

# Assessment and Management of Sleep Problems in Youths With Attention-Deficit/Hyperactivity Disorder

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**Objective:** To provide evidence- or consensus-based recommendations concerning the assessment and management of sleep problems in youths with attention-deficit/hyperactivity disorder (ADHD). **Method:** PubMed, Ovid, EMBASE, and Web of Knowledge were searched through October 31, 2012. When no evidence was available, consensus of the authors was achieved. The evidence-level of the recommendations on the management of sleep disturbances was based on the Scottish Intercollegiate Guidelines Network (SIGN) system. **Results:** A total of 139 original articles on sleep and childhood ADHD were retrieved, including 22 on treatment of sleep disturbances. This review focuses on behaviorally based insomnia, circadian rhythm disorder, sleep-disordered breathing, restless legs syndrome/periodic limb movement disorder, and sleep disturbances due to comorbid psychiatric disorders or ADHD medications. Healthy sleep practices are recommended as the foundation of management strategies. Behavioral interventions should be considered as first-line treatment of insomnia, although further evidence from randomized controlled trials (RCTs) is needed to prove their efficacy in ADHD. Among pharmacological treatments, RCTs support the use of melatonin to reduce sleep-onset delay, whereas there is more limited evidence for other medications. **Conclusion:** Growing empirical evidence is informing assessment/management strategies of sleep problems in youths with ADHD. However, further RCTs are warranted to support current recommendations. *J. Am. Acad. Child Adolesc. Psychiatry*, 2013;52(8):784–796. **Key Words:** assessment, attention-deficit/hyperactivity disorder (ADHD), management, sleep

Over the past few decades, there has been increasing research and clinical interest in sleep problems associated with attention-deficit/hyperactivity disorder (ADHD). From the research perspective, it is becoming progressively clear that the brain regions involved in the regulation of arousal and sensitive to sleep deprivation, such as dorsolateral and ventrolateral prefrontal and dorsal anterior cingulate cortices, are also implicated in ADHD pathophysiology.<sup>1,2</sup> Genetics studies point to the involvement of the catecholaminergic system in both ADHD and sleep regulation<sup>1</sup>; in addition, specific genetic alterations, such as those of CLOCK genes, may be common

both to ADHD and sleep rhythm disorders.<sup>1</sup> From the clinical standpoint, recent guidelines<sup>3</sup> mention sleep disturbances as one of the most common conditions associated with ADHD. Unfortunately, evidence regarding the assessment and management of sleep problems in ADHD remains limited. This, together with the recognized lack of specific training in sleep medicine among childhood mental health professionals,<sup>4</sup> creates significant challenges for the clinician faced with sleep problems in youths with ADHD. Nonetheless, the assessment and treatment of sleep problems in this population are crucial, as sleep disturbances may aggravate ADHD symptoms and contribute to the functional impairment of children/youths and their families.<sup>5</sup> In addition, sleep disturbances may mimic ADHD in individuals referred for ADHD-like symptoms.<sup>5</sup>



Clinical guidance is available at the end of this article.

This paper presents evidence-based recommendations for the assessment/management of sleep problems in youths with ADHD. When no empirical evidence was available, recommendations were based on the consensus of the authors.

## METHOD

PubMed, Ovid, EMBASE, and Web of Knowledge were searched from their inception to October 31, 2012 (search strategy available from corresponding author). We opted not to search for unpublished, non-peer-reviewed data because, as pointed out by the Cochrane group,<sup>6</sup> the inclusion of unpublished data may introduce bias. Grades of evidence for recommendation on the management of sleep problems were assessed using the Scottish Intercollegiate Guidelines Network (SIGN) system (<http://www.sign.ac.uk/>). When no or scant empirical data were available, recommendations were based on consensus among the authors, achieved as per the Delphi method.<sup>7</sup>

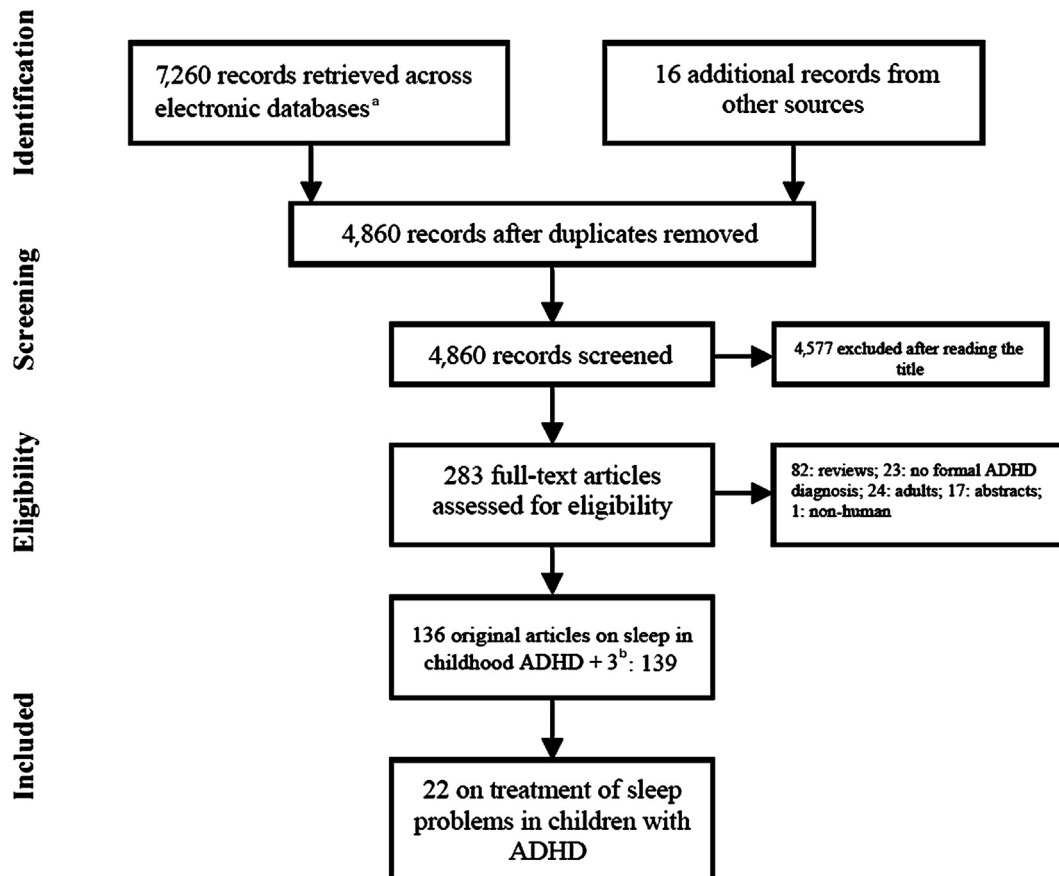
## LITERATURE SEARCH RESULTS

After selection, 139 original articles were retained, including 22 papers on treatment (Figure 1). Building on this body of evidence, the following sections present our recommendations, preceded by an introductory section on sleep problems in youths with ADHD.

## SLEEP PROBLEMS IN YOUTHS WITH ADHD

As many as 70% of children with ADHD have been reported to display mild to severe sleep problems.<sup>8</sup> Prevalence rates differ as a function of ADHD subtype (highest prevalence in the combined subtype,<sup>9</sup> although sleepiness may be more frequent in the inattentive subtype<sup>5</sup>), psychiatric comorbidities, and medication use (both increasing the prevalence of sleep problems)<sup>9</sup>.

**FIGURE 1** Flow chart showing the results of the search (performed August 18, 2012, and updated October 31, 2012). Note: <sup>a</sup>Pubmed (Medline): 1,114; OVID databases PsycInfo + Ovid Medline + EMBASE + EMBASE CLASSIC: 3,892; WEB OF KNOWLEDGE (Web of science [science citation index expanded], biological abstracts, biosis, food science, and technology abstracts): 2,254. <sup>b</sup>From updated search on October 31, 2012.



The most recent meta-analysis on sleep in ADHD<sup>10</sup> found that children and/or their parents reported bedtime resistance, sleep-onset difficulties, night awakenings, difficulties with morning awakenings, sleep breathing problems, and daytime sleepiness significantly more than healthy comparison individuals. Although there is no sleep problem specific to ADHD,<sup>8</sup> the most commonly reported is “difficulty falling asleep.”<sup>8</sup>

**Causes of Sleep Problems in Children With ADHD**  
“Sleep problems” refers to nonspecific sleep-related complaints (e.g., sleep-onset difficulties) that may be caused by several mutually exacerbating conditions. For example, prolonged sleep onset may be due to the following:

- One or more specific sleep disorders, such as behaviorally based insomnia, circadian rhythm sleep disorder, or restless legs syndrome (Table 1 provides a description of the most common sleep disorders in childhood); the prevalence of specific sleep disorders in ADHD has been inadequately investigated
- Poor sleep practices (e.g., use of electronics before bedtime)
- Psychiatric comorbidities (e.g., mood/anxiety disorders)
- Associated medical conditions and their treatments (e.g., asthma, obesity)

- Medications
- ADHD per se (children/youths with ADHD may find it difficult to slow down their thoughts to settle for sleep, with consequent sleep-onset delay<sup>5</sup>)

Therefore, the key to the management of sleep problems in ADHD is an accurate differential diagnosis.

## ASSESSMENT OF SLEEP PROBLEMS IN CHILDREN WITH ADHD IN THE MENTAL HEALTH SETTING

We recommend a baseline sleep evaluation during the initial assessment of ADHD as well as regular systematic screening for sleep problems as a necessary component of ongoing ADHD care. Although this review focuses on the management of sleep problems in children with an established diagnosis of ADHD, it is important to bear in mind that sleep disorders may mimic ADHD symptoms. Therefore, it is fundamental to screen for sleep disorders also in children referred for ADHD-like symptoms who do not have a diagnosis of ADHD, as treatment of the primary sleep disorder may reduce or even eliminate such symptoms.

The initial screening should include questions exploring sleep complaints, such as the

**TABLE 1** Most Relevant Childhood Sleep Disorders

Disorder	
Insomnia	
Sleep-onset association type	Falling asleep in a reasonable time is possible only if is associated with a specific form of stimulation (e.g., watching TV) or setting (e.g., parents' bed). The associations are highly problematic or demanding.
Limit-setting type	Parental difficulty in setting limits and managing behavior. When limits are instituted, sleep onset is not delayed.
Delayed sleep phase syndrome	Delay in the habitual sleep wake times relative to conventional or socially acceptable times. When allowed to choose their preferred schedule, patients exhibit normal sleep quality/duration.
Night wakings	Brief arousals from sleep are common in infancy and childhood. Those who develop inappropriate sleep association to fall asleep (see above) also have difficulty self-soothing after the arousals during the night and thus alert their parents (crying, going into their bed, etc.).
Partial arousal parasomnias	Concomitant presence of behaviors of the waking phase and deep sleep state. They occur within 1–2 hours after sleep onset and are characterized by retrograde amnesia, autonomic or skeletal muscle disturbance. The child has the appearance to be awake but (s)he is not.
Rhythmic movement disorders	Repetitive movements of large muscles occurring mainly during sleep–wake transitions.
Sleep disordered breathing	A group of disorders characterized by abnormalities of respiratory pattern or the quantity of ventilation during sleep. The most common of these is obstructive sleep apnea.
Restless legs syndrome	Irresistible urge to move the legs, often accompanied by uncomfortable sensations which are relieved by movement and worse in the evening or night and at rest.
Periodic limb movement disorder	Periodic episodes of repetitive and stereotyped limb movements during sleep, often associated with a partial arousal or an awakening.

5-item instrument known as BEARS (B = Bedtime issues, E = Excessive daytime sleepiness, A = night Awakenings, R = Regularity and duration of sleep, S = Snoring)<sup>11</sup> and the use of specific sleep questionnaires, such as the Children's Sleep Habits Questionnaire,<sup>12</sup> which can explore in more detail sleep symptoms. If sleep complaints are found, we suggest to ask the parent and/or child (depending on the child's age and ability level) to complete a 2-week sleep diary to gather information on the sleep-wake patterns. A graphic sleep diary (<http://www.sleepfoundation.org/>) is preferable to information in written format. The diagnosis of sleep disorders should be based on formal criteria, such as those of the International Classification of Sleep Disorders (ICSD), 2nd ed.<sup>13</sup> Although some disorders can be assessed with a clinical interview, the diagnosis of other disorders, such as sleep apnea or periodic limb movement (PLM) disorder (Table 1), requires polysomnography (PSG) (Table 2 describes PSG and other objective diagnostic tools). The Multiple Sleep Latency Test can be used to provide an objective measure of an individual's level of daytime sleepiness and is typically used to diagnose narcolepsy or other hypersomnias. Although PSG and MSLT are performed by a sleep specialist, less intensive

objective tools, such as actigraphy or related devices as the Zeo sleep system (<http://www.myzeo.com/sleep/>), might be more easily implemented in the clinical practice of the mental health professional in the future.

## ASSESSMENT OF SPECIFIC SLEEP DISORDERS/CONDITIONS

### Behaviorally Based Insomnia

(Note: Because the term "behavioral insomnia" will disappear from the next edition of the ICSD, here "insomnia" refers to sleep-onset association and limit-setting disorders [Table 1]).

If impairing symptoms of insomnia are reported during the screening phase, a 2-week sleep diary should be kept to more clearly identify behaviors and patterns associated with insomnia (for diagnostic criteria of insomnia, see the American Academy of Sleep Medicine criteria<sup>13</sup>). Because individuals with ADHD may have night-to-night variability in their sleep patterns,<sup>14</sup> it is important to confirm that symptoms have been present over time (>3 months). In general, a sleep study is not indicated unless specific symptoms suggestive of sleep-disordered breathing (i.e., frequent snoring) or sleep-related movement disorders (e.g., kicking movements) are also present.

**TABLE 2** Objective Tools to Assess Sleep and Sleep Disturbances

Technique	Description	Useful for the diagnosis of:
Polysomnography (PSG)	Recording during sleep of physiologic parameters including: Brain electrical activity Eye and jaw muscle movement Leg muscle movement Airflow Chest and abdominal excursion Oxygen saturation Electrocardiogram (EKG)	Sleep disordered breathing disorders Sleep-related movement disorders Hypersomnolence of unknown origin
Actigraphy	Monitoring cycles of physical activity and rest by means of an actimetry, a wristwatch-like device (put on the wrist or ankle) that continually records movements. The data are analyzed offline. Sleep parameters (sleep/wake periods, total duration of sleep, number of arousals, and length of sleep onset) are inferred by the patterns of rest/movement.	Delayed sleep phase disorder
Multiple sleep latency test (MSLT)	It consists of four or five 20- to 30-minute nap opportunities given at 2-hour intervals during the day. The basic parameters measured are <i>latency to sleep onset</i> and <i>latency to REM sleep</i> on the polysomnographic recording. MSLT provides a measure of an individual's level of daytime sleepiness.	Narcolepsy
Infrared video camera	To monitor body movements during sleep in a dark environment.	Abnormal behaviors or movements during sleep

### Circadian Rhythm Sleep Disorders

Parent-report and self-evaluations can be used to determine the presence of Circadian rhythm sleep disorders (CRSD) symptoms as defined by the ICSD 2nd ed.<sup>13</sup> In addition, sleep diaries should be completed over at least 2 weeks. Actigraphy over the same 2 weeks can provide more precise information on patterns of sleep and wakefulness. Assessment of the circadian phase by collecting an hourly sampling of plasma or saliva to determine melatonin levels<sup>15</sup> is not yet feasible in many clinical settings.

### Sleep Disordered Breathing

The American Academy of Pediatrics recommends that children undergoing evaluation for ADHD should be systematically screened for sleep disordered breathing (SDB) (see Wolraich *et al.*<sup>3</sup> for criteria). Clinical history alone cannot distinguish primary snoring from obstructive sleep apnea in children. Although PSG is the diagnostic gold standard<sup>16</sup> and is becoming increasingly available, clinicians can perform simple procedures to assess symptoms of and risk factors for SDB, including physical examination of the throat and nasal passages, asking the parent to watch their child sleep to see if (s)he snores or moves during sleep, and looking for mouth breathing and allergy symptoms.

SDB severity is measured by the apnea-hypopnea index (AHI, number of apneas/hypopneas/hours of sleep), evaluated with PSG. An AHI of >1 is considered the threshold for pediatric SDB.<sup>13</sup> Nocturnal oximetry or overnight videotaping may be useful if positive, but, if negative, these tools do not provide much information, as they typically underestimate SDB.

### Restless Legs Syndrome and Periodic Limb Movement Disorder

Restless legs syndrome (RLS) diagnosis is based on clinical criteria (<http://irls.org/diagnostic-criteria/>). When exploring these criteria in children,<sup>17</sup> it is important to use age-specific vocabulary (e.g., "Do your legs bother you?") and encourage the child to report symptoms in his/her own words (e.g., "got to kick"). To decide on the appropriateness of a possible treatment, clinicians should assess not only the severity of symptoms but also the impact of RLS symptoms on sleep, cognition, and mood.

Periodic limb movement disorder (PLMD) diagnosis<sup>17</sup> requires PSG. We note that there is substantial night-to-night variability in the

frequency of PLMS.<sup>18</sup> PSG may also be useful in corroborating the diagnosis of RLS in children when they are unable to verbalize symptoms or if there are strong indications for associated PLMD (i.e., report of repetitive movements of legs during sleep).

Based on evidence showing a role of iron deficiency in the pathophysiology of RLS, and reports of low serum ferritin (a marker of peripheral iron status) in RLS, some authors<sup>18</sup> recommend measuring serum ferritin in children with suspected RLS. Although there is no formal consensus of the cut-off indicating iron deficiency in children, a value of 50 µg/L has been proposed as indicative of increased risk of RLS in adults.<sup>18</sup> It should be borne in mind that ferritin is an acute-phase reactant, and is thus elevated in inflammatory states.

### Comorbid Psychiatric Disorders

Sleep problems are explicitly included among symptoms of *DSM-IV*-defined generalized anxiety disorder, separation anxiety disorder, dysthymia, major depressive disorder, and mania. The high rates of overlap between ADHD and these disorders substantially increase the likelihood that a child with ADHD will display significant sleep problems due to ADHD, a comorbid disorder, or both. However, it is important to keep in mind that not every child with 1 of these comorbid diagnoses will have associated sleep problems.

The most common disorders co-occurring with ADHD in younger children are oppositional defiant disorder and anxiety disorders<sup>19</sup>; among older children and adolescents, incidence of depression or underlying mood disorders tends to become more common, along with oppositional and anxiety problems. Those whose difficulties are predominantly oppositional are likely to be resistant to bedtime, as they are reluctant to follow parental rules and demands in many other domains. Children and adolescents who experience chronic anxiety are often equally resistant because they are afraid to sleep alone or are fearful of having scary dreams or being attacked or kidnapped while they are sleeping. One PSG study found that children with anxiety disorders take longer to fall asleep and have more awakenings and less slow-wave sleep than children with major depressive disorder or controls.<sup>20</sup> Sleep difficulties are 6 times greater in children or adolescents with comorbid bipolar disorder than in children with ADHD alone<sup>21</sup>; difficulties

may include accelerated mood/energy or depressive mood in evening, delay of sleep onset, and difficulty in awakening. Clinical queries of the child and parents are needed to clarify possibly overlapping reasons for the child's resistance to bedtime or other sleep problems, to determine how sleep difficulties are related to other disorders, and to prioritize treatment strategies.

#### Effects of ADHD Medications

ADHD medications, particularly psychostimulants, may exacerbate sleep-onset delay<sup>22</sup> via both direct and indirect mechanisms. As for direct effects, there is wide individual variability in the impact of ADHD medications on sleep, and study findings differ depending on the study population (e.g., age, comorbidity, whether stimulant naive), dose/dosing schedule, and duration of treatment.<sup>23</sup> However, all psychostimulants may cause sleep disturbance in a particular child, including sleep onset delay greater than 30 minutes,<sup>21</sup> but also sleep-phase shift<sup>24</sup> or difficulty getting up in the morning.<sup>23</sup> Sleep disturbance may also be related to a rebound effect (i.e., increase over baseline values in ADHD symptoms when the medication wears off), rather than to psychostimulant per se.<sup>25</sup> Some effects, such as difficulty falling asleep or delayed sleep onset, often occur during titration and for some individuals improve over time.<sup>23</sup> Anecdotal evidence, not supported by randomized controlled trials (RCTs), suggests that falling asleep when in rebound from medication is more difficult in some individuals than falling asleep after a low evening dose of stimulant.<sup>26</sup>

As for nonstimulant medications, an RCT<sup>27</sup> showed that methylphenidate (t.i.d.) increased sleep-onset latency significantly more than atomoxetine (b.i.d.). Moreover, child and parental diaries indicated a better quality of sleep with atomoxetine compared with methylphenidate. Both medications decreased nighttime awakenings, but the decrease was significantly greater with methylphenidate ( $p < .002$ ). A meta-analysis of atomoxetine studies found that somnolence was reported by 9.9% and 4.6% of treated and placebo-assigned participants, respectively ( $p < .001$ ).<sup>28</sup>

Before initiating pharmacological treatment, we recommend a sleep screening and baseline assessment with a sleep questionnaire and, for compliant patients and/or parents, a sleep diary. During titration or medication follow-up visits, changes in sleep should be queried and, if

**TABLE 3** Healthy Sleep Practices:

Recommended	Not Recommended
Goes to bed about the same time	Drinks lots of liquids before bedtime
Goes to bed in the same place	Does things that are alerting
Sleeps alone	Uses bed for things other than sleep
Caffeine and naps a maximum of 4 hours before bedtime	Put to bed after falling asleep
Has a calming bedtime routine	Stays up past usual bedtime
Does relaxing things before bedtime	
Gets out of bed at same time in morning	

*Note: Selected Items Adapted From the Children's Sleep Hygiene Scale (CSHQ).<sup>29</sup>*

reported, assessed in more detail to determine whether the problem is temporally related to initiating medication, change in dose or dosing schedule, or other factors.

## MANAGEMENT OF SLEEP PROBLEMS IN CHILDREN WITH ADHD

Management of sleep problems in children/youth with ADHD needs to be tailored to the specific conditions underlying sleep complaints. Before discussing the specific management of such conditions, we present a section on healthy sleep practices, the implementation of which should precede the targeted management of specific sleep disorders/conditions.

#### Healthy Sleep Practices

Healthy sleep practices, commonly referred to as "sleep hygiene," include modifiable daytime, bedtime, and nighttime practices that have a positive impact on sleep (Table 3).<sup>29</sup> One of the most important elements of healthy sleep practices is a regular sleep/wake schedule. Another important aspect involves ensuring adequate opportunity for sleep. Although there is some variability in sleep needs across individuals, standard guidelines exist for recommended sleep amounts in children (Table 4). When assessing individual sleep needs, it is important to educate parents about clues that suggest that a child is not getting sufficient sleep (e.g., sleeping longer on weekends and during school vacations, difficulty waking up in the morning, dozing off during the day).

**TABLE 4** Healthy Sleep Practices: Recommended Sleep Amounts in Youths

Age	Hours
Newborns (0–2 months)	12–18
Infants (3–11 months)	14–15
Toddlers (1–3 years)	12–14
Preschoolers (3–5 years)	11–13
School-age children (6–10 years)	10–11
Teens (10–17 years)	8.5–9.25

Note: From <http://www.sleepfoundation.org>.<sup>58</sup>

As for ADHD, a nonrandomized phase of an RCT<sup>30</sup> showed the efficacy of healthy sleep practices (such as consistent bed and awakening time or targeting sleep duration according to age-expected norms) in reducing sleep-onset delay in 21% of ADHD children (an additional 21% were rated as minimally improved). Thus, healthy sleep practices implementation may be necessary but not sufficient for many children with ADHD. We also note that in approximately 25% to 30% of cases, parents of children with ADHD have ADHD themselves and may present time and sleep management difficulties. These difficulties may make developing a consistent sleep schedule for themselves and other family members challenging. For example, a parent who has never established a stable circadian rhythm cannot easily help their child develop and maintain an appropriate bedtime routine. Therefore, effective management of sleep of the child often requires the clinician to address relevant psychopathology in other family members as well. Table 5 provides additional specific tips for healthy sleep habits in ADHD.

Nutrition may also play a role in healthy sleep practices. Based on the hypothesis that a hypersensitivity reaction to food underlies both ADHD and sleep disturbances, a pilot RCT showed that a 5-week elimination diet, consisting only of a limited number of hypoallergenic foods (rice, turkey, lamb, several vegetables, and pears), significantly reduced sleep complaints in children with ADHD.<sup>31</sup> However, further replication is needed, as this was a pilot study.

*Recommendation:* Before addressing any specific management of sleep disorders, implement healthy sleep practices. There is insufficient evidence to recommend a specific dietetic regimen. *Level of evidence according to the SIGN system:* Sleep hygiene: C (nonrandomized phase of an RCT<sup>30</sup>). The level for a dietary regimen is pending the full-trial results of the trial described by Pelsser *et al.*<sup>31</sup>

## Insomnia

Strong evidence shows the effectiveness of behavioral treatments for insomnia in children in general.<sup>32</sup> Unfortunately, there is very little research evaluating behavioral sleep interventions specifically for children with ADHD. One case series showed that a structured 5-session distance treatment program provided to 3 children with ADHD was successful at improving symptoms of insomnia.<sup>33</sup> This intervention was used in an RCT for children 6 to 12 years of age. Preliminary analyses of this RCT<sup>34</sup> demonstrated that 80% of children with ADHD had a positive response. Another RCT is currently being conducted,<sup>35</sup> based on face-to-face consultations and 1 follow-up phone call. A pilot study<sup>36</sup> found this intervention to be feasible and to result in improved sleep based on parent report.

Given the lack of research specific to children with ADHD, we recommend that evidence-based treatments be used for behavioral insomnia in typically developing children<sup>37</sup> and that these be modified for children with ADHD. For example, when promoting positive bedtime routines, children with ADHD may require more warnings before being called to bed so that they know that bedtime is coming. The routine should be structured to allow sufficient time to complete each activity (e.g., brushing teeth) but not so much time that the child has opportunities to become distracted. Instructions should be given by parents 1 step at a time. Pictorial representations of bedtime routine should be posted to be easily seen by the child.<sup>5</sup>

*Recommendation:* Behavioral interventions, adapted for ADHD children, should be the first-line treatment. *Level:* Pending the full publication of two ongoing RCTs.<sup>34,36</sup>

## Circadian Rhythm Sleep Disorders

Multimodal treatment approaches, in consultation with a sleep specialist, are recommended. One possible approach is chronotherapy,<sup>38</sup> which targets the sleep-wake schedule by progressively delaying bedtimes and wake times until the sleep-wake cycle has rotated around the clock toward the desired schedule.<sup>15</sup> So far, evidence of the effectiveness of this intervention in ADHD is available only from a case report.<sup>38</sup> Bright light therapy, or phototherapy, has also been successfully used. It involves timed light exposure at wake time to advance the sleep-wake cycle. In studies on CRSD, the time and length of light

**TABLE 5** Tips for Healthy Sleep Practice in Attention-Deficit/Hyperactivity Disorder (ADHD)

Practices
Promoting Sleep Regulation
Maintain an organized and consistent sleep–wake cycle
Set and enforce a consistent bedtime weekdays and weekends
Set and enforce a consistent wake time weekdays and weekends
Keep a regular daily schedule of activities, including meals
Avoid bright light in the bedroom at bedtime and during the night
Increase light exposure in the morning
Establish an appropriate napping schedule
Promoting Sleep Conditioning
Establish a regular and consistent bedtime routine
Limit activities that promote wakefulness while in bed (watching TV, cell phone use); use the bed for sleep only
Do not use bed for punishment (“time out”)
Avoid using staying up late as a reward for good behavior and going to bed as a punishment for undesired behavior
Avoid sleeping in environments other than the bedroom (e.g., couch, car)
Reducing Arousal and Promoting Relaxation
Keep electronics out of the bedroom and limit use of electronics before bedtime
Reduce stimulating play at bedtime
Avoid heavy meals and vigorous exercise close to bedtime
Reduce cognitive and emotional stimulation before bedtime
Eliminate caffeine
Include activities in the bedtime routine that are relaxing and calming
Promoting Adequate Sleep Quantity and Quality
Set an age-appropriate bedtime and wake time to ensure adequate sleep
Maintain a safe and comfortable sleeping environment (low noise and light levels, cooler temperatures, age-appropriate bedding and sleeping surface)

exposure varied from a single 4-hour pulse of 12,000 lux administered 30 minutes after awakening<sup>39</sup> to 2 weeks of therapy with light administered between 6 and 9 AM,<sup>40</sup> or 1 week of 30 minutes of light therapy of 10,000 lux between 6 and 7 AM.<sup>41</sup> One case report in a child<sup>41</sup> and 1 open-label trial<sup>42</sup> in adults showed the effectiveness of phototherapy for CRSD in ADHD.

An alternative/complementary approach is the use of melatonin, which can be administered 4 hours before the average sleep-onset time,

although there is no consensus on the recommended schedule. In research settings, melatonin is administered 2 hours before the estimated “dim light melatonin onset” (DLMO), that is, the time at which a salivary concentration of 4 pg/mL is reached. The common dose is 3 to 6 mg; however, the minimally effective dose is not well defined, and because since melatonin is not regulated by the Food and Drug Administration (FDA), commercially available formulations vary in terms of purity and strength. Two RCTs,<sup>30,43</sup> a follow-up study of 1 of them,<sup>43</sup> and an open label study<sup>44</sup> have demonstrated that evening melatonin is an effective treatment of sleep-onset delay (likely related to CRSD) among children with ADHD, although a formal diagnosis of CRSD was not provided in these studies. Very often, morning bright light and evening use of melatonin are combined.

**Recommendation:** Options include bright light therapy, chronotherapy, and melatonin.

*Level: Bright light therapy and chronotherapy: D (case reports<sup>38,41</sup>). Melatonin: B (Extrapolated from 2 RCTs rated as 1++<sup>30,43</sup>).*

#### Use of Medications for Symptoms of Insomnia

A range of medications are used in clinical practice to treat symptoms of insomnia in children/youths with ADHD<sup>45</sup>; however, none have FDA approval, and the efficacy/safety profile is unknown for the majority of them. Open-label studies have reported the efficacy and safety of clonidine in the treatment of ADHD-related sleep disturbances.<sup>46,47</sup> A controlled trial of zolpidem (0.25 mg/kg/day) did not find any improvements in terms of sleep onset latency in 6- to 17-year olds with ADHD, and reported significant adverse events (e.g., dizziness, headache).<sup>48</sup> An alternative that is sometimes used clinically, but has not been tested, is low doses of mirtazapine (7.5–15 mg) taken at night.

There is more substantial evidence on the effectiveness of melatonin in treating sleep onset difficulties in ADHD, whether or not these are associated with a circadian misalignment.<sup>30,43,44</sup> Available studies (2 RCTs<sup>30,43</sup> and an open-label study<sup>44</sup>) used “sleep onset” as the main outcome, without performing a formal diagnosis of “(Behavioral) insomnia”; therefore, it is possible that the reduction found in sleep onset was due either to melatonin effectiveness for (behavioral) insomnia, via its hypnotic properties, or for CRSD, to its chronobiotic properties.



There is no empirical evidence on the pharmacological treatment of middle-of-the-night awakenings. Clonidine (or zaleplon in older children) given in the middle of the night (but before 3 AM to avoid morning hangover) or mirtazapine before bedtime may be an option. Some clinicians use long-acting melatonin before bedtime or a second dose of melatonin when the child wakes up, but there is no evidence that melatonin significantly decreases the number of awakenings after sleep time onset or increases total sleep time in children with ADHD.<sup>30,43</sup> In our experience, trazodone before bedtime may be effective in some cases, but the excessive sedation because of its long duration of action is a concern. Doxepin is FDA approved for the treatment of middle-of-the-night awakenings in adults, but no published data are available in children. There are also no RCTs supporting the use of antihistamines (e.g., diphenhydramine) or antipsychotics (such as quetiapine), despite their frequent use in clinical practice. We particularly discourage the use of antipsychotics, given their tolerability profile. As for sleep-onset insomnia, we recommend behavioral interventions as first-line strategy to address the behavioral component of middle-of-the-night awakenings (the child may wake up to sleep in the parents' bed).

**Recommendation:** If behavioral strategies are not effective, a pharmacological treatment may be considered for sleep-onset difficulties. Two RCTs<sup>30,43</sup> and 1 open label study<sup>44</sup> showed the effectiveness of melatonin in reducing sleep-onset delay. *Level: Melatonin: B (extrapolated from 2 RCTs rated as 1++<sup>30,43</sup>). Clonidine: D (case series<sup>46,47</sup>).*

### Sleep Disordered Breathing

In children, the first line of treatment for SDB is adenotonsillectomy. In a prospective nonrandomized controlled trial assessing ADHD before and 1 year after adenotonsillectomy, 50% of children with ADHD (as per *DSM-IV*) no longer met ADHD diagnosis criteria at 1 year post surgery.<sup>49,50</sup> In a prospective, nonrandomized, open trial assessing the best treatment for children with ADHD and mild SDB (i.e., an AHI of >1 and <5),<sup>51</sup> 55% of children with ADHD (as per *DSM-IV* criteria) were found to have SDB. Treatment groups included the following: methylphenidate; adenotonsillectomy; or no treatment. At 6-month follow up, ADHD symptoms improved in both treatment arms compared

to the no-treatment controls; the adenotonsillectomy group demonstrated significantly greater improvement than the medication group in the hyperactivity, inattention, and total score subscales of the ADHD rating scale.

**Recommendation:** An AHI of >1 on polysomnography should alert the practitioner to consider adenotonsillectomy.

*Level: Adenotonsillectomy: C (nonrandomized studies rated as 2+<sup>49,51</sup>).*

### Restless Legs Syndrome and Periodic Limb Movement Disorder

The management of RLS/PLMD relies on nonpharmacological as well as on pharmacological strategies for severe cases. The former, which suffice in mild cases (i.e., cases with minimum or mild impact on sleep, cognition, and behavior) include the following: establishing healthy sleep habits, physical exercise, and avoiding exacerbating factors, such as insufficient sleep for age, irregular sleep schedule, low body iron stores, pain, caffeine, nicotine, alcohol, and certain drugs (e.g., selective serotonin reuptake inhibitors [SSRIs], antihistamines, and neuroleptics).<sup>18</sup>

Based on the possible role of iron deficiency in the pathophysiology of RLS, oral iron supplementation (50–65 mg of elemental iron once or twice a day) has been recommended in children with RLS and a serum ferritin <50 µg/L, with a recheck of serum ferritin in 2 to 3 months.<sup>18</sup> So far, only 1 small RCT has shown the effectiveness of iron supplementation (ferrous sulfate, 80 mg/day for 12 weeks) for RLS in children with ADHD.<sup>52</sup>

Evidence on pharmacological treatment is also limited and, to date, no drug has received FDA approval for childhood RLS. One double-blind placebo-controlled trial<sup>53</sup> showed the effectiveness of L-DOPA, a dopaminergic agent, for RLS/PLMD symptoms (but not ADHD) in children, although the relatively small sample size (N=29) and the baseline difference in ADHD severity between groups suggest the need for caution when interpreting the results. Besides this, a case series and a case report support the effectiveness of dopaminergic agents (L-DOPA, pergolide, or ropinirole) for RLS/PLMD in children with ADHD.<sup>54,55</sup> Another case series suggests that levetiracetam may be an option for ADHD children with RLS and interictal epileptic discharges.<sup>56</sup> Possible "augmentation," that is, worsening of RLS symptoms after starting the

medication, needs to be carefully managed with a dose reduction or a change to another medication. No data on the long-term effectiveness and tolerability of these agents in children are available. Their use should be considered in severe cases, in consultation with a sleep specialist.

**Recommendation:** Avoid factors exacerbating RLS (e.g., pain, caffeine, nicotine, alcohol). Oral iron supplementation if serum ferritin is  $<50 \mu\text{g/L}$  may be considered. For severe cases: consider off-label use of L-DOPA or other dopaminergic agents, in consultation with a sleep specialist.

**Level:** Dopaminergic agents: C/D (1 RCT<sup>53</sup> with risk of bias, plus case reports<sup>54,55</sup>).

#### Management of Sleep Problems in Children With ADHD and Comorbid Psychiatric Disorders

Clinical care for any patient with comorbid disorders requires assessment of each of those disorders, followed by prioritizing of which disorders require the most immediate intervention. For patients with ADHD and any of the aforementioned comorbid disorders, initial assessment should rule out other medications currently being taken as potential causes of the sleep problems. If this does not seem a likely cause, the clinician should assess for needed changes in sleep hygiene. If this is not sufficient to improve sleep, then behavioral interventions tailored to the specific needs of the patient should be

considered. When these interventions are not sufficient, a trial of melatonin, antihistamine, clonidine, mirtazapine, clonazepam, trazadone, or, in cases of comorbid bipolar disorder, a mood stabilizer or neuroleptic may be appropriate, depending on the specific patient and situation and the relative risk/benefit ratio. The clinician should also bear in mind the effects on sleep of the drugs used in child/adolescent psychiatry; for example, antidepressants (e.g., SSRIs) may exacerbate RLS (Table 6).

**Recommendation:** Prioritize which disorders require the most immediate interventions (behavioral as first line, followed by pharmacological therapies).

**Level:** D (expert consensus).

#### Management of the Effect of ADHD Medications on Sleep

We recommend implementation of healthy sleep habits as first option even if the sleep complaints are thought to be medication-related; in one RCT,<sup>30</sup> sleep hygiene was effective in a subsample of children with ADHD treated with stimulants. If, after some weeks (during which the negative effect of medication on sleep may spontaneously decrease) sleep hygiene is not effective, further options are as follows: reducing the total dose; changing the dose regimen or formulation so that less medication is

**TABLE 6** Effects on Sleep of the Most Commonly Used Drugs in Child and Adolescent Psychiatry

Drug	Effects on sleep
<b>Anticonvulsants</b>	
Carbamazepine	Increased daytime somnolence; may decrease sleep onset latency
Valproic acid	Increased daytime somnolence
Topiramate	Daytime sedation in 15%–25% of cases
Gabapentin	Daytime sedation in 5%–15% of cases
<b>Antidepressants</b>	
Bupropion	Insomnia in 5% to 20% of adults; increases REM sleep and decreases REM onset latency
SSRIs	Increase sleep onset latency; suppress REM sleep; may cause daytime sedation; may worsen restless legs syndrome. Citalopram may have fewer sleep disrupting effects
Tricyclic antidepressants	Decrease sleep onset latency. May exacerbate restless legs syndrome. May lead to daytime somnolence. Used to treat partial arousal parasomnias. Withdrawal associated with possible rebound effect (increased nightmares and partial rousal parasomnias).
Venlafaxine	May cause sleep onset delay and difficulty maintaining sleep. May lead to daytime somnolence.
Mirtazapine	May lead to daytime somnolence, less likely than SSRI to cause insomnia.
Antihistamines	Promote sleep; reduce daytime alertness
Antipsychotics	Traditional agents (e.g., thioridazine) may increase daytime somnolence. Newer agents (e.g., risperidone, olanzapine) are less sedating, although clozapine presents high incidence of sedation. Most antipsychotic suppress REM sleep and increase sleep continuity.

*Note:* Adapted from Mindell and Owens.<sup>59</sup> REM = rapid eye movement; SSRI = selective serotonin reuptake inhibitor.

administered later in the day; adding a third dose of stimulant in the evening if sleep-onset delay is due to a rebound effect; changing to a different stimulant (e.g., switching to methylphenidate from amphetamine or vice versa); changing to a nonstimulant (e.g., atomoxetine), adding an  $\alpha_2$  agonist; or adding another medication, such as, melatonin. A recent RCT<sup>57</sup> showed that adding melatonin (3–6 mg) can significantly decrease sleep-onset delay in children with ADHD treated with methylphenidate.

**Recommendation:** Promote healthy sleep habits. If sleep difficulties persist: try alternative dosages, dose regimen, formulations, or alternative ADHD medications, or add a sleep promoting medication (e.g., melatonin).

**Level:** Adding melatonin: B (1 RCT rated as 1+<sup>57</sup>); for other approaches: D (expert consensus).

## TIPS FOR ADOLESCENTS AND YOUNG ADULTS

Several factors (e.g., hormonal, emotional, and social) make sleep problems in adolescents and young adults more problematic than in younger children. One factor that may contribute to sleep problems of adolescents and young adults is use of electronic media. Another factor that may complicate sleep and exacerbate arousal problems in this population is substance use. Some adolescents with ADHD report that they frequently make use of marijuana before bedtime to help them relax and fall asleep more readily. This may be effective in helping them to reduce sleep latency, but it is likely also to make it more difficult for them to get up on time in the morning. Clinical interventions for sleep problems experienced by adolescents and young adults begin with an empathic but detailed inquiry into sleep patterns and the degree to which these individuals see themselves as having a problem with sleep, followed by the development of workable strategies to alleviate sleep problems.

The key to the management of sleep problems in ADHD is an appropriate differential diagnosis, followed by a specific treatment of the disorder(s)/condition(s) underlying a particular sleep problem. Before addressing the specific sleep disorder/condition, we recommend the implementation of healthy sleep practices as the

foundation of sleep problems management. Although RCTs support the use of melatonin for sleep-onset delay, empirical evidence concerning nonpharmacological therapies (behavioral, light therapy, and chronotherapy) and drugs other than melatonin for most of the sleep disturbances associated with ADHD is still limited. Therefore, further RCTs are urgently needed to support evidence-based recommendations for the management of sleep onset difficulties and of middle-of-the-night awakenings, which is a particularly neglected area of investigation. Another interesting but overlooked research topic is the relationship between ADHD and hypersomnias (including narcolepsy). Prospective follow-up studies of the effectiveness/tolerability of pharmacological and nonpharmacological treatments will also contribute greatly to the field. &

### CG Clinical Guidance

- The key to the management of sleep problems in attention-deficit/hyperactivity disorder (ADHD) is an appropriate differential diagnosis, followed by a specific treatment of the underlying condition(s), including: behaviorally based insomnia, circadian rhythm disorder, sleep disordered breathing, restless legs syndrome/periodic limb movement disorder, and sleep disturbances due to comorbid psychiatric disorders or ADHD medications.
- Healthy sleep practices are the foundation of management strategies.
- Behavioral interventions should be the first-line treatment of insomnia.
- If behavioral strategies are not effective, melatonin should be considered for sleep-onset difficulties.
- Bright light therapy, chronotherapy, and melatonin are options for circadian rhythm disorder.
- Adenotonsillectomy should be considered if the apnea–hypopnea index is  $>1$ .
- Off-label dopaminergic agents should be considered only for severe cases of restless legs syndrome/periodic limb movement disorder.
- Options for sleep problems induced by ADHD medications include alternative dosages, dose regimen, formulations, or ADHD medications, and adding a sleep-promoting medication (e.g., melatonin).

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## REFERENCES

- Owens J, Gruber R, Brown T, *et al.* Future Research Directions in Sleep and ADHD: Report of a Consensus Working Group [published online ahead of print September 2012]. *J Atten Disord.* <http://dx.doi.org/10.1177/1087054712457992>.
- Cortese S, Kelly C, Chabernaud C, *et al.* Toward systems neuroscience of ADHD: a meta-analysis of 55 fMRI studies. *Am J Psychiatry.* 2012;169:1038-1055.
- Wolraich M, Brown L, Brown RT, *et al.* ADHD: clinical practice guideline for the diagnosis, evaluation, and treatment of attention-deficit/hyperactivity disorder in children and adolescents. *Pediatrics.* 2011;128:1007-1022.
- Owens JA, Mindell JA. Pediatric sleep medicine: priorities for research, patient care, policy and education. *J Clin Sleep Med.* 2006;2:77-88.
- Corkum P, Davidson F, MacPherson M. A framework for the assessment and treatment of sleep problems in children with attention-deficit/hyperactivity disorder. *Pediatr Clin North Am.* 2011;58:667-683.
- Cochrane Collaboration. *Cochrane Handbook for Systematic Reviews of Interventions* Version 5.1.0. Higgins JPT, Green S (eds). 2011. Available at: [www.cochrane-handbook.org](http://www.cochrane-handbook.org), see: [http://handbook.cochrane.org/chapter\\_10/10\\_3\\_2\\_including\\_unpublished\\_studies\\_in\\_systematic\\_reviews.htm](http://handbook.cochrane.org/chapter_10/10_3_2_including_unpublished_studies_in_systematic_reviews.htm). Accessed May 30, 2013.
- Jaeschke R, Guyatt GH, Dellinger P, *et al.* Use of GRADE grid to reach decisions on clinical practice guidelines when consensus is elusive. *BMJ.* 2008;337:a744.
- Sung V, Hiscock H, Sciberras E, Efron D. Sleep problems in children with attention-deficit/hyperactivity disorder: prevalence and the effect on the child and family. *Arch Pediatr Adolesc Med.* 2008;162:336-342.
- Mayes SD, Calhoun SL, Bixler EO, *et al.* ADHD subtypes and comorbid anxiety, depression, and oppositional-defiant disorder: differences in sleep problems. *J Pediatr Psychol.* 2009;34:328-337.
- Cortese S, Faraone SV, Konofal E, Lecendreux M. Sleep in children with attention-deficit/hyperactivity disorder: meta-analysis of subjective and objective studies. *J Am Acad Child Adolesc Psychiatry.* 2009;48:894-908.
- Owens JA, Dalzell V. Use of the 'BEARS' sleep screening tool in a pediatric residents' continuity clinic: a pilot study. *Sleep Med.* 2005;6:63-69.
- Owens JA, Spirito A, McGuinn M. The Children's Sleep Habits Questionnaire (CSHQ): psychometric properties of a survey instrument for school-aged children. *Sleep.* 2000;23:1043-1051.
- American Academy of Sleep Medicine. *The International Classification of Sleep Disorders*. 2nd edition. Westchester, IL: American Academy of Sleep Medicine; 2005.
- Gruber R, Sadeh A, Raviv A. Instability of sleep patterns in children with attention-deficit/hyperactivity disorder. *J Am Acad Child Adolesc Psychiatry.* 2000;39:495-501.
- Gruber R, Sheshko D. Circadian sleep disorders in children and adolescents. In: Ivanenko A, ed. *Sleep and psychiatric disorders in children and adolescents*. New York: Informa Healthcare; 2008.
- American Thoracic Society. Standards and indications for cardiopulmonary sleep studies in children. *Am J Respir Crit Care Med.* 1996;153:866-878.
- Allen RP, Picchiatti D, Hening WA, Trenkwalder C, Walters AS, Montplaisir J. Restless legs syndrome: diagnostic criteria, special considerations, and epidemiology. A report from the restless legs syndrome diagnosis and epidemiology workshop at the National Institutes of Health. *Sleep Med.* 2003;4:101-119.
- Picchiatti MA, Picchiatti DL. Advances in pediatric restless legs syndrome: iron, genetics, diagnosis and treatment. *Sleep Med.* 2010;11:643-651.
- Jensen PS, Hinshaw SP, Kraemer HC, *et al.* ADHD comorbidity findings from the MTA study: comparing comorbid subgroups. *J Am Acad Child Adolesc Psychiatry.* 2001;40:147-158.
- Forbes EE, Williamson DE, Ryan ND, Birmaher B, Axelson DA, Dahl RE. Peri-sleep-onset cortisol levels in children and adolescents with affective disorders. *Biol Psychiatry.* 2006;59:24-30.
- Geller B, Zimmerman B, Williams M, *et al.* DSM-IV mania symptoms in a prepubertal and early adolescent bipolar disorder phenotype compared to attention-deficit hyperactive and normal controls. *J Child Adolesc Psychopharmacol.* 2002;12:11-25.
- Corkum P, Panton R, Ironside S, MacPherson M, Williams T. Acute impact of immediate release methylphenidate administered three times a day on sleep in children with attention-deficit/hyperactivity disorder. *J Pediatr Psychol.* 2008;33:368-379.
- Stein MA, Weiss M, Hlavaty L. ADHD treatments, sleep, and sleep problems: complex associations. *Neurotherapeutics.* 2012;9:509-517.
- Ironside S, Davidson F, Corkum P. Circadian motor activity affected by stimulant medication in children with attention-deficit/hyperactivity disorder. *J Sleep Res.* 2010;19:546-551.
- Lecendreux M, Cortese S. Sleep problems associated with ADHD: a review of current therapeutic options and recommendations for the future. *Exp Rev Neurother.* 2007;7:1799-1806.
- Jerome L. Can methylphenidate facilitate sleep in children with attention deficit hyperactivity disorder? *J Child Adolesc Psychopharmacol.* 2001;11:109.
- Sangal RB, Owens J, Allen AJ, Sutton V, Schuh K, Kelsey D. Effects of atomoxetine and methylphenidate on sleep in children with ADHD. *Sleep.* 2006;29:1573-1585.
- Cheng JY, Chen RY, Ko JS, Ng EM. Efficacy and safety of atomoxetine for attention-deficit/hyperactivity disorder in children and adolescents—meta-analysis and meta-regression analysis. *Psychopharmacology (Berl).* 2007;194:197-209.
- Harsh J, Easley A, LeBougeois M. An instrument to measure children's sleep hygiene. *Sleep.* 2002;25:A136.

30. Weiss MD, Wasdell MB, Bomben MM, Rea KJ, Freeman RD. Sleep hygiene and melatonin treatment for children and adolescents with ADHD and initial insomnia. *J Am Acad Child Adolesc Psychiatry.* 2006;45:512-519.
31. Pelsser LM, Frankena K, Buitelaar JK, Rommelse NN. Effects of food on physical and sleep complaints in children with ADHD: a randomised controlled pilot study. *Eur J Pediatr.* 2010;169:1129-1138.
32. Mindell JA, Kuhn B, Lewin DS, Meltzer LJ, Sadeh A. Behavioral treatment of bedtime problems and night wakings in infants and young children. *Sleep.* 2006;29:1263-1276.
33. Mullane J, Corkum P. Case series: evaluation of a behavioral sleep intervention for three children with attention-deficit/hyperactivity disorder and dyssomnia. *J Atten Disord.* 2006;10:217-227.
34. Corkum P, Davidson F, Lingley-Pottie P, *et al.* Behavioral treatment for diagnosed pediatric insomnia in school-aged children. Fifth Annual Conference on Pediatric Sleep Medicine. Denver: CO, October 3, 2009.
35. Sciberras E, Efron D, Gerner B, *et al.* Study protocol: the Sleeping Sound with Attention-Deficit/Hyperactivity Disorder Project. *BMC Pediatr.* 2010;10:101.
36. Sciberras E, Fulton M, Efron D, Oberklaid F, Hiscock H. Managing sleep problems in school aged children with ADHD: a pilot randomised controlled trial. *Sleep Med.* 2011;12:932-935.
37. Vriend J, Corkum P. Clinical management of behavioral insomnia of childhood. *Psychol Res Behav Manag.* 2011;4:69-79.
38. Dahl RE, Pelham WE, Wiersom M. The role of sleep disturbances in attention deficit disorder symptoms: a case study. *J Pediatr Psychol.* 1991;16:229-239.
39. Dawson D, Morris M, Lack L. The phase shifting effects of a single 4 h exposure to bright morning light in normals and DSPS subjects. *Sleep Res.* 1989;17:415.
40. Rosenthal NE, Joseph-Vanderpool JR, Levendosky AA, *et al.* Phase-shifting effects of bright morning light as treatment for delayed sleep phase syndrome. *Sleep.* 1990;13:354-361.
41. Gruber R, Grizenko N, Joobar R. Delayed sleep phase syndrome, ADHD, and bright light therapy. *J Clin Psychiatry.* 2007;68:337-338.
42. Rybak YE, McNeely HE, Mackenzie BE, Jain UR, Levitan RD. An open trial of light therapy in adult attention-deficit/hyperactivity disorder. *J Clin Psychiatry.* 2006;67:1527-1535.
43. van der Heijden KB, Smits MG, Van Someren EJ, Ridderinkhof KR, Gunning WB. Effect of melatonin on sleep, behavior, and cognition in ADHD and chronic sleep-onset insomnia. *J Am Acad Child Adolesc Psychiatry.* 2007;46:233-241.
44. Tjon Pian Gi CV, Broeren JP, Starreveld JS, Versteegh FG. Melatonin for treatment of sleeping disorders in children with attention deficit/hyperactivity disorder: a preliminary open label study. *Eur J Pediatr.* 2003;162:554-555.
45. Kratochvil CJ, Lake M, Pliszka SR, Walkup JT. Pharmacological management of treatment-induced insomnia in ADHD. *J Am Acad Child Adolesc Psychiatry.* 2005;44:499-501.
46. Prince JB, Wilens TE, Biederman J, Spencer TJ, Wozniak JR. Clonidine for sleep disturbances associated with attention-deficit hyperactivity disorder: a systematic chart review of 62 cases. *J Am Acad Child Adolesc Psychiatry.* 1996;35:599-605.
47. Wilens TE, Biederman J, Spencer T. Clonidine for sleep disturbances associated with attention-deficit hyperactivity disorder. *J Am Acad Child Adolesc Psychiatry.* 1994;33:424-426.
48. Blumer JL, Findling RL, Shih WJ, Soubrane C, Reed MD. Controlled clinical trial of zolpidem for the treatment of insomnia associated with attention-deficit/hyperactivity disorder in children 6 to 17 years of age. *Pediatrics.* 2009;123:e770-e776.
49. Chervin RD, Ruzicka DL, Giordani BJ, *et al.* Sleep-disordered breathing, behavior, and cognition in children before and after adenotonsillectomy. *Pediatrics.* 2006;117:e769-e778.
50. Dillon JE, Blunden S, Ruzicka DL, *et al.* DSM-IV diagnoses and obstructive sleep apnea in children before and 1 year after adenotonsillectomy. *J Am Acad Child Adolesc Psychiatry.* 2007;46:1425-1436.
51. Huang YS, Guilleminault C, Li HY, Yang CM, Wu YY, Chen NH. Attention-deficit/hyperactivity disorder with obstructive sleep apnea: a treatment outcome study. *Sleep Med.* 2007;8:18-30.
52. Konofal E, Lecendreux M, Deron J, *et al.* Effects of iron supplementation on attention deficit hyperactivity disorder in children. *Pediatr Neurol.* 2008;38:20-26.
53. England SJ, Picchetti DL, Couvadelli BV, *et al.* l-Dopa improves Restless Legs Syndrome and periodic limb movements in sleep but not Attention-Deficit-Hyperactivity Disorder in a double-blind trial in children. *Sleep Med.* 2011;12:471-477.
54. Walters AS, Mandelbaum DE, Lewin DS, Kugler S, England SJ, Miller M. Dopaminergic therapy in children with restless legs/periodic limb movements in sleep and ADHD. Dopaminergic Therapy Study Group. *Pediatr Neurol.* 2000;22:182-186.
55. Konofal E, Arnulf I, Lecendreux M, Mouren MC. Ropinirole in a child with attention-deficit hyperactivity disorder and restless legs syndrome. *Pediatr Neurol.* 2005;32:350-351.
56. Gagliano A, Arico I, Calarese T, *et al.* Restless leg syndrome in ADHD children: levetiracetam as a reasonable therapeutic option. *Brain Dev.* 2011;33:480-486.
57. Mohammadi MR, Mostafavi SA, Keshavarz SA, *et al.* Melatonin effects in methylphenidate treated children with attention deficit hyperactivity disorder: a randomized double blind clinical trial. *Iran J Psychiatry.* 2012;7:87-92.
58. National Sleep Foundation. How much sleep do we really need? <http://www.sleepfoundation.org/article/how-sleep-works/how-much-sleep-do-we-really-need>. Accessed June 2013.
59. Mindell JA, Owens JA. A clinical guide to pediatric sleep. Diagnosis and management of sleep problems. Philadelphia: Lippincott Williams and Wilkins; 2003.