Pediatric Sleep Disorders: Validation of the Sleep Disorders Inventory for Students

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Abstract. Approximately 20%–25% of the pediatric population will likely develop a sleep disorder sometime during childhood or adolescence. Studies have shown that untreated sleep disorders can negatively affect cognitive abilities, and academic and behavior performance. The Sleep Disorders Inventory for Students (SDIS) is a screening instrument designed to be used by school psychologists to determine if problems related to sleep may be affecting a student's educational performance. The SDIS was validated on 821 students in the southeastern United States and seven sleep centers nationally. This study presents the development of both forms of the SDIS, the SDIS—Children's Form and the SDIS—Adolescent Form, as well as the empirical data to support the reliability of the scores and the validity of the inferences. Practical implications for the use of the SDIS are discussed, and suggestions for future research related to the screening of pediatric sleep disorders are presented.

Most professionals working with children and adolescents have limited awareness of pediatric sleep disorders and the growing amount of medical research demonstrating the significant effect these disorders can have on students' cognition, achievement, and behaviors (Friedman, Hendeles-Amitai, & Kozminsky, 2003; Gozal, 1998; Montgomery-Downs, Crabtree, & Gozal, 2005; Taras & Potts-Datema, 2005). Results of a 1999 epidemiologic study suggested that 20%–25% of the pediatric population will develop a sleep disorder sometime in their childhood or adolescence (Mindell, Owens, & Carskadon, 1999).

Some sleep disorders will disappear during childhood (Owens, Spirito, McGuinn, & Nobile, 2000). However, in 2001, the National Institute of Health made a conservative estimate, based on numerous pediatric sleep studies, that 12%–15% of all students may have a sleep disorder impairing their daytime functioning that will not disappear without treatment. A random sample of 1,000 parents of elementary-school-aged students indicated that 43% of their children have had sleep difficulties lasting more than 6 months (Kahn et al., 1989). Twelve percent reported that their child was on a sedative to induce sleep, 14% reported a sleep delay longer than 30 min with at least one awakening in the night, and 3.4% said their child had failed at least one grade from sleep problems causing sleepiness or learning delays.

It is estimated that only 1%–3% of the pediatric population with a correctable sleep disorder are being referred, accurately diagnosed, and treated (Rosen, Zozula, Jahn, & Carson, 2001). Consequently, the average amount of time that may elapse from onset of a sleep disorder until time of diagnosis and treatment is usually many years, and often not until adulthood. This is partially because many pediatricians, psychologists, and other pediatric professionals have limited knowledge of pediatric sleep disorders and their negative effects on daytime performance and health (Owens, 2001). There is also a need for a pediatric sleep screening instrument with good structural validity and reliability that has been developed for use by school psychologists and other pediatric professionals in school and private practice settings. Without such a screening instrument for use by pediatric professionals to identify the large numbers of children with sleep disorders, many untreated sleep disorders are impairing students' achievement, interpersonal relationships, behaviors, and cognition, and in some cases even preventing high school graduation (Gozal, 1998; Taras & Potts-Detema, 2005; Urschitz et al., 2003). Because sleep disorders are not typically considered a possible cause for school or behavioral–emotional difficulties, numerous research findings suggest that some children

with sleep disorders may be inaccurately or prematurely identified as having a learning disability (Gozal, 1998; Guilleminault, Winkle, Korobkin, & Simmons, 1982; Urschitz et al., 2003), an emotional–behavioral disturbance (Dahl, Holttum, & Trubnick, 1994), attention deficit hyperactivity disorder (ADHD; Chervin, Dillon, Bassetti, Ganoczy, & Pituch, 1997; Picchietti et al., 1999), or other mental health disorders (Dahl et al., 1994). Although sleep disorders have significant costs to our society and far-reaching consequences on the child, the family, and the educational system, they are very treatable if identified (Mindell & Owens, 2003).

Sleep Disorders in Children and Adolescents

Five primary sleep disorders have been identified that impair children's cognition, academic performance, behavioral–emotional regulation, health, and/or safety: obstructive sleep apnea syndrome (OSAS), narcolepsy (NARC), periodic limb movement disorder (PLMD), restless legs syndrome (RLS), and delayed sleep phase syndrome (DSPS). The selection of these primary sleep disorders for a pediatric screening instrument was based on empirical research citing the high prevalence rates of these disorders and their significant impairment on daytime functioning (Carskadon, 1990; Kotagal & Silber, 2004; Johnson & Roth; 2006; Marcus, 2001), and the frequency of their diagnosis at the pediatric sleep centers participating in this study (Luginbuehl, 2004). When considering this cumulative information, it appeared that an instrument identifying OSAS, NARC, PLMD, RLS, and DSPS would screen approximately 87%–96% of the pediatric sleep disorders that impair daytime functioning (Luginbuehl, 2004). The following sections provide an overview of each of these five sleep disorders.

Obstructive Sleep Apnea Syndrome (OSAS)

OSAS is considered the most dangerous form of all sleep disorders if it goes undetected (Carroll & Loughlin, 1995). Most children

with OSAS have a breathing obstruction from enlarged tonsils and/or adenoids, which causes raspy breathing or light snoring in young children and loud snoring in teens (Carroll & Loughlin, 1992). This obstruction can result in belabored breathing or an absence of breathing for brief periods of time during sleep. This difficulty in breathing may result in waking the child from sleep or a deficit in oxygen intake during sleep.

The prevalence rate of OSAS in children under 8 years of age is believed to be approximately 2.5% (Marcus, 2001) and as high as 6% in adolescents (Johnson & Roth, 2006). Sixty-seven percent of children with Down syndrome have OSAS (Marcus, Keens, Bautista, von Pechann, & Davidson-Ward, 1991). Two epidemiologic studies indicated that African American children and men under 25 years of age are twice as likely to have OSAS as Caucasians of the same ages (Johnson & Roth, 2006), whereas Rosen (1999) reported that African American children were three times more likely to have OSAS than Caucasian or Hispanic American children.

Untreated OSAS may result in developmental delays (Carroll & Loughlin, 1992), significantly lower cognitive scores on intelligence measures (Friedman et al., 2003; Montgomery-Downs et al., 2005), lower grade point averages (Gozal, 1998; Johnson & Roth, 2006; Taras & Potts-Datema, 2005; Urschitz et al., 2003), and more behavior problems, including ADHD and depression (Chervin et al., 2002; Crabtree, Varni, & Gozal, 2004; Johnson & Roth, 2006).

Narcolepsy (NARC)

NARC may exist when an individual experiences excessive daytime sleepiness (EDS) throughout the day. In later adolescence, this EDS is usually accompanied by episodes of cataplexy, which is sudden loss of muscle tone when experiencing emotional duress or excitement (Lowenfeld, 1902). Other characteristics that may develop are sleep paralysis and hypnagogic hallucinations, which are vivid, frightening dream-like experiences that occur while falling asleep or awakening.

NARC typically has onset in adolescence, but in rare cases, it can begin in early childhood, with the primary symptom being EDS (Wise, 1998).

The exact prevalence rate of childhood or adolescent NARC is unknown because it develops gradually and is underdiagnosed (Wise, 1998). The only prevalence studies in the United States were done with adult populations several decades ago, reporting rates to be approximately 1 in 1,500 to 1 in 2,000 (Dement, Carskadon, & Ley, 1973).

There has been limited research focused on the affects of NARC on academic performance and behaviors. The existing research suggests that these children may make normal progress in early childhood and elementary school, but as the NARC and EDS increase with age, these students often experience a steady deterioration in academic performance by middle or high school (Wise, 1998). In a retrospective study of 180 narcoleptic patients, 51% attributed their poor or falling grades to EDS; 34% reported interpersonal problems with teachers because of poor work production, sleepiness, and memory problems; 25% experienced reoccurring suicidal thoughts; and 32% noted frequent embarrassment and social isolation in school because of ridicule from peers about their EDS and frequent sleep attacks (Broughton et al., 1981). NARC can become a very debilitating disorder if not identified and treated when it first develops (Wise, 1998). Teachers are often the first professionals to note and report these problems to parents, school psychologists, and physicians because of the EDS noted in class.

Periodic Limb Movement Disorder (PLMD)

PLMD "is characterized by the *periodic* (every 20–40 seconds) and *sustained* (0.5–4.0 seconds in duration) contractions" of one or both front leg muscles in the absence of perceived arousal (Mahowald & Thorpy, 1995, p. 118). These contractions result in repetitive jerks of the feet, legs, and/or thighs that occur during the night, disrupting the quality of sleep and often awakening the child (Mont-

plaisir, Godbout, Pelletier, & Warnes, 1994). Children with PLMD also experience problems falling asleep and remaining asleep throughout the night (Picchietti, England, Walters, Willis, &Verrico, 1998).

No exact pediatric prevalence rates have been determined for PLMD because, until the 1990s, this disorder was thought to exist only in adults. In two studies of students with reported ADHD, 25% of these children had PLMD in the first study (Picchietti et al., 1998) and 64% had PLMD in the second study, which used *Diagnostic and Statistical Manual of Mental Disorders, 4th Edition* (*DSM-IV*; American Psychiatric Association, 1994) criteria to diagnose ADHD (Picchietti et al.,1999).

There are no published research studies reporting the direct effect of PLMD on academic outcomes. However, three studies suggest that the primary effects of PLMD are ADHD-like characteristics (e.g., hyperactivity, distractibility, impulsivity), which impair school performance (Chervin et al., 2002; Picchietti et al., 1998, 1999).

Restless Legs Syndrome (RLS)

RLS is a frequently occurring leg movement disorder whereby the child experiences uncomfortable tingling leg sensations that cause irresistible urges to move the legs (Montplaisir et al., 1994). These uncomfortable sensations worsen when the child sits still or lies down at night. These sensations are partially relieved by frequent leg movements or kicking, which can disrupt sleep (The International Restless Legs Syndrome Study Group, 1995). Eighty percent of individuals diagnosed with RLS have PLMD (Montplaisir et al., 1994).

The National Sleep Foundation conducted three U.S. population studies on the prevalence rate of PLMD and RLS (1995, 1998a, 1998b). Prevalence rates of PLMD and RLS together ranged from 9% to 15% in the adult population. Prevalence rates of RLS in the pediatric population have been reported to be 6% (Kotagal & Silber, 2004).

"There is growing evidence that RLS may masquerade as 'attention deficit disorder

with hyperactivity' and 'growing pains'. . ." (Mahowald, Chokroverty, Kader, & Schenck, 1997, p. 82). Given the similarity in presentation of behaviors, it appears necessary that RLS and PLMD be ruled out as possible causes for ADHD-like symptoms.

Delayed Sleep Phase Syndrome (DSPS)

DSPS is a common form of insomnia found in adolescents when they cannot fall asleep until midnight or later, and then have difficulty awakening for school or staying awake in early morning classes (Weitzman, Czeisler, Coleman, Dement, & Pollack, 1979). DSPS is reportedly caused by biological changes in the circadian rhythm of the individual and is influenced by poor sleep habits or hygiene. Approximately 7% of adolescents develop a circadian rhythm (internal clock) longer than 24 hours and tend to stay up later on weekends and during vacation (Thorpy, Korman, Spielman, & Klovinsky, 1988). This results in waking later in the morning or taking afternoon naps, thus leading to very late sleep onset (Carskadon, 1990).

Students with DSPS are often absent, tardy, likely to sleep through early morning classes, and receive lower grades than peers who go to bed earlier and are alert in classes (Wolfson & Carskadon, 2003). Many of these adolescents tend to consume large amounts of caffeinated drinks in the evening, smoke, and/or engage in computer activities, video games, or watch television that are stimulating and delay sleep onset (Carskadon, Wolfson, Acebo, Tzischinsky, & Seifer, 1998). Forty percent of these students reported frequent use of alcohol or drugs to help fall asleep earlier (Roth, 1995). It is believed that many of these students may drop out of high school because of their inability to perform adequately in early morning classes (Thorpy, Korman, Spielman, & Klovinsky, 1988). Most attempts to move their sleep time earlier fail unless parents and professionals intervene with strategies to improve sleep habits (Roehrs & Roth, 1994).

Limitations of Present Sleep Screening Instruments

At the present time, there are two existing pediatric sleep screening instruments that have undergone validation. The first is the Children's Sleep Habits Questionnaire (Owens, Spirito, & McGuinn, 2000), which screens children from 4 through 10 years of age and provides a total score and eight sleep domain scores: (a) Bedtime Resistance, (b) Sleep Duration, (c) Parasomnias, (d) Sleep-Disordered Breathing, (e) Night Awakenings, (f) Daytime Sleepiness, (g) Sleep Anxiety, and (h) Sleep Onset Delay. This questionnaire was developed using children from one sleep clinic and three schools in the northeastern United States. The participants do not reflect the U.S. Census demographics and the Children's Sleep Habits Questionnaire is not designed to screen adolescents who also have many sleep problems and/or disorders needing treatment. It also does not screen for PLMD or RLS, which are prevalent in this population. Many of its scales have good validity, but the scales for the community sample have lower reliability coefficients than are desirable. The developer of this questionnaire reported that the primary purpose of the Children's Sleep Habits Questionnaire is to be used for research by pediatric sleep specialists, not for screenings by clinicians or school districts.

The second validated screening instrument is the Pediatric Sleep Questionnaire, which also was developed for use by pediatric sleep specialists (Chervin, Hedger, Dillon, Kenneth, & Pituch, 2000). The Pediatric Sleep Questionnaire provides a total score and five sleep scale scores: (a) Sleep-Related Breathing Disorder, (b) Snoring, (c) Sleepiness, (d) Behavior, and (e) PLMD. It does not screen for RLS, NARC, or DSPS, which are three of the major pediatric sleep disorders. The Pediatric Sleep Questionnaire was validated in two stages, but the sample sizes were fairly small ($n = 162$ and $n = 113$) and not representative of the U.S. Census demographics. The scales have exhibited good validity and reliability in the initial stage of development, with the exception of the PLMD scale's validity coeffi-

cient being less than desirable. There is only one instrument for children from 2 through 18 years old, which may be problematic. A more recent study suggested that there are significant sleep differences between younger children and adolescents (Luginbuehl, 2004). Using one instrument to screen both age groups may result in an underidentification of sleep disorders in young children and overidentification of sleep disorders in adolescents. Therefore, it appears that there is a need for a well-validated sleep screening instrument that is reflective of the U.S. Census demographics, can be used by any pediatric professional, screens for the five major pediatric sleep disorders, and provides separate forms for children and adolescents.

Purpose

In summary, initial research in the fields of sleep medicine and education strongly suggests that there are at least five pediatric sleep disorders that may significantly impair cognition, academic performance, and/or behavioral and psychosocial functioning of children and adolescents if not corrected. Consequently, there is a need for a nationally available screening instrument for use by all professionals working with children and adolescents to aid in the screening and identification of pediatric sleep disorders.

Presently, there are two pediatric sleep screening instruments that have been developed, but they are primarily for use by pediatric sleep specialists, and neither instrument screens for all five major pediatric sleep disorders. They both have some sampling problems, and one has numerous scales with lower than desirable reliability. Therefore, given the high number of children and adolescents with unidentified sleep disorders, there is a significant need for a sleep screening instrument with good psychometric qualities that can be used by professionals in the schools and private practice. To address this need, the Sleep Disorders Inventory for Students (SDIS) was developed as a parent-report sleep screening inventory created with one form for children from 2 through 10 years of age and a second

Table 1
Demographic Comparison of the Sample to the 2000 U.S. Census

Parameter	Frequency: Sample	Percent Sample	Percent U.S. Census
Ethnicity			
Caucasian	443	74.58	69.13
African American	59	9.93	12.06
Hispanic American	47	7.91	12.55
Multicultural	30	5.05	1.64
Asian American	11	1.85	3.60
Native American	2	0.34	0.74
Hawaiian/Pacific Islander	0	0.00	0.13
Other	2	0.34	0.17
Income			
<$25,000	148	24.87	28.68
$25,000–50,000	187	31.42	29.34
$50,001–80,000	141	23.69	~22.69
$80,001+	104	17.50	~19.29
No parent response	15	2.52	0.00
Educational attainment			
Less than 9th grade	16	1.4	7.5
9th to 12th grade, no diploma	74	6.5	12.1
High school grad (including GED)	386	34.1	28.6
Some college/technical school	96	8.5	21.0
Associate degree	196	17.3	6.3
Bachelor's degree	214	18.9	15.5
Graduate/professional degree	137	12.1	8.9
Unknown	17	1.5	0.0

form for adolescents from 11 through 18 years of age (Luginbuehl, 2004). The purpose of this investigation was to examine the structural and criterion-related validity of the SDIS and the accuracy with which this instrument predicts sleep disorder diagnoses made by sleep specialists.

Method

Participants

The sample consisted of 595 children with diversified family demographics (ethnicity, family income, and parent education) that closely reflected the 2000 U.S. Census data (see Table 1). Students from general education, gifted, and special education were included in this study sample as well as students with *DSM-IV* mental health diagnoses. There

were more elementary-aged children than other age groups because more children of this age were referred to psychologists and sleep centers (132 participants from 2 to 5 years old; 280 participants from 6 to 10 years old; 119 participants from 11 to 14 years old;61 participants from 15 to 18 years old).

Data collection (completed in 2002–2003) included children from four different regions of the United States: (a) The southern region included children from two sleep clinics in Florida and students from 45 schools in three school districts in west central Florida; (b) the mid-Atlantic region was represented by children from a sleep center in Baltimore, Maryland; (c) the midwest was represented by children from a sleep center in Urbana, Illinois; and (d) the western region was represented by participants from a sleep disorders

clinic in Stanford, California. All five sleep centers were American Academy of Sleep Medicine accredited, although the diagnostic criteria established in the American Academy of Sleep Medicine's International Classification of Sleep Disorders (2000) for OSAS was controversial at the time and varied somewhat among sleep centers when diagnosing younger children.

The study utilized five sampling groups: (a) a retrospective sample of 37 parents who responded to the mailing of the SDIS and demographic surveys; (b) a prospective sleep clinic sample of 146 parents whose children had been referred for an overnight study at one of the sleep centers and did not yet know if their child had a sleep disorder; (c) a sample of 255 students from 29 schools referred to school psychologists for a wide variety of learning or behavior concerns or gifted assessment; (d) a sample of 131 parents working in a variety of positions in the school district who agreed to complete the SDIS on their children; and (e) a sample of 26 parents of students referred for learning and behavioral concerns or gifted assessment to two psychology private practices in west central Florida. The retrospective sample consisted of children who had undergone an overnight sleep study at one of the participating sleep centers within the past 3–12 months. The majority of these children had been diagnosed with OSAS, PLMD, or NARC. The school samples were combined with the sleep study samples to obtain a group that would be as diverse in sleep characteristics as the group the SDIS was designed to screen.

Instrumentation

The SDIS was developed as a parent-report sleep screening inventory created for children and youth from 2 to 18 years of age (Luginbuehl, 2004). The items are based on characteristics of five sleep disorders (OSAS, NARC, PLMD, RLS, and DSPS), and are rated on a well-defined 7-point scale (1 = *the child never exhibits this behavior*; 2 = *child exhibits the behavior maybe once every month or two*; 3 = *child exhibits the behavior 3-to-4 times per month*; 4 = *child exhibits the behavior several times per week*; 5 = *child exhibits this behavior on a daily basis*; 6 = *child displays behavior multiple times per day or night*; 7 = *child exhibits behavior multiple times per hour daily or nightly*). Each item is rated across a broad range of time and behavioral frequencies to increase the reliability and specificity of the scales. The SDIS also has "lie detector items" to help professionals evaluate rater reliability. This was accomplished by selecting items that cannot be accurately rated with the extreme scores (6 or 7 points on this scale) because the behavior cannot occur that frequently (e.g., "Difficulty waking up child in the morning" can only occur once per day → 5).

The SDIS was refined through several stages. Fifty-four potential sleep items were initially developed based on an extensive review of the pediatric sleep research literature and recommendations from sleep specialists to describe the characteristics of the sleep disorders (Luginbuehl, 2004). The set of original items was reviewed by an expert panel of sleep specialists, school psychologists, and one measurement professor specialized in inventory development. This led to the revision, deletion, and addition of items. The six sleep experts on the panel then indicated whether each of the revised items described at least one of the five sleep disorders. The agreement for the retained items ranged from 67% to 100%, with an average agreement of 94%. The experts also indicated which sleep constructs the items described. The level of agreement for these decisions ranged from 67% to 100%, with an average level of agreement of 86% (Luginbuehl, 2004).

The resulting set of 43 items was then field tested with a sample of 226 children ranging in age from 2 to 18 years of age. An exploratory factor analysis suggested 5 underlying factors: OSAS, PLMD, NARC/RLS, DSPS, and EDS. The results of the field test also suggested the parents' ratings for the younger groups (2–5 years old and 6–10 years old) differed from the older groups (11–14 years old and 15–18 years old), and thus called

into question whether the factor structure may vary across groups (Luginbuehl, 2004).

The sleep centers used polysomnography (PSG), which is equipment that measures many physiological features of the child's sleep, such as heart rate, the Respiratory Distress Index (RDI), or number of complete or partial pauses in breathing during sleep (resulting in insufficient amounts of oxygen circulating through the brain and body), types of brain waves indicating stages of sleep, and periodic limb movements (Carroll & Loughlin, 1995). The RDI score for each child was correlated with the SDIS: OSAS total score and the snoring item. The periodic limb movements were correlated with the SDIS:PLMD total score.

Procedures

For the school and private practice samples, a packet was completed by the parent or guardian of each student when he or she came into the school or private practice to obtain the results of the child's evaluation. The packet contained (a) the 43-item version of the SDIS, (b) a consent form, and (c) a family survey requesting demographic information about the parents' address, education level, annual income, ethnicity, primary language, as well as the student's grade point average, behaviors, educational classification, and medical or psychiatric diagnoses. The psychologists did not record the parent nonresponder rate, but they reported that the responder rate was almost 100% because these parents wanted more information about their child's problems.

To obtain a school sample that was more reflective of the U.S. school demographics than the group being assessed by the school psychologists, all employees with children in three randomly selected schools in Pasco County, Florida, were assembled to explain the study and asked if they would complete the packet on their children and return them to the school psychologists. Ninety-two percent of the school employees with children agreed to participate and were included in the study.

For the prospective sleep center samples, parents completed the same packet with the addition of a medical release consent form. After the sleep study was completed, sleep technicians or secretaries returned the packets by mail. They reported the students' sleep study (PSG) scores, sleep diagnoses, and recommended treatment. Sleep centers did not record the percentage of nonresponders, but reported that a high percentage of parents participated.

For the retrospective sample, the packets were mailed. The SDIS was slightly modified before it was administered (written in past tense with an additional response of 0 = *Don't remember*). In addition, the retrospective instructions were modified to ask the parent to complete the inventory "based on your child's behaviors during the 6-to-12 months before your child received an overnight sleep evaluation" as opposed to "based on your child's behaviors only over the past 6-to-12 months."

The retrospective group had a poor return rate (37 out of 167) because of many returned packets with "address unknown" or parents reporting lack of time to read complex hospital consent forms. A preliminary analysis was conducted comparing the retrospective parents' responses to the prospective responses on the SDIS. The mean total score for the retrospective group mean was 136.54 with a standard deviation of 42.52. The prospective group mean was 135.25 with a standard deviation of 34.82. The difference between the two means was not statistically significant. Descriptive analyses of SDIS subscale means and standard deviations were compared for both groups even though the sample sizes for all retrospective groups were too small to be statistically analyzed after they were divided into age and sleep diagnosis groups. However, it did not appear that there were significant differences between the two groups based on similarity of subscale group means and variances. Therefore, to ensure a larger sample size of students with diagnoses of NARC and PLMD, the retrospective sample was included.

Among all samples, there were 42 children whose parents spoke Spanish as their primary language. These parents completed Spanish translations of the SDIS, the consent form, and the demographic data form. These

forms were translated by two Spanish-speaking professionals, one who was experienced in hospital translation of medical terminology and demographic data from English to Spanish for surveys, and one who was a bilingual psychologist familiar with Spanish terminology used on behavior rating scales. These ratings were included after descriptive analyses showed no notable differences between Spanish- and English-speaking parent responses when comparing the subscale means and standard deviations for both groups. Therefore, to ensure a larger sample size of students with and without sleep diagnoses, the Spanish sample was included.

Results

Structural Validity

Younger age group—Exploratory factor analysis (EFA). Data from the samples were separated into the 2- to 10-year age group ($n = 412$) and the 11- to 18-year age group ($n = 182$) based on results of the field test EFA suggesting that there might be differences in rating of item severity between the two age groups. The younger age group was then randomly split into two subsamples. The first of these subsamples ($n = 188$) was used for an EFA to determine if the factor structure was different for younger children than the five-factor model that had emerged during field testing when all ages were combined. The remaining subsample of 201 children was saved for a confirmatory factor analysis (CFA).

The EFA was estimated using principal axes methods with initial communality estimates based on the squared multiple correlations. The choice of common factor analysis over principal components analysis was based on the desire to focus on the common variance and thus gain insight into the latent variables whose effects were reflected in the responses to the 43 SDIS items. The communality estimates, shown in Table 2, ranged widely from a low of 0.11 for headaches to a high of 0.70 for late sleep onset on week nights. A visual inspection of the scree plot suggested four factors be retained (see eigenvalues in the footnote of Table 2). Four factors accounted for 70% of the common variance and led to a more interpretable solution than solutions based on greater numbers of factors.

Promax rotation was used to obtain an oblique solution because it was anticipated that excessive daytime sleepiness may arise as a factor, as it had in the field test, and this factor would theoretically have positive relationships with other factors. The factor correlations, which are positive and low to moderate, are reported in Table 2. Also reported in Table 2 are both the pattern coefficients and the structure coefficients. The pattern coefficients led to the labeling of the four factors as OSAS, EDS, PLMD, and DSPS, and the factors uniquely accounted for similar amounts of the variance (values of 3.61, 2.90, 2.30, and 2.69, respectively). Because NARC usually has onset after 9 years of age and the first symptom is EDS, parents of young children with a diagnosis of NARC only rated their children significantly on the EDS items and did not endorse most NARC items. Parents also did not endorse the questions for RLS for this young age group. Eight of the items had pattern coefficients <.35, which suggested these items could be deleted for children because of poor item discrimination (e.g., "Child wets bed at night," "Takes daytime naps").

Younger age group—CFA. A CFA with maximum likelihood estimation was conducted using the sample of 201 children in the younger group who had not been used in the EFA. The initial model was based on the results of the EFA. The 8 items that had low pattern coefficients were not included in the model. Four correlated factors were used to model the remaining 35 items, whereby each item was explained by a single factor, the one for which it had the greatest pattern coefficient in the EFA. This initial model resulted in inadequate fit indices. For example, the comparative fit index (CFI) and the non-normed fit index (NNFI) were in the .70's, which is substantially below recommended guidelines of .9 or higher. Based on these results, a series of modifications were made to improve fit.

Ten items were deleted that had R^2 values lower than .30 because they were not

Table 2
Results from EFA—Young Group: Principal Axis Factor Analysis with Promax Rotation

Shortened Item	OSAS P	OSAS S	EDS P	EDS S	PLMD P	PLMD S	DSPS P	DSPS S	h^2	Deleted Items
1. Stops breathing 5+ s	**.76**	.77	.20	.43	−.18	.15	−.02	.01	.64	
2. Mouth breather/daytime	**.66**	.62	−.10	.17	−.08	.21	.11	.15	.40	
3. Mouth breather/nighttime	**.71**	.70	.13	.20	−.27	.32	−.01	.17	.51	
4. More sleepy in daytime	.00	.34	**.79**	.82	.09	.38	.01	.19	.69	
5. Difficulty arising in a.m.	−.06	−.21	**−.30**	−.36	−.08	−.23	−.05	−.15	.15	Deleted
6. Unable to talk when waking	.14	.37	**.34**	.47	.28	.42	−.08	.10	.32	Deleted
7. Leg jerks and movements	.28	.47	.14	.38	**.43**	.54	−.12	.09	.41	
8. Raspy breathing/light snoring	**.71**	.70	−.22	.13	.19	.37	.01	.10	.54	
9. Loud snoring	**.82**	.83	−.01	.32	.04	.31	−.04	.05	.68	
10. Confusion on awakening	.32	.59	**.46**	.67	.25	.52	−.03	.18	.63	
11. Rolls around bed	**.37**	.49	−.05	.24	**.42**	.52	−.03	.14	.38	
12. Awake past 1:00 a.m.	−.11	.12	.27	.36	−.15	.16	**.50**	.51	.35	
13. Gasps/chokes/snorts in sleep	**.79**	.81	.13	.41	−.07	.25	.01	.08	.68	
14. Bed wetting	.07	.21	.14	.24	−.27	.31	−.08	.04	.13	Deleted
15. Sweats a lot in sleep	**.51**	.59	−.03	.24	**.31**	.40	−.20	.05	.42	
16. Irritable upon awakening	.08	.37	.27	.50	**.51**	.66	.07	.31	.52	
17. Restless leg pain in child	.10	.28	**.46**	.38	.28	.37	.10	.23	.22	
18. Restless leg pain in parent	.06	.22	.11	.26	**.32**	.40	.07	.21	.18	Deleted
19. Tired in a.m./alert in p.m.	.03	.24	**.36**	.46	.14	.35	.20	.32	.28	
20. Sleeps in strange positions	**.56**	.61	.08	.31	.06	.26	−.06	.02	.38	
21. Attacks of muscle weakness	.10	.24	**.42**	.47	−.13	.16	.27	.32	.29	
22. Heavy breathing while sitting	**.72**	.72	.11	.36	−.15	.18	.09	.12	.55	
23. Accident-prone	.28	.47	.07	.36	**.45**	.60	.09	.28	.45	
24. Awakens in the night	.05	.29	.26	.44	**.39**	.54	.11	.31	.37	
25. Tired after enough sleep	−.06	.31	**.70**	.78	**.31**	.52	−.06	.18	.67	
26. Vivid, frightening dreams	.19	.38	.24	.44	**.48**	.47	.18	.34	.36	
27. Skips or late for early classes	−.03	.17	**.39**	.45	.12	.30	.13	.25	.24	
28. 30+ min to go to sleep	−.09	.12	.01	.22	**.51**	.61	**.37**	.54	.50	
29. Falls asleep talking/standing	.04	.26	**.64**	.62	−.09	.15	.00	.09	.39	
30. Difficulty shifting slp onset earlier	−.07	.06	.27	.34	−.09	.22	**.66**	.67	.51	
31. Headaches	.15	.25	.14	.26	.11	.24	.08	.16	.11	Deleted
32. Strange automatic behaviors	−.04	.14	.19	.32	.25	.40	.25	.37	.25	Deleted
33. Dry mouth upon awakening	.29	.42	.07	.29	.25	.40	.06	.18	.26	Deleted
34. Difficulty breathing at night	**.42**	.46	.25	.34	−.16	.05	.06	−.03	.27	
35. Sleeps more in daytime	−.07	.26	**.86**	.82	−.03	.24	−.06	.09	.67	
36. High activity level	−.07	.13	−.14	.09	**.71**	.65	.04	.26	.45	
37. Touchy and temper tantrums	−.08	.22	.09	.33	**.76**	.76	−.03	.25	.60	
38. Noncompliant	−.09	.17	−.03	.21	**.80**	.75	−.01	.25	.57	
39. Late sleep onset—week nights	−.11	.02	.09	.23	.09	.36	**.78**	.82	.70	
40. Late sleep onset—weekends	−.08	.02	.04	.18	.06	.32	**.77**	.80	.64	
41. Amount of sleep—week nights	−.03	−.09	.05	−.12	−.03	−.29	**−.76**	−.76	.58	
42. Amount of sleep—weekends	−.18	−.13	**.34**	.11	−.10	−.26	**−.63**	−.62	.48	
43. Daytime naps	**.30**	.37	.19	.29	.03	.15	−.15	−.07	.18	Deleted

Factor correlations					
	OSAS	1.00			
	EDS/NARC	.39			
	PLMD/RLS	.35	.36		
	DSPS	.08	.19	.36	
Unique variance for each factor		3.61	2.90	2.30	2.69

Note: EFA = Exploratory factor analysis; P = pattern coefficient; S = structure coefficient; h^2 = communality estimate; OSAS = obstructive sleep apnea syndrome; EDS/NARC = excessive daytime sleepiness/narcolepsy; PLMD/RLS = periodic limb movement disorder/restless legs syndrome; DSPS = delayed sleep phase disorder. Pattern coefficients greater than |.30| are in bold. Decision to retain four factors based on fit with theoretical model, 70% variance explained criterion, and visual examination of scree plot. The first 10 eigenvalues prior to rotation were 10.72, 3.83, 2.21, 1.82, 1.18, 1.13, 1.07, .99, .89, .78.

discriminators of sleep disorders in younger students (e.g., "Child stayed up past 1:00 a.m. on school nights," "Child skipped or was late for early classes due to difficulty waking up"). In addition, 9 items appeared to measure two or three factors, suggesting some of the indicators were not unique to a single factor. Additional paths were added for these items. Finally, error correlations were added for six pairs of items, indicating the relationship between these items exceeded what could be accounted for by the four factors (e.g., "Mouth breather during the day" and "Mouth breather during the night" had errors that correlated, suggesting the 2 items shared more than the common factor of OSAS). The revised model is shown in Figure 1.

After these modifications were made, the χ^2 was still statistically significant ($\chi^2[250, n = 188] = 366.88, p < .05$), but the descriptive fit indices suggested acceptable levels of fit using commonly recommended guidelines. The relative fit indices, CFI and NNFI, were both at .95 or higher (CFI = .96, NNFI = .95). The root mean square error of approximation (RMSEA), which is a global measure adjusting for parsimony, also indicated a good fit ($<.05$).

The standardized results from the final four-factor model, which measured OSAS, PLMD, DSPS, and EDS, are shown in Figure 1 (the unstandardized results with standard errors are available from the first author). The correlations among the factors were positive and ranged from .19 to .66. The R^2 values, indicating the proportion of item variance associated with the factors, ranged from .30 to .92, showing moderate to strong item to factor associations. The standardized path coefficients show that 11 items are indicators of OSAS, 11 items are indicators of PLMD, 4 items are indicators of DSPS, and 7 items are indicators of EDS.

The 25 items in the final model were included in the SDIS Children's Form (SDIS-C) provided in Appendix A. The fit indices and item to factor relationships are in the acceptable range, and the finding that some indicators of sleep problems are not unique to a particular sleep problem is plausible. However, the added complexity calls into question the degree to which responses to this instrument can be used to make valid inferences about a particular sleep disorder. The results from the predictive validity analyses help to address this question.

Older age group—CFA. The adolescent sample, 11- to 18-year age group, was smaller ($n = 182$) and could not be split for EFA and CFA analyses. Consequently, only CFA with maximum likelihood estimation was conducted for the adolescent sample. The initial model was a correlated, five-factor (OSAS, NARC, PLMD, DSPS, EDS) model based on the results of the field test reported by Luginbuehl (2004). In the field test, 3 of the items (i.e., "Sweats excessively in sleep," "Complains of headaches," and "Complains of a dry mouth upon awakening") were noted to have pattern coefficients of <.35 for all factors. These items were not included in the CFA model. Each of the remaining 40 items was represented by the factor with which it had the highest pattern coefficient. This initial CFA resulted in inadequate fit indices (e.g., CFI and NNFI in the .60's and .70's).

As with the younger sample, modifications were made to improve fit. Ten items that were poor measures of the sleep domains ($R^2 < .30$) were deleted, 15 items were allowed to function as indicators of two or more factors, and 9 pairs of item errors were allowed to correlate. The final model is shown in Figure 2. With this model, the χ^2 was still statistically significant ($\chi^2 [352, n = 182] = 517.98, p < .05$), but the descriptive fit indices suggested good fit between the model and the data (CFI = .95, NNFI = .94, RMSEA = .05).

The standardized results from the final model are shown in Figure 2 (the unstandardized results with standard errors are available from the first author). The correlations between factors were positive, with estimates ranging from .12 to .46. The factor structure differs somewhat from what was found in younger children. Instead of four factors, five factors were measured: OSAS, NARC, PLMD/RLS, DSPS, and EDS. These factors are indicated by 8 items, 13 items, 9 items, 8 items, and 11 items, respectively. The standardized path coefficients show

moderate to strong relationships among items and factors, as do the R^2 values, which range from .33 to .86.

The 30 items in the final model were included in the SDIS Adolescent Form (SDIS-A), which is provided in Appendix B. The fit indices and the strength of the item to factor

relationships are in the range one would anticipate, and the finding that some indicators of sleep problems are not unique to a particular sleep disorder seems plausible. The added complexity, however, again calls into question the degree to which responses to the items on this instrument can be used to make valid
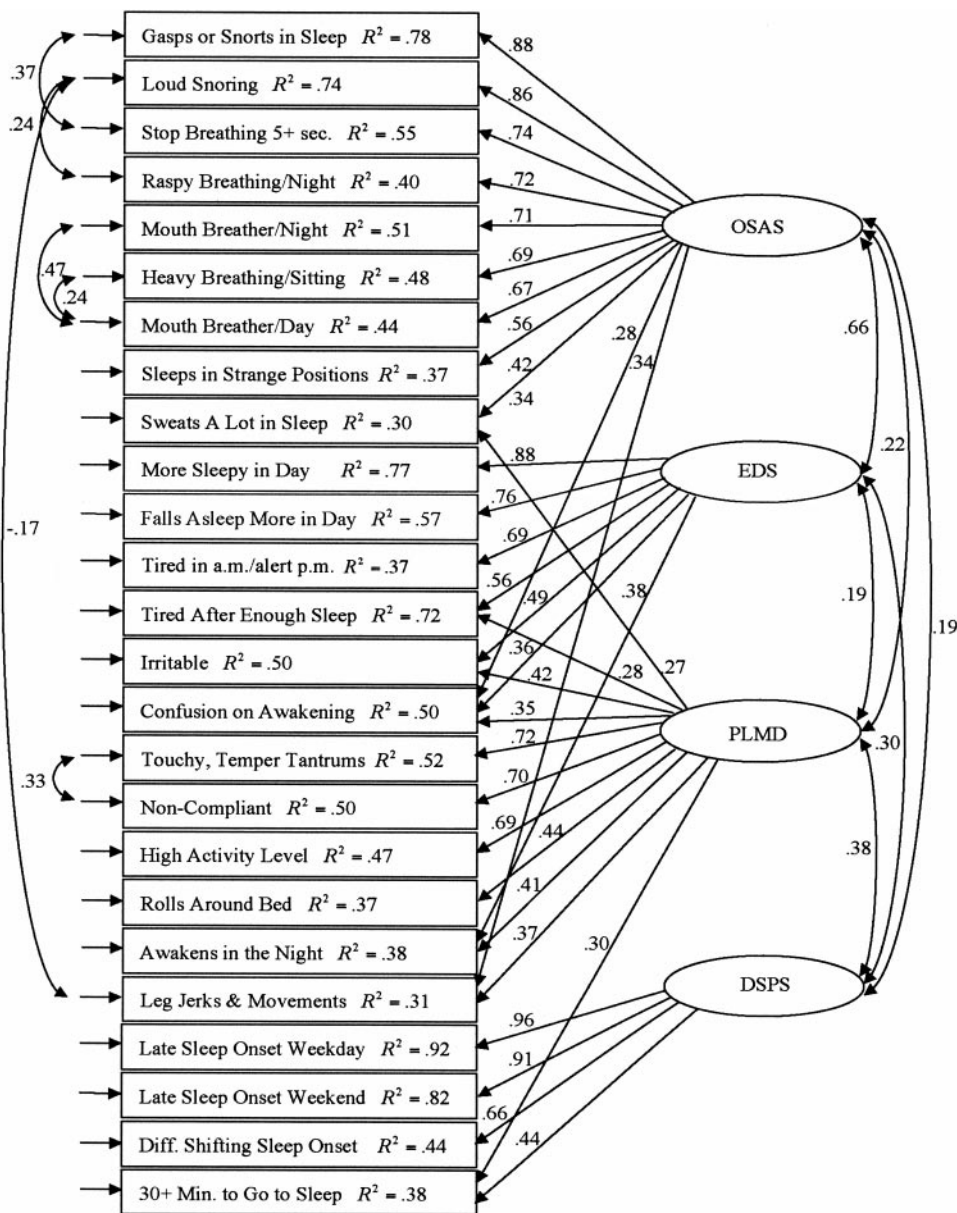

Figure 1. Standardized solution for the confirmatory factor analysis of the Sleep Disorders Inventory for Students—Children's Form.
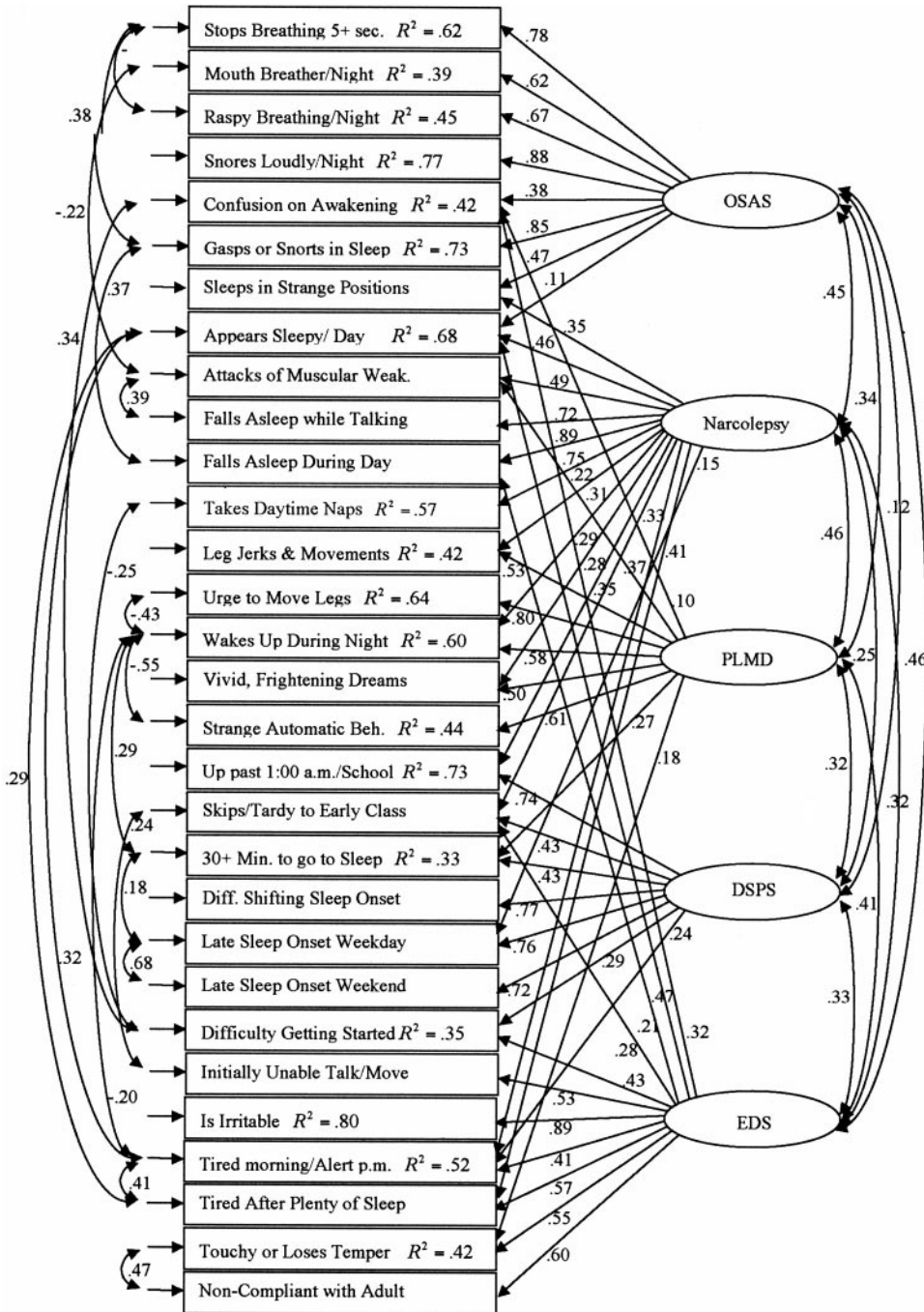
Figure 2. Standardized solution for the confirmatory factor analysis of the Sleep Disorders Inventory for Students—Adolescent Form.

inferences regarding a particular sleep disorder. Again, the predictive validity analyses will help to address this question.

Reliability

The final SDIS-C and SDIS-A subscales were assessed for internal consistency reliability using Cronbach's alpha. Total scale reliability coefficients for the SDIS-C and SDIS-A were .91 and .92, respectively. The SDIS-C subscale reliabilities were estimated to be .90 for OSAS, .84 for EDS, .85 for PLMD, and .76 for DSPS. For the SDIS-A subscales, OSAS was .88, .92 for NARC, .83 for PLMD/RLS, .71 for DSPS, and .83 for EDS.

Test–retest reliability was also assessed for a small subsample of the participants (30 SDIS-C and 24 SDIS-A) selected randomly from all samples, except the retrospective or prospective participants who had received treatment that could have altered responses. Although the time that normally elapses for test–retest is 2–4 weeks, the lapse in time between test and retest was 2–6 months because of delays in professionals returning the first SDIS completed. The SDIS-C had a stability coefficient of .97 ($p < .0001$), and the SDIS-A coefficient was .86 ($p < .0001$), despite the long time delays.

Validity

Concurrent validity was assessed using Pearson correlations to compare the sleep study samples' PSG RDI with the OSAS scale of the SDIS. A positive correlation of .33 ($p < .0005$) was found for the sample of 106 sleep study cases of children. For the sample of 48 sleep study cases of adolescents, the correlation was .57 ($p < .0001$).

Correlations were also examined for the relationship of the PSG Snore Index (snoring severity) and the SDIS item (". . . snores loudly at night."). The Pearson correlation coefficient for the SDIS snoring item with the PSG Snore Index was .43 ($p < .0001$) for 98 children and .64 ($p < .0001$) for 43 adolescents. The PLMD, RLS, NARC, and DSPS sample sizes were too small to obtain accurate

concurrent validity coefficients with PSG or NARC Multiple Sleep Latency Test (which measures the speed of falling asleep).

The sensitivity, specificity, Positive Predictive Power (PPP), and Negative Predictive Power (NPP) were measured by examining the degree to which the sleep factor scores on the SDIS-C and -A predicted sleep specialists' diagnoses of sleep disorders using both the retrospective and prospective hospital cases. If the sleep specialists were uncertain about a child's diagnosis, or if they made other medical diagnoses for which the SDIS did not screen (e.g., nocturnal seizure disorder, epilepsy, and so forth), these cases were omitted from the analyses. If a sleep specialist made more than one sleep diagnosis that was screened by the SDIS, both sleep disorders were calculated into the predictive validity.

A cutoff T score of ≥ 65 was chosen because most of these sleep disorders have a prevalence rate $\geq 2\%$ of the population, and a T score of 70 would only include about 2% of the population, resulting in too many false negatives. Using the cutoff level of ≥ 65, the SDIS predicted membership into one of six categories based on sleep center diagnoses and the school or private practice groups: (a) OSAS-diagnosed (dx) group, (b) PLMD or PLMD/RLS-dx group, (c) NARC-dx group, (d) DSPS-dx group, (e) no sleep study—general education group, and (f) no sleep study—special education group.

The no sleep study group had three times more participants in the 6- to 10-year age range than the other three age ranges because this was the typical age for children to be referred to psychologists or sleep centers for evaluation. Therefore, approximately 33% of these cases were randomly selected for analyses. These school samples also were divided into general education and special education groups because previous studies have reported more sleep problems or disorders, especially OSAS, in children with learning or behavior problems (Ax, 2006; Montgomery-Downs et al., 2005).

Table 3
Sensitivity, Specificity, Positive Predictive Power, and Negative Predictive Power Results for the SDIS-C and SDIS-A Forms, Hospital-Diagnosed Samples

Sleep Disorder	Number with Diagnosis	Sensitivity	PPP	No Diagnosis	Specificity	NPP
SDIS-C						
DSPS	5	1.00	.71	88	.98	1.00
NARC	5	.80	.67	90	.98	.99
OSAS	53	.91	.75	42	.62[a]	.84
PLMD/RLS	14	.50[b]	.54	80	.93	.91
Total	77	.83	.71	300	.91	.95
SDIS-A						
DSPS	7	1.00	.78	40	.95	1.00
NARC	8	.88	.70	39	.92	.97
OSAS	21	.86	.86	26	.88	.88
PLMD/RLS	11	.55[b]	.75	36	.94	.87
Total	47	.81	.79	141	.93	.94

Note: SDIS-C = Sleep Disorders Inventory for Students—Children; SDIS-A = Sleep Disorders Inventory for Students—Adolescents; PPP = positive predictive power; NPP = negative predictive power; DSPS = delayed sleep phase syndrome; NARC = narcolepsy; OSAS = obstructive sleep apnea syndrome; PLMD/RLS = periodic limb movement disorder/restless legs syndrome; RDI = Respiratory Distress Index.
[a]Sleep centers used varying RDI criteria to diagnose children's OSAS that lowered specificity of the SDIS-C: OSAS scale.
[b]One night of PLMD measures used at the time of this study may not have been as accurate as multiple night measures, bringing these results into question.

SDIS-C. There were 77 children (2–10 years of age) in the hospital-diagnosed sample that were diagnosed with one of the four sleep disorders that the SDIS-C was designed to measure. There were 142 children in the no sleep study groups (general education = 109; special education = 36). The overall SDIS-C sensitivity for the hospital-diagnosed sample was 0.83 and the overall specificity was 0.91 (see Table 3). In other words, when the sleep study diagnosed a specific sleep disorder, the SDIS-C agreed 83% of the time. When the sleep study did not diagnose a specific sleep disorder, the SDIS-C agreed 91% of the time. All of the sleep scales except PLMD had good sensitivity: DSPS = 1.00, NARC = 0.80, OSAS = 0.91, and PLMD = 0.50. The scales had high specificity except for the OSAS scale: DSPS = .98, NARC = .98, OSAS = .62, and PLMD = .93.

PPP was also calculated on the hospital sample to determine the chances that a child who receives an abnormal score actually has that specific sleep disorder. The same calculations were conducted for NPP to determine the chances that a child does not have a specific sleep disorder when the SDIS score is within the normal range. For example, Table 3 shows that if the child's SDIS:DSPS score was within the abnormal range, there was a 71% chance (PPP) that the child had DSPS. If the child's DSPS score was within the normal range, then there was a 100% chance (NPP) that the child did not have DSPS. The SDIS-C was very accurate at predicting when the child did not have a specific sleep disorder. It was

Table 4
Percentage of Participants in Preschool and School Samples Identified with a Sleep Disorder by the SDIS-C and SDIS-A Forms

	SDIS-C			SDIS-A		
Disorder	Gen Ed[a] (*N* = 106)	Spec Ed (*N* = 36)	Total (*N* = 142)	Gen Ed (*N* = 92)	Spec Ed (*N* = 37)	Total (*N* = 129)
DSPS	2.8	8.3	4.2	2.2	10.8	4.7
NARC	0.0	0.0	0.0	1.0	2.7	1.6
OSAS	15.0	25.0	17.6	2.2	13.5	5.4
PLMD/RLS	4.7	8.3	5.6	2.2	0.0	1.6
Total	22.6	41.7	27.5	7.6	27.0	13.2

Note: SDIS-C = Sleep Disorders Inventory for students—children; SDIS-A = Sleep Disorders Inventory for students—Adolescents; *N* = sample; Gen Ed = general education students; Spec Ed = special education students; DSPS = delayed sleep phase syndrome; NARC = narcolepsy; OSAS = obstructive sleep apnea syndrome; PLMD/RLS = periodic limb movement disorder/restless legs syndrome. [a] This sample has more children with learning and/or behavior problems than is represented in general education nationwide.

moderately accurate when predicting the exact sleep disorder. Even for the cases in which the SDIS-C or SDIS-A predicted the wrong sleep disorder, the child often had a sleep disorder of some type and needed a comprehensive sleep evaluation.

For the no sleep study sample (Table 4), combining general education and special education students, the SDIS-C predicted that 27.5% of this group had a high probability of a sleep disorder, which is slightly higher than a prevalence study suggesting that 20%–25% of elementary-school-aged children are reported by parents to have significant sleep problems or disorders (Mindell et al., 1999). The SDIS-C prediction rates of PLMD (5.6%), NARC (0.0%), and DSPS (4.2%) are consistent with previous findings. The SDIS-C predicted rate of OSAS for this school sample of 17.6% was significantly higher than past reports of OSAS prevalence rates ranging from 2% to 3% in children under 8 years of age.

SDIS-A. There were 47 hospital-diagnosed cases and 129 adolescents from the no sleep study group (general education = 92; special education = 37). The overall sensitiv-

ity for the SDIS-A hospital-diagnosed sample was 0.81 and the overall specificity was 0.93. All of the sleep scales except PLMD had good sensitivity: DSPS = 1.00, NARC = 0.88, OSAS = 0.86, and PLMD/RLS = 0.55. The sleep scales had the following specificity: DSPS = .95, NARC = .92, OSAS = .88, and PLMD = .94. The PPP for the SDIS-A ranged from 0.70 to 0.86 and the NPP ranged from 0.87 to 1.0.

For the no sleep study sample of general education and special education students combined, the SDIS-A predicted that 13.2% of this group had a high probability of a sleep disorder. The SDIS-A predicted the following rates of specific sleep disorders in this sample: PLMD = 1.6%, NARC = 1.6%, OSAS = 5.4%, and DSPS = 4.7%. The percentage of OSAS is consistent with previous findings, but the rate of NARC is slightly higher, and the rates of PLMD and DSPS are significantly lower. It is believed that some survey reports of PLMD and DSPS prevalence rates have been too high because these symptoms were really caused by undetected OSAS, which causes excessive periodic limb movements and difficulty falling asleep in some adoles-

cents. If this study would have counted the SDIS-A cases where OSAS was escalating the PLMD and DSPS scales, then the rates would have been similar to previous prevalence study estimates and ~4% higher for both PLMD and DSPS. When considering the results of the SDIS predictions for the no sleep study groups across sleep scales and ages, the rate of predicted sleep disorders doubled for the students in the special education groups compared to the rates for students in general education, except for PLMD/RLS in adolescents (see Table 4).

Interestingly, 49% of the participants with medical diagnoses of one or more sleep disorders were in special education, which exceeds the national average of 12%–14%. Furthermore, the SDIS predicted that 41.7% of the younger special education group and 27% of the adolescent special education group had a high probability of a sleep disorder. These initial findings substantiate accounts by others (Gozal, 1998; Montgomery-Downs et al., 2005; Witte, 2006) reporting sleep problems or sleep disorders to be very common in children with learning or behavior problems.

Discussion

The purpose of this study was to develop and validate the SDIS, the only comprehensive sleep screening instrument available for use by all pediatric professionals to help identify five major sleep disorders in children and adolescents that significantly impair their achievement, behaviors, and/or cognitive functioning. The SDIS was developed with the assistance of many leading pediatric sleep specialists. The analysis of structural validity suggested the instrument was more complex than originally anticipated, with multiple items indicating more than one sleep disorder. These dual or multiple loadings are because some sleep disorders share similar symptoms (e.g., OSAS and PLMD both cause frequent movements in sleep, sweating, EDS). As a result, the SDIS-C and -A were accurate in predicting that a child had no sleep disorder or a significant sleep disorder needing a compre-

hensive sleep evaluation. They were moderately accurate in predicting the exact type of sleep disorder because some sleep disorders share a few common characteristics. However, the sleep scales provide school professionals and clinicians valuable information that helps them know when to refer a child to a pediatrician or sleep specialist for a comprehensive sleep examination, and when the professional can work with the parents and student on home interventions (in the case of DSPS, which does not need an overnight sleep study in most cases). The SDIS scales also provide the sleep specialist excellent information that helps develop strong hypotheses about which sleep disorders need to be thoroughly evaluated and ruled out, and the type of sleep study that needs to be pursued.

There were structural validity differences between the field study (Luginbuehl, 2004) and current studies because the field study was a much smaller sample derived from only one region of the United States with less diversity, and it combined all age groups together. The current study demonstrated that younger children have less severe sleep disorder symptoms than adolescents, and with some disorders, like DSPS, NARC, or OSAS, the younger group exhibited fewer symptoms than the adolescents did because the sleep disorder was sometimes just emerging. Therefore, a sleep screening instrument measuring these four or five major sleep disorders needs to have two separate inventories: one for children 2–10 years old and one for those 11–18 years old.

Internal consistency and test–retest reliability estimates were appropriate for screening purposes. Criterion validity evidence suggested responses on the SDIS scales were related to the PSG RDI and Snore Index. In addition, predictive validity evidence was encouraging, with diagnoses of specific sleep disorders accurately being predicted 83% of the time for children and 81% of the time for adolescents. Overall PPP was 71% for the SDIS-C and 79% for the SDIS-A. Overall NPP was 95% for the SDIS-C and 94% for the SDIS-A. Criterion-related validity findings

may have been mildly affected by sleep centers using inconsistent scoring criteria on the PSG when making the hospital diagnosis, especially when diagnosing OSAS and PLMD. At the time this study was conducted, two of the hospitals were still using adult criteria for OSAS diagnoses of children, while the SDIS-C was adjusted to the now accepted milder pediatric criteria used at three of the hospitals. Furthermore, many pediatric sleep specialists presently believe that a one-night PSG study is missing some of the PLMD cases because of nightly inconsistencies in limb movements. Sleep clinics are gradually switching to use of actigraphy, which is a watch-like instrument worn on the leg that measures limb movements over multiple nights and is conducted at home. As a result, some of the hospital sleep studies done at the time of this study may have missed some of the OSAS and PLMD cases that the SDIS-C may have predicted, lowering the validity estimates of the SDIS-C.

Finally, the SDIS-C and SDIS-A were validated on community, school, private practice, and hospital populations with the purpose of using these inventories for a wide range of pediatric populations in multiple settings, even if the professionals conducting the screenings have limited knowledge about sleep disorders. Considering the high rate of sleep problems or disorders in at-risk populations, if the SDIS continues to demonstrate good reliability and validity on further validation studies, it would be expedient to use it as a comprehensive screening instrument for children and adolescents reporting sleep problems, learning or behavior problems, EDS, ADHD, frequent tardiness or truancy, obesity, or when parents are concerned about their child's sleep habits. A comprehensive sleep screening appears to be even more crucial with African American children exhibiting these concerns given that several studies have suggested that they have a 2–3 times higher rate of OSAS than Caucasian children.

Limitations

With regard to the sampling, there were a limited number of students in the 15- to 18-year age range because fewer referrals of

this age group were made to sleep centers and psychologists. There were a limited number of participants from the hospital samples who were diagnosed with NARC, DSPS, or RLS in this initial study, necessitating further validation studies with larger sample sizes. Furthermore, the recent changes in diagnostic criteria for OSAS and PLMD in children require further validation studies with larger sample sizes using these new hospital diagnostic criteria. It is believed that further studies will demonstrate higher predictive validity for the SDIS-C because two of the five sleep centers in this current study were not using pediatric criteria and may have underidentified a few of the OSAS and PLMD cases that the SDIS-C predicted.

Parents did not observe their child's sleep during the night while validating the SDIS, which may have decreased the predictive validity of the OSAS and PLMD scales. Expanded directions now ask parents to observe their child's sleep before rating the SDIS. It is believed that these instructions will increase rater accuracy.

All behavior rating scales, including the SDIS, are subject to rater bias. To attempt to decrease this rater bias, the SDIS has some items that cannot be rated at the extreme scores (i.e., 6 or 7 points on the SDIS), which the practitioner can use to measure the parent's accuracy.

Future Research Needs

Additional validation studies on the SDIS are advised now that parent instructions have been expanded. Sleep specialists may have found a more valid and reliable method of measuring PLMD, and these specialists also have reached a broader consensus of the criteria for diagnosing OSAS. These validity studies should include larger sample sizes of all age ranges, especially older students, more Spanish-speaking participants, and larger samples of NARC-, DSPS-, and PLMD/RLS-diagnosed cases.

Conclusion

Best practices in school psychology emphasize prevention, early identification, and

intervention. Presently, only 1%–3% of children with sleep disorders are being identified because of limited awareness of sleep disorders and the absence of a screening instrument that can be used within the educational or private practice settings. The SDIS was developed to facilitate large-scale or individual comprehensive screenings of children by school and clinical psychologists, school nurses, pediatricians, and other pediatric professionals as part of the problem-solving process. This study provides initial evidence that the SDIS can be used as an effective and thorough screening instrument for pediatric sleep disorders. Through large-scale preventative screenings and early identification, children and adolescents with sleep disorders may receive effective treatment, and the academic and behavior problems frequently associated with these disorders may be prevented.

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APPENDIX A

Items on the SDIS-C

1. Child stops breathing for 5 or more seconds while sleeping.

2. Breathes through the mouth while awake.

3. Breathes through the mouth while asleep.

4. Appears sleepy more often in daytime than other children of the same age.

5. Makes repeated leg or arm jerking movements during sleep.

6. Child has raspy breathing or snores lightly at night.

7. Snores loudly at night.

8. Shows confusion or disorientation when awakened. (*Rater Reliability Detector Item*)

9. Child rolls or moves around the bed when sleeping.

10. Gasps, snorts, or chokes for breath during sleep.

11. Sweats a lot while asleep.

12. Is irritable.

13. Child is very tired during the morning in school between 8:00 a.m. and 12:00 noon, but alert in the afternoon and evening.

14. Sleeps in strange positions such as cocking the head backwards or sleeping while sitting upright on pillows or kneeling.

15. Exhibits heavy breathing without exercising.

16. Wakes up during the night.

17. Seems tired after getting plenty of sleep.

18. Takes more than 30 minutes to fall asleep once child is in bed and attempts to sleep. (*Rater Reliability Detector Item*)

19. Child's attempts to change bedtime from a post-11:00 p.m. to earlier on school nights are unsuccessful because the child is unable to fall asleep earlier. (*Rater Reliability Detector Item*)

20. Falls asleep more during the daytime than other children of the same age.

21. Has a high activity level and has difficulty sitting still.

22. Child is often touchy or loses temper.

23. Actively defies or refuses to comply with adults' requests.

24. Has difficulty falling asleep on school (week) nights before (circle one answer): (1) No difficulty; (2) 10:00 p.m.; (3) 11:00 p.m.; (4) 12:00 a.m.; (5) 1:30 a.m.; (6) 3 a.m.; (7) 4 a.m.

25. Has difficulty falling asleep on weekend nights before (circle one answer): (1) No difficulty; (2) 10:00 p.m.; (3) 11:00 p.m.; (4) 12:00 a.m.; (5) 1:30 a.m.; (6) 3 a.m.; (7) 4 a.m.

APPENDIX B

Items on the SDIS-A

1. Student stops breathing for 5 or more seconds while sleeping.

2. Breathes through the mouth while asleep.

3. Appears sleepy more often in daytime than other students of the same age.

4. When student is awakened on school days by parent or alarm clock, s/he takes longer than 5–10 minutes to arise and begin the daily routine. (*Rater Reliability Detector Item*)

5. Is unable to talk or move for seconds to minutes when awakened by parents. (*Rater Reliability Detector Item*)

6. Makes repeated leg or arm jerking movements during sleep.

7. Child has raspy breathing or snores lightly at night.

8. Snores loudly at night.

9. Shows confusion or disorientation when awakened. (*Rater Reliability Detector Item*)

10. Stays up past 1:00 a.m. on school nights (playing video/computer games, watching TV, talking on the phone, or partying with friends. (*Rater Reliability Detector Item*)

11. Gasps, snorts, or chokes for breath during sleep.

12. Is irritable.

13. Student reports an urge to move legs or an uncomfortable crawling feeling in legs or arms when resting or laying down.

14. Child is very tired during the morning in school between 8:00 a.m. and 12:00 noon, but alert in the afternoon and evening. (*Rater Reliability Detector Item*)

15. Sleeps in strange positions such as cocking the head backwards or sleeping while sitting upright on pillows or kneeling.

16. Has attacks of extreme muscular weakness or loss of muscle function (such as limpness in the neck, knees, or limbs, inability to speak clearly, and/or falling down) that occurs only when laughing, surprised, fearful, or angry.

17. Wakes up during the night.

18. Seems tired after getting plenty of sleep.

19. Student has complained of vivid, often frightening dreams or hallucinations when drifting into sleep or awakening.

20. Skips or is late for early classes due to difficulty waking up (check report card if unsure). (*Rater Reliability Detector Item*)

21. Takes more than 30 minutes to fall asleep once child is in bed and attempts to sleep. (*Rater Reliability Detector Item*)

22. Falls asleep while talking to others or while standing up.

23. Student's attempts to change bedtime from a postmidnight to a premidnight pattern on school nights are unsuccessful because the student is unable to fall asleep earlier. (*Rater Reliability Detector Item*)

24. Performs some strange automatic behaviors (i.e., like putting a jacket in the refrigerator), and does not remember doing them.

25. Falls asleep more during the daytime than other students of the same age.

26. Student is often touchy or loses temper.

27. Actively defies or refuses to comply with adults' requests.

28. Has difficulty falling asleep on school nights before (circle one answer): (1) No difficulty; (2) 10:00 p.m.; (3) 11:00 p.m.; (4) 12:00 a.m.; (5) 1:30 a.m.; (6) 3 a.m.; (7) 4 a.m.

29. Has difficulty falling asleep on weekend nights before (circle one answer): (1) No difficulty; (2) 10:00 p.m.; (3) 11:00 p.m.; (4) 12:00 a.m.; (5) 1:30 a.m.; (6) 3 a.m.; (7) 4 a.m.

30. Circle the average amount of time student takes daytime naps: (1) No naps; (2) naps 2–3 times/wk; (3) 30 min/day; (4) 1 hr/day; (5) 1½ hr/day; (6) 2 hr/day; (7) 3+ hr/day

Additional Items for Parasomnias

Both the SDIS-C and SDIS-A have 5 questions about parasomnias added postvalidation study because of parents expressing concerns about these parasomnias throughout the study and desiring more information. They are not calculated into any of the sleep scales. The interpretive report provides information and intervention ideas if any of these items is endorsed by the parent:

1. Does the child/adolescent grind teeth while sleeping?

2. Does the child/adolescent sleepwalk?

3. Does the child/adolescent talk in sleep?

4. Does child/adolescent awaken with night terrors (wild-eyed, crying or screaming; unresponsive to parent comforting) and cannot remember the night terror the following morning?

5. Does child/adolescent have bed-wetting episodes?

Additional OSAS Health Items

The following 11 questions are rated "yes" or "no" by parents on both inventories to provide more information to physicians about the possibility of OSAS, even though they are not calculated into the OSAS scoring scale:

1. Was your child/adolescent underweight as an infant or preschool-aged child? Yes/No

If yes, circle one: a) mildly underweight; b) moderately; c) severely

2. Is your child/adolescent underweight now? Yes/No

If yes, circle one: a) mildly underweight; b) moderately; c) severely

3. Is your child/adolescent overweight now? Yes/No

If yes, circle one: a) mildly underweight; b) moderately; c) severely

4. Was child/adolescent under normal height as an infant or preschool-aged child? Yes/No

If yes, circle one: a) mildly under height; b) moderately; c) severely

5. Is child/adolescent under normal height for his/her age now? Yes/No

If yes, circle one: a) mildly under height; b) moderately; c) severely

6. Does your child/adolescent have multiple ear infections per year? Yes/No

7. Does your child/adolescent have multiple respiratory infections per year? Yes/No

8. Has a physician ever reported that your child/adolescent has large tonsils? Yes/No

9. Have your child/adolescent's tonsils been removed? Yes/No

10. Has a physician ever reported that your child/adolescent has enlarged adenoids? Yes/No

11. Have your child/adolescent's adenoids been removed? Yes/No