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Sleep Disorder Symptoms in Children With Low-Functioning Autism

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ABSTRACT: Although there is evidence that children with low-functioning autism experience sleep disturbance at a higher rate than typically developing peers, there is inconsistency in the results of previous research. The identification of specific sleep problems experienced more often by children with autism may lead to greater accuracy of diagnosis and treatment. The present study assessed sleep disorder symptoms in affected children and typically developing controls while addressing methodological issues in the existing literature. Parents completed a norm-referenced measure of sleep disorder symptoms. Children with autism scored significantly higher than matched typically developing children on symptoms of obstructive sleep apnea syndrome, periodic limb movement disorder, and sleep disorder symptoms in general. A moderate correlation was also found between sleep disorder symptoms and module 1 of the Autism Diagnostic Observation Schedule-Generic.

Autism is a pervasive developmental disorder characterized by impairment in social interaction, communication skills, and the presence of stereotyped behavior and restricted interests. Autistic characteristics fall along a continuum known as the autism spectrum disorders (ASD). On one end of the spectrum, individuals exhibit many autistic characteristics and lower general levels of functioning, while on the other end fewer autistic characteristics are observed and impairment is less severe. The core impairments in ASD are often accompanied by a variety of medical conditions and psychiatric disorders, such as epilepsy, food intolerance, gastrointestinal dysfunction, attention deficit hyperactivity disorder, and mood disorders (e.g., Ming, Brimacombe, Chaaban, Zimmerman-Bier, & Wagner, 2008).

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ASDs are also associated with sleep disturbance (Ming et al., 2008; Stores & Wiggs, 1998). In the last 10–15 years there has been increased research interest regarding the sleep problems of young people, particularly those with ASD. The concern appears to be justified. For example, parents of young people with low-functioning autism report that their children experience some sort of sleep disturbance at a significantly higher rate than typically developing peers (Cotton & Richdale, 2006; Polimeni, Richdale, & Francis, 2005). However, research attempting to identify the specific sleep problems of these children remains inconclusive. Studies using objective sleep measures such as polysomnography and actigraphy have generated mixed results. Some researchers have found no differences in sleep parameters compared to controls (Hering, Epstein, Elroy, Iancu, & Zelnik, 1999), while others have found that children with ASD spend significantly less time in bed and less time sleeping than controls do (Elia et al., 2000; Goodlin-Jones, Tang, Liu, & Anders, 2008). The results of subjective sleep measures, such as questionnaires, have also varied. Standardized questionnaires have suggested either a variety of specific problems relative to controls (Hoffman, Sweeney, Gilliam, & Lopez-Wagner, 2006) or no significant differences between groups (Polimeni et al., 2005).

As a result, additional research is needed to illuminate the sleep problems experienced by children with lower functioning autism. The identification of consistent, specific sleep problems in these children may lead to increased accuracy of diagnosis and treatment. Reduction of sleep problems may then result in reduced negative emotional consequences for children and families, such as the stress experienced by primary caregivers. For example, there is recent evidence that the sleep problems of children with low-functioning autism contribute significantly to subjective levels of stress reported by the children's mothers (Hoffman et al., 2008). Improved identification and treatment of sleep disorders may help to alleviate such stress. In the research literature, the lack of consistent findings may be related to important considerations such as diagnostic subgrouping, the manner in which sleep disturbance is measured, the age of the participants, concurrent medication or supplement use that may affect sleep patterns, and/or the level of supporting evidence for an autism classification.

CONSIDERATIONS FOR SLEEP RESEARCH WITH INDIVIDUALS WITH ASD

If there is indeed a relationship between ASDs and sleep problems, then the ability to draw conclusions is affected by a number of methodological concerns in the research literature. In previous studies there has been diagnostic variability in the samples being studied, as well as variability in the measures used to examine their sleep. Some researchers have studied autism, Asperger's disorder, and pervasive developmental disorder–not otherwise specified as separate diagnostic entities (e.g., Goodlin-Jones et al., 2008; Polimeni et al., 2005). However, a comparable number of researchers have examined heterogeneous samples of young people diagnosed with various ASDs (e.g., Couturier et al., 2005; Malow et al., 2006; Schreck & Mulick, 2000; Schreck, Mulick, & Smith, 2004). Another source of variability involves the measurement of sleep variables through parent-report questionnaires. In many cases, these questionnaires have been researcher created (e.g., Cotton & Richdale, 2006; Hering et al., 1999; Liu, Hubbard, Fabes, & Adam, 2006; Oyane & Bjorvatn, 2005; Williams, Sears, & Allard, 2004), raising concerns about the reliability and replicability of the results, as well as the ability to make comparisons between studies.

When attempting to isolate the relationship between ASDs and sleep disturbance, specific participant characteristics must also be controlled in order to avoid confounding of the results. Characteristics that are particularly salient in this area of research are the participants' age, their concurrent use of medications or supplements, and considerations related to their diagnosis. There is evidence to suggest that typically developing children experience important changes in sleep regulation during the transition into adolescence that are both biological and environmental in nature (Carskadon, 1990; Jenni & Carskadon, 2004; Ohayon, Carskadon, Guilleminault, & Vitiello, 2004). Nevertheless, many researchers studying the sleep of young people with ASD have analyzed samples in which the age of participants

varies greatly from early childhood through adolescence (e.g., Cotton & Richdale, 2006; Elia et al., 2000; Hoffman et al., 2006; Liu et al., 2006; Polimeni et al., 2005; Williams et al., 2004).

The use of medications or supplements to treat comorbid medical and psychiatric disorders is a common occurrence among young people with ASD (Gringras, 2000). Many of these substances are known to affect sleep parameters. A majority of studies to date have not taken into consideration the use of medication or supplements by their participants (e.g., Cotton & Richdale, 2006; Couturier et al., 2005; Hoffman et al., 2006; Honomichl, Goodlin-Jones, Burnham, Gaylor, & Anders, 2002; Polimeni et al., 2005; Schreck & Mulick, 2000; Schreck et al., 2004; Williams et al., 2004).

Finally, the heterogeneous presentation that is typical of individuals with ASDs leads to a concern about the validity of research findings. In order to ensure that participants are representative of the disorders in question, researchers must establish that participants meet criteria for the disorders based on contemporary definitions. In the sleep research on children with ASD, there is variability in the diagnostic evidence acquired by researchers. Some have relied solely on parent report of an existing diagnosis without further confirmation (e.g., Polimeni et al., 2005). In other studies, participant diagnoses have been established through records from healthcare providers, such as pediatricians, child psychiatrists or psychologists, or neurologists (e.g., Honomichl et al., 2002; Malow et al., 2006; Ming et al., 2008). *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV-TR; American Psychiatric Association, 2000) criteria are typically referenced as the basis for the formal diagnosis. And although less common, some researchers have obtained records and administered standardized measures of autism symptoms prior to including participants in their studies (e.g., Bruni et al., 2007; Hoffman et al., 2006; Schreck & Mulick, 2000).

Of these standardized measures, the most frequently utilized has been the Gilliam Autism Rating Scale (GARS; Gilliam, 1995, 2005), a norm-referenced parent-report measure of autism symptoms. Other standardized measures of autism symptoms include the Autism Diagnostic Observation Schedule-Generic (ADOS-G; Lord et al., 2000) and the Autism Diagnostic Interview-Revised (ADI-R; Lord, Rutter, & Le Couteur, 1994). The ADOS-G and the ADI-R are highly regarded and have received empirical support for their usefulness in autism research (Cicchetti, Lord, Koenig, Klin, & Volkmar, 2008; Cox et al., 1999; Gray, Tonge, & Sweeney, 2008; Mazefsky & Oswald, 2006). In contrast, the GARS has not fared as well under the scrutiny of empirical research, tending to underestimate the likelihood of autism (e.g., Mazefsky & Oswald, 2006; South et al., 2002). These findings are significant because some of the studies on sleep problems in autism have used the GARS for the purposes of diagnostic classification (e.g., Hoffman et al., 2006; Schreck & Mulick, 2000).

There have only been a few options in terms of standardized parent-report measures of sleep. The Children's Sleep Habits Questionnaire (CSHQ; Owens, Spirito, & McGuinn, 2000) has been used most frequently by researchers. The CSHQ provides an omnibus sleep disturbance score and eight scales: Bedtime Resistance, Sleep Onset Delay, Sleep Duration, Sleep Anxiety, Night Wakings, Parasomnias, Sleep-Disordered Breathing, and Daytime Sleepiness. Researchers have found significant differences on these scale scores between young people with ASD and controls. Hoffman et al. (2006) found that their large sample of children and adolescents with autism scored significantly higher on all of the scales except Daytime Sleepiness. In comparison, the substantially smaller sample of children with an ASD studied by Couturier et al. (2005) scored significantly higher on four of the scales: Sleep Onset Delay, Sleep Duration, Sleep Anxiety, and Parasomnias.

Another standardized instrument is the Behavioral Evaluation of Disorders of Sleep (BEDS; Schreck, Mulick, & Rojahn, 2003). The BEDS generates five scale scores, including a total score: Expressive Sleep Disturbances, Sensitivity to the Environment, Disoriented Awakening, Sleep Facilitators, and Apnea and Bruxism. Schreck and Mullick (2000) found that their sample of children with ASD scored significantly higher than controls on all scales with the exception of Disoriented Awakening. In contrast, in a study comparing samples of children and adolescents with autism disorder or Asperger's disorder to typically

developing peers, Polimeni et al. (2005) found a significant group difference on only the Disoriented Awakening scale. Their Asperger's disorder group scored significantly higher on that scale than the control group; however, the autism group did not score higher than controls. The only other significant difference reported by Polimeni et al. was the BEDS total score. The Asperger's disorder group scored significantly higher than the other two groups, indicating significantly higher symptoms of sleep disturbance.

Autism spectrum populations have yet to be studied with a standardized sleep instrument screening measure called the Sleep Disorders Inventory for Students (SDIS; Luginbuehl, 2004). The five scales of the SDIS-Children's form (SDIS-C), Obstructive Sleep Apnea Syndrome (OSAS), Periodic Limb Movement Disorder (PLMD), Delayed Sleep Phase Syndrome (DSPS), and Excessive Daytime Sleepiness (EDS) were derived from factor analysis, and pertain specifically to sleep disorders as defined by diagnostic systems such as the *International Classification of Sleep Disorders* (American Academy of Sleep Medicine, 2005). In addition, the SDIS is a norm-referenced instrument that provides standard scores, allowing comparisons to a large sample of same-age children. This is not the case for the CSHQ. Relative to the BEDS, which is norm referenced, the SDIS was derived from a larger normative sample that is more representative of the U.S. population (Luginbuehl, Bradley-Klug, Ferron, Anderson, & Benbadis, 2008). There are two forms of the SDIS: the children's form, for ages 2–10, and the adolescent form, for ages 11–18. As a result, differences in sleep which may be developmental in nature are better accounted for by the SDIS.

THE PRESENT STUDY

It remains unclear to what extent children with low-functioning autism experience specific sleep problems relative to controls. The problematic sleep-related behaviors reported by some researchers may be indicative of the presence of a sleep disorder. In an examination of archival data, Ming et al. (2008) determined the co-occurrence of autism spectrum disorders and either medical or psychiatric disorders. Among the 160 children and adolescents in their sample, lifetime incidence of sleep disorders was 53%, with more difficulties noted in children age 10 and under. In a study specifically addressing children with the diagnosis of autism, Thirumalai, Shubin, and Robinson (2002) recruited 11 children whose parents had reported a sleep problem. The children underwent a full sleep evaluation, known as polysomnography, which includes sleep electroencephalogram. Thirumalai et al. (2002) reported that five of the children had REM sleep behavior disorder, two children had obstructive sleep apnea, two children had periodic limb movements with associated arousals, and four children had bruxism (i.e., teeth grinding). It is feasible that, for children with autism, a clinically diagnosable sleep disorder may underlie their sleep problems.

Rationale

The present study examined symptoms of four sleep disorders in children with autism and controls while addressing methodological issues in the existing literature. There are several strengths of the present study relative to previous research. The sleep problems of a specific age cohort, prepubertal children aged 2–10, were examined. The study included both an autism group, referred to as the affected group, and a matched control group of typically developing children. All children in the affected group had previously undergone the same assessment procedure to provide support for an autism classification, including two well-validated diagnostic measures, the ADOS-G and the ADI-R. The affected group contained only children with a diagnostic classification of autism who had exhibited clear impairment in each of the three domains of the diagnosis; other ASDs were excluded. Children's sleep patterns were assessed with the SDIS, a norm-referenced parent-report measure of sleep disorder symptoms. Children who were taking a medication or supplement to treat sleep problems at the time of data collection were excluded from data analysis so that parents could rate their children's true sleep patterns without the effect of any altering medications.

Hypotheses

It was hypothesized that children with autism would exhibit more symptoms of OSAP and PLMD than matched children, scoring significantly higher on the OSAS and PLMD scales of the SDIS-C. Thirumalai et al. (2002) found diagnosable cases of these disorders using polysomnography, and in the study by Hoffman et al. (2006) affected children scored significantly higher on the Sleep-Disordered Breathing scale of the CSHQ. On the other hand, it was hypothesized that children with autism would not exhibit more symptoms of DSPS and EDS than matched children, with no significant difference between groups on the DSPS and EDS scales of the SDIS-C. Also in the study by Hoffman et al. (2006), the affected group did not score differently from controls on the Daytime Sleepiness scale of the CSHQ. It was further hypothesized that children with autism would exhibit more general sleep disorder symptoms than matched controls, scoring significantly higher on the Sleep Disturbance Index (SDI) scale of the SDIS-C. Finally, it was hypothesized that sleep disorder symptoms would be greater for children who exhibited more severe symptoms of ASD as measured by autism assessment instruments (i.e., the ADOS).

METHOD

Participants in this study were obtained from two sources, and are designated the affected group and the control group. The affected group was recruited from the research participant pool of an autism research center in the southwestern United States. Participants in this group were the parents of children between the ages of 2 and 10 years old. The parents and children were associated with a Social/Behavioral Institutional Review Board–approved genetics study conducted by the Southwest Autism Research and Resource Center (SARRC). The parents had previously gone through consent procedures for that study, and had given permission to be contacted about other studies.

We mailed 110 packets to parents, and 68 were returned after a follow-up phone call for those who did not respond within 1–2 weeks, for a response rate of 62%. Of the 68 parents who returned packets, 28 of those cases were excluded from the study. Four cases were excluded due to missing data. An additional 15 cases were excluded because the child did not receive an autism classification on either the ADOS-G or the ADI-R. Finally, nine more cases were excluded because at the time of the study the child was taking a medication or supplement to treat sleep problems. The supplement most often reported by parents was melatonin (n = 5). After exclusions, the size of the affected group was 40. The age range of affected group children was 2 years, 1 month to 9 years, 8 months, with a mean age of 5 years, 1 month. There were 33 males and 7 females in the group. This ratio of males to females (4.7:1) was consistent with epidemiological studies that suggest a ratio of 4.3:1 among children with ASDs (Fombonne, 2005).

Affected group children had a previous diagnostic classification of autism based on an assessment conducted at SARRC. Assessment instruments were administered by trained and supervised SARRC employees. For the purposes of this study, autism was operationally defined as exceeding recommended diagnostic cut-off scores on both the ADOS-G and the ADI-R. Specifically, the children had met the cut-off score for autism on the Social-Communication Total (an omnibus score) for each previously administered module of ADOS-G. They had also met the cut-off score for autism on at least three of the four domains of the ADI-R, which are Qualitative Abnormalities in Reciprocal Social Interaction; Qualitative Abnormalities in Communication; Restricted, Repetitive, and Stereotyped Patterns of Behavior; and Abnormality of Development Evident At or Before 36 Months. The ADI-R does not generate a compositve or omnibus score.

Data for the control group were archival in nature. Participants in this group were the parents of typically developing children who participated in the national norming study of the SDIS. Although the norming sample consisted of more than 800 children with 12 students selected from special education programs for mental retardation, visual impairment, deaf or hard of hearing, physical impairment, and autism, only typically developing students who were not on medication were chosen for participation in

this study. At the time of data collection, the children were between the ages of 2 and 10 years old. They were matched to the affected group on age and gender. Their scores were provided by the publisher of the SDIS, Child Uplift, Inc. As a result, the size of the control group was also 40. Thus, the total sample size for the study was 80.

Materials

The age range for the SDIS-C is from 2 to 10 years old. There are a total of 30 items. Each item consists of a statement followed by a Likert-type response scale, on which the examinee responds on a scale of 1 (*never*) to 7 (*always*). Each record form is scored through the accompanying scoring software. The SDIS-C generates four scales relating to a specific sleep disorder: OSAS, PLMD, DSPS, and EDS. SDI, which is a composite score for the instrument, is also generated.

Standard scores on each scale and the total SDI are T-scores with a mean of 50 and standard deviation of 10. The developer of the SDIS provides a classification for the clinical implications of these standard scores. A score of less than 60 indicates that the child is in the *normal* range of sleep: Their sleep patterns are typical of students in the specified age range. If the score is from 60 to 64, then the child is in the *caution* range of sleep: Their sleep patterns are more problematic than many students. T-scores of 65 or higher place the child in the *high risk* range for a sleep disorder: Their sleep patterns are more problematic than most students.

Procedures

The study was carried out with the assistance of staff in the research department at the SARRC. Permission to conduct this study was obtained from both the director of research at SARRC and the Social/Behavioral Institutional Review Board at Arizona State University. The recruitment of participants for the affected group was conducted as follows. A mediator who was a SARRC employee assisted with accessing participant information. The mediator used records to identify children in the research participant pool who were between 2 and 10 years of age. The mediator assigned a study-specific code to each identified child. For each case, the mediator provided us the phone numbers and mailing addresses of parents. Prior to sending study materials, we made an initial phone contact with each parent, if possible.

We prepared packets for which all materials and envelopes were labeled with a study-specific code. Each packet included the following materials: a letter of invitation, a consent form, the SDIS-C form, a questionnaire asking whether the child was receiving any medication, a postcard for requesting a summary of the study results, and a prepaid return envelope. All materials to be returned were labeled with the study-specific code to protect confidentiality. In the letter of invitation, parents were asked to sign informed consent and fill out both questionnaires. The consent form included a request for permission to access certain archival data possessed by SARRC, including scores from the ADOS-G and ADI-R. The main purpose of the child health questionnaire was to confirm that each child met inclusion criteria for the study.

Parents mailed the consent form and the two questionnaires back to the researchers. They were asked to do so within 1 week of receiving the packet, whether they chose to participate or not. We contacted each parent by phone as a follow-up 1–2 weeks after each packet was mailed. If a parent chose to participate and signed the consent form, then the mediator helped us to obtain archival ADOS-G and ADI-R scores as requested in the consent. We did not view any other information that the parent had provided to SARRC in the past. Finally, if a parent chose to do so, they could also mail in the postcard requesting a summary of the study results.

Participants for the control group were identified after data collection for the affected group was completed. Each child successfully recruited for the affected group was paired with data from a typically developing, control group child, matched on both age and gender.

RESULTS

All mean scores for both groups were less than 60, thereby falling in the normal range of sleep on the SDIS-C. The mean affected group score was higher than the mean control group score on all of the five scales (see Table 1). Standard deviations were relatively consistent, ranging from 5.72 to 8.18, with one exception. The standard deviation for affected group scores on the DSPS scale was quite large (*SD* = 12.8). An examination of boxplots indicated that the distributions of scores on that scale and the EDS scale were skewed (see Figure 1). However, normal distribution of difference scores was examined and supported to a reasonable degree through examination of histograms. As a result, transformation of scores prior to statistical significance testing was not deemed necessary.

Table 1. Mean T-Scores and Paired-Samples t-Tests for Affected and Control Groups

	Affected	Control			
Scale	Mean (*SD*)	Mean (*SD*)	*t* (39)	*p*	Partial η^2
OSAS	51.95 (7.06)	46.17 (5.75)	3.95*	.000	.286
PLMD	52.22 (7.10)	46.35 (6.35)	4.27*	.000	.318
DSPS	52.87 (12.80)	46.72 (5.72)	2.92	.006	.180
EDS	51.80 (8.18)	49.08 (7.11)	1.82	.076	.078
SDI	53.62 (7.69)	47.40 (6.38)	4.20*	.000	.311

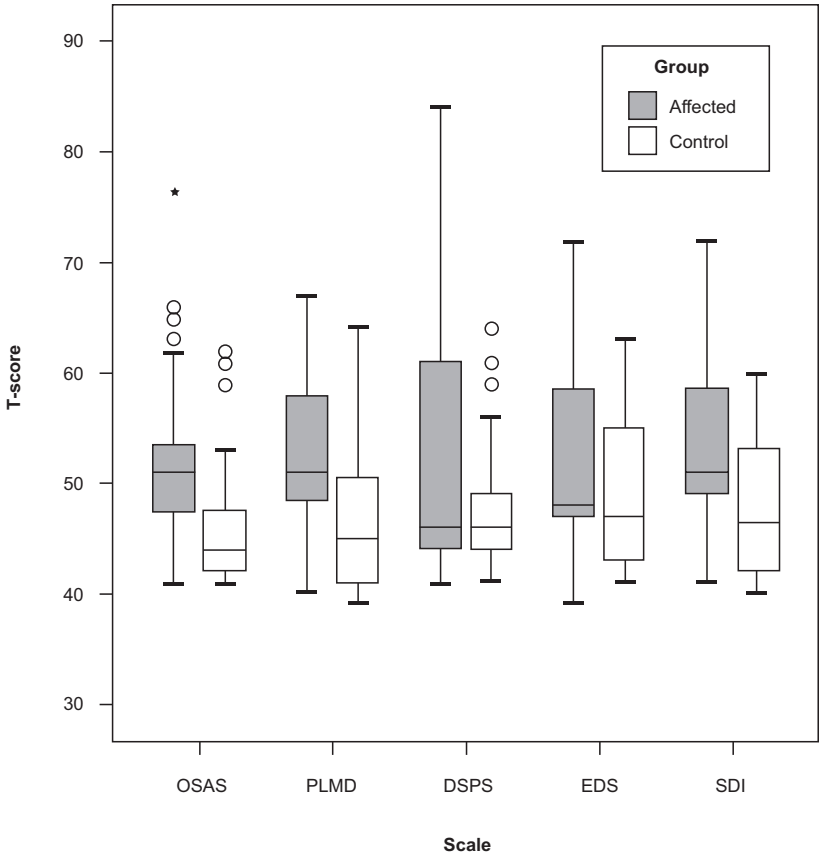
*$p < .001$.

Matched-Samples Comparisons

Five paired-samples t-tests were conducted to examine the relationship between group membership and scores on the SDIS-C. The two groups, affected and control, were compared on five scales: OSAS, PLMD, DSPS, EDS, and SDI. The results were evaluated using a Bonferroni-type correction, yielding a significance level of .01 for each of the five comparisons. For one-tailed hypotheses, including the OSAS, PLMD, and SDI scales, the region of rejection was specified as the extreme .01 of the distribution. For two-tailed hypotheses, including the DSPS and EDS scales, the region of rejection was specified as the extreme .005 of the distribution.

The mean score for the affected group was significantly higher than that of the control group on the OSAS scale, t (39) = 3.95, $p < .001$ (51.95 versus 46.17); the PLMD scale, t (39) = 4.27, $p < .001$ (52.22 versus 46.35); and the SDI scale, t (39) = 4.20, $p < .001$ (53.62 versus 47.40). The strength of the relationships was moderate, with group membership accounting for about 29% of the variance in T-scores on the OSAS scale, partial $\eta^2 = .286$; about 32% of the variance on the PLMD scale, partial $\eta^2 = .318$; and about 31% of the variance on the SDI scale, partial $\eta^2 = .311$. For the DSPS and EDS scales, group differences were not statistically significant at the required alpha level of .005 (see Table 1).

Figure 1. T-Score Distributions for Affected and Control Groups on the Fives Scales of the SDIS-C Form



Note. Boxes represent scores from the 25th to 75th percentile, and lines within the boxes represent the median or 50th percentile. Error bars represent standard deviations.

Autism Assessment Instruments

Of the 40 cases included in the affected group, module 1 of ADOS-G had been administered to 22 of the children and module 2 had been administered to 16 children. Only two children had been administered module 3 of ADOS-G and, consequently, data from that module were not used in the correlational analysis. Thirty-eight of the 40 children met the cut-off score for autism on all four domains of ADI-R, while only two children met the cut-off score on three of the four domains. For each case in the affected group, the five scales from SDIS-C were correlated with raw scores from relevant autism assessment instruments. Because the ADI-R does not generate a composite or omnibus score, the raw scores from three domains were used. The Abnormality of Development domain was not analyzed. Because all affected group children had received scores of 1 on that domain, there was no variance to examine. The Social-Communication Total from ADOS-G modules, which represents an omnibus score on the instrument, was correlated with SDIS-C scales. Due to variability in the scores pertaining to each child, sample sizes varied for each Pearson correlation coefficient.

The only instrument to exhibit a significant relationship with SDIS-C scores was module 1 of ADOS-G (ADOS1; see Table 2). There was a moderate relationship between ADOS1 and four of the five SDIS-C scales, including PLMD (r = .488, p < .05), DSPS (r = .413, p < .05), EDS (r = .473, p < .05), and SDI (r = .399, p < .05). The correlation coefficients indicated that higher raw scores on ADOS-1 were associated with higher T-scores on those scales. On the SDIS-C, higher T-scores represent greater symptoms of sleep disorders.

Table 2. Correlations Between SDIS Scales and Autism Assessment Instruments

	ADIsoca	ADIcomvb	ADIcomnc	ADIbehd	ADOS-1e	ADOS-2f
OSAS	−.047	−.200	.153	.142	.173	−.253
PLMD	−.121	−.097	.056	.045	.488*	.011
DSPS	−.006	.107	−.207	.175	.413*	.280
EDS	−.105	−.102	.082	.126	.473*	.077
SDI	−.078	−.131	.077	.172	.399*	−.047

[a]Reciprocal social interaction domain; n = 40. [b]Communication domain (verbal children); n = 26. [c]Communication domain (nonverbal children); n = 14. [d]Restricted, Repetitive, and Stereotyped Patterns of Behavior domain; n = 40. [e]Module 1 Social-Communication Total; n = 22. [f]Module 2 Social-Communication Total; n = 16.
*p < .05.

DISCUSSION

Compared to scores from typically developing children, children with a comprehensive diagnostic classification of autism scored significantly higher on the OSAS, PLMD, and SDI scales of a norm-referenced, parent-report measure of sleep disorder symptoms. The results also suggested a relationship between sleep disorder symptoms and autistic disorder, such that children with low-functioning autism may be more likely to demonstrate symptoms of OSAS and PLMD than children without autism. Children with autism may also be more likely to exhibit sleep disorder symptoms in general, as suggested by significantly higher scores on the SDI composite.

All hypotheses pertaining to between-group differences on the five scales of SDIS-C were supported by the results. Specifically, the hypotheses that anticipated group differences (OSAS, PLMD, and SDI) and those that did not anticipate group differences (DSPS and EDS) were each supported.

There was a moderate correlation between the Social-Communication Total from module 1 of the ADOS-G and the PLMD, DSPS, EDS, and SDI scales from the SDIS-C. Higher scores on module 1 of ADOS-G were associated with greater parent-reported symptoms of PLMD, DSPS, and EDS. Children who receive higher raw scores on module 1 of ADOS-G may be more likely to demonstrate symptoms of those sleep disorders. Also, higher module 1 scores were associated with greater sleep disorder symptoms in general, as represented by the SDI composite score. Because module 1 is usually administered to very young children, and/or children with minimal or no verbal language, it is possible that children with autism having those characteristics are more likely to exhibit symptoms of sleep disorders than other children with autism.

The hypothesis that sleep disorder symptoms would be positively correlated with autism symptoms was partially supported by the results. However, there was no apparent relationship between SDIS-C scales and other measures of autism symptoms, including module 2 of ADOS-G and the domain scores from the ADI-R.

The results of the present study are consistent with previous research in which children with autism were found to have more sleep problems than typically developing children. Using the CSHQ, Hoffman et al. (2006) found that children and adolescents with autism scored significantly higher than a control group on seven of the eight scales: Bedtime Resistance, Sleep Onset Delay, Sleep Duration, Sleep

Anxiety, Night Wakings, Parasomnias, and Sleep-Disordered Breathing. The groups did not exhibit a difference on the Daytime Sleepiness scale. In the present study, the autism group fared similarly. The children scored higher than controls on the OSAS scale, a form of sleep-disordered breathing, and did not exhibit a difference on the EDS scale.

The present study also expands upon the literature examining the relationship between sleep disorders and autism. Using a different methodological approach than Thirumalai et al. (2002), a norm-referenced questionnaire, the present study also suggests an association between childhood autism and both OSAS and PLMD.

Future research would benefit from systematically examining the relationship between age and the sleep disorder symptoms of children with low-functioning autism. For example, younger children in the age range of 2–5 years old could be compared to older children in the age range of 6–9 years old, as well as adolescents. Due to the age distribution of our sample, a statistical analysis based on age range was not appropriate in the present study. In addition, the research literature would benefit from more polysomnographic studies examining the sleep of young people with autism, in which particular attention is paid to symptoms of sleep disorders. Finally, research could be directed at comparing outcome performance for students who were treated for sleep disorder symptoms versus those who were left untreated.

CONCLUSION

Given the significantly higher prevalence of sleep disorder symptoms in children with ASD, there are several clinical implications from our results. School psychologists should be aware of the research on sleep disorders, especially in the case of children with autism. They should interview parents concerning their children's sleeping patterns and administer sleep questionnaires such as the SIDS-C (Luginbuehl, 2004) when indicated. They can also help parents to identify typical and disordered sleep behaviors. Parents and teachers should be made aware of the effects of disordered sleeping on classroom performance and behavior. For example, disrupted sleep in childhood is associated with attention problems (Fallone, Acebo, Seifer, & Carskadon, 2005) and diminished cognitive abilities (Randazzo, Muehlbach, Schweitzer, & Walsh, 1998), which may affect the ability of school-age children with autism to participate in their education.

In addition, school psychologists can help parents learn basic interventions for sleep disorders. These include a sleep diary where intensive daily records concerning sleep patterns and other factors such as daily events or diet are kept for review. Sleep hygiene is also important in helping children to improve their sleep patterns. These may include having a regular bedtime, providing nonstimulating activities prior to bedtime, and giving the child a specific and consistent sleeping area. Other interventions may include behavior management techniques; the use of light treatment or light therapy; dietary changes such as the elimination of caffeine; or the addition of melatonin, an over the counter product which has been shown to be effective in improving some sleep disorders (Smits, Nagtegaal, van der Heijden, Coenen, & Kerkhof, 2001). More intractable cases may require prescription medications.

The school psychologist can also proactively monitor children who receive higher scores on autism measures such as module 1 of the ADOS-G, since our study found that there was a significant relationship between this measure and sleep problems. Furthermore, the school psychologist can also be influential in suggesting the need for further consultation with a pediatrician. After data have been collected and interventions have been tried without success, the school psychologist can help to justify the expense and time needed for a polysomnography, which remains the definitive assessment for sleep disorders. In the event that a disorder is detected, treatment is likely to benefit both the children and their parents (Hoffman et al., 2008) because improved sleep hygiene or medication may also limit parental stress.

ADDITIONAL RESOURCES

In addition to the references provided, the following resources may be useful to school psychologists, parents, and educational staff.

American Academy of Sleep Medicine: Resource for professionals and students interested in sleep medicine; www.aasmnet.org

Dawson, P. (2004). *Sleep and sleep disorders in children and adolescents: Information for parents and educators.* Bethesda, MD. National Association of School Psychologists. http://www.nasponline.org/resources/health_wellness/sleepdisorders_ho.aspx

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National Sleep Foundation: Specific sites on sleep patterns of children and adolescents. Contains developmental information on sleep as well as suggested interventions. www.sleepfoundation.org

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