, much of the outside research reviewed will focus on the original version.

Merrell (1994) found test-retest reliability estimates to range from 0.36 to 0.78. More specifically, test-retest reliability for the Social Skills Total at 3 weeks and 3 months was 0.58 and 0.69, respectively. Test-retest reliability for the Problem Behaviors Total was 0.86 and 0.78, respectively. Alpha and split-half coefficients measuring internal reliability range from 0.90 to 0.97 for Total Scores, and ranged from 0.80 to 0.90 for the Social Skills and Problem Behaviors subscales. Inter-rater agreement coeffiecients were moderate to moderately strong, ranging from 0.36 to 0.61 for Social Skills subscales, and from 0.46 to 0.63 for Problem Behaviors.

In order to examine the criterion-related reliability of the Spanish version, it was compared to the English version using the Pearson bivariate product-moment method. Reliability coefficients of 0.93 for Social Skills and 0.94 for Problem Behaviors were reported. In addition, internal consistency of the Spanish form was found to be high at 0.93 for Social Skills and 0.96 for Problem Behaviors (Carney & Merrell, 2002).

Criterion-related validity of the English form was explored through a study of 94 kindergarteners in which scores on the PKBS-2 were correlated with scores on the Teacher's Report Form (Achenbach, 1991). A correlation of 0.94 was found between PKBS-2 externalizing problems subscale score and the externalizing scale score of the TRF. Similarly, a correlation of 0.93 was found between the Problem Behaviors Composite of the PKBS-2 and the Total Problems index of the TRF. The correlation between the Problem Behaviors scale on both the PKBS-2 and the TRF was slightly lower at 0.76.

Several studies have examined the validity of the first version of the PKBS. Divergent and convergent construct validity were determined between the Adjustment Scales for Children and Adolescents (ASCA; McDermott, Marston, & Stott, 1993) and the PKBS (1st edition; Canivez & Rains, 2002). Kindergarten and first grade teachers completed both the PKBS and the ASCA. The authors report a significant and high correlation between the PKBS Externalizing Problems subscale and the ASCA Overactivity syndrome (r=0.84), a finding which supports the convergent validity of the PKBS. Divergent validity was supported as well through the low correlation found between the PKBS Externalizing Problems scale and the ASCA Underactivity syndrome (r=-.06).

Winsler and Wallace (2002) examined the agreement between different raters of the PKBS and between ratings on the PKBS and relations with classroom observations. They

reported modest overall agreement between parents and teachers (-.09 to .38). Cross-informant correlations were poor for Social Skills Total (-.09 to .27), low for Internalizing Behaviors (.15 to .36), and modest for Externalizing Behaviors (.29 to .38). In addition, they found that the parent report of behavior was not significantly correlated with an independent observer of the child's behavior. However, these findings should be interpreted cautiously because the informants were rating the children based on behavior in different settings.

Overall, while the SDIS, DIAL-R, and PKBS-2 are all considered to be screening instruments, exploration of their technical properties show that scores obtained through these instruments are adequately reliable and valid. The technical properties of these instruments, along with their lack of instrusiveness and appropriateness for the characteristics of this sample make them appropriate instruments to use in this study.

Procedure

First, permission was obtained to conduct research with human subjects through the University of South Florida Institutional Review Board (IRB), and through the Pasco County School District research department. Permission also was obtained from the FDLRS team leader. A letter was mailed to the parents or guardians of children who had screening appointments with the FDLRS team in order to explain the study (see Appendix B). Parents and guardians who were able to observe their child's sleep and behavior for at least the past six and three months, respectively, were eligible for participation in this study. Parental consent forms (see Appendix C) and a demographic information sheet were given to the parents upon arrival to the screening meeting, and the researcher was present as well to answer any additional questions. In addition, the researcher explained to the parent specifically what the PKBS-2 and the SDIS measure and how to complete these instruments.

After the parent signed the consent form and completed the arrival intake form, the parent or guardian waited for 20-30 minutes until their child completed the DIAL-R assessment administered by members of the FDLRS team. During this time, the parent was asked to complete both the SDIS and the PKBS-2. The researcher was available to answer questions from the parents. After the parent finished completing these forms, the forms were returned to the researcher at the arrival desk and given to the researcher. The researcher completed the scoring of the SDIS-C immediately and generated a computerized print-out of the results. After the screening, the researcher recorded scores of the DIAL-R, the SDIS-C, and the PKBS-2, assigning research numbers (beginning with the number 1) to each name to protect the confidentiality of each child.

An inter-rater agreement of 99% was calculated in order to ensure accurate scoring of the SDIS- C and PKBS-2 by comparing the scores of two different raters. A graduate level student independently scored 30% of randomly selected SDIS-C, and PKBS-2 forms. The PKBS-2 forms were scored by hand and the SDIS-C scores were entered into the computer. Afterwards, a total agreement was calculated by dividing the total number of agreements obtained by the total number of questions on the rating scale.

During typical FDLRS screening procedures, members of the screening team share the testing results with the parents and answer any questions that they may have concerning the assessments. If parents are concerned with their child's sleep, they are provided with the SDIS-C to complete. If the SDIS-C reveals significant sleep problems, they are given contact information of sleep specialists if they wish to have their child further. A similar procedure was followed during this study, in that parents whose children received sleep disorders scores in either the

moderate risk or high risk category received consultation from the FDLRS team and were provided with contact information of sleep specialists.

Data Analysis

A separate data analysis was conducted for each of the four research questions. The first research question, which sought to determine the prevalence of sleep disorders in this sample, was answered by conducting a percentage with a confidence interval. In doing so, the level of sleep disorders was changed into a categorical variable of suspected presence of a sleep disorder and no suspected presence of a sleep disorder based on the pre-determined cut-off scores on the SDIS-C. A 95% confidence interval was calculated as well in order to determine a possible range of percentages.

The second research question was aimed at comparing the level of social skills deficits between children whose sleep disorders symptoms place them into the normal, cautionary, or high risk ranges. An analysis of variance (ANOVA) was used to test for significant differences between the means of those who the SDIS-C detected to have sleep scores in the normal, cautionary, and high risk ranges. The Social Skills Total score on the PKBS-2 served as the continuous outcome variable.

The third research question comparing the level of externalizing problems between children who had sleep disorders symptoms in the categories of normal, cautionary, and high risk, were also analyzed using an ANOVA. In this case, the categorical placements of normal, cautionary, and high risk sleep disorders symptoms served as the categorical variable and the Externalizing Problems subscale score on the PKBS-2 served as the continuous outcome variable.

The fourth research question was designed to compare pre-academic concerns between children whose sleep problems fell into the normal, cautionary, and high risk ranges. Another ANOVA was conducted in order to answer this question. Again, participants were placed into normal, cautionary, or high-risk sleep scores based on the pre-determined cutoff scores suggested by the SDIS-C. The total score on the DIAL-R was used as the continuous outcome variable.

Descriptive statistics were collected as well in order to gather more information concerning scores on the DIAL-R and the PKBS-2. The mean, median, mode, and skewness and kurtosis values of scores on the DIAL-R and PKBS-2 Social Skills Total scale and Externalizing Problems subscale were reported.

Chapter 4

Results

Instrumentation

Sleep Disorders Inventory for Students – Children's version

The parent or guardian of each child who was present at the FDLRS screening completed the Sleep Disorders Inventory for Students – Children's version (SDIS-C). Parents generally completed this assessment at the same time that the FDLRS personnel were administering the DIAL-R to their children. In this study, the reliability estimate for the total sleep disturbance scale of the SDIS-C was .87.

Preschool and Kindergarten Behavior Scales – 2nd edition

Each parent or guardian attending the FDLRS screening with their child was also asked to complete the Preschool and Kindergarten Behavior Scales (PKBS-2). Parents of the children completed the PKBS-2 and the SDIS-C in succession in the order which they chose. Results showed that the reliability estimate for the PKBS-2 was .94 for the social skills scale, .95 for the externalizing problems scale, and .84 for the internalizing problems scale.

Developmental Indicators for the Assessment of Learning

Each child participating in the study completed the DIAL-R. The DIAL-R was administered and scored by FDLRS personnel, and the results (total scores and subscale scores) were provided to the researcher by a FDLRS child-find specialist. Reliability estimates for the DIAL-R were not obtained in this study due to the fact that the individual item scores were not available to the researcher.

Descriptive Statistics

Initial descriptive statistics were computed in order to obtain means for each measure used for analysis. These means were then inserted into the database for all observations with missing data, in order to increase power and ensure a consistent sample size. This final dataset without missing values was used in the reporting of descriptive statistics and other analyses. A total of 4 imputations for the SDIS-C, 16 imputations for the DIAL-R, and 9 imputations for the PKBS-2, were made (Green, 1997). Upon examination of the sleep scores, it was found that the mean score for all of the sleep disorders scales were in the low to mid 50s, with standard deviations ranging from 7.92 to 12.15 points (see Table 2). The means and standard deviations were as follows: 95.08 and 15.40 for the total social skills scale, 106.98 and 15.95 for the internalizing problems subscale, and 103.76 and 16.52 for the externalizing problems subscale (see Table 3). The reported scores on the pre-academic measure were raw scores, and different criteria were used to judge whether or not the child was within normal limits based on his or her age. In other words, the normal limit range was determined by a sliding scale based on age. Older children would be expected to obtain higher raw scores as compared to younger children. Therefore, raw scores were converted into a percentage of a standard deviation in order to compare performance across subjects. As for the children's academic skills scores, it can be seen in Table 4 that the mean on the PKBS-2 was -.02 (indicating that the average performance for this sample was 0.02 standard deviations below the national average) and the standard deviation was 0.75 (indicating that the average standard deviation for this sample was .75 of the typical sample standard deviation seen by the standardization sample).

Table 2

SDIS-C Descriptive Statistics

	Mean	Standard deviation	Median	Mode	Skew-ness	Kurtosis	Min	Max
OSAS	53.60	8.55	51.5	51	0.69	-0.18	39	76
PLMD	52.94	8.64	52.0	49.0	0.60	0.68	36	78
DSPS	54.55	12.15	51.0	41.0	0.91	0.09	41	90
EDS	52.08	7.92	52.0	55.0	0.35	-0.43	39	71
SDI Index	55.03	8.71	54.5	55.0	0.50	0.20	38	77

Table 3

PKBS-2 Descriptive Statistics

	Mean	Standard Deviation	Median	Mode	Skew-ness	Kurtosis	Min	Max
Cooperation	91.92	17.82	91.92	92	-1.07	1.22	34	118
Independence	101.01	12.81	101.00	101	-.89	1.17	58	118
Interaction	99.06	13.77	99.00	99	-.75	-0.07	54	116
Total social skills	95.08	15.40	95.00	95	-.86	1.22	44	120
Internalizing behavior	106.98	15.95	107.00	107	0.43	-0.37	78	148
Externalizing behavior	103.76	16.52	103.50	104	0.76	0.41	76	152

Table 4

DIAL-R Descriptive Statistics

	Mean	Standard Deviation	Median	Mode	Skew-Ness	Kurtosis	Min	Max
Pre-academic Skills	-.02	0.75	0.17	0.42	-0.64	-0.33	-1.90	1.31

Prevalence of Sleep Disorders

The first research question sought to determine the prevalence rates of sleep disorders in the study population. According to the overall index of sleep disorders (SDI), 74.42% of children scored in the normal range of sleep. However, 9.30% of children received sleep scores in the cautionary range, and 16.28% scored in the high-risk range. Frequencies for the specific types of sleep disorders can be found in Table 5.

Table 5

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	70	81.40 73.18-89.6	6	6.98 1.57-12.37	10	11.63 4.85-18.41
PLMD	72	83.72 75.92-91.52	7	8.14 2.36-13.93	7	8.14 2.36-13.92
EDS	71	82.56 74.54-90.58	6	6.98 1.57-12.37	9	10.47 4.00-16.94
DSPS	58	70.73 61.11-80.35	11	8.14 2.36-13.92	17	20.73 12.16-29.30
SDI	64	74.42 65.20-83.60	8	12.79 5.73-19.85	14	16.2 8.80-24.08

When individual subscales were examined, it was found that 56.98% 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, and excessive daytime sleepiness (see Table 6). Further analysis revealed that 10.47% of the sample had a moderate risk of having at least one type of sleep disorder. The remainder of the children, 32.56%, were at high risk for having at least one type of sleep disorder.

Table 6

SDIS-C Subscale Percentages.

	Overall		Males		Females	
	n	Percentage 95% C.I.	n	Percentage 95% C.I.	n	Percentage 95% C.I.
Normal	49	56.98 46.52-67.44	51	76.12 67.11-85.13	13	68.42 58.60-78.24
Caution	9	10.47 4.00-16.94	7	10.45 3.98-16.92	1	5.26 0.54-9.98
High Risk	28	32.56 22.66-42.46	9	13.43 6.22-20.64	5	26.32 17.01-35.63

Externalizing Problems and Sleep Disorders

The distribution for each of the 3 groups can be seen in Appendix D, Figure 1. The means and standard deviations for each group on the externalizing problems scale are displayed in Table 7.

Table 7

Externalizing Problems Means and Standard Deviations by Sleep Score

	Mean	Standard Deviation
Normal	99.70	14.06
Caution	109.88	16.63
High Risk	118.79	18.15

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

externalizing subscale of the PKBS-2 had a small positive skew (0.76), and kurtosis was normal (0.41), indicating that the assumption of normality was passed. Boxplots of each condition reveal that the high-risk sleep disorder category had the most variability of scores, while the caution sleep disorder category had the least variability. However, this variation was not different enough for it to be problematic in conducting the ANOVA (Stevens, 1995).

After checking all assumptions, a one-way ANOVA was conducted in order to determine whether or not difference existed between scores on the externalizing problems subscale of the PKBS-2, based on the category of sleep disorder. The level of overall sleep disorder risk (normal, caution, and high risk) served as the categorical variable, while the score on the externalizing problems subscale of the PKBS-2 served as the continuous variable. There was a statistically significant difference among the three groups $(F(2,83)=10.03, p=.0001)$. This indicates that because the ANOVA was significant at the .05 level, there is a difference in parent-reported externalizing problems based on the overall level of sleep disorder. A listwise deletion was performed in order to create a database which did not include those participants with missing observations. Another ANOVA was conducted using the alternate dataset to determine whether or not the ANOVA was affected by the insertion of means for missing values. Results showed no substantive difference between the two ANOVAs $(F(2,72)=10.35, p=.001; F=10.35)$.

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 externalizing scores. The Tukey test indicated a difference between the normal level and high risk level of sleep disorders at a .05 confidence level (error degrees of freedom=83).

The difference between sample means was 19.083, with a 95% chance that the difference between population means was between 8.522 and 29.643. No differences were found between the caution level and either of the other 2 levels of sleep disorders. Overall, this indicates that children who were rated as high risk for a sleep disorder received significantly higher scores on the externalizing problems subscale of the PKBS-2 as compared to children who scored in the normal sleep range.

Internalizing Problems and Sleep Disorders

The distribution of internalizing problems for each of the 3 groups can be seen in Appendix D, Figure 2. The means and standard deviations for each sleep disorders risk classification on the internalizing problems scale are displayed in Table 8.

Table 8

Internalizing Problems Means and Standard Deviations by Sleep Score

	Mean	Standard Deviation
Normal	102.69	13.54
Caution	112.88	9.26
High Risk	123.21	18.23

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 externalizing problems. Scores on the internalizing subscale of the PKBS-2 had a small positive skew (0.43), and the distribution was neither leptokurtic or platykurtic (-.37). Standard deviations of each condition reveal that the

high-risk sleep disorder condition had the most variability of scores, while the caution sleep disorder condition had the least variability.

After checking all assumptions, an ANOVA was conducted in order to determine whether or not a difference existed between scores on the internalizing problems subscale of the PKBS-2, 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 internalizing problems subscale of the PKBS-2 served as the continuous variable. Results of the ANOVA revealed that a significant difference existed between the three groups $(F(2,83)=12.97, p=.0001)$. This indicates that at the .05 level, there is a difference in parent-reported internalizing problems based on the overall level of sleep disorder. Another ANOVA was again conducted using an alternate dataset from the listwise deletion, in order to determine whether or not the ANOVA was affected by the insertion of means for missing values. Results showed no substantive difference between the two ANOVAs $(F(2,72)=13.35, p=.001)$.

A Tukey test was conducted in order to determine for which levels of overall sleep disorders risk there was a difference in internalizing problems. The Tukey test showed a difference between the normal level and high risk level of sleep disorders at a .05 confidence level. This indicates that children with high risk factors for sleep disorders had significantly more internalizing problems, as compared to children with no risk factors for sleep disorders. The difference between sample means was 20.527, with a 95% chance that the difference between populations means was between 10.608 and 30.446. However, no significant differences in internalizing problems were found between the caution risk level and either the normal or high risk level of sleep disorders.

Social Skills and Sleep Disorders

The distribution of social skills for each of the 3 groups can be seen in Figure 3 of Appendix D. In addition, the means and standard deviations for each sleep disorders risk classification on the social skills scale of the PKBS-2 are displayed in Table 9.

Table 9

Social Skills Means and Standard Deviations by Sleep Score

	Mean	Standard Deviation
Normal	98.47	17.27
Caution	86.38	11.77
High Risk	84.57	18.47

The same assumptions of independence, normality, and homogeneity were checked again in reference to the total social skills scale of the PKBS 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 PKBS-2 had a small negative skew (-0.86), and the distribution was leptokurtic (1.22). Boxplots of each condition again reveal that the high-risk sleep disorder category had the most variability of scores, while the caution sleep disorder category had the least variability. Even though the data were found to be slightly non-normal, and ANOVA was still used because the data are considered to be robust to these issues.

After checking all assumptions, an ANOVA was conducted in order to determine whether or not a difference exists between scores on the total social skills scale of the

PKBS-2, based on the category of sleep disorder. Again, the level of overall sleep disorder risk was used as the categorical variable, while the score on the total social skills scale of the PKBS-2 served as the continuous variable. The results of the ANOVA again showed a significant difference between the three groups of sleep disorders risk ($F_{(2,83)}=9.04$, p=.0003), meaning that there is a difference in parent-reported total social skills based on the overall risk level of sleep disorder. No substantive difference was seen between these results and the ANOVA conducted without the insertion of missing values ($F_{(2,72)}=10.35$, p=.001).

A Tukey test was conducted in order to determine for which levels of overall sleep disorders risk there was a difference in total social skills. The Tukey test indicated a difference between the normal level and high risk level of sleep disorders at a .05 confidence level (df=2, 83). The difference between sample means was 15.460, with a 95% chance that the difference between population means was between 5.518 and 25.402. Also, a difference of 13.656 was found between the normal and caution levels (95% confidence interval of 1.020 and 26.292). No discrepancies in social skills scores were found between the caution and high risk levels of sleep disorders. This indicates that children who were rated in the high risk range of sleep disorders 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 have moderate levels of sleep disorders risk factors also had fewer social skills when compared to those children who were rated as having normal sleep. However, children who are displaying both moderate and high risk sleep had no significant differences in their social skills.

Pre-academic Skills and Sleep Disorders

The distribution of pre-academic skills for each of the 3 groups can be seen in

Figure D4. The means and standard deviations for each sleep disorders risk classification

on the DIAL-R, a measure of pre-academic skills, are found in Table 10.

Table 10

Pre-academic Skills Means and Standard Deviations by Sleep Score

	Mean	Standard Deviation
Normal	0.17	0.65
Caution	-0.67	0.55
High Risk	-0.48	0.87

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

independently completed the academic measure, the DIAL-R, it is logical that the

assumption of independence is passed. Scores on the pre-academic skills subscale of the

PKBS-2 had a small negative skew (-0.639), and the distribution was slightly slightly

platykurtic (-.326). Visual inspection of the boxplots of each condition showed that the

each condition of sleep disorder risk had similar variability of scores. Therefore, the

assumption of homogeneity was passed.

An ANOVA was conducted in order to determine whether or not a difference

existed between scores on the pre-academic skills scale of the PKBS-2, based on the

category of sleep disorder. Again, the level of overall sleep disorder risk was used as the

categorical variable, while the score on the pre-academic skills scale of the PKBS-2

served as the continuous variable. The results revealed that the ANOVA was significant ($F(2,83)=7.22$, $p=.0015$), meaning that there was a difference in scores that children received on the assessment of kindergarten readiness based on the overall level of sleep disorder. Another ANOVA was conducted without the insertion of missing values to ensure that the imputed values did not affect the outcome. There was no substantive difference found between the two ANOVAs ($F(2,83)=7.16$, $p=.0014$).

A Tukey test was conducted in order to determine for which levels of overall sleep disorders risk there is a difference in pre-academic skills. The Tukey test indicated a difference between the normal level and high risk level of sleep disorders at a .05 confidence level (error degrees of freedom=83). The difference between sample means was 0.6502, with a 95% chance that the difference between population means was between 0.1170 and 1.1835. Also, a difference of 0.8437 was found between the normal and caution levels (95% confidence interval of 0.1283 and 1.5591) at a .05 confidence level. No differences in pre-academic scores were found between children who fell into the caution and high risk levels of sleep disorders.

Summary

The present findings indicate that the prevalence rates of sleep disorders in at-risk populations of young children is significantly high. In this sample, while the majority of children appeared to have normal sleep as rated by their parents or guardians (57%), 33% of children were found to be at high-risk for having at least one type of sleep disorder. Additionally, 10% were in the cautionary range, a lower yet still significant risk category for having a sleep disorder. A large percentage of children, 43%, were experiencing significant sleep problems.

Several different problem behaviors also were associated with symptoms of sleep disorders. All of the behaviors measured on the behavioral rating scale were related to the child's sleep. Specifically, a positive relationship was found between sleep and both internalizing problems and externalizing problems. Children who experienced more behavior problems in both of these areas also tended to have an increased risk of having a sleep disorder. In addition, a negative relationship was found between sleep and social skills. This indicates that children with more sleep problems were rated as having fewer or more poorly developed social skills in the areas of social cooperation, social independence, and social interaction.

A negative relationship was also found between children's performance on a pre-academic skills test and their sleep, suggesting that risk factors for sleep disorders (higher scores on the sleep disturbance index of the SDIS-C) are inversely related to basic pre-academic skills for young children. In other words, the children who were likely to be at risk for a sleep disorder were more likely to have fewer skills that are required for success in kindergarten (i.e., skills in language, motor, and conceptual knowledge).

Chapter 5

Discussion

The increasing emphasis on school accountability clearly shows the importance of demonstrating relationships between students' health and educational outcomes. There are major benefits to a better understanding of the impact of health on educational outcomes, such as enhancement of health education programs and improvements in how schools address pediatric health problems. Through increasing the knowledge that school personnel have about pediatric sleep disorders, and implementing more effective practices concerning early identification and intervention, the negative outcomes associated with sleep disorders may be significantly reduced.

The purpose of this study was to examine the prevalence of sleep disorders in an at-risk population of pre-kindergarten children, and to analyze the relationship between sleep disorders and other common childhood problems. Specifically, the relationships between sleep and behavior (including internalizing problems, externalizing problems, and social skills), and between sleep and pre-academic skills, were examined. This final chapter will address each research question. It will discuss how each hypothesis was supported, the implications of the research findings on the practice of school psychology, and directions for future research in the area of pediatric sleep disorders. This chapter will also analyze the findings as a whole and discuss the limitations of the current study.

Research Question 1

What is the prevalence of symptoms of sleep disorders, as measured by the Sleep Disorders Inventory for Students (SDIS), in pre-kindergarten children participating in an at-risk screening program?

Results of this study indicated that 33% 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). In this sample, particularly high rates of sleep disorders were found in the areas of delayed sleep phase syndrome/behavioral insomnia of children (20.73% high risk), obstructive sleep apnea (11.63% high risk), and excessive daytime sleepiness/narcolepsy (10.47% high risk). Periodic limb movement disorder was not quite as prevalent as the other types of sleep disorders, but still occurred in a relatively high percentage of the sample (8.54% high risk). High rates of high risk and moderate risk in each individual category led to impaired scores in the sleep disturbance index. While the majority of children had normal sleep overall (74.42%), 9.30% of children had moderate risk overall, and 16.28% had high risk overall for having at least one type of sleep disorder.

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, much of the previous research has grouped wide age ranges together instead of examining rates in narrow age ranges of pre-kindergarten children. Overall, the prevalence rates of sleep disorders in

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this sample were higher than the rates expected based on previous research. For example, 19% 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). Higher rates of sleep disorders is this population may be due to the fact that the sample is at-risk, and not reflective of the typical preschool population.

It is critical that school psychologists are aware of the high rates of pediatric sleep disorders. The job responsibilities of typical school psychologists require them to interact with children and adolescents who are reflective of the sample used in this study in that they have a higher risk for school failure or some other type of social, emotional, or language delay. The results of this study suggest that at-risk populations of children commonly suffer from a sleep disorder in addition to having other problems. Therefore, consistent and even universal screening of sleep disorders in children experiencing a wide range of difficulties should be considered best practice in order to improve the problem identification stage of the provision of psychological services.

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 behavior problems as measured by the Preschool and Kindergarten Behavior Scales?

School psychologists are also 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 and even the potential causes of these challenging behaviors. The results of this study show a significant relationship between behavior and sleep; those children who were at high-risk for a sleep disorder had more parent-reported behavior problems as compared to those children whose sleep was rated normal. Specifically, a relationship was shown between sleep and internalizing behavior, externalizing behavior, and social skills. Therefore, it is clear that in this sample, impaired sleep was related to a wide variety of behavior problems and even poorly developed social skills.

Although it is evident that a difference exists between children who have normal sleep and those who have sleep that is disturbed enough to be at high-risk for having a sleep disorder, no difference was found between the caution range of sleep and either of the other two categories. In other words, significant discrepancies in behavior were not apparent between caution and either normal or high risk sleep. This indicates that the behavioral problems that were seen in the high risk group were not apparent for those in the moderate risk category. However, it is important to remember that children who score in the cautionary range are less likely to have a medically diagnosable sleep disorder. Therefore, the lack of a difference found in this category may be due to the possibility that these children do not have a diagnosable sleep problem. It may be because negative behavioral effects are only apparent with severe sleep problems.

This study is unique because it compared types of behavior between children in 3 different categories of risk for a sleep disorders. The results of this study are aligned with previous research that determined a relationship between sleep disorders and behavior problems, particularly ADHD (Picchietti, England, Walters, Willis, & Verrico, 1998), and between sleep disorders and internalizing problems (Fallone, Acebo, Seifer, &

Carskadon, 2005). In addition, this study expands the research by examining multiple problem areas within a narrow preschool age range of 3 to 5 years old.

This study also found a significant relationship between symptoms of sleep disorders and social skills. Although it is clear that sleep problems are common in children who have disorders related to social skills such as mental retardation (Janowsky & Davis, 2005) and autism (Schreck, Mulick, & Smith, 2004), this is the only study that looked explicitly at the relationship between social skills and sleep disorders in a community sample. It is possible that there were factors such as mental retardation or autism that contributed to the relationship between sleep disorders symptoms and social skills. It is also plausible that the relationship between social skills and sleep disorders symptoms was affected by the high rate of externalizing problems (a sign of ADHD) seen in the sample. In other words, externalizing problems or ADHD may be the underlying cause of the lack of social skills in this sample. Additional research is needed to explore these hypotheses and determine if the relationship between social skills and sleep disorders exists on its own or whether the relationship is instead caused by other factors.

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 pre-academic skill problems as measured by the DIAL-R?

Previous research has made it clear that success in early learning experiences is critical for young children. For example, it is predicted that young children who fall behind their peers in the area of reading will fall farther and farther behind as time goes on (Good, 1998). Therefore, intervention is particularly important at earlier ages. In this

sample, sleep was found to be a factor in the children's performance on the DIAL-R, a test of pre-academic skills. There was a significant negative relationship between sleep and academic skills; children who were rated as having increased levels of sleep problems displayed progressively worse academic performance.

Analyses comparing all 3 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, academic problems were present when compared with children whose parents rated their child's sleep as normal. Comparably, the academic problems become more severe as children score in the high risk classification. When individual components of the academic assessment were analyzed (motor, concepts, and language), all domains were individually found to significantly relate to the child's risk for sleep disorders. Thus, differences within each domain contributed to the difference that was apparent when the overall score was examined. Although research exists indicating a relationship between academic performance and pediatric sleep disorders (Blunden, Lushington & Kennedy, 2000; Hansen & Vandenberg, 2001), there is little research available that looks at the nature of this potential association prior to school-age. Importantly, this study shows that symptoms of sleep disorders are related to the development of pre-academic skills even before children reach school-age.

Implications for Practitioners: Early Identification and Intervention

Prevention and intervention of sleep disorders in educational settings is limited by a lack of sleep disorder assessment tools. While it is true that sleep disorders can only be

diagnosed by a doctor of medicine, school professionals can still play a role in identifying children who may be at risk for or demonstrate symptoms of a sleep disorder. The Sleep Disorders Inventory for Students (SDIS; Luginbuehl et al., 2003) was developed in order to respond to the need for a school-based screening instrument to recognize the sleep disorders of OSAS, Narcolepsy, PLMD, EDS, and DSPS. To date, the SDIS is the only school-based screening instrument that is available for use in a school setting. However, even though this tool exists for the screening for pediatric sleep disorders, previous research has shown that many cases of pediatric sleep disorders go undetected, despite the fact that prevalence rates are surprisingly high (Zozula, Rosen, & Jahn, 2005). Therefore, in order to establish appropriate interventions and improve the quality of life for children with sleep disorders, identification is the first step.

In a school setting, school psychologists who hypothesize that a child may have a sleep disorder should ensure that the child is screened to confirm or rule out sleep as a possible cause for problem behavior and/or poor academic skills. In order to accomplish this task, school psychologists may request that the parent complete the SDIS. In fact, because the SDIS is relatively easy and quick to administer, it may also be given universally to large groups of school children so that no child has to live with an undetected sleep disorder. 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. 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.

Screening for sleep disorders in a school setting should lead to more thorough assessment and intervention. 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, however, the knowledge that a child has a sleep disorder logically leads to improvements in the problem-solving process. For example, for many children with sleep disorders, the problem is mis-identified, leading to inappropriate interventions (Chervin, 1997). For example, many children with 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). In order to guard against an erroneous 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.

It is also possible to provide prevention and intervention services to children on a universal scale. Although sleep disorders are typically medically based and thus require medical interventions, 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 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. Brown, Buboltz, and Soper (2006) looked at the effects of a sleep

treatment and education program for university students and found that those students who received treatment reported significantly improved sleep quality and sleep hygiene afterwards. Simore, Crassard, Rechatin, and Locard (1987) examined the effects of a sleep education campaign geared towards the parents of children ages 2 to 6 years and found that the children of parents involved in the campaign went to bed earlier, slept longer at night, and had fewer sleep disorders. Collaboration with teachers, parents, coaches, educators, pediatricians, and school nurses should be an integral part of awareness campaigns, and programs should be adapted to meet a wide range of cultures, literacy levels, and developmental levels. In fact, the low levels of identification by health care professionals may warrant education intervention as well. In-service training on the recognition of sleep disorders has been shown to lead to increased recognition and diagnosis in the medical community (Zozula, Rosen, & Jahn, 2005).

Another potential prevention and intervention method for dealing with pediatric sleep disorders is the delaying the school start time. Several studies have explored the benefits of delaying the school start time, but the majority of these studies focus on high school students (Dexter, Bijwadia, Schilling, & Applebaugh, 2003). However, two international studies have found that even for young children, there are benefits to delaying the time that school starts. Epstein, Chillag, and Lavie (1998) found that students in Israel who started school at 7:10 a.m. reported significantly more daytime fatigue and sleepiness, as well as attention and concentration difficulties, even when controlling the reported hours of sleep, as compared to students who started school between 7:20 a.m. and 7:55 a.m. Similarly, Moran, Varvalho, Prado and Prado (2005) determined that the school start time may have effects on sleep disorders and motor

performance of 5 year-old children in Brazil. These two studies indicate that the school start time has an effect on sleep and performance across several different areas, even for young children in elementary school. The research showing the benefits of delaying the school start time should lead to increased levels of advocacy on the part of school personnel. School psychologists, in particular, should be familiar with this literature and work with administrators to promote this change in their school systems.

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).

Although the results of this study clearly indicate that pediatric sleep disorders are associated with behavioral and cognitive concerns, there is ample research suggesting that interventions for these disorders lead to positive outcomes. Thus, working with medical professionals to facilitate interventions for children with sleep disorders may result in positive educational outcomes for these children. However, effective intervention begins with early identification. It is necessary to provide families and the educational community with information on the impact of sleep disorders so

that assessment and early identification becomes a regular part of developmental and educational screening practices.

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 100 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 3 categories of risk for a sleep disorder: normal risk, moderate risk, and high risk.

In addition to using larger samples, 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. However, this sample is similar to those children who are referred to school psychologists for academic and/or behavioral concerns. Additional studies exploring similar questions of the relationship between sleep, behavior, and academics, should be explored with narrow age brackets of children. By performing additional research in this area, the prevalence of sleep disorders across the child's development can be examined and refined. Previous research studies have found wide ranges of prevalence rates. Additional studies in this area may help to narrow this range down to the most accurate prevalence rates for each age.

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. Although the sleep disorders screening tool that was used for data collection is extremely accurate, it is not intended for diagnostic purposes and there is no way to tell whether or not those children who scored in the high risk category of sleep disorders actually have a medically diagnosable sleep disorder. 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., 2003).

In addition, the accuracy of the DIAL-R scores is unknown. The researcher was able to obtain the results of the DIAL-R, but there was no way to check the reliability of these scores due to the fact that only one FDLRS specialist was available to administer and score the DIAL-R. Therefore, mistakes could have potentially been made in the administration of the DIAL-R, the scoring of the items, or the recording of the results. However, all of the FDLRS personnel are highly trained professionals who have been trained in measurement issues, which should increase the accuracy of the DIAL-R scores.

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 academic and 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 and cognitive skills tend 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 behavior and cognitive performance.

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 sample, 33%, are at high risk for having at least one type of sleep disorder. High rates of sleep disorders symptoms were observed across all disorder categories, particularly in Delayed Sleep Phase Syndrome and Obstructive Sleep Apnea Syndrome. This indicates that the symptoms of sleep disorders are already apparent even at this young age of three to five years old. In addition, a significant relationship was found between sleep disorders

symptoms and multiple problem areas including behavior and pre-academic skill development.

It is apparent that sleep disorders are commonly associated with other 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 even advocating for altering the school day so that children are educated during the times in which they are most alert. With these factors in place, school psychologists may greatly improve the quality of life for children with sleep disorders.

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Demographics Form

Child's name: _____

1. Your relationship to the child (please circle one):
a. Mother
b. Father
c. Grandmother/Grandfather

d. Friend of the family
e. Other:

_____

2. Which adults live in the child's home? (please circle all that apply)
a. Mother
b. Father
c. Stepmother
d. Stepfather

e. Grandmother
f. Grandfather
g. Other adults:

_____

3. Child's sex:
a. Male

b. female

4. Child's race:
a. Black/African American
b. American Indian/Alaskan Native
c. Hispanic/Latino
d. Caucasian

e. Asian
f. Native Hawaiian/Pacific Islander
g. Mixed race (please specify):
h. Other (please specify):

_____

5. Language spoken in the child's home:
a. English
b. Spanish

c. Other: _____

6. Is it ok if we contact you in the future for additional research studies?

a. Yes
b. No

If yes, here is my contact information (please print):

Name: _____ Phone number: _____

Address:

_____

_____

_____

Appendix B

Letter to Parents

Dear parent or guardian,

You and your child are scheduled to take part in a screening with the Florida Diagnostic Learning and Resource System (FDLRS). During this time, your participation in a research project will be requested. This research project will attempt to expand what we know about childhood sleep disorders and how they affect behavior and learning. All families who are participating in the FDLRS screening process this spring will be requested to participate in this study, but your participation is purely voluntary. If you choose to participate, your child's name will be replaced with a number to protect his or her confidentiality. Your child's name will never be connected to the results of this study in any way.

Taking part in this study will involve filling out a sleep screening questionnaire that takes approximately 8 to 15 minutes to complete. In addition, you will be asked to complete a behavior rating scale, which will require approximately 10 to 12 minutes of your time. All of this information will be completed at the FDLRS screening center while your child is taking an assessment of kindergarten readiness. The primary researcher will be present at the time of the screening and will be available to answer any questions you may have.

There are several benefits to participating in this study. First of all, your participation will help to increase our knowledge of how sleep disorders affect young children. Also, you will be provided with a computerized printout which gives additional information about your child's sleep and tips to help improve his or her sleep habits.

Thank you,

Rachel Witte, M.A.

University of South Florida
School Psychology Program

Appendix C

Parental Permission Form

Dear Parent or Caregiver:

This letter provides information about a research study that will be conducted at Florida Diagnostic Resource System (FDLRS) screening locations by a school psychology graduate student from the University of South Florida. My goal in conducting the study is to determine the prevalence of sleep disorders symptoms in pre-school children and examine the relationship between sleep disorders symptoms and both academic performance and behaviors.

✓ Who I Am: I am Rachel Witte, M.A., a school psychology graduate student at the University of South Florida (USF)

✓ Why I am Requesting your Child's Permission: This study is being conducted as part of a project entitled, "The Relationship between Sleep Disorders, Behaviors, and Pre-academic Skills in Pre-Kindergarteners". Your child is being asked to participate because he or she is being screened through FDLRS.

✓ Why Your Child Should Participate: We need to learn more about sleep disorders in young children! The information that we collect from students may help increase our overall knowledge of the rate of sleep disorders symptoms in pre-kindergarteners and the relationship between symptoms of sleep disorders and behaviors and academic performance. In addition, you will be provided with additional information concerning your child's sleep and additional resources should you wish your child to be assessed more thoroughly. Please note neither you nor your child will be paid for your child's participation in this study.

✓ What Participation Requires: If you and your child participate in the study, during the 30 minute time period that you wait for your child to finish his or her FDLRS academic screening test, you will be asked to complete several forms. These forms include a short demographics form that takes approximately 3 minutes to complete, a behavior rating scale that will take approximately 10 to 12 minutes to complete, and a sleep questionnaire that takes approximately 8 to 15 minutes to complete. Another part of participation involves the access of the results to your child's academic screening

✓ Please Note: Your decision to participate and to allow yoru child to participate in this research study must be completely voluntary. You are free to allow your child to participate in this research study or to withdraw him or her at any time. If you choose not to participate, or if you withdraw at any point during the study, this will in no way affect your relationship with FDLRS, USF, or any other party.

✓ Confidentiality of Your Child's Response: There is minimal risk to your child for participating in this research. I will be present during administration of the scales in order to provide you with assistance and answer questions should concerns arise. Your child's privacy and research records will be kept confidential to the extent of the law. Authorized research personnel, employees of the Department of Health and Human Services, and the USF Institutional Review Board may inspect the records from this research project, but your child's individual responses will not be shared with school system personnel or anyone other than us and our research assistants. All information will be assigned a code number to protect the confidentiality of responses. All completed documents will be stored in a secure location which will be accessible only to me.

✓ What We'll Do With your Child's Responses: We plan to use the information from this study to inform educators and psychologists about the relationship between sleep disorders and behaviors and academic performance. The results of this study may be published. However, the data obtained from your child will be combined with data from other people in the publication. The published results will not include your child's name or any information that would in any way personally identify your child.

✓ Questions? If you have any questions about this research study, please contact me at (813)760-7870. If you have questions about your child's rights as a person who is taking part in this research study , you may contact a member of the Division of Research Compliance of the University of South Florida at 813-974-9343.

✓ Want your Child to Participate? To participate, please complete the attached form.

Sincerely,

Rachel Witte, M.A.
Department of School Psychology

Consent for Child to Take Part in this Research Study
I freely give permission to let my child take part in this study. I understand that this is research. I have received a copy of this letter and consent forms for my records.

_____   _____
Printed name of child   Grade level of Child

_____   _____
_____
Signature of parent   Printed name of parent   Date
of child taking part in the study

Statement of Person Obtaining Informed Consent

I certify that participants have been provided with an informed consent form that has been approved by the University of South Florida's Institutional Review Board and that explains the nature, demands, risks, and benefits involved in participating in this study. I further certify that a phone number has been provided in the event of additional questions.

_____   _____   _____
Signature of person   Printed name of person   Date
Obtaining consent   obtaining consent

Figure 1

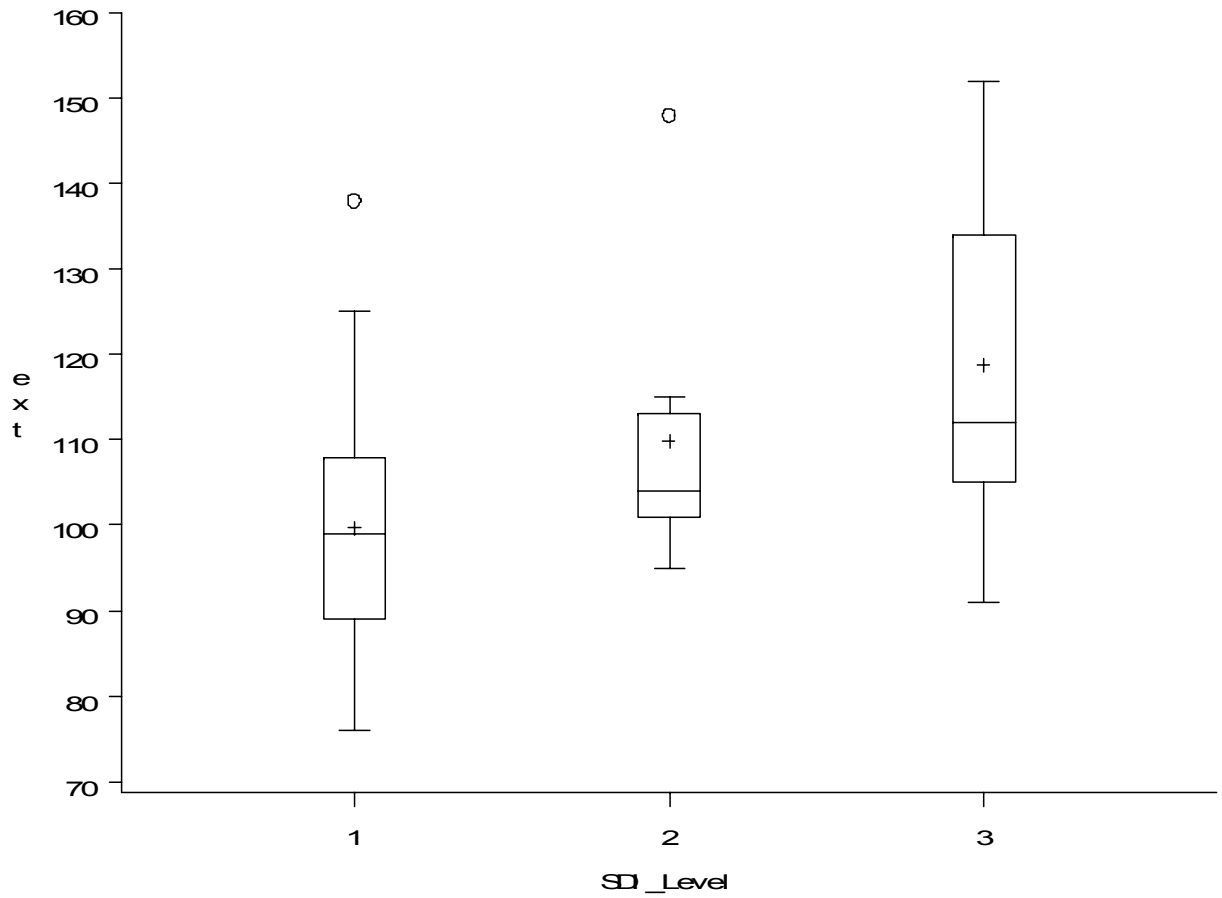# Distribution of Externalizing Problems Scores by Sleep Level

Figure 2

Distribution of Internalizing Problems Scores by Sleep Level

Figure 3

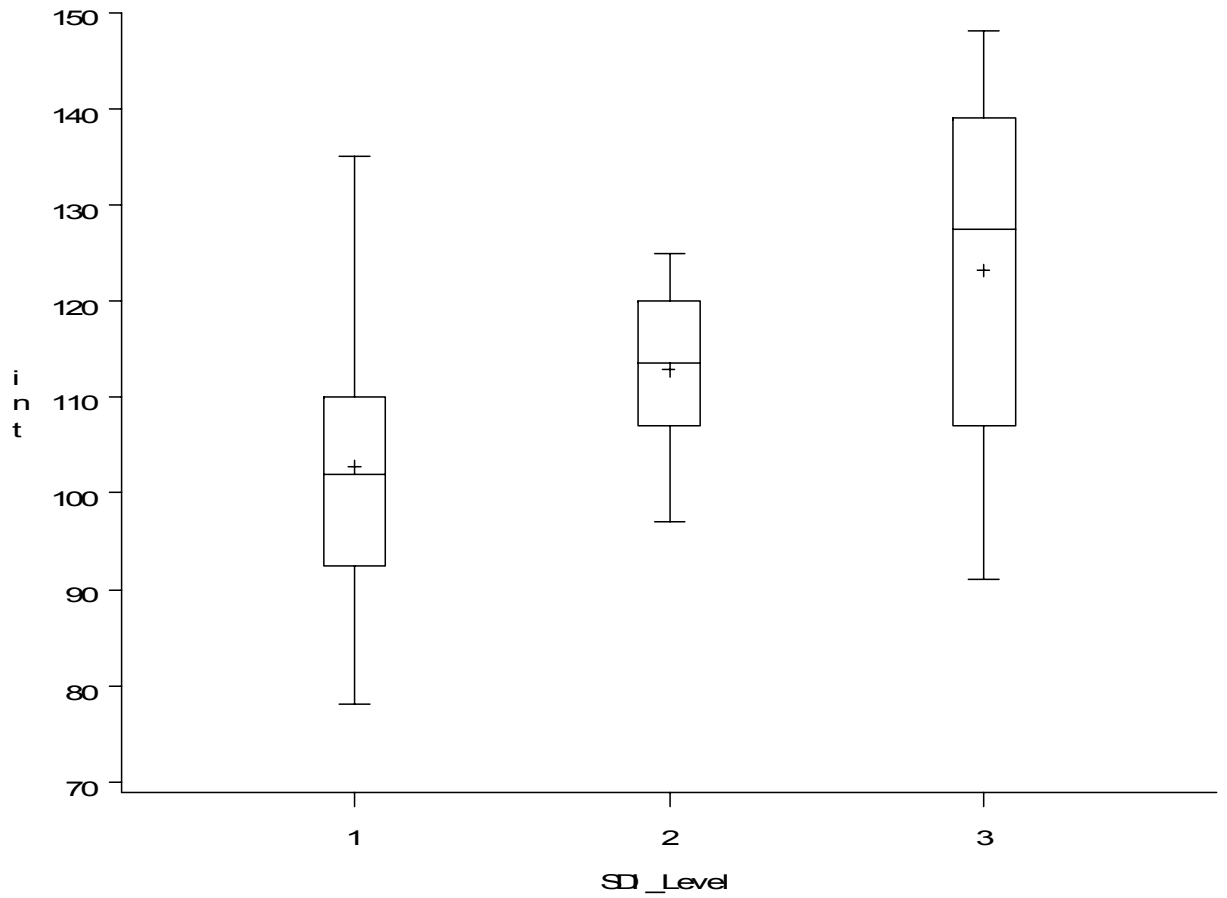

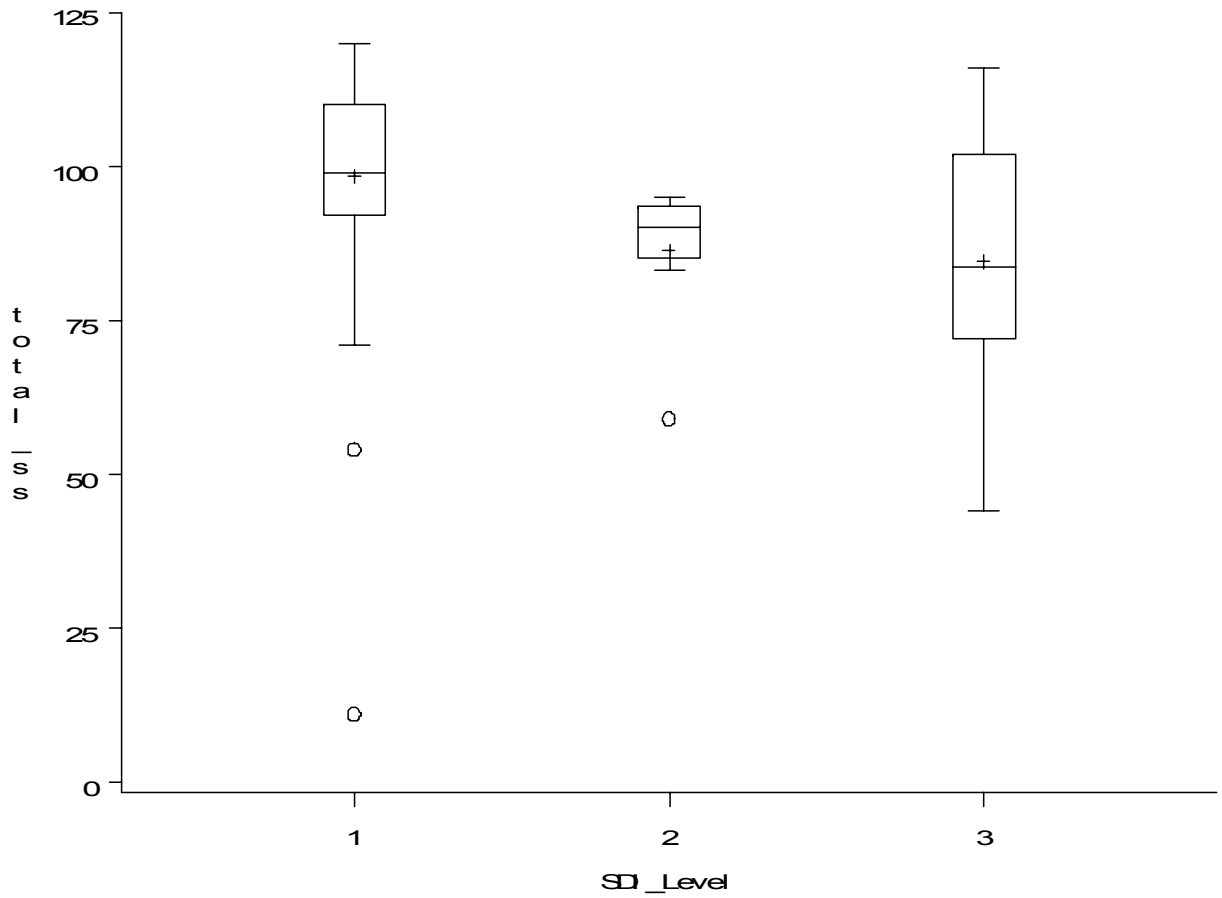Distribution of Social Skills Scores by Sleep Level

Figure 4.

Distribution of Pre-Academic Skills Scores by Sleep Level