Similar to many other presenting complaints in the pediatric population, such as headaches or shortness of breath, insomnia in children and adolescents should be viewed as a symptom or constellation of symptoms that result from a wide range of possible causes. The causes of childhood insomnia are varied, and include both primarily medical (eg, medication-related, pain-induced) and behavioral (eg, associated with lack of a regular sleep schedule or negative sleep-onset associations) issues, and are often the result of a combination of these factors. In a general sense, the working definition of insomnia in children may be construed as similar to that in adults, (eg, significant difficulty initiating or maintaining sleep); however, from a clinical standpoint, the most frequent manifestations of childhood insomnia, particularly in younger children, are bedtime refusal or struggles, difficulty falling asleep after “lights out,” or frequent or prolonged night wakings requiring parental intervention.

The diagnosis of insomnia in children may be more challenging than in adults for several reasons. First, the patient rarely presents with a complaint of sleeplessness; caregiver concerns and their subjective observations regarding a child’s sleep patterns and behaviors often serve to define sleep disturbances in the clinical context. Parents’ ability and willingness to recognize and report sleep problems in children also vary across age groups, with parents of infants and toddlers more likely to observe and thus be aware of sleep concerns than parents of school-aged children and adolescents.

In addition, sleep problems in the pediatric population must be viewed against a background of the normal developmental trajectory across childhood and appropriate developmental norms; “normal” bedtime behavior, time to sleep onset, and sleep duration are dramatically different in 6-month-old infants, 6-year-old school-aged children, and 16-year-old adolescents.

Finally, culturally based differences in values and beliefs regarding the meaning, relative importance, and role of sleep in daily life, and sleep practices (eg, sleeping space and the timing of sleep periods, solitary sleep vs bed-sharing, use of transitional
objects) have a profound effect on not only how a parent defines a sleep “problem” but also the relative acceptability of various treatment strategies. Finally, the consequences of childhood insomnia, in addition to or instead of direct repercussions on the child (eg, daytime sleepiness, behavior problems), may principally involve caregiver stress and sleeplessness. For example, several studies have documented secondary effects of childhood sleep problems on parents (eg, maternal depression) and on family stress and functioning. This issue is particularly salient in families of children with chronic medical or neurodevelopmental conditions, for whom the additional caregiver burden of chronic sleeplessness and fatigue may be considerable.

**PEDIATRIC INSOMNIAS**

**Behavioral Insomnia of Childhood**

Behavioral insomnia of childhood (BIC) is the most common behavioral sleep disorder experienced by young children, and is characterized by bedtime problems and night wakings, as indicated by parent report. For didactic purposes, the sleep-onset association and limit-setting subtypes of BIC are defined as separate entities. However, in reality, the two often coexist, and many children present with both bedtime delays and night wakings, which is the combined subtype.

**BIC, sleep-onset association type**

BIC, sleep-onset association type (BIC-SOA) presents with frequent and prolonged night wakings that require caregiver intervention to help the child return to sleep. The diagnostic criteria for this disorder include (1) prolonged sleep onset that requires particular conditions, (2) demanding sleep-onset conditions, (3) significant delay of sleep onset in absence of those conditions, and (4) caregiver intervention is required to return the child to sleep after night wakings. Thus, BIC-SOA involves sleep regulation for a child to both fall asleep at bedtime without parental intervention or assistance and fall back asleep after normally occurring brief arousals during the night. Children with BIC-SOA are unable to self-soothe to sleep at bedtime or during the night, but rather signal the caregiver by crying (or coming into the parents’ bedroom if the child is no longer in a crib) until the necessary associations are provided.

The capacity to self-soothe begins to develop in the first 12 weeks of life, and is a reflection of both neurodevelopmental maturation and learning. However, the developmental goal of independent self-soothing in infants at bedtime and after night wakings may not be shared by all families, and voluntary or lifestyle bed- or room-sharing between children and parents is a common and accepted practice in many cultures and ethnic groups. Sleep behavior in infancy, in particular, must also be understood in the context of the relationship and interaction between child and caregiver, which impacts greatly on the quality and quantity of sleep. Furthermore, a diagnosis of BIC-SOA before the age of 6 months is not typical.

Both internal and external factors affect the risk for and reinforcement of the presence of prolonged night wakings. For example, parental presence while falling asleep, intentional cosleeping, or feeding a child to sleep increase the likelihood that a child will not have the ability to return to sleep independently. Medical conditions (eg, reflux) or periodic illness; scheduling changes or vacations; acquisition of typical developmental milestones; or a difficult temperament can also affect the frequency of arousals and the ability of a child to self-soothe. Insecure maternal–child attachment, parental anxiety, and maternal depression are additional risk factors for prolonged night wakings in young children. Finally, sleep disturbances also reflect complex combined influences of biologic, environmental, and cultural factors, and thus may differ substantially across different cultures and in different contexts.
**BIC, limit-setting type**

The limit-setting type of BIC (BIC-LST) is characterized by noncompliant behaviors at bedtime, such as refusal to go to bed, verbal protests, and repeated demands at bedtime (“curtain calls”), rather than night wakings. These behaviors result in delayed sleep onset generally without prolonged night wakings, although resistant behaviors may occur during the night. Diagnostic criteria include (1) trouble initiating or maintaining sleep, (2) stalling or refusal to go to sleep at bedtime or after night wakings, and (3) lack of or insufficient limits set by caregiver regarding bedtime and sleep behaviors. BIC-LST is most common in children who are preschool-aged and older. If sleep onset is sufficiently prolonged, the delay may result in inadequate sleep. This sleep problem most commonly develops from a caregiver’s inability or unwillingness to set consistent bedtime rules and enforce a regular bedtime, and is often exacerbated by the child’s oppositional behavior.

Both developmental and external issues can also contribute to the onset and maintenance of bedtime behaviors associated with BIC-LST. For example, the development of the imagination may result in increased nighttime fears. An increase in separation anxiety, especially during the early toddler years, may lead to bedtime resistance and problematic night wakings. Furthermore, an increased need for autonomy and independence may result in increased bedtime resistance. In some cases, however, the child’s resistance at bedtime may be from an underlying problem in falling asleep caused by other factors (such as asthma, medication use, restless legs, or anxiety) or a mismatch between the child’s intrinsic circadian preferences (“night owl”) and parental expectations. Finally, additional factors specific to the parents (eg, permissive parenting style, conflicting parental discipline styles, unrealistic parental expectations) or child (eg, age, temperament, daytime oppositional behavior) may contribute to the sleep problems.

**BIC, combined type**

Children with the combined type of BIC (BIC-C) typically present with bedtime resistance (eg, multiple requests, refusal) in conjunction with frequent and problematic night wakings. In these cases, caregivers usually set insufficient or no limits at bedtime and these children ultimately require the presence of a negative sleep association to fall and return to sleep.

**Prevalence**

In general, behavioral insomnia of childhood is a disorder of young children (0–5 years of age), although it can persist into middle childhood and beyond, especially in those with special needs. Prevalence studies of insomnia in children and adolescents, especially for BIC, are hampered by the lack of standardized research criteria in terms of the frequency, severity, and chronicity of symptoms such as “sleep-onset delay” and “problematic night wakings.” In general, study definitions of insomnia in children tend to be based on a priori inclusion criteria that can range from the more general (parental report of “difficulty falling asleep”) to the more specific (“takes longer than 30 minutes to fall asleep at least 3 nights per week for at least 3 months”), and clearly vary with age and developmental status, although studies indicate considerable variability in cross-cultural studies. For example, in one study asking parents whether their child had a sleep problems, prevalence rates varied from approximately 10% in Vietnam and Thailand to 25% to 30% in the United States and Australia and as high as 75% in China and Taiwan.

Despite this variation in definition, the identified prevalence of sleep disturbances overall in children is remarkably similar across studies (albeit almost all studies cited
are conducted in predominantly Caucasian countries). Overall, an estimated 20% to 30% of children in cross-sectional studies are reported to have some significant bedtime problems or night wakings.\(^6,11,12\) For infants and toddlers, night wakings are one of the most common sleep problems, with 25% to 50% of children older than 6 months of age continuing to awaken during the night. Bedtime resistance is found in 10% to 15% of toddlers. However, because these two sleep complaints frequently coexist, and similar treatments strategies may be used for both, many studies do not approach them as separate concerns, and therefore individual prevalence rates are difficult to estimate.

Difficulties falling asleep and night wakings (15%–30%) are also common in preschoolers.\(^11,13\) Although sleep problems were previously believed to be rare in middle childhood, more recent studies have reported an overall prevalence of any parent-reported sleep problem in 25% to 40% of these children, including 15% who experience bedtime resistance and almost 11% of 4- to 0-year-olds who have sleep-related anxiety.\(^14,15\)

**Assessment**

Typically, behavioral insomnia of childhood is identified based on parent report of sleep concerns. A comprehensive evaluation should include assessment of current sleep patterns, usual sleep duration, and sleep/wake schedule, which is often best assessed using a sleep diary, in which parents record daily sleep behaviors for an extended period (approximately 2 weeks). A review of sleeping arrangements, bedtime routines, and parental behaviors and responses to the child both at bedtime and after night wakings can help assess for factors contributing to the sleep problem. An evaluation for medical contributions is also warranted, especially pain (eg, ear infections) and reflux.

**Treatment**

When left untreated, bedtime and sleep problems can be chronic, and children rarely “outgrow” them. However, behavioral treatments can yield effective and durable results. Consistent with the conclusions of two previous reviews,\(^16,17\) a recent review of 52 treatment studies indicates that behavioral therapies produce reliable and durable changes in both bedtime resistance and night wakings in young children.\(^18\) Of the studies, 94% found behavioral interventions to be efficacious, with more than 80% of treated children showing clinically significant improvement maintained for up to 3 to 6 months. No study reported detrimental effects. Several studies also found positive effects of sleep interventions on secondary child-related outcome variables, such as daytime behaviors (eg, crying, irritability, detachment, self-esteem, emotional well-being).\(^18\) Behavioral interventions for sleep problems also led to improvements in parental well-being (eg, effects on mood, stress, marital satisfaction) in several studies.\(^19–22\)

Successful treatment of BIC generally involves a combination of behavioral strategies for eliminating inappropriate sleep-onset associations, reducing undesirable nighttime behaviors, and encouraging parental limit-setting. For all of these behavioral strategies, it is critical for parents to be consistent in applying behavioral programs to avoid inadvertent intermittent reinforcement of night wakings. They should also be forewarned that protest behavior frequently temporarily escalates at the beginning of treatment (“post-extinction burst”). Pediatric practitioners can offer several highly effective treatment recommendations:

- Establish a consistent bedtime routine that does not include stimulating activities, such as television viewing
• Introduce more appropriate sleep associations that will be readily available to the child during the night, such as use of a transitional object (eg, blanket, stuffed animal)
• Encourage development of self-soothing skills, that is having children fall asleep independently at bedtime without parental presence
• Practice bedtime fading, which involves temporarily setting the child’s bedtime to the current sleep-onset time and then gradually advancing bedtime
• Decrease parental attention for problematic bedtime behaviors, such as stalling and additional requests
• Provide positive reinforcement for appropriate behaviors, such as stickers for remaining in bed
• Teach self-relaxation techniques and cognitive-behavioral strategies, which can also be beneficial in older children.

**Psychophysiologic Insomnia**

The term *insomnia* that is often used by patients and caregivers typically refers to sleep-onset or sleep-maintenance difficulties. The form of sleep-onset or sleep-maintenance insomnia that is defined in adults as psychophysiologic insomnia occurs primarily in older children and adolescents, rather than young children. This type of insomnia is characterized by a combination of learned sleep-preventing associations and heightened physiologic arousal, resulting in a complaint of sleeplessness. A hallmark of this type of insomnia is excessive worry about sleep and an exaggerated concern regarding the potential daytime consequences. This type of insomnia is frequently the result of predisposing factors (eg, genetic vulnerability, underlying medical or psychiatric conditions) combined with precipitating factors (eg, acute stress) and perpetuating factors (eg, poor sleep habits, caffeine use, maladaptive cognitions about sleep).

**Prevalence**

A recent study found that the lifetime prevalence of insomnia in 13- to 16-year-old adolescents approaches 11%. In addition, up to 35% of adolescents experience insomnia at least several times a month. Similar to adults, insomnia has an increased prevalence in girls postpuberty. Furthermore, lower socioeconomic status is associated with increased insomnia. In contrast, primary insomnia seems to be uncommon in prepubertal children.

**Assessment**

As with all sleep disorders, a thorough assessment is critical before the development of a treatment plan. First, a thorough evaluation of other possible causes of sleep-onset and sleep-maintenance difficulties should be conducted, including:

• Negatively contributing sleep habits (eg, erratic sleep schedules, caffeine use) and lifestyle issues (eg, staying up late to socialize, electronics use)
• Presence of other sleep disorders, especially delayed sleep-phase disorder, obstructive sleep apnea, and restless legs syndrome
• Acute and chronic medical disorders (especially pain conditions)
• Psychiatric disorders, especially attention deficit hyperactivity disorder (ADHD), anxiety, and depression
• Concurrent medications, especially psychostimulants
• Smoking and alcohol and drug use.

A sleep diary, typically kept for 2 weeks, can be highly informational. Use of additional diagnostic tools such as polysomnographic evaluation are seldom warranted
for routine evaluation of insomnia, but may be appropriate if an underlying sleep disruptor, such as obstructive sleep apnea or periodic limb movements, is suspected.

**Treatment**

Most studies on the treatment of psychophysiologic or primary insomnia have been conducted with adults, with clear evidence-based support for psychological and behavioral treatments. In a recent review of the literature, five treatments met criteria for empirically supported treatments, including stimulus control therapy, sleep restriction, relaxation, paradoxical intention, and cognitive–behavioral therapy. Very few studies on the nonpharmacologic treatment of psychophysiologic insomnia have been conducted in adolescents, however, and almost none have been conducted in children. Studies evaluating the efficacy of pharmacologic treatment of psychophysiologic insomnia in children and adolescents are even more limited (see section on pharmacologic treatment).

In the pediatric practice, simple changes can often result in significant improvements in insomnia. **Box 1** provides a practice handout on the “Seven Rules for Beating Insomnia.”

Overall, recommendations by the pediatric practitioner may include:

- Educating the child or adolescent about principles of sleep hygiene, including a developmentally appropriate bedtime, a consistent sleep schedule on weekdays and weekends (both bedtimes and wake times), avoidance of naps,

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**Box 1**

**Seven rules for beating insomnia**

1. **Choose a set wake-up time.** Wake up at the same time every day, no matter how much sleep you got the night before.

2. **Choose a bedtime.** Choose the earliest possible bedtime that enables you to get the sleep you need. However, too much time in bed will lead to lighter, more interrupted sleep, so an appropriate bedtime is one that enables you to get the sleep that you need but doesn’t let you be in bed too long. You only want to spend the amount of time in bed that you actually need for sleep.

3. **Go to bed when you are sleepy, but not before your chosen bedtime.** Don’t go to bed until you are sleepy. So if you are still wide-awake at your chosen bedtime, wait a while longer until you are sleepy enough to fall asleep quickly.

4. **Get out of bed when you can’t sleep.** If you are lying in bed and can’t sleep, get out of bed and do something relaxing out of the bedroom. Read a book, watch television, or do something else relaxing; then go back to bed when you feel sleepy enough to fall asleep quickly. Again, if you do not fall asleep quickly, get up. Keep repeating this cycle until you fall asleep. You need to get out of bed when you can’t sleep both at bedtime and in the middle of the night.

5. **Don’t worry or plan in bed.** When lying in bed at night, don’t spend the time worrying or planning for the next day. Set aside another time of the day to do these things. If you automatically start thinking and worrying when you get in bed, get up and don’t head back to bed until your thoughts won’t interfere with falling asleep. Thinking in bed is a habit, and one that you can break.

6. **Only use your bed for sleep.** Don’t do anything but sleep in your bed. That is, don’t do other activities, such as eat, watch television, or [do homework].

7. **Avoid naps.** Naps will interfere with your ability to fall asleep at bedtime, so no naps.

avoidance of caffeine, a sleep-conducive environment, and removal of electronics from the bedroom.

- Recommending behavioral interventions, including instructing the patient to use the bed for sleep only and to get out of bed if unable to fall asleep (stimulus control); restricting time-in-bed to the actual time asleep (sleep restriction); and teaching relaxation techniques to reduce anxiety.
- Teaching the patient to counter inappropriate thoughts using cognitive restructuring, which includes (1) identifying the inappropriate sleep cognition, (2) challenging the validity of each sleep cognition, and (3) replacing the thought with a more productive one.

**INSOMNIA IN SPECIAL PEDIATRIC POPULATIONS**

Because the evaluation and treatment of insomnia in specific populations, such as children with autism spectrum disorders and chronic medical conditions, are discussed in detail elsewhere in this issue, the following section presents only a brief discussion of some of the factors contributing to the high prevalence of sleep problems in these groups. The concept of “primary” versus “secondary” (ie, resulting from an underlying medical or mental health condition) insomnia has largely been supplanted in favor of describing the insomnia as being “comorbid” or “coexisting” with these conditions, because the latter characterization avoids implying directionality or causality. Furthermore, insomnia in these populations is often different from that in typically developing healthy children in terms of severity, frequency, and chronicity, rather than in the “type” of insomnia; thus, many of the principles of evaluation and management of insomnia in children discussed earlier are applicable.

**Children With Neurodevelopmental Disorders**

Overall, the prevalence rates of sleep problems in children with a wide variety of neurodevelopmental disorders are very high, ranging from 13% to 85%. For example, that significant sleep problems are estimated to occur in 30% to 80% of children with severe mental retardation and in at least half of children with less-severe cognitive impairment. The types of sleep disorders that occur in these children are generally not unique to these populations, but rather are more frequent and more severe than in the general population, and typically reflect the child’s developmental level/IQ rather than chronologic age. Significant problems with settling at bedtime in children with unusual or prolonged bedtime routines, frequent night wakings, shortened sleep duration, irregular sleeping patterns, partial arousal parasomnias, and early morning waking, for example, have been reported in a variety of different neurodevelopmental disorders, including Asperger, Angelman, Rett, Smith-Magenis, and Williams syndromes. Sleep problems, especially in children with special needs, are often chronic in nature and unlikely to resolve without aggressive treatment. In addition, sleep disturbances in these children often have a profound effect on the quality of life of the entire family.

Sleep issues in these children may be related to any number of factors, including intrinsic abnormalities in sleep regulation and circadian rhythms, increased or decreased sensitivity to environmental factors, comorbid medical conditions such as seizures, and medications used to treat these associated conditions. Common behavioral contributing factors include maladaptive learned sleep practices, parental reluctance to set appropriate limits, and caregiver stress. Psychiatric disorders such as depression and anxiety in children and adolescents with developmental delays
and autistic spectrum disorders, and medications used to treat these disorders (eg, atypical antipsychotics) may further contribute to sleep problems.

**Children With Psychiatric Disorders**

Sleep disturbances are extremely common in child mental health clinical settings and often have a significant impact on symptom severity and the management of psychiatric disorders in children and adolescents. Psychiatric disorders can be associated with a range of sleep problems, including hypersonia and fatigue, irregular sleep–wake patterns, disturbing dreams and nightmares, early morning awakenings, and impairments in sleep initiation and maintenance. Studies of children with major depressive disorder, for example, have reported a prevalence of up to 75% for insomnia and 30% for severe insomnia, and sleep-onset delay in a third of depressed adolescents. Sleep complaints, especially difficulty falling asleep, refusal to sleep alone, increased nighttime fears, and nightmares, are also common in anxious children and children who have experienced severely traumatic events (including physical and sexual abuse). Use of psychotropic medications, which may have significant negative effects on sleep, often complicates the issue. Conversely, growing evidence suggests that insomnia in childhood is a risk factor for developing psychiatric conditions, particularly depressive and anxiety disorders, in adolescence and adulthood.

Clinicians who evaluate and treat children with ADHD frequently report sleep disturbances, especially difficulty initiating sleep and restless and disturbed sleep. Surveys of parents and children with ADHD consistently report an increased prevalence of sleep problems, including delayed sleep onset, poor sleep quality, restless sleep, frequent night wakings, and shortened sleep duration. However, more objective methods of examining sleep and sleep architecture (eg, polysomnography, actigraphy) have overall disclosed minimal or inconsistent differences between children with ADHD and controls, except for increased movements during sleep and more night-to-night variability in sleep patterns.

Sleep problems in children with ADHD may have a variety of causes, and potential causes range from bedtime resistance related to a comorbid anxiety or oppositional defiant disorder in some children to psychostimulant-mediated delayed sleep onset in others. In still other children, settling difficulties at bedtime may be related to a resurgence of or even an increase in ADHD behaviors (ie, “rebound”) in the evening after the effects of daytime medication are no longer present, or deficits in sensory integration associated with ADHD, whereas an intrinsic circadian phase delay may be the primary cause of bedtime resistance in a percentage of children. From a clinical standpoint, then, an important part of managing the individual child with ADHD should be evaluation of any comorbid sleep problems, followed by an appropriate diagnostically driven behavioral or pharmacologic intervention.

**Children With Chronic Medical Disorders**

Relatively little data currently exist regarding the impact of sleep problems on both acute and chronic health conditions, such as asthma, diabetes, sickle cell disease, cancer, and juvenile rheumatoid arthritis in children. However, the interaction between insufficient or poor quality sleep, particularly in children with chronic pain conditions, is likely to significantly impact on quality of life and clinical management. For example, a recent study found that 3% of children hospitalized for medical issues were treated with sleep medications, suggesting that prescribing medication for sleep in hospitalized children is a fairly common practice.
Several patient, caregiver, and environmental factors, such as the impact of underlying disease processes, repeated hospitalization, caregiver stress, comorbid mood and anxiety disorders, and concurrent medications, are clearly important to consider in assessing the bidirectional relationship of insomnia and chronic illness in children. Specific medical conditions that may also have an increased risk of sleep problems include allergies; atopic dermatitis; asthma; migraine headaches; seizure disorders; juvenile rheumatoid arthritis; other rheumatologic conditions, such as chronic fatigue syndrome and fibromyalgia; and chronic gastrointestinal disorders, such as inflammatory bowel disease. Over-the-counter and prescription medications used to treat medical conditions may significantly affect sleep and should be evaluated within the context of sleep issues.

PHARMACOLOGIC AGENTS IN PEDIATRIC INSOMNIA

Studies have suggested that the use of medications to treat insomnia in children is widespread and that a broad variety of medications are being recommended by both pediatric and child mental health practitioners in community and academic settings for sleep disturbances in children. Because no medications, except chloral hydrate, are currently labeled by the U.S. Food and Drug Administration (FDA) for the treatment of insomnia in children, the use of these medications in practice settings seems to be based largely on clinical experience, empirical data derived from adults, or small case series of hypnotics in the pediatric population.

Although pharmacologic interventions as an adjunct to behavioral strategies for the treatment of childhood insomnia may be appropriate in selected clinical situations and in specific populations (eg, children with ADHD or autism spectrum disorders), most sleep disturbances in children can be successfully managed with a combination of behavior therapy and modification of sleep practices alone.

If medication is believed to be potentially therapeutically beneficial in a given clinical situation (ie, appropriately implemented behavioral interventions are not fully effective), the following guidelines should be kept in mind. First, the choice of medication as an option for any given child with insomnia should be diagnostically driven; in other words, the specific cause or causes (eg, medication, pain, anxiety, primary sleep disorders such as obstructive sleep apnea) should first be determined and appropriate treatment, in the case of a primary sleep disorder, should be instituted before hypnotic medication is considered. Medication use should also be viewed in the context of the child’s medical history and developmental age, and the risks and benefits weighed in the context of the clinical situation.

Clinicians should determine treatment goals that are both realistic and mutually acceptable to the child, caregivers, and family, and should establish measurable treatment outcomes (eg, reduction in sleep latency or number of night wakings). Finally, contraindications for pharmacotherapy in children include insomnia caused by a self-limited condition that often leads to night wakings such as teething; when the potential exists for drug interactions with concurrent medications (eg, opiates); in the presence of alcohol or illicit substance use; when limitations exist to adequate follow-up and monitoring of side effects (eg, parent frequently misses appointments); when insomnia occurs in the context of a primary sleep disorder (eg, obstructive sleep apnea); and when insomnia is determined to be caused by a developmentally based normal sleep behavior (ie, from inappropriate parent or practitioner expectations regarding child’s sleep behaviors).

The pharmacokinetic properties of agents (eg, half-life, onset of action) should be considered in targeting specific sleep symptoms such as delayed sleep onset or night
wakings. All medications prescribed for sleep problems should be closely monitored for the emergence of side effects. In addition, patients should be screened for concurrent use of nonprescription sleep aids and other herbal supplements, which may intensify the effect of or interact with hypnotic drugs.

A summary of pharmacologic and clinical properties of medications that are currently most commonly used in the treatment of pediatric insomnia are described in the following sections (to avoid any implied rank order in preference, medication classes are listed in alphabetical order).

**Alpha Agonists**

Clonidine and guanfacine are noradrenergic $\alpha_2$-agonists that are widely used in pediatric and psychiatric practice, particularly in children with sleep-onset delay and ADHD. Despite a paucity of data regarding efficacy and safety in children, clonidine is often prescribed to shorten sleep latency in children with ADHD. A case series has also reported that clonidine seems to be beneficial and fairly well tolerated in intractable sleep problems in children and young adults with neurodevelopmental disorders. Guanfacine seems to be less sedating and is associated with fewer anticholinergic and cardiovascular side effects than clonidine because of its more selective $\alpha$-receptor binding. Clonidine is rapidly absorbed with onset of action in 1 hour and peak effects at 2 to 4 hours; the half-life is 6 to 24 hours. Guanfacine has a greater volume of distribution and longer half-life. Potential side effects include anticholinergic effects, irritability, and dysphoria, and rebound hypertension on abrupt discontinuation. Clonidine has a narrow therapeutic index and has been associated with significant cardiotoxicity and death with overdoses.

**Antidepressants**

Sedating atypical antidepressants (mirtazapine, nefazodone, and trazodone), selective serotonin reuptake inhibitors, and tricyclic antidepressants are used in clinical practice to treat insomnia in adult and pediatric populations. Antidepressants are believed to mediate sleep promotion through influencing activity of non-$\gamma$-aminobutyratic acid neurotransmitters that regulate sleep and wakefulness (eg, histamine, acetylcholine, serotonin). Most antidepressants, especially those with anticholinergic effects, suppress rapid eye movement (REM), and increase latency to REM sleep; thus, abrupt withdrawal may lead to increased nightmares (REM rebound). Although frequently used in clinical practice, overall little methodologically rigorous research supports the use of any of the antidepressants for insomnia in adults or children. Thus, the use of antidepressants for insomnia should generally be limited to clinical situations in which concurrent mood issues are present, because treating the underlying mood disorder will often result in improved sleep.

**Antihistamines**

Parental and provider familiarity tend to make antihistamines an acceptable choice for many families. Over-the-counter sleep aids typically contain diphenhydramine or doxylamine, both of which have shown modest efficacy in reducing sleep latency. A double-blind placebo-controlled study of diphenhydramine in school-aged children showed significant subjective improvement in sleep latency and night waking. However, a more recent study of 44 children aged 6 to 15 months found that diphenhydramine was no better than placebo in reducing night waking. Potential adverse effects include anticholinergic effects (eg, dry mouth, blurred vision, urinary retention), morning “hangover” with daytime drowsiness, and paradoxical excitation. Tolerance to antihistamines may develop, necessitating increasing doses.
Benzodiazepines and Nonbenzodiazepine Gabaminergic Receptor Agonists

GABA is the major inhibitory neurotransmitter in the brain; thus, the hypnotic effect of the benzodiazepines is mediated by their action at GABA type A receptors (GABA A). These medications shorten sleep latency, increase total sleep time, and improve sleep maintenance. The benzodiazepines also have muscle relaxant, anxiolytic, and anti-convulsant properties. Use of longer-acting benzodiazepines may lead to morning “hangover,” daytime sleepiness, and compromised daytime functioning. Anterograde amnesia and disinhibition may also occur. Finally, these medications are also associated with a risk of habituation or addiction and with withdrawal phenomena. In general, this class of medication should only be used for short-term or transient insomnia, or in clinical situations in which their other properties (eg, anxiolytic) are advantageous.

The nonbenzodiazepine receptor agonists (NBzRAs) bind more selectively to GABA A receptor complexes. Two short-acting NBzRAs are approved for use in adults (zaleplon and zolpidem). Two NBzdRAs with longer half-lives are also approved for sleep maintenance and sleep-initiation insomnia (zolpidem-CR and eszopiclone). A single published clinical trial of zolpidem in children failed to show efficacy. Potential side effects include dizziness, anterograde amnesia, confusion, hallucinations, and headache.

Melatonin

Melatonin is a hormone secreted by the pineal gland that binds to receptors in the suprachiasmatic nucleus in the hypothalamus. Depending on the dose and timing of administration, exogenous synthetic melatonin has both chronobiotic (ie, shifts the circadian sleep–wake cycle) and mild hypnotic (ie, sedating) effects. For example, studies of melatonin in adults with delayed sleep-phase disorder have reported that smaller doses (eg, 0.5 mg) taken 5 to 7 hours before sleep onset may be more effective in treating sleep-onset delay in the context of a circadian rhythm disorder. Alternatively, because plasma levels of exogenous melatonin peak within 1 hour after administration, it may be most helpful in reducing sleep-onset insomnia not related to a delay in circadian timing when taken in larger doses (eg, 3–5 mg) closer to bedtime.

Several studies have shown efficacy in reducing sleep latency in children with ADHD, based on the premise that some of these children have a circadian-mediated phase delay (ie, delayed sleep onset and offset compared with developmental norms). Additional clinical uses for melatonin include treatment of circadian rhythm disturbances (eg, delayed sleep-phase syndrome) and of children with special needs or neurodevelopmental disorders (eg, blindness, Rett syndrome, autism). Although generally regarded as safe, potential adverse effects of melatonin include suppression of the hypothalamic-gonadal axis (potentially triggering precocious puberty on abrupt discontinuation) and increased reactivity of the immune system in children with immune disorders or who are taking immunosuppressants.

Melatonin Receptor Agonists

Synthetic melatonin receptor agonists act selectively at the MT1 and MT2 receptors, and have been reported to be potentially useful in the pediatric population. Ramelteon is the only drug in this class that is FDA approved for the treatment of insomnia, and is also the only schedule VI approved hypnotic. The sleep-promoting effect of ramelteon is postulated to be related to reduction of alerting output of the suprachiasmatic nucleus. It has shown moderate efficacy in clinical trials in adults in reducing sleep latency.
Other Pharmacologic Agents

Finally, other classes of medications that are not indicated for insomnia but that have been reportedly used in pediatric clinical practice include anticonvulsants (carbamazepine, valproic acid, topiramate, gabapentin), atypical antipsychotics (risperidone, olanzapine, quetiapine), and chloral hydrate. In most instances, these medications are being prescribed for alternative indications (eg, bipolar disorder, aggression), and the side effect of daytime sedation that occurs with these medications is used to promote nighttime sleep.

Although these medications may have sedative effects, they should be used with caution, if at all, for insomnia in children. Data are lacking or limited on safety and tolerability for this indication in either adults or children. Furthermore, the sedating effects may interfere with daytime functioning and learning. These medications can also have negative effects on sleep parameters. For example, many of the newer atypical antipsychotics have weight gain as a significant side effect, and thus can worsen obstructive sleep apnea. Finally, the American Academy of Pediatrics recommends against the use of chloral hydrate in children, except for short-term sedation because of the risk of hepatotoxicity.

FUTURE DIRECTIONS

Further elucidation of fundamental questions regarding the cause and impact of insomnia in children is likely to contribute significantly to the understanding. Key areas for future research include the interactions among genetic susceptibility, environmental factors, developmental stage, and learned behaviors in the genesis of childhood insomnia; elucidation of the scope, magnitude, natural history, and impact of insomnia in children and adolescents in general, and on children with medical, mental health, and developmental disorders; risk and protective factors (eg, race/ethnicity, temperament, parenting styles, poverty) influencing the development of childhood insomnia; the relative efficacy of treatments, including behavioral interventions and pharmacotherapy; and the impact of treatment on the natural history of insomnia into adulthood, including the role of sleep problems in predicting the eventual emergence of psychiatric comorbid conditions (depression, anxiety, bipolar disorder).

The diagnostic features of insomnia in children both common to and distinct from adult insomnia need to be further refined, and the characteristics that differentiate normal developmental variation or self-limited sleep problems from “pathology” across the age spectrum need to be clarified. Evidence-based clinical screening and evaluation tools for insomnia in children that may be easily adapted to primary care must be developed and systematically evaluated. Educational interventions targeted toward health care providers and caregivers to raise awareness of the significance of pediatric insomnia are fundamental to primary and secondary prevention efforts. Finally, the potential substantial impact of childhood insomnia on patients and their families clearly deserves further study.

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