

Sleep Patterns Among Children with Attention-Deficit Hyperactivity Disorder: A Reexamination of Parent Perceptions

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Surveyed parents of children with and without ADHD for their perceptions of their children's sleep patterns. All children had been referred for learning or behavior problems to an outpatient assessment center. Diagnoses of ADHD were based on DSM-III-R, rather than DSM-III criteria, avoiding a possible confound from diagnostic criteria that formerly included sleep disturbance as a defining characteristic of ADHD. Data replicated past findings showing that parents perceive children with ADHD to have greater sleep difficulty than normally developing children. Parents perceived few differences between sleep patterns of children with ADHD who were taking or not taking stimulant medication. Implications of these findings are discussed in the context of past literature and present clinical practice.

KEY WORDS: attention-deficit/hyperactivity disorder; sleep disorders; Ritalin; hyperactivity.

Attention-deficit/hyperactivity disorder (ADHD) is a thoroughly researched disorder with over 15,000 professional references that have focused principally on its childhood manifestations (Barkley, 1990). Child psychologists working closely with pediatricians in new health care models are especially likely to be con-

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sulted about associated problems of ADHD, including frequently reported sleep disturbances (Ball & Koloian, 1995; Dahl, Pelham, & Wierson, 1991). Yet, theory and research is sparse and often contradictory with regard to sleep patterns among children with this disorder.

Sleep difficulties among these children have been attributed to core difficulties in regulating attention (Douglas & Peters, 1979) or to just one more aspect of general behavioral problems (Dahl et al. 1991). There is a logical association between the physiology of sleep and the presence of sleep disorders among individuals with ADHD. Sleep is an autonomically governed process reflecting cyclical changes in brain arousal (Ware & Orr, 1983), and ADHD may result from irregular arousal functioning (Laufer, Denhoff, & Solomons, 1957; Satterfield, Cantweel & Satterfield, 1974). Modern neuroimaging research has documented underaroused cortical functioning in the frontal lobes (Zametkin et al., 1990) of the brain among patients with ADHD. Thus, the association between ADHD and the arousal system has direct implications for the influence of ADHD on the autonomic processes associated with the regulation of sleep. Previous research has further established this link by demonstrating positive associations between physiological indices of arousal obtained from children during the day and a history of a sleep disturbance (Fisher & Rinehart, 1990).

There is only a small collection of empirical literature addressing the relationship between ADHD and sleep. Within this literature, data from parent perceptions has often suggested greater sleep difficulty for these children than has objective polysomnogram data (Busby, Firestone, & Pivik, 1981). Explanations for parent-perceived sleep difficulties in the absence of more objective evidence have included the idea that parents of children with ADHD may complete questionnaires with a negative halo effect, leading them to overreport all behavioral problems (Greenhill, Anich, Goetz, Hanton, & Davies, 1983). Methodological problems in past research complicates this issue. Anecdotal reports of practicing clinicians have long suggested that the sleep of children with ADHD is disturbed, but empirical tests of this presumption have only been conducted since 1980, relying entirely on diagnostic criteria of ADHD drawn from the *Diagnostic and Statistical Manual, 3rd Edition* (DSM-III; American Psychiatric Association [APA] 1980). However, prior to the publication of this manual, sleep disturbance among children with ADHD was already so widely presumed that DSM-III listed sleep disturbance as one of the defining characteristics of ADHD. Neither of the two more recent diagnostic manuals (APA, 1987, 1994) have included sleep disturbance as a criterion symptom of ADHD. Thus, parent perception research regarding ADHD sleep patterns has been based, to date, on an outdated diagnostic manual and includes a potential confound in research design. Specifically, since parent perceptions of sleep difficulty helped define ADHD in these studies, subsequent discoveries of parent-perceived sleep difficulty for ADHD groups relative to controls may have occurred due to subject selection bias.

The present authors reexamined parent perceptions of sleep patterns of children with ADHD, relying on DSM-III-R (APA, 1987), rather than DSM-III, criteria to identify experimental subjects. This study also minimized any halo effect by using as control subjects other children who had been referred by their parents for psychological evaluations.

METHOD

Participants

A review of all patient files in a medical school based neuropsychology assessment center yielded a total of 180 children who (a) were referred by their parents to help determine whether their academic and/or behavioral difficulties were attributable to ADHD, a learning disability, or some other emotional or behavioral problem, (b) were of at least average intellectual ability through formal assessment, and (c) had been given several specific tests and procedures during their assessment.

Parents of all subjects completed a written behavioral checklist indicating the simple presence or absence of DSM-III-R (APA, 1987) criteria for ADHD. For purposes of this study, children with ADHD were operationally defined by the criterion that parents reported the presence of at least 8 (of a possible 14) DSM-III-R symptoms of ADHD over a period encompassing at least the past 6 months and (for older children) since before the age of 7. On the basis of parent responses to this checklist, children were divided into an ADHD Index Group ($n = 102$) or a non-ADHD Comparison Group ($n = 78$). Children who met criteria for ADHD were then subdivided into those who were currently taking some form of stimulant medication prescribed for ADHD and those who were medication-free at the time of this testing.

Procedures

As part of a comprehensive formal assessment, each child's parents underwent an hour-long interview and history taking, each child was interviewed, and each family received a battery of psychological tests that usually included the Wechsler Intelligence Scale for Children (Revised or 3rd Edition) (WISC-R or WISC-III; Wechsler, 1974, 1991), the Personality Inventory for Children-Revised (PIC-R; Wirt, Lachar, Klinedinst, & Seat, 1982), the 48-item version of the Conners' Parents' Rating Scales (CPRS-48; Conners, 1989), and other psychological test instruments. Test batteries varied, but most children in this study were also administered the Gordon Diagnostic System (GDS; Gordon, McClure, & Post, 1983), and the Wide Range Achievement Test (either the Revised or 3rd Edition)

(Jastak & Wilkinson, 1984; Wilkinson, 1993). As all subjects were evaluated by a single licensed clinical psychologist, it was possible to compare the clinician's judgment about the presence or absence of ADHD, as determined by written conclusions in the psychological report prepared by the clinician for each subject, with determinations of ADHD made simply on the basis of a parent-completed checklist of criterion symptoms of ADHD from the DSM-III-R. A percentage of agreement analysis yielded a total agreement of 82% between these two methods of defining ADHD. The contingency coefficient for this agreement analysis was statistically significant, $C = .54$, $\chi^2(1, N = 180) = 73.3$, $p < .001$.

Sleep patterns of these children were not a specific subject of inquiry at the time of their assessment, but a retrospective analysis focused on Item 42 of the CPRS-48 ["Problems with sleep (can't fall asleep, up too early, up in the night)"] to which parents responded: "Not at all," "Just a little," "Pretty much," and "Very much." Additionally, analysis were conducted for eight sleep-related items from the PIC-R: Items 59 ("My child goes to bed on time without complaining."), 82 ("My child frequently has nightmares."), 108 ("My child has as much pep and energy as most children."), 127 ("My child seems tired most of the time."), 157 ("My child often gets up at night."), 166 ("My child gets exhausted easily."), 180 ("Often my child will sleep most of the day on a holiday."), and 222 ("My child insists on keeping a light on while sleeping.").

RESULTS

Table I lists salient demographic characteristics, relevant test scores, and ADHD symptom characteristics of all children in this study. These data illustrate that children who were identified as ADHD on the basis of parent responses to a DSM-III-R based checklist of salient symptoms also show likely ADHD on the basis of such other diagnostic tools as the CPRS-48 Hyperactivity Index, the number of commission errors on the GDS (a continuous performance test), and the Hyperactivity Scale of the PIC-R.

Comparisons between sleep problems in the ADHD Index and Comparison Groups are summarized in Table II. Among medication-free children who met *DSM-III-R* criteria for ADHD ($n = 74$), a large number of parents (52.7%) reported some degree of sleep difficulty on item 42 of the CPRS-48. Among children who did not have ADHD, fewer parents reported that their children had sleep problems ($n = 76$; 32.9%). The difference in the numbers of parents reporting sleep problems between the ADHD-without-medication and the non-ADHD groups was statistically significant, $\chi^2(1, N = 150) = 6.02$, $p < .05$. Assigning parent ratings of 1 (*not at all*), 2 (*just a little*), 3 (*pretty much*), and 4 (*very much*) on Item 42 of the CPRS-48, the ADHD-without-medication group ($M = 0.93$, $SD = 1.08$) also showed higher ratings of intensity of sleep difficulty

Table 1. Demographic Characteristics and Additional Test Data for All Subjects

Characteristics and related tests	Comparison group (<i>n</i> = 78)	ADHD Index group	
		Medication (<i>n</i> = 28)	No medication (<i>n</i> = 74)
Age			
<i>M</i>	8.9	9.0	8.7
<i>SD</i>	2.8	2.7	3.1
Male			
<i>n</i>	56	22	56
%	71.8	78.6	75.7
Female			
<i>n</i>	22	6	18
%	28.2	21.4	24.3
Caucasians			
<i>n</i>	69	25	68
%	88.4	89.3	91.9
African Americans			
<i>n</i>	5	2	4
%	6.4	7.1	5.4
Other ethnicity			
<i>n</i>	4	1	1
%	5.2	3.6	1.4
Unknown ethnicity			
<i>n</i>	0	0	1
%	0	0	1.4
WISC-R/WISC-III FSIQ			
<i>n</i>	73	26	65
<i>M</i>	99.9	97.31	99.42
<i>SD</i>	11.59	8.89	11.48
Gordon Diagnostic System			
Response delay (<i>n</i>)	49	11	44
Efficiency			
<i>M</i>	0.74	0.71	0.71
<i>SD</i>	0.11	0.08	0.11
Commissions			
<i>M</i>	20.43	25.70	24.87
<i>SD</i>	9.1	9.72	15.28
Omissions			
<i>M</i>	13.45	16.00	10.58
<i>SD</i>	10.73	7.27	9.09
PIC-R Hyperactivity Scale (<i>T</i> scores)			
<i>n</i>	78	28	74
<i>M</i>	52.4	63.54	69.12
<i>SD</i>	9.34	21.75	12.49
Conners Parents' Questionnaire Hyperactivity Index (<i>T</i> -scores)			
<i>n</i>	78	28	74
<i>M</i>	60.24	81.53	80.09
<i>SD</i>	12.28	10.91	11.43

Table II. Significant Differences in Sleep Problems of Comparison and ADHD Index Groups of Children

Specific items	Comparison group (<i>n</i> = 78) %	ADHD Index group (<i>n</i> = 102)	
		Medication (<i>n</i> = 28) %	No medication (<i>n</i> = 74) %
Conners Parents' Questionnaire #42 (Yes = 1, 2, or 3) "Problems with Sleep"	32.9 ^{a,b} (<i>M</i> = 0.49 ^{a,b} ; <i>SD</i> = 0.81)	64.2 (<i>M</i> = 1.24; <i>SD</i> = 1.19)	52.7 (<i>M</i> = 0.92; <i>SD</i> = 1.06)
PIC-R #157 (True) "Often up at night"	10.5 ^{a,b}	27.6	32.4
PIC-R #222 (True) "Insists on a night light"	19.7 ^b	31.0	45.4
PIC-R #59 (True) "Complains going to bed"	46.1	62.1	63.5
PIC-R #82 (True) "Frequent night- mares"	9.2	20.7	5.4
PIC-R #108 (False) "Energy of most children"	12.3	10.3	10.5
PIC-R #129 (True) "Usually tired"	7.9	6.9	16.2
PIC-R #166 (True) "Easily exhausted"	10.5	13.8	20.3
PIC-R #180 (True) "Sleeps most holi- days"	5.4	3.4	6.6

^aDifference between Comparison and ADHD-with-medication groups, significant at $p < .003$ (with Bonferonni correction).

^bDifference between Comparison and ADHD-without-medication groups, significant at $p < .003$ (with Bonferonni correction).

than did the non-ADHD comparison group ($M = 0.50$, $SD = 0.86$), $t(148) = 2.70$, $p < .01$.

On the eight sleep-related items from the PIC-R, there were several significant findings. These findings were the same whether using Bonferoni corrections ($p < .003$) or, less conservatively, setting the alpha level for statistical significance at $p < .01$. Parents of the children with ADHD more often reported "True" to Item 157, "My child often gets up at night," $\chi^2(1, N = 150) = 10.43$, $p < .01$, and "True" to Item 222, "My child insists on keeping a light on while sleeping," $\chi^2(1, N = 150) = 11.78$, $p < .01$. Across the other PIC-R questions there were no significant group differences.

Among children with ADHD ($n = 102$), comparisons between children who were medication-free ($n = 74$) and medicated ($n = 28$) yielded no statistically significant differences. These two groups were comparable with regard to parent endorsement of the sleep item on the CPRS-48, and, on the PIC-R, parents of children with ADHD, with and without medication, responded comparably on all eight sleep-related items, whether applying Bonferonni corrections ($p < .003$) or setting alpha at $p < .01$.

DISCUSSION

The present study addresses several methodological problems associated with prior research regarding parent perceptions of sleep patterns among children with ADHD. First, the use of DSM-III-R rather than DSM-III criteria for identifying ADHD eliminated a potential confound between parent perceptions of sleep difficulties used in making and then evaluating the effects of ADHD. Second, a post hoc investigation of sleep questions embedded within a routine evaluative procedure offered to parents of children with and without ADHD, both referred for behavioral and/or learning problems, minimized any differences due to a halo effect related to general behavioral problems.

The results of this study replicate earlier findings of a significant relationship between the presence of ADHD and the presence of parent-perceived sleep disturbance. Parents of children with ADHD more often reported sleep problems than did parents of other children referred for psychological evaluations. Parents of children with ADHD also reported a greater intensity of sleep difficulty, and they noted specific types of differences. Children with ADHD awoke more often during the night and more often insisted on keeping a light on while sleeping.

The contradiction between parent perceptions and polysomnogram data that has been evident in prior research remains unresolved. Perhaps children with ADHD are more likely to make their sleep problems known to parents than are other children, even those with similar learning and/or behavioral problems. Rose et al. (1995) found, on a parent-completed pediatric sleep questionnaire, that, relative to parents of children with medical problems and parents of normally developing children, parents of children with ADHD tend to report the types of sleep problems that may have to do with psychological factors (anxiety, emotional lability, and shortened total sleep time) rather than excessive daytime sleepiness, excessive depth of sleep, respiratory problems, or sleep hygiene problems. Given the comorbidity between ADHD and other psychological disorders, it is possible that separate but related psychological problems are the basis for parent-perceived sleep difficulties among children in the ADHD Index Group. However, if there are only parent-perceived differences in psychological influences on sleep among children with ADHD, these parent perceptions merit serious consideration, particularly since they have been robust over time and across different research investigations.

Among children with ADHD, sleep difficulties were no more or less prevalent or intense whether or not children were taking stimulant medication. Polysomnogram research has found few consistent insomnia side effects to stimulant medication, though several researchers reported decreased rapid eye movement (REM) activity for children on methylphenidate (Chatoor, Wells, Conners, Seidel, & Shaw, 1983; Greenhill et al., 1983). Thus, most sleep side effects of stimulant medication are not well established empirically, and there continues to

be contradictory and confusing data regarding which children may experience sleep side effects of stimulant medication.

With regard to clinical implications of these findings, it is likely that many parents are experiencing nighttime as well as daytime frustrations in managing children with ADHD. Many families undergo a great deal of stress and conflict during evening homework assignments when children with ADHD are often medication-free to avoid presumed insomnia side effects. These children are often unable to work efficiently, and parents exert considerable time and energy in their management and close supervision. Past parent-perception research has suggested adverse sleep side effects of stimulant medication, but this literature is largely anecdotal. One study with much improved research methodology (Barkley, McMurray, Edelbrock, & Robbins, 1990) summarized these findings by suggesting mild medication-related sleep disturbances. However, even in this study, data were only gathered over 7–10 days for each group studied. Several leading physicians who are experienced in the use of stimulant medications in the treatment of children with ADHD have suggested that insomnia side effects are transient rather than long-lasting (Conners, 1972; Eisenberg, 1972; Lytton & Knobel, 1959). If stimulant medication has a less significant deleterious effect on sleep than has been formerly suspected and if many children (and families) would benefit from late-day stimulant doses, then the current practice of not prescribing stimulant medication after dinner may need a closer review. Other researchers have made similar suggestions about the possible benefits of late-day stimulant medication (Chatoor et al., 1983). However, to date, there has been no empirical validation of the efficacy of late-day stimulant medications in assisting sleep for these children.

There are several important limitations of the present study. First, as there is no litmus test for the diagnosis of ADHD, the ADHD Index and Comparison Groups may each contain children who were incorrectly diagnosed. While the method selected in this study puts particular emphasis on parent ratings of ADHD symptoms, it has the advantage of applying strict DSM-III-R criteria to group assignment. Moreover, there was general agreement between this method and clinician determinations, and, as reported in Table 1, children diagnosed with ADHD by the DSM-III-R criteria showed other test findings that have previously been shown to be typical of children with ADHD.

As a second limitation, no comparisons were made with children who had not been referred for behavioral or learning problems. Normally developing children without ADHD or high-functioning children with ADHD might have shown less extreme sleep problems than did these subjects. Future research should include both normally developing control subjects and high-functioning children with ADHD to better judge the generalizability of these findings. In a related issue, while DSM-III-R diagnostic criteria are an improvement over the earlier DSM-III criteria that introduced a potential confound in all prior sleep

studies of children with ADHD, future research is needed to determine how DSM-IV based diagnoses might alter these results. DSM-IV distinctions between children with Primary Inattentive and Primary Hyperactive/Impulsive subtypes of ADHD raise new hypotheses. As the Inattentive subtype may represent less pronounced behavioral symptoms, fewer sleep problems among those children, relative to the Hyperactive/Impulsive subtype, are likely. If this hypothesis is confirmed, it would suggest that behavioral disturbances rather than a specific sleep problem might best account for the discrepancy between parent perceptions of sleep difficulty and polysomnogram research of no sleep difficulty for children with ADHD. Future research is also needed, using subtypes of children with ADHD under varying stimulant drug regimens and schedules (daytime and nocturnal administrations) to address unresolved questions of how these variables might affect parent reports of children's sleep problems. Finally, for older children and adolescents with ADHD, future survey research should attempt to gather data regarding children's perceptions of their own sleep.

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