ADHD Subtypes and Comorbid Anxiety, Depression, and Oppositional-Defiant Disorder: Differences in Sleep Problems

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Objective Sleep problems were analyzed in children with ADHD (Attention-deficit hyperactivity disorder). **Methods** Scales were completed by parents of 135 control children and 681 children with ADHD combined type (ADHD-C) or inattentive type (ADHD-I) with or without comorbid oppositional defiant disorder (ODD), anxiety, or depression. **Results** Children with ADHD-I alone had the fewest sleep problems and did not differ from controls. Children with ADHD-C had more sleep problems than controls and children with ADHD-I. Comorbid anxiety/depression increased sleep problems, whereas ODD did not. Daytime sleepiness was greatest in ADHD-I and was associated with sleeping more (not less) than normal. Medicated children had greater difficulty falling asleep than unmedicated children. **Conclusions** Differences in sleep problems were found as a function of ADHD subtype, comorbidity, and medication.

Key words ADHD, anxiety; depression; sleep; medication; oppositional-defiant disorder.

ADHD (Attention-deficit Hyperactivity Disorder) and Sleep Overview

Parent-reported sleep problems are common in children with ADHD (Ball, Tiernan, Janusz, & Furr, 1997; Chervin, Dillon, Bassetti, Ganoczy, & Pituch, 1997; Corkum, Moldofsky, Hogg-Johnson, Humphries, & Tannock, 1999; Corkum, Tannock, Moldofsky, Hogg-Johnson, & Humphries, 2001; Ring et al., 1998; Stein, 1999), and children with ADHD have greater movements during sleep than children without ADHD (Corkum et al., 1999; Corkum, Tannock, & Moldofsky, 1998; Cortese, Konofal, Yareman, Mouren, & Lecendreux, 2006; Konofal, Lecendreux, Bouvard, & Mouren-Simeoni, 2001). Some objective polysomnograph sleep data, on the other hand, do not show differences between children with ADHD and controls, including lack of differences in sleep latency and efficiency, nighttime awakenings, and sleep stages (Cooper, Tyler, Wallace, & Burgess, 2004; Golan, Shahar, Ravid, & Pillar, 2004; Gruber & Sadeh, 2004; Gruber, Sadeh, & Raviv, 2000; Huang et al., 2004; Kirov et al., 2004; Konofal et al., 2001; Lecendreux, Konofal, Bouvard, Falissard, & Mouren-Simeoni, 2000). Data on sleep-disordered breathing are inconsistent. Children with ADHD had a higher apnea–hypopnea index than controls in two studies (Golan et al., 2004; Huang et al., 2004), but not in another (Cooper et al., 2004). Studies show a nonsignificant relationship between severity of ADHD symptoms and severity of sleep-disordered breathing (Melendres, Lutz, Rubin, & Marcus, 2004; Ring et al., 1998), and ADHD ratings do not differ between children with and without sleep-disordered breathing (Chervin & Archbold, 2001).

Children with ADHD have greater daytime sleepiness than children without ADHD, as indicated by parent report (LeBourgeois, Avis, Mixon, Olmi, & Harsh, 2004) and by shorter sleep latency during a standardized daytime nap procedure (Cortese et al., 2006). Interestingly, daytime sleepiness was not related to objective polysomnograph sleep measures (Lecendreux et al., 2000) or to parent report of sleep problems (LeBourgeois et al., 2004).

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ADHD Comorbidity and Sleep

Comorbidity is common in ADHD and may affect sleep. Approximately one-half of children with ADHD have oppositional defiant disorder (ODD), 33% have an anxiety disorder, and 33% have dysthymic disorder or major depression (Faraone, Biederman, Weber, & Russell, 1998; Greene, Beszterczey, Katzenstein, Park, & Goring, 2002; Jensen, Shervette, Xenakis, & Richters, 1993; MTA, 1999; Wilens et al., 2002). Sleep problems often occur in children with anxiety and depression (Alfano, Beidel, Turner, & Lewin, 2006; Armitage et al., 2000; Dahl & Lewin, 2001; Garland, 2001; Ivanenko, Crabtree, & Gozal, 2004; Stores & Wiggs, 2001), and behavior problems are more common in poor sleepers than in good sleepers (Sadeh, Gruber, & Raviv, 2002). However, little has been published on the relationship between comorbidity in ADHD and sleep problems (Cortese et al., 2006). Corkum et al. (1999) found that ADHD in combination with ODD was associated with resistance to going to bed and resistance to awaking in the morning. In the same study, ADHD with anxiety was associated with increased movement during sleep. Stein et al. (2002) reported that comorbid depression was linked with greater self report of sleep problems in adolescents with ADHD. Cortese et al. (2006) conducted a meta-analysis of studies on ADHD and sleep and noted that comorbidity was a key mediating variable. Significant sleep differences (awakenings, restlessness, and parasomnias) between children with ADHD and controls reported in some studies were nonsignificant, in other studies when comorbidity and medication status were controlled.

ADHD Subtypes and Sleep

ADHD subtypes differ on important dimensions, which may have implications for sleep. Research supports the validity of the ADHD combined (ADHD-C) and ADHD inattentive (ADHD-I) types, but empirical support for the hyperactive–impulsive type is lacking (Baeyens, Roeyers, & Walle, 2006; Cantwell & Baker, 1992; de Nijs, Ferdinand, & Verhulst, 2007; Goodyear & Hynd, 1992; Paternite, Loney, & Roberts, 1996; Woo & Rey, 2005). The hyperactive–impulsive type may not be a true ADHD subtype because it does not include attention deficit, the core deficit in ADHD (Woo & Rey, 2005). Further, few if any children meet criteria for the hyperactive–impulsive type in research studies (Greene et al., 2002; Mayes & Calhoun 2004, 2006a).

ODD and behavior problems are more prevalent in ADHD-C than in ADHD-I (Barkley, DuPaul, & McMurray, 1990; Cantwell & Baker, 1992; Faraone et al., 1998; Goodyear & Hynd, 1992; Hynd et al., 1991; Lalonde, Turgay, & Hudson, 1998; Milich, Balentine, & Lynam, 2001; Morgan, Hynd, Riccio, & Hall, 1996; Stanford & Hynd, 1994), and children with ADHD-C have more severe ADHD symptoms than children with ADHD-I (Barkley et al., 1990; Gross-Tsur et al., 2006). However, rates of comorbid anxiety and depression do not differ between the two subtypes (Cantwell & Baker, 1992; Faraone et al., 1998; Milich et al., 2001; Power, Costigan, Eiraldi, & Leff, 2004).

Parent-reported sleep problems did not differ between children with ADHD-C versus ADHD-I in a study by LeBourgeois et al. (2004), though other studies found differences. Children with ADHD-C had poorer sleep efficiency and more fragmented sleep than children with ADHD-I in a polysomnograph laboratory study (Ramos Platon, Vela Bueno, Espinar Sierra, & Kales, 1990). Corkum et al. (1999) reported that ADHD-I was not associated with increased movement during sleep, whereas ADHD-C was. Two other studies investigated daytime sleepiness. A study using multiple sleep latency showed greater daytime sleepiness in ADHD-I than ADHD-C (Lecendreux et al., 2000), consistent with a parent-report study (LeBourgeois et al., 2004).

ADHD Medication and Sleep

Using subjective reports, medicated versus unmedicated children with ADHD did not differ in sleep disturbance in one study (Ball et al., 1997), but medicated children had greater sleep problems in other studies (Stein, 1999; Stein et al., 2002). Medicated children have more severe ADHD symptoms than nonmedicated children, which has not been controlled in these medication and sleep studies (Stein et al., 2002). In placebo-controlled studies, sleep latency was similar in children with ADHD on methylphenidate versus placebo (Kent, Blader, Koplewicz, Abikoff, & Foley, 1995; Tirosh, Sadeh, Munvez, & Lavie, 1993), but total sleep duration was shorter with methylphenidate than placebo (Tirosh et al., 1993).

Purpose

The primary objective of our study is to investigate differences in the frequency and type of parent-reported sleep problems as a function of ADHD subtype, symptom severity, medication, and comorbid anxiety, depression, and ODD. Very few studies have controlled for these confounding factors (Cortese et al., 2006; van der Heijden, Smits, & Gunning, 2005). Further, samples in published studies

are generally small. In ADHD and sleep studies reviewed by Cortese et al. (2006), mean sample sizes were 35 for ADHD and 28 for controls.

Methods

ADHD Sample

The 681 children with ADHD were consecutive referrals to our child psychiatry clinic who had normal intelligence (WISC-III or WISC-IV IQ $\geq$ 80) and were diagnosed with ADHD-C or ADHD-I by a PhD-level, licensed psychologist using DSM-IV criteria. The psychological test battery included: (a) teacher and parent questionnaires and rating scales [Pediatric Behavior Scale (PBS), Lindgren & Koeppl, 1987], (b) a computerized continuous performance test assessing impulsivity, inattention, and distractibility (Gordon Diagnostic System, Gordon, 1983), (c) parent and child interview, (d) observations of the child during testing, and (e) a review of the child's developmental history, school transcripts from kindergarten to the present, and prior evaluations.

To be included in the study, each child received a diagnosis of ADHD-C or ADHD-I with or without ODD, anxiety disorder (generalized anxiety disorder, social anxiety disorder, or obsessive–compulsive disorder), or depression (major depressive disorder or dysthymic disorder) using DSM-IV criteria. All children had a confirmatory diagnosis by another psychologist or physician. Subgroup sizes were 271 for children with ADHD-C alone, 144 for ADHD-I alone, 102 for ADHD-C and ODD, 79 for ADHD-C and anxiety/depression, 43 for ADHD-C and ODD and anxiety/depression, and 42 for ADHD-I and anxiety/depression. There were no children who had ODD in combination with ADHD-I.

Children with ADHD-C and ADHD-I were both significantly elevated (mean *T*-score >65) on the PBS Attention Deficit subscale, but only children with ADHD-C were significantly elevated on the Hyperactivity and Impulsivity subscales, supporting their diagnoses of ADHD-C and ADHD-I. Similarly, children with ODD had significant elevations on the Conduct Problems subscale, and children without ODD did not. Children with anxiety or depression were elevated on the Depression–Anxiety subscale, and children without anxiety or depression were not. The mean age of the ADHD sample is 9 years (range 6–16, *SD* 2), and the mean IQ is 106 (*SD* 13). Seventy-one percent of the children are male, 93% are white, 41% have a parent with a professional or managerial position, and 31% were on medication to treat ADHD symptoms. Our study was approved by the Penn State College of Medicine Institutional Review Board. Informed consent was waived because the study was a retrospective review of existing clinical data.

Control Sample

The control sample comprised 135 kindergarten through fifth grade students in three local suburban and urban school districts who were subjects in a prospective general population epidemiologic study of the prevalence of sleep disorders in children. Questionnaires were sent home to the parents of every elementary student in these districts ($n = 7312$), with a 78.5% response rate. From this sample, students were invited (using stratified random sampling so that the sample matched the original survey sample on age, gender, race, and risk for sleep-disordered breathing) for further evaluation in the sleep laboratory. Seventy percent of the invited families agreed to participate. Children in this sample who received special education services, had been diagnosed with a psychiatric disorder according to parent report, or who were significantly elevated on the parent PBS ADHD subscale were excluded from the control sample in our study. The mean age of the control sample is 9 years (range 6–12 years, *SD* 2), and the mean IQ is 108 (*SD* 13). Forty-six percent of the children are male, 73% are white, and 61% have a parent with a professional or managerial occupation. Informed consent was obtained from parents of all control participants and assent was obtained from all children prior to participation.

Instrument

Parents rated their children on a four-point scale from ''not at all a problem'' to ''very often a problem'' on the 165-item PBS (Lindgren & Koeppl, 1987). The PBS has norm referenced T scores for subscales including sleep problems, ADHD, conduct problems, anxiety, and depression. The PBS significantly differentiates diagnostic groups (Lindgren & Koeppl, 1987; Mayes, Calhoun, & Crowell, 2001), internal consistency for subscale scores is high (median coefficient .91), and inter-rater reliability for mothers and fathers is .71 (Lindgren & Koeppl, 1987). The PBS has been used as a diagnostic instrument and as a measure of behavior, attention, mood, cognitive, sleep, and health problems in several published studies (Max et al., 1997; Max, et al., 1998; Max, Robin et al., 1998; Mayes & Calhoun, 2002, 2004, 2006a, 2006b, 2007a, 2007b; Mayes, Calhoun, & Crowell, 1998, 2000, 2001; Nichols et al., 2000; Wolraich et al., 1994).

The PBS yields a total Sleep Problems *T*-score and scores on ten sleep items: (a) difficulty falling asleep, (b) wakes often during the night, (c) restless during sleep, (d) nightmares, (e) walks or talks in sleep, (f) wets

bed, (g) wakes too early, (h) sleeps less than most children, (i) sleeps more than most children, and (j) sleepy during the day. In a study by Mayes, Calhoun, Bixler, and Vgontzas (in press), the PBS total sleep problems score correlated significantly ($r = .76$ and .72, respectively) with total sleep disturbance scores on the Children's Sleep–Wake Scale (LeBourgeois et al., 2004) and the Pediatric Sleep Questionnaire (Chervin, Hedger, Dillon, & Pituch, 2000).

Data Analyses

MANCOVA (covarying for any between group differences in age, gender, race, and parent occupation) and Cohen's *d* effect size statistic were used to investigate differences between groups on nighttime sleep problems. ANCOVA (covarying for any between group differences in age, gender, race, and parent occupation) and Cohen's *d* were applied to determine the difference in daytime sleepiness between children with ADHD-C, ADHD-I, and controls. Partial correlation coefficients (controlling for age, gender, race, and parent occupation) and the effect size statistic r^2 were calculated to determine the degree of relationship between variables and the proportion of explained variance. Chi-square with a continuity correction assessed the significance of differences in variable frequencies between groups. Simultaneous and stepwise linear regression analysis (with the effect size statistic R^2) indicated the relative importance of medication status and parent PBS ratings of ADHD, conduct problems, anxiety, and depression in predicting sleep problems. A Bonferroni correction was applied to all probability levels to control for the number of comparisons.

Results

ADHD Subtype and Sleep

Significant differences between subgroups were found for age ($F = 7.3$, $p < .0001$), race ($\chi^2 = 96.5$, $p < .0001$), gender ($\chi^2 = 65.7$, $p < .0001$), and parent occupation ($\chi^2 = 21.6$, $p = .001$), which were, therefore, covaried. Children with ADHD-I alone did not differ significantly from controls on the total Sleep Problems *T*-score ($t = 1.2$, $p = .70$, $d = 0.1$) or on any of the nine sleep problems scores ($t = 0.2$–2.1, $p > .10$, $d \leq 0.2$). In contrast, children with ADHD-C alone had greater sleep problems scores than children with ADHD-I alone and controls in all areas (difficulty falling asleep, restless during sleep, wakes often during the night, nightmares, walks or talks in sleep, wets bed, wakes too early, and sleeps less than normal), except sleeping more than normal. Compared with controls, children with ADHD-C had significantly greater problems with falling asleep, bed wetting, and sleeping less than normal ($t = 2.5$–3.1, $p \leq .04$, $d \geq 0.3$). Relative to children with ADHD-I, children with ADHD-C had significantly more trouble falling asleep, restlessness during sleep, waking during the night, and nightmares ($t = 2.6$–3.3, $p < .03$, $d \geq 0.3$)

ADHD Comorbidity and Sleep

Children with anxiety or depression were combined into a single subgroup because Sleep Problems *T*-scores did not differ significantly between children with anxiety and depression ($t = 0.9$, $p = .45$). Total Sleep Problems *T*-scores (Table I) were significantly greater in the ADHD subgroups when anxiety or depression was present than when anxiety or depression was absent ($t = 3.0$–4.4, $p \leq .003$, mean $d = 0.6$). All mean comparisons showed greater total sleep problems, difficulty falling asleep, restlessness during sleep, waking during the night, nightmares, walking or talking in sleep, waking too early, and sleeping less than normal in the subgroups with versus without anxiety or depression (e.g., ADHD-I plus anxiety/depression vs. ADHD-I alone). In contrast, this was not the case for ODD. Children with ADHD-C and ODD did not differ significantly from children with ADHD-C without ODD on total sleep problems ($t = 0.6$, $p = .54$, $d = 0.1$), nor did children with ADHD-C and anxiety/depression differ from children with ADHD-C and anxiety/depression and ODD ($t = 0.9$, $p = .35$, $d = 0.2$). Unlike children with and without anxiety–depression, children with ODD did not have consistently higher nighttime sleep problem scores than children without ODD.

Relationships Between Sleep Problems and ADHD Severity

Correlations between PBS Sleep Problems and ADHD scores were significant for the 816 study children ($r = .32$, $p < .0001$, explained variance 10%). Scores on difficulty falling asleep, restless during sleep, nightmares, wakes often during the night, walks or talks in sleep, and wakes too early were significantly correlated with each

Table I. Mean Sleep Problems *T*-scores

Subgroup	*T*
ADHD-C, ODD, and anxiety/depression	72
ADHD-C and anxiety/depression	68
ADHD-I and anxiety/depression	67
ADHD-C and ODD	62
ADHD-C alone	61
Typical children	57
ADHD-I alone	55

other ($r = .17–.64$, $p < .0001$), but they did not correlate significantly with wets bed ($r = .00–.09$, $p > .19$).

Daytime Sleepiness

Daytime sleepiness was not significantly correlated with sleeping less than normal ($r = .04$, $p = .29$, explained variance 0%), but was associated with sleeping more than normal ($r = .33$, $p < .0001$, explained variance 11%). Children with ADHD-I alone had greater daytime sleepiness than children with ADHD-C alone ($t = 2.2$, $p = .03$, $d = 0.3$) and controls ($t = 2.7$, $p = .02$, $d = 0.4$). Children with ADHD-C did not differ from controls in daytime sleepiness ($t = 0.7$, $p = 1.0$, $d = 0.0$).

Medication

The 212 children on medication to treat ADHD had significantly higher total Sleep Problems *T*-scores ($M = 65$) than the 469 children with ADHD not treated with medication ($M = 60$), $F = 3.5$, $p = .001$, $d = 0.3$. However, children on medication also had more severe ADHD symptoms (mean $T = 82$) than children not on medication (mean $T = 74$), $t = 7.2$, $p < .0001$, $d = 0.6$. When severity of ADHD was covaried, differences in total sleep problems between medicated and unmedicated children were nonsignificant ($t = 1.2$, $p = .24$). Scores on wakes often during the night, restless during sleep, nightmares, walks or talks in sleep, wets bed, wakes too early, sleeps less than most children, sleeps more than most children, and sleepy during the day did not differ significantly between children on and not on medication when ADHD severity was covaried ($t = 0.2–1.4$, $p > .16$, $d \leq 0.2$). However, children on medication had greater difficulty falling asleep than children not treated with medication ($t = 3.5$, $p < .0001$, $d = 0.4$).

Predicting Sleep Problems

Medication status and *T*-scores on the PBS ADHD, Conduct Problems, Anxiety, and Depression subscales were used to predict the Sleep Problems *T*-scores in children with ADHD. Using stepwise linear regression analysis, the most powerful single predictor was the ADHD *T*-score, accounting for 12% of the variance ($R = .35$, $t = 7.8$, $p < .0001$). When the anxiety and depression *T*-scores were added, prediction increased to 22% ($R = .47$, $t = 4.7$, $p < .0001$). The Conduct Problems *T*-score and medication status did not significantly improve prediction ($t = 1.5$, $p = .14$ and $t = 0.6$, $p = .52$). Results were similar for simultaneous entry regression analysis. The ADHD *T*-score had the highest standardized β-coefficient (0.24), followed by the Anxiety *T*-score (0.19) and the Depression *T*-score (0.16), $p < .0001$. The Conduct Problems *T*-score and medication status β-coefficients were nonsignificant (0.07 and 0.02, $p > .15$).

Discussion

ADHD Subtype

In our study, parent-reported sleep problems were associated with ADHD-C and not ADHD-I. Children with ADHD-I alone did not differ from controls in nighttime sleep problems, whereas children with ADHD-C had significantly greater sleep problems than controls and children with ADHD-I. Though children with ADHD-I had fewer sleep problems than children with ADHD-C, children with ADHD-I experienced greater daytime sleepiness than children with ADHD-C and controls, suggesting a neurophysiologic underarousal in ADHD-I. Sluggish cognitive tempo, slow processing speed, underarousal, and underactivity are associated with the ADHD inattentive type more often than with the combined type (Barkley et al., 1990; Barkley, Grodzinsky, & DuPaul, 1992; Calhoun & Mayes, 2005; Cantwell & Baker, 1992; Goodyear & Hynd, 1992; Hartman, Willcutt, Rhee, & Pennington, 2004; Stanford & Hynd, 1994). ADHD-I may be characterized by global physiologic underarousal, affecting activity level, cognitive tempo, and sleep.

In contrast, children with ADHD-C are overactive by definition and may have intrinsically high levels of energy, regardless of sleep duration. A study in addition to ours also found that children with ADHD-C had increased movement during sleep, whereas children with ADHD-I did not (Corkum et al., 1999). This suggests that ADHD-C may be a ''24 hr disorder'' for at least some children (Cortese et al., 2006). In our study, children with ADHD-C had greater nighttime sleep problems than children with ADHD-I and controls, but they did not differ from controls in daytime sleepiness and they had less daytime sleepiness than children with ADHD-I. Our findings indicate that sleep may be an additional and potentially important dimension differentiating the ADHD combined and inattentive subtypes. The two subtypes differ not only in ADHD symptoms, but also physiologically, as indicated by differences in nighttime sleep variables and daytime alertness. Objective sleep studies have yielded results similar to ours. A study using polysomnography showed better sleep efficiency and less fragmented sleep in children with ADHD-I than ADHD-C (Ramos Platon et al., 1990). Daytime sleepiness determined by multiple sleep latency tests is greater in ADHD-I than in ADHD-C (Lecendreux et al., 2000). These findings and ours point to the critical need to differentiate between ADHD combined and

inattentive types in sleep research studies, because combining the two (which most studies do) confounds research findings.

ADHD Comorbidity

Comorbid anxiety and depression intensified sleep problems in our children with ADHD, consistent with a study by Stein et al. (2002). In contrast, comorbid ODD was not associated with an increase in sleep problems in our study. Therefore, sleep problems in children with ADHD do not appear to be the result of oppositional behavior. Similarly, improved sleep in children with ADHD treated with melatonin was not associated with a decrease in behavior problems in a study by van der Heijden, Smits, van Someren, Rudderinkhof, and Gunning (2007).

ADHD Severity

Correlations between parent ratings of total sleep problems and ADHD symptoms were significant for children in our study. This relationship has been found in other studies and has often been interpreted as indicating that sleep problems cause ADHD-like symptoms (American Psychiatric Association, 2000). It is certainly reasonable to hypothesize that sleep problems have a negative impact on daytime functioning for some children. However, this does not mean that sleep problems are a primary cause of attention deficit or hyperactivity. Existing studies are purely correlational (not causal). The association may not be unidirectional (i.e., ADHD may cause sleep problems) or causal (i.e., sleep problems and ADHD may be comorbid and have a common neurophysiologic etiology).

Enuresis

Scores on difficulty falling asleep, restless during sleep, nightmares, wakes often during the night, walks or talks in sleep, and wakes too early were significantly intercorrelated, but did not correlate significantly with wets bed. Corkum et al. (1999) also found a nonsignificant relationship between enuresis and sleep problems in children with ADHD. Therefore, enuresis appears to be separate and distinct from nighttime sleep problems and probably is not a true sleep problem.

Daytime Sleepiness

Daytime sleepiness was not significantly correlated with sleeping less than normal, but was associated with sleeping more than normal. Children who had longer sleep durations also had greater daytime sleepiness, suggesting that children who are sleepier during the day are also sleepier at night. This is contrary to the common belief that if children sleep less at night, they will be sleepier during the day. This may be the case for some children, but is not true for large samples of children with ADHD and community control children. Other ADHD studies have also found that daytime sleepiness is not related to parent report of sleep problems (LeBourgeois et al., 2004) or to objective polysomnograph measures of sleep problems (Lecendreux et al., 2000). These findings are consistent with a study in adults showing that sleepiness in obese patients with and without sleep apnea was not related to disturbed sleep (Vgontzas et al., 1998).

Medication

Our results suggest that sleep problems are primarily related to ADHD severity and not medication. Of the eight nighttime sleep problems (difficulty falling asleep, wakes often during the night, restless during sleep, nightmares, walks or talks in sleep, wets bed, wakes too early, and sleeps less than most children), only difficulty falling asleep differed significantly between children on and not on medication when the severity of ADHD symptoms was controlled. Recent research shows that melatonin and sleep hygiene may help to ameliorate sleep problem in children with ADHD. Melatonin was effective in reducing sleep latency and increasing total sleep time in children with ADHD in a randomized, double-blind placebo study (van der Heijden et al., 2007). In children with ADHD treated with stimulant medication, melatonin and sleep hygiene were both effective in reducing sleep latency (Weiss, Wasdell, Bomben, Rea, & Freeman, 2006).

Summary

Our analyses suggest that (a) parent reported sleep problems are associated with ADHD-C not ADHD-I, (b) comorbid anxiety and depression intensify sleep problems, but comorbid ODD does not, (c) greater ADHD severity is associated with greater sleep problems, (d) children with ADHD-I have greater daytime sleepiness than children with ADHD-C and community controls, (e) daytime sleepiness in children with ADHD-C is equivalent to controls, even though children with ADHD-C sleep less and have more sleep problems than controls, (f) daytime sleepiness is significantly related to sleeping more than normal, not sleeping less, (g) enuresis is probably not a sleep problem, and (h) when controlling for ADHD severity, medication to treat ADHD is not associated with waking during the night, restlessness during sleep, nightmares, walking or talking in sleep, enuresis, waking

too early, and sleeping less than normal, but children on medication have greater difficulty falling asleep than children not treated with medication.

Future studies are needed to determine if our findings are supported by objective sleep data (including measures of obstructive sleep apnea, restless leg syndrome, and sleep duration) and other subjective measures of sleep problems. Research also needs to determine if results for our psychiatric clinic sample apply to children with ADHD from general pediatric clinics. Last, further research is necessary to explore the relationship between sleep and specific medications, including medications used to treat ADHD and comorbid problems and medications used to improve sleep.

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