Actigraphic and Parental Reports of Sleep Difficulties in Children With Attention-Deficit/Hyperactivity Disorder

Allan Hvolby, MD; Jan Jørgensen, MD; Niels Bilenberg, MD, PhD

**Objectives:** To describe actigraphically detected and parent-reported sleep problems in nonmedicated children with attention-deficit/hyperactivity disorder (ADHD); to clarify whether or not comorbid oppositional defiant disorder contributes to sleep difficulties; and to compare objectively measured sleep with the parents' observations of sleep.

**Design:** Case-control study.

**Setting:** A child and adolescent psychiatric department of a teaching hospital.

**Participants:** Two hundred six children aged 5 to 11 years, including 45 with a diagnosis of ADHD, 64 with a diagnosis of other psychiatric diagnoses (psychiatric control group), and 97 healthy control subjects (reference group).

**Intervention:** Sleep was monitored by parent-completed sleep diaries and 5 nights of actigraphy. We used a semistructured interview to diagnose psychiatric disorders according to *Diagnostic and Statistical Manual of Mental Disorders* (Fourth Edition) criteria.

**Main Outcome Measures:** Actigraphically measured sleep variables and parent-estimated sleep by diary.

**Results:** We found that children with ADHD have significantly longer sleep onset latency and a more irregular sleep pattern than the psychiatric control or healthy reference subjects. Average sleep onset latencies were 26.3 minutes in the ADHD group, 18.6 minutes in the psychiatric control group, and 13.5 minutes in the healthy reference group. There was no apparent relationship between sleep problems and comorbid oppositional defiant disorder. We found discrepancies between the objectively measured sleep variables and those reported by parents, who overestimated sleep onset latency.

**Conclusions:** The results of this study allow us to conclude that some children with ADHD have impaired sleep that cannot be referred to comorbid oppositional defiant disorder. However, it is important to make an in-depth review of the sleep complaints, as the problem may be a product of the parents’ perception rather than the child’s actual experience.

**Trial Registration:** clinicaltrials.gov Identifier: NCT00224731


ATTENTION-DEFICIT/HYPERACTIVITY DISORDER (ADHD) is the most common problem presented to child and adolescent mental health services. The disorder affects approximately 5% of all school-aged children. The core symptoms of the disorder include varying degrees of inattention, hyperactivity, and impulsivity. In addition, ADHD is often associated with other problems (eg, academic underachievement, poor social relations, and sleep disturbances), and the disorder shows a high rate of comorbidity (eg, oppositional defiant disorder [ODD], anxiety, and depression).

Sleep problems in children with ADHD have been addressed in many studies in recent years, but the issue is still unsettled. It is difficult to judge accurately the extent and nature of sleep problems in children with ADHD because the range of studies addressing this issue has methodological problems (eg, small sample sizes, waverin diagnostic criteria, and different status of medication and comorbidity). Most studies have compared sleep difficulties in children diagnosed as having ADHD with healthy or pediatrically referred children, but not with children with other psychiatric disorders.

Parents of children with ADHD often report that their children have sleep difficulties. These difficulties are largely concerned with low sleep requirement, long sleep onset latency, restless sleep, fre-
quent awakenings, and fatigue in the morning. The children diagnosed as having ADHD also report sleep difficulties more frequently than do children without ADHD. More than half of the children with ADHD claim to have sleep difficulties.

In studies using actigraphy, Gruber et al found no difference with regard to sleep onset latency and duration of sleep but an increased day-to-day variability in the sleep-wake pattern of children with ADHD compared with children without ADHD. This is in contrast to estimated sleep difficulties in healthy children, in whom insomnia has been found in 5% to 14%. Other studies show that sleep problems in general are found in 6% of all children. Sleep difficulties used to be so closely associated with ADHD that they were regarded diagnostic criteria for the disorder. Sleep difficulties appear on various ADHD rating scales as well. This association is, however, based on clinical observations rather than theoretical considerations of sleep difficulties as part of ADHD. Most often, sleep difficulties have been reported from the point of view of subjective measurements (ie, questionnaires, sleep diaries, and interviews), focusing exclusively on the difficulties that could be observed. The informants have typically been parents, and it has been suggested that parents might overestimate the problem. Various studies show a discrepancy between parents' reports on sleep difficulties and objective sleep difficulties as measured by polysonomography and actigraphy.

It has been shown that children's sleep difficulties are stressful for their parents. One hypothesis states that children with ADHD are more likely to wake their parents at night than are children without ADHD. Parents of children with ADHD might, therefore, be more aware of possible sleep difficulties. However, this hypothesis has not been documented.

In child psychiatric clinical populations, sleep difficulties have been associated with anxiety and ODD. Recent studies point out that most cases relating sleep difficulties to ADHD have been confounded with comorbidity (eg, anxiety, ODD, and depression) and/or medical treatment, but very few studies have addressed this possible connection. Other studies have shown an interrelationship between sleep disorder and enhanced risk of developing depression.

Primary sleep disorders, such as sleep-related breathing disorder and periodic limb movement disorder, are found to be related to hyperactivity and inattentiveness and are often mistaken for the symptoms seen in ADHD (ie, inattention, hyperactivity, and impulsivity). However, when treated, the symptoms of hyperactivity and inattentiveness have been reduced or even resolved. It still remains uncertain whether there is an increased proportion of sleep difficulties among children who have ADHD compared with children who have other psychiatric disorders and healthy children, and, if so, whether the difficulties are related directly to the ADHD or to the comorbidity. To the best of our knowledge, this is the first study using actigraphic sleep recording and parent-evaluated sleep diaries that compared children who have ADHD with children who have other psychiatric diagnoses and with healthy children.

The main objective of the present study was to determine the relationship between the existence of sleep problems and the occurrence of ADHD. We will describe the extent of sleeping difficulties for children with ADHD compared with sleep patterns for children in the 2 comparison groups—one consisting of children with other psychiatric disorders and the other of healthy children. A second objective was to clarify whether comorbidity (especially comorbid ODD) contributes to sleep difficulties, and a third was to compare the objectively measured sleep with the parents’ experience of the sleep.

**METHODS**

**PARTICIPANTS**

A total of 206 children aged 5 years 9 months to 12 years 4 months, with an average age of 8 years 5 months, were included. Of these, 109 were referred by general practitioners to the Department of Child and Adolescent Psychiatry, Psychiatric Centre West, Esbjerg. All were referred owing to a suspected psychiatric disorder. None were referred for sleeping problems. Ninety-seven healthy children were randomly recruited through a public school. The total number included 133 boys and 53 girls. No members of the referred group had been treated with stimulants and none had received any medication to treat sleep difficulties.

After psychiatric evaluation, children with major sensory-motor handicaps (eg, blindness, deafness, and paralysis), autism, psychoses, or estimated full-scale IQ of less than 80 were excluded.

**DIAGNOSTIC MEASURES**

Each participant in the referred group underwent thorough clinical assessment. The diagnostic evaluation was based on a face-to-face parent interview and a clinical assessment. All of the referred children participated in a standard clinical examination and received a diagnosis in accordance with the International Statistical Classification of Diseases, 10th Revision classification of mental and behavioral disorders. In view of the high rates of comorbidity with behavioral and emotional disturbances, all underwent a clinical diagnostic interview to establish a Diagnostic and Statistical Manual of Mental Disorders (Fourth Edition) DSM-IV diagnosis and potential comorbidity. For that purpose, we used the Schedules for Affective Disorders and Schizophrenia for School-aged Children—Present and Lifetime Version. The healthy comparison group was treated merely as a reference group and did not undergo any clinical interview.

A DSM-IV–based ADHD Rating Scale (ADHD-RS) was completed by the parents of all participants, including the healthy reference group, to establish a possible relation between the severity of ADHD symptoms and sleeping difficulties.

**SLEEP**

To obtain an objective view of sleep patterns, we used an actigraph (Basic Mini Motionlogger; Ambulatory Monitoring, Inc, Ardsley, New York) consisting of a wrist-watch–sized activity sensor worn on the dominant wrist. The children wore the actigraph for 7 consecutive nights to obtain usable data from 5 nights, during which all movement was registered. If usable data from 5 nights were not obtained in the first attempt, another study of an additional 7 nights was performed. When usable information was obtained for more than 5 nights, the sixth (and even-
tual seventh) night was omitted. When uploaded to the computer, the accumulated data were analyzed according to the Actigraphic Scoring Analysis Program (Acta 4, version 1.05; Ambulatory Monitoring, Inc). Study of the frequency and pattern of movement permits detection of basic sleep-wake patterns. The variables generated were sleep onset latency (time from the parents’ note of lights out and the actigraphically measured first sleep onset), total duration of sleep (actual sleep time, excluding sleep latency and awakening after sleep onset), number of awakenings after sleep onset, and length of each awakening.

Actigraphy is an established and well-reputed method of sleep examination. In other studies, actigraphy led to findings consistent with the ones obtained by the polysomnographic methods, with an agreement rate of 95%. The sleep recording took place in the children’s own homes, which is an additional advantage because the children’s sleep did not seem to be affected negatively.

As recommended, actigraphic data were averaged across 5 consecutive nights for each child. During the same 5-night period, a sleep diary was completed by the parents to provide subjective assessment of sleep-wake patterns and to provide more accurate actigraphic measurements. Parents were instructed to observe and specify their children’s sleep and awake states (bedtime, lights out, observed awakenings, and number of times the child woke up). Thus, we were able to calculate sleep onset latency.

**DATA ANALYSIS**

A statistical analysis was performed using SPSS for Windows statistical software, version 14.0 (SPSS Inc, Chicago, Illinois). For univariate comparison of groups, we used 1-way analysis of variance for continuous outcomes and the Fisher exact test for binary outcomes. Adjustment for sex and family type was performed using a 3-way analysis of variance for continuous outcomes and general linear model univariate analysis and chi² testing with 2 df for binary outcomes. Significance was assumed at P < .01.

**RESULTS**

**DIAGNOSTIC GROUPS**

Of the 109 clinically referred children, 45 met the DSM-IV criteria for ADHD, and 64 were included as a clinical comparison group. All the children were medically naive. A nonclinical group of 97 children was recruited from a local public school. These children did not complete the clinical examination and were regarded as a reference group only.

**SUBJECT CHARACTERISTICS**

Demographic data are shown in Table 1. The families whose children had been referred to psychiatric treatment represent a variety of different social classes and family types. The children’s ages ranged from 5 years 9 months to 12 years 4 months, with an average of 8 years 5 months. There were more boys than girls. In the ADHD group, there were more families with 1 parent than in the other 2 groups. Our analyses of the results take all these differences into account. The healthy reference group consisted of children ranging in age from 6 years to 11 years 1 month, with an average age of 8 years.

All of the children, whether referred or healthy, attended mainstream schools, and no significant differences with respect to age or social class were found between the groups. No children were prescribed stimulants or hypnotics, but 46 children had a diagnosis of a childhood disease (predominantly asthma and nocturnal enuresis), of which 29 (primarily asthmatic children) were medically treated.

The results of the actigraphic measurements can be seen in Table 2. There was a significant difference in sleep onset latency among the 3 groups, even after corrections for sex and family type. In the ADHD group, the average sleep onset latency was 26.3 minutes. In the psychiatric control group, the average was 18.6 minutes, whereas it was 13.5 minutes in the healthy reference group.

We found a significant difference among the groups regarding the differences between the longest and shortest individual sleep onset latency and averages of longest sleep onset latency. In the ADHD group, 31.1% of the children required on average more than 30 minutes to fall asleep compared with 9.4% and 7.2% in the psychiatric and healthy groups, respectively.
The total number of nights spent with sleep onset latency of more than 30 minutes was also significantly greater in the ADHD group. There appeared to be an increased day-to-day variation in the sleep onset latency time for the children with ADHD compared with the psychiatric control and healthy reference groups.

The other objective sleep variables showed no difference among the 3 groups. There was an average of 8.7 awakenings per night in the ADHD group, with an average of 2.7 minutes of awake time per awakening. In the psychiatric control group, the figures were 8.2 awakenings of 2.7 minutes of awake time per night, and in the healthy reference group the corresponding figures were 9.5 awakenings with an average of 2.8 minutes of awake time per night.

For the ADHD group, the total duration of sleep was 555 minutes (9 hours 15 minutes); for the psychiatric control group, 555 minutes (9 hours 15 minutes); and for the healthy reference group, 560 minutes (9 hours 20 minutes). None of these differences were significant.

Table 2. Actigraphic Sleep Measures

<table>
<thead>
<tr>
<th></th>
<th>ADHD Group (n=45)</th>
<th>Psychiatric Control Group (n=64)</th>
<th>Healthy Reference Group (n=97)</th>
<th>P Value</th>
<th>Adjusted P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sleep onset latency, min</td>
<td>26.3 (16.3)</td>
<td>18.6 (9.7)</td>
<td>13.5 (8.9)</td>
<td>&lt;.001</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Average of longest sleep onset latency, min</td>
<td>48.2 (29.7)</td>
<td>34.3 (19.5)</td>
<td>25.3 (17.1)</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Difference between longest and shortest individual sleep onset latency, min</td>
<td>38.3 (25.6)</td>
<td>26.7 (19.1)</td>
<td>19.9 (16.0)</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>No. of awakenings</td>
<td>8.7 (4.6)</td>
<td>8.2 (4.8)</td>
<td>9.5 (6.2)</td>
<td>.19</td>
<td>.11</td>
</tr>
<tr>
<td>Average time awake, min</td>
<td>2.7 (1.2)</td>
<td>2.7 (0.6)</td>
<td>2.8 (0.8)</td>
<td>.6</td>
<td>.6</td>
</tr>
<tr>
<td>Total sleep time, min</td>
<td>555 (42)</td>
<td>555 (41)</td>
<td>560 (36)</td>
<td>.6</td>
<td>.6</td>
</tr>
<tr>
<td>Sleep onset latency &gt; 30 min, %</td>
<td>31.1</td>
<td>9.4</td>
<td>7.2</td>
<td>.001</td>
<td>NC</td>
</tr>
<tr>
<td>Sleep onset latency &gt; 30 min, %</td>
<td>32.4</td>
<td>21.8</td>
<td>12.4</td>
<td>&lt;.001</td>
<td>NC</td>
</tr>
</tbody>
</table>

Abbreviations: ADHD, attention-deficit/hyperactivity disorder; ODD, oppositional defiant disorder.

<table>
<thead>
<tr>
<th></th>
<th>ADHD Group With ODD (n=25)</th>
<th>ADHD Group Without ODD (n=20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sleep onset latency, min</td>
<td>23.8 (15.8)</td>
<td>28.6 (16.3)</td>
</tr>
<tr>
<td>Average of longest sleep onset latency, min</td>
<td>42.8 (29.2)</td>
<td>53.1 (29.3)</td>
</tr>
<tr>
<td>Difference between longest and shortest individual sleep onset latency, min</td>
<td>33.3 (24.8)</td>
<td>43.3 (25.3)</td>
</tr>
<tr>
<td>No. of awakenings</td>
<td>10.2 (4.8)</td>
<td>7.3 (4.0)</td>
</tr>
<tr>
<td>Average time awake, min</td>
<td>2.6 (0.9)</td>
<td>2.8 (1.3)</td>
</tr>
<tr>
<td>Total sleep time, min</td>
<td>564 (34.5)</td>
<td>547 (45.3)</td>
</tr>
</tbody>
</table>

Abbreviations: ADHD, attention-deficit/hyperactivity disorder; ODD, oppositional defiant disorder.

There were no significant differences in sleep onset latency between the children with ADHD without ODD and children with ADHD and comorbid ODD (Table 3 and Table 4). The group without comorbid ODD, however, seemed to have a longer sleep onset latency time, a larger difference between the longest and shortest individual sleep onset latency, and a larger difference in the average of the longest sleep onset latency, but none of these differences was significant.

Children who have ADHD (with or without comorbid ODD) seem to have a longer sleep onset latency than do children with ODD and anxiety as primary diagnoses. In particular, children who have ADHD without comorbid ODD seem to have a longer sleep onset latency than do children with ODD alone (28.6 vs 18.8 minutes), but the difference is not significant.

Anxiety without ADHD seems to cause an extension of the sleep onset latency (18.0 minutes) when these children are compared with healthy children (13.5 minutes), but not when they are compared with children who have ADHD. There was no significant difference regarding the number of awakenings, and the total sleep times were identical.

As shown in Table 5, the ADHD-RS parental scores were significantly higher in the ADHD group than in the comparison groups. We did not find any correlation between sleep onset latency and ADHD-RS scores in the ADHD and the psychiatric control groups. On the other hand, there was a significant correlation between onset latency and ADHD-RS scores in the healthy reference group.

Parental views on sleep onset latency are reported in Table 6. We compared the parents’ estimation (by sleep diary) of sleep onset latency (the time from the parents’ notes of lights out to first sleep onset) with the objectively (actigraphically) measured sleep onset latency (time from the parents’ note of lights out to actigraphically measured first sleep onset). In 73% of the psychiatric control and healthy reference cases and in 72% of the ADHD...
cases, the parents overestimated the duration of sleep onset latency.

It is interesting that the parents of children with ADHD estimated their children’s sleep onset latency to be significantly longer than did the parents of the other children. In fact, the parents of the children with ADHD estimated that it took an average of 44.3 minutes for their children to fall asleep, whereas the parents of the healthy children estimated that their children fell asleep after only 24.8 minutes. This difference was significant.

The present study found that children with ADHD have longer sleep onset latency and that significantly more children with ADHD spend more than 30 minutes (on average) falling asleep. As also found by other authors, an increased intraindividual day-to-day variability was seen in children with ADHD compared with healthy children and children with other psychiatric diagnoses.

In contrast to other studies, we did not find that comorbid ODD or comorbid anxiety aggravated sleep problems in children with ADHD. In fact, the ADHD group without comorbid ODD seemed to have longer sleep onset latency, a larger difference between the longest and shortest individual sleep onset latency, and a larger difference in average of longest sleep onset latency than did the ADHD group with comorbid ODD, although the differences were not significant.

The number and duration of awakening periods during the night were the same for all 3 groups. We did not find any correlation between sleep onset latency and the

### Table 4. Sleep Measures and Comorbid ODD, ODD, and Anxiety

<table>
<thead>
<tr>
<th></th>
<th>ADHD Group With ODD (n=25)</th>
<th>ADHD Group Without ODD (n=20)</th>
<th>ODD (n=17)</th>
<th>Anxiety (n=14)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sleep onset latency, min</td>
<td>23.8 (15.8)</td>
<td>28.6 (16.3)</td>
<td>18.8 (9.9)</td>
<td>18.0 (7.9)</td>
</tr>
<tr>
<td>Average of longest sleep onset latency, min</td>
<td>42.8 (29.2)</td>
<td>53.1 (29.3)</td>
<td>35.1 (20.3)</td>
<td>34.8 (13.1)</td>
</tr>
<tr>
<td>Difference between longest and shortest individual sleep onset latency, min</td>
<td>33.3 (24.8)</td>
<td>43.3 (25.3)</td>
<td>28.1 (20.4)</td>
<td>24.8 (13.2)</td>
</tr>
<tr>
<td>No. of awakenings</td>
<td>10.2 (4.8)</td>
<td>7.3 (4.0)</td>
<td>8.9 (6.7)</td>
<td>8.4 (5.8)</td>
</tr>
<tr>
<td>Average time awake, min</td>
<td>2.6 (0.9)</td>
<td>2.8 (1.3)</td>
<td>3.5 (0.9)</td>
<td>3.3 (1.3)</td>
</tr>
<tr>
<td>Total sleep time, min</td>
<td>564 (34.5)</td>
<td>547 (45.3)</td>
<td>563 (39.3)</td>
<td>543 (30.0)</td>
</tr>
</tbody>
</table>

Abbreviations: ADHD, attention-deficit/hyperactivity disorder; ODD, oppositional defiant disorder.

### Table 5. ADHD Rating Scale Scores

<table>
<thead>
<tr>
<th></th>
<th>ADHD Group (n=45)</th>
<th>Psychiatric Control Group (n=64)</th>
<th>Healthy Reference Group (n=97)</th>
<th>P Valueb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hyperactivity</td>
<td>18.3 (4.7)</td>
<td>10.6 (5.3)</td>
<td>5.6 (3.4)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Inattentiveness</td>
<td>17.7 (4.6)</td>
<td>10.4 (5.7)</td>
<td>5.1 (3.6)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Pearson correlation</td>
<td>-.030</td>
<td>-.10</td>
<td>0.33</td>
<td>NA</td>
</tr>
<tr>
<td>P value</td>
<td>2</td>
<td>.5</td>
<td>&lt;.01</td>
<td>NA</td>
</tr>
</tbody>
</table>

Abbreviations: ADHD, attention-deficit/hyperactivity disorder; NA, not applicable.

### Table 6. Parental vs Actigraphic Estimated Sleep Onset Latency

<table>
<thead>
<tr>
<th></th>
<th>ADHD Group (n=45)</th>
<th>Psychiatric Control Group (n=64)</th>
<th>Healthy Reference Group (n=97)</th>
<th>P Valueb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean (SD) sleep onset latency, min</td>
<td>26.3 (16.3)</td>
<td>18.6 (9.7)</td>
<td>13.5 (8.9)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Actigraphic measure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parental estimation</td>
<td>44.3 (21.4)</td>
<td>34.3 (15.3)</td>
<td>24.8 (11.1)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Difference</td>
<td>18.2 (14.6)</td>
<td>15.3 (15.0)</td>
<td>11.3 (9.9)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Parents who overestimate, %</td>
<td>72</td>
<td>75</td>
<td>75</td>
<td>NS</td>
</tr>
</tbody>
</table>

Abbreviations: ADHD, attention-deficit/hyperactivity disorder; NS, not significant (P > .01).

Parents’ estimation (by sleep diary) of sleep onset latency (time from the parents’ note of lights out and parents’ note of first sleep onset) compared with the objectively (actigraphically) measured sleep onset latency (time from the parents’ note of lights out and actigraphically measured first sleep onset).

Data were analyzed with 3-way analysis of variance, adjusted for sex and family type.

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ADHD-RS score in the ADHD or the psychiatric control group, whereas there was a significant correlation in the healthy reference group. In light of these findings, it must be questioned whether ADHD per se can cause sleep disturbances, as suggested in a study by O'Brien et al.40 Because the total duration of sleep seems to be the same for all 3 groups, it is debatable whether the prolonged sleep onset latency for children with ADHD is clinically relevant.

However, in a unique subset of children with ADHD there seems to be a significant reduced sleep quality. It has been shown that sleep onset latency of more than 19 minutes interferes with daytime functioning.31,42 A subgroup of children with ADHD may therefore experience considerable sleep problems, here visible by prolonged sleep onset latency.

In accordance with other studies,18-20 we found poor correspondence between parental recordings of sleep problems and the objective measurements (actigraphy). We found disagreement in all 3 groups, but it was most pronounced in the group of parents whose children had ADHD. Corkum et al3 claim that the lack of correspondence between objective and subjective measurements of sleep onset latency, which is the most frequently reported problem area, is due to the children’s problematic behavior around bedtime. In addition, the individually based day-to-day variation in the sleep pattern of children with ADHD found in our study may well contribute toward making the problem appear greater than it really is. These phenomena may play an important role in parents’ experiences of their child’s problems falling asleep because parents may recall the worst-case scenarios.

The present study has not included possible differences between the subtypes of ADHD. However, Wiggs et al33 found that the parents of children diagnosed as having the ADHD inattentive subtype underestimated their children’s sleep onset time. Those authors believed that it could be explained by the far less externalized behavior pattern of this group, although the result might also be explained by the relatively small number in this particular group. This could lead to the conclusion that the high rate of parent-reported sleep onset latency in children with ADHD may be owing to these children’s behavior around bedtime (eg, bedtime resistance), which is not necessarily due to comorbid behavioral disorders.

However, the present study has also shown that some children with ADHD have sleep difficulties that may require special treatment. It has been demonstrated that sleep onset latency of more than 19 minutes interferes with daytime functioning.43 Actigraphy seems to be a relevant means of reviewing possible sleep problems. In case of real and serious problems, the measurements are able to confirm the parents’ experience, whereas in other cases they may serve as an important tool to correct the parents’ mistaken views of their child’s sleep.

Actigraphy is an established and well-reputed method of sleep examination, but it is not possible to provide information on sleep architecture or sleep disrupters (eg, periodic leg movement disorder, snoring). Furthermore, we did not screen and assess restless legs syndrome, which might explain some of the sleep onset problems seen in children with ADHD.

In this study, we were not able to differentiate between sleep patterns on weekdays and weekends, and we were not able to differentiate between seasons, which might have an influence on the results. However, actigraphic sleep registration took place on random days equally in all 3 groups.

Because the study deals with a stimulant-naive ADHD population only, it offers no information about the relationship between medication and sleep. Stimulants are frequently used to treat ADHD, and insomnia is a well-known adverse effect.44 We have no information as to how large a proportion of the ADHD group later received medical treatment. It will be relevant to perform supplementary studies to investigate how sleep is influenced by medication. It will be particularly interesting to examine how the sleep of the individual child with ADHD is affected by treatment with stimulants.

The study has not taken into account any possible primary sleep disorders (eg, sleep-related breathing disorder, periodic limb movement disorder, and sleep apnea). The correlation between such disorders and ADHD is, however, not beyond dispute. Apart from a description of ODD, this material is too limited to offer an assessment of the possible significance of comorbid diagnoses on the quality of sleep.

We have no information about the families who did not want to participate in the study. There were equal dropout rates in both clinical groups, but some selection bias may have been introduced. Nevertheless, the present study is, to our knowledge, one of the largest in terms of numbers of medication-naive children with ADHD, comparing them with children with other psychiatric disorders and healthy children.

We have no information on psychiatric symptoms in the healthy reference group. Some children in this group may have had undetected psychiatric disorders, which may have influenced the results. However, because there seemed to be more sleep problems in the psychiatric control group and even more in the ADHD group, diagnosing psychiatric problems and subsequently excluding these subjects from the healthy reference group would probably increase rather than decrease the difference found between groups.

This study found that children with ADHD have prolonged sleep onset latency and an increased intraindividual day-to-day variability. Additional comorbid ODD or anxiety seems not to contribute to further sleep difficulties. Because there may be potentially negative effects of disturbed or unstable sleep on daytime functioning, it is most relevant for clinicians to take sleep complaints seriously. However, because of the poor correspondence between parental recordings of sleep problems and the objective measurements, it is advisable to review the sleep complaint in depth and to try to objectify the problem by using actigraphy before implementing actual treatment because the complaint could be a product of the parents’ perception of the problem rather than an objective fact.

Although the general sleep onset latency for children with ADHD is only slightly prolonged, whereas it may vary a great deal from day to day on the individual level, it seems...
reliable to question whether actigraphy used for only 5 nights is sufficient to register the quality of these children’s sleep. It seems worth considering whether measurements for a longer period (ie, > 5 days) could be expected to provide a more precise picture of the children’s sleep pattern.

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Correspondence: Allan Hvoldy, MD, Bornepsykiatrisk Afdeling, Gl. Vardevej 101, 6715 Esbjerg N, Denmark (allan.hvoldy@pcv.regionsyddanmark.dk).

Author Contributions: Study concept and design: Hvoldy, Jørgensen, and Bilenberg, Acquisition of data: Hvoldy, Jørgensen, and Bilenberg, Analysis and interpretation of data: Hvoldy. Drafting of the manuscript: Hvoldy. Critical revision of the manuscript for important intellectual content: Jørgensen and Bilenberg. Statistical analysis: Hvoldy and Bilenberg. Obtained funding: Hvoldy, Jørgensen, and Bilenberg. Administrative, technical, and material support: Jørgensen and Bilenberg. Study supervision: Jørgensen and Bilenberg.

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