INSOMNIA IN CHILDREN WITH ATTENTION DEFICIT HYPERACTIVITY DISORDER (ADHD) AND AUTISM SPECTRUM DISORDER (AUTISM SPECTRUM DISORDER)

Kiran Maski, MD
Boston Children's Hospital

Epidemiology

Insomnia is the most commonly reported sleep difficulty reported to pediatric heath care providers,[1,2] and is frequently noted among children with a range of neurological conditions including headache[3,4] and epilepsy[5]. Rates of insomnia are particularly high among children with neurodevelopmental disorders including ADHD and ASD.[6,7]

Clinical features

International Classification of Sleep Disorders (ICSD)[8] defines insomnia as one or more of the following: difficulty initiating sleep, difficulty sleeping without caregiver, bedtime resistance, difficulty maintaining sleep, and/or waking earlier than desired. Additionally, the ICSD requires a daytime consequence of these sleep difficulties in the child and/or family: daytime fatigue/sleepiness, limitations to academic/occupational functioning, impaired cognitive capabilities, mood disturbances, and/or behavior problems. In chronic insomnia, sleep disturbances must occur for at least 3 days per week and for at least 3 months; short-term insomnia is present for <3 months per ICSD classification. Underlying the diagnosis of insomnia is the assumption that the child has sufficient time and an appropriate environment to sleep. For example, children with neurodevelopmental disorders commonly use media (TV, computer, videogames, hand-held devices) at night which disrupt their sleep patterns and reduced total sleep time. [10,11]

There is a wealth of literature describing associations between insomnia and emotional dysregulation, depression, suicidality, and externalizing behavior problems such as hyperactivity.[12-14] More disrupted sleep in children with ASD is associated with poorer verbal and socialization skills and adaptive functioning.[15] Likewise, correlations between sleep problems and externalizing behaviors, oppositional behavior, and depressive symptoms exist among children with ADHD.[16]

Pathophysiology

The pathophysiology of insomnia is unknown but one salient theory is that it reflects a hyper-aroused state. This theory postulates that autonomic, somatic, and cortical arousal associated with factors such as stress or predisposing conditions increase sensory processing and results in insomnia.[17,18] Adolescents with insomnia demonstrate increased beta activity (15-35 Hz) during sleep onset and NREM sleep suggesting that this hyper-aroused state can be present early in the lifespan.[19] Two small studies using qualitative EEG analysis of sleep among children with ADHD and ASD did not show differences in power spectra in NREM sleep compared to controls,[20,21] but this may be an area of future research in larger cohorts.

Diagnosis

While the diagnosis of insomnia is based on clinical history from both the child and caregiver/parent; clinical providers may not always routinely screen for sleep problems in the

office setting.[2] Many pediatric sleep questionnaires are available for clinical use[22] but one commonly used instrument is the Children's Sleep Habits Questionnaire (CSHQ)[23]. The CSHQ includes domains of bedtime problems, excessive daytime sleepiness, awakenings at night, habitual sleep duration and timings, presence of snoring, parasomnias and has been validated for healthy children ages 4-10 years of age; however, it has been used in a number of research studies with children with ASD and ADHD.[24,25] A sleep log or diary kept for a period of 2 consecutive weeks that includes bedtime, estimated sleep onset time, timings of awakenings during the night, rise time, and naps can be a very helpful diagnostic tool. Lastly, actigraphy (a wristwatch-like monitoring device that captures and stores movement data using validated computer algorithms to generate approximations of sleep-wake patterns over time) can provide objective assessment of sleep-wake parameters. Consumer wearable sleep monitoring devices do not show reliable or valid sleep data, though newer technology may be promising.[26]

Treatment

Behavioral counseling is the foundation of managing insomnia in children. Sleep hygiene recommendations can be found on the website for the National Sleep Foundation[27]; effective recommendations for caregivers of children with ASD are also available through the Autism Speaks, Autism Treatment Network website.[28,29] Two recent randomized controlled trials did not find any short or long-term negative effects on any of the cognitive, emotional, stress-related, or attachment parameters measured in either children or caregivers following behavioral interventions.[30,31] Cognitive behavioral therapy for insomnia (CBT-I) has also been shown to be effective in a recent randomized controlled trial for adolescents with insomnia.[32] There are no hypnotic/sedative medications approved in the United States to treat insomnia in children. Nonetheless, medication management for insomnia is common and systematic reviews of commonly used medications for pediatric insomnia are referenced here[9,33]. Table 1 is a list of sleep medications studied in children with neurodevelopmental disorders and is adapted from one of these reviews[9]. Ultimately, it is critical for practioners to recognize that these sleep medications are an adjunct to good sleep hygiene and behavioral strategies to improve refractory insomnia.

Medication	Group Studied	Dosing	Use	Reference
Iron	ASD	1-3 mg/kg/day Upto 6 mg/kg	Restless sleep, PLMS, RLS	Dosman CF 2007
Melatonin	SMS, Angelman, Rett, ASD	1-3 mg typical Max dose 10 mg	Sleep onset	Goldman SE 2014, Cortesi F 2012, Wasdell MB 2008
Ramelteon	ASD	2-8 mg	Sleep onset, maintenance	Stigler KA 2006
Clonidine	ASD, DD	0.05-0.1 mg	Sleep Maintenance	Ingrassia A 2005
Gabapentin	Refractory insomnia	5-15 mg/kg	Sleep onset and maintenance	Robinson AA, 2013
Clonazepam	Williams syndrome	0.25-0.75 mg	Sleep maintenance, PLMS	Arens R, 1998
Zolpidem	ADHD	2.5-10 mg	No benefit	Blumer JL 2009
Trazodone	OMS	25 mg-100 mg	Sleep maintenance	Pranzatelli MR 2005
Mirtazapine	ASD	7.5-25 mg	Sleep Maintenance	Posey DJ 2001

Table 1: Sleep Medications used to Treat Insomnia in Children with Neurodevelopmental Disabilities.[9]

1. Honaker SM, Meltzer LJ. Sleep in pediatric primary care: A review of the literature. Sleep medicine reviews 2016;25:31-9.
2. Owens JA, Mindell JA. Pediatric insomnia. Pediatr Clin North Am 2011;58:555-69.
3. Luc ME, Gupta A, Birnberg JM, Reddick D, Kohrman MH. Characterization of symptoms of sleep disorders in children with headache. Pediatr Neurol 2006;34:7-12.
4. Esposito M, Roccella M, Parisi L, Gallai B, Carotenuto M. Hypersomnia in children affected by migraine without aura: a questionnaire-based case-control study. Neuropsychiatr Dis Treat 2013;9:289-94.
5. Vendrame M, Yang B, Jackson S, Auerbach SH. Insomnia and epilepsy: a questionnaire-based study. Journal of clinical sleep medicine : JCSM : official publication of the American Academy of Sleep Medicine 2013;9:141-6.

6. Souders MC, Mason TB, Valladares O, et al. Sleep behaviors and sleep quality in children with autism spectrum disorders. Sleep 2009;32:1566-78.
7. Konofal E, Lecendreux M, Cortese S. Sleep and ADHD. Sleep medicine 2010;11:652-8.
8. American Academy of Sleep Medicine. International Classification of Sleep Disorder, 3 rd edition, 2014.
9. Blackmer AB, Feinstein JA. Management of Sleep Disorders in Children With Neurodevelopmental Disorders: A Review. Pharmacotherapy 2016;36:84-98.
10. Orsmond GI, Kuo HY. The daily lives of adolescents with an autism spectrum disorder: discretionary time use and activity partners. Autism 2011;15:579-99.
11. Engelhardt CR, Mazurek MO, Sohl K. Media use and sleep among boys with autism spectrum disorder, ADHD, or typical development. Pediatrics 2013;132:1081-9.
12. Liu X, Zhao Z, Jia C. Insomnia symptoms, behavioral/emotional problems, and suicidality among adolescents of insomniac and non-insomniac parents. Psychiatry Res 2015;228:797-802.
13. Armstrong JMR, P.L.; Klein, M.H.; Essex, M.J.; Benca, R.M. Associations of child insomnia, sleep movement, and their persistence with mental health symptoms in childhood and adolescence. Sleep 2014;37:9.
14. Zhang J, Lam SP, Li SX, Li AM, Lai KY, Wing YK. Longitudinal course and outcome of chronic insomnia in Hong Kong Chinese children: a 5-year follow-up study of a community-based cohort. Sleep 2011;34:1395-402.
15. Taylor MA, Schreck KA, Mulick JA. Sleep disruption as a correlate to cognitive and adaptive behavior problems in autism spectrum disorders. Research in developmental disabilities 2012;33:1408-17.
16. Becker SP, Langberg JM, Evans SW. Sleep problems predict comorbid externalizing behaviors and depression in young adolescents with attention-deficit/hyperactivity disorder. Eur Child Adolesc Psychiatry 2015;24:897-907.
17. Perlis ML, Giles DE, Mendelson WB, Bootzin RR, Wyatt JK. Psychophysiological insomnia: the behavioural model and a neurocognitive perspective. J Sleep Res 1997;6:179-88.
18. Riemann D, Spiegelhalder K, Feige B, et al. The hyperarousal model of insomnia: a review of the concept and its evidence. Sleep medicine reviews 2010;14:19-31.
19. Fernandez-Mendoza J, Li Y, Vgontzas AN, et al. Insomnia is Associated with Cortical Hyperarousal as Early as Adolescence. Sleep 2016;39:1029-36.
20. Prehn-Kristensen A, Goder R, Fischer J, et al. Reduced sleep-associated consolidation of declarative memory in attention-deficit/hyperactivity disorder. Sleep medicine 2011;12:672-9.
21. Maski K, Holbrook H, Manoach D, Hanson E, Kapur K, Stickgold R. Sleep Dependent Memory Consolidation in Children with Autism Spectrum Disorder. Sleep 2015.
22. Spruyt K, Gozal D. Pediatric sleep questionnaires as diagnostic or epidemiological tools: a review of currently available instruments. Sleep medicine reviews 2011;15:19-32.
23. 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;23:1043-51.
24. Veatch OJ, Maxwell-Horn AC, Malow BA. Sleep in Autism Spectrum Disorders. Curr Sleep Med Rep 2015;1:131-40.
25. Corkum P, Lingley-Pottie P, Davidson F, et al. Better Nights/Better Days-Distance Intervention for Insomnia in School-Aged Children With/Without ADHD: A Randomized Controlled Trial. J Pediatr Psychol 2016.
26. Evenson KR, Goto MM, Furberg RD. Systematic review of the validity and reliability of consumer-wearable activity trackers. The international journal of behavioral nutrition and physical activity 2015;12:159.
27. Sleep for Kids. 2016. (Accessed May 29, 2016, at www.sleepforkids.org/html/practices.htm.)
28. Autism Treatment Network Sleep Tool Kit. 2016. (Accessed May 29, 2016, at https://www.autismspeaks.org/science/resources-programs/autism-treatment-network/tools-you-can-use/sleep-tool-kit.)

29. Malow BA, Adkins KW, Reynolds A, et al. Parent-based sleep education for children with autism spectrum disorders. J Autism Dev Disord 2014;44:216-28.
30. Price AM, Wake M, Ukoumunne OC, Hiscock H. Five-year follow-up of harms and benefits of behavioral infant sleep intervention: randomized trial. Pediatrics 2012;130:643-51.
31. Gradisar M, Jackson K, Spurrier NJ, et al. Behavioral Interventions for Infant Sleep Problems: A Randomized Controlled Trial. Pediatrics 2016.
32. de Bruin EJ, Bogels SM, Oort FJ, Meijer AM. Efficacy of Cognitive Behavioral Therapy for Insomnia in Adolescents: A Randomized Controlled Trial with Internet Therapy, Group Therapy and A Waiting List Condition. Sleep 2015;38:1913-26.
33. Hollway JA, Aman MG. Pharmacological treatment of sleep disturbance in developmental disabilities: a review of the literature. Research in developmental disabilities 2011;32:939-62.