The Pediatric Sleep Program at Children’s Hospital of Pittsburgh of UPMC, co-directed by Sangeeta Chakravorty, MD, and Hiren Muzumdar, MD, is a multidisciplinary program dedicated to diagnosing and treating sleep disorders in children from birth to age 21, whether these disorders arise from medical conditions, or from behavioral or developmental problems.

**Team Approach**

Dr. Chakravorty’s background in neurology and Dr. Muzumdar’s in pediatric pulmonology, combined with expertise from pediatric plastic surgeons and otolaryngologists, allow them to work in a closely coordinated fashion on the care of children with more complicated issues, including those requiring ventilatory support, or with Prader-Willi or Down syndrome. In addition, the Pediatric Sleep Program is involved with the Autism Treatment Network. A pediatric behavioral therapist, Melissa Milbert, MS, is embedded within the program, allowing comprehensive care for insomnia, parasomnia, hypersomnia, sleep disruption due to mental/psychiatric disorders, and circadian rhythm disorders.

The American Academy of Sleep Medicine-accredited sleep lab at Children’s Hospital of Pittsburgh of UPMC has seven beds at two locations, and nine sleep technologists. Craig Halper, RPSGT, is lead sleep technologist. The program conducts more than 1,200 sleep studies per year on pediatric patients from infancy to young adulthood.

**Our Fellowship Program**

The Sleep Medicine Fellowship is a combined program involving Children’s Hospital of Pittsburgh of UPMC, the University of Pittsburgh, and the Pittsburgh VA Medical Center. The program is fully accredited by the Accreditation Council for Graduate Medical Education (ACGME). Over the last 10 years, our program has trained more than 20 sleep fellows, including a pediatric neurologist, family medicine doctor, pediatric pulmonologist, psychiatrists, otolaryngologists, and adult pulmonologists.

The physicians in the Pediatric Sleep Program and all of the physicians in the Division of Pulmonary Medicine, Allergy, and Immunology always are available to discuss their work, offer consultations, or accept patient referrals.

To contact a physician, please call Melissa Kennedy, administrative coordinator, at 412-692-8736.
A sleepy teenager in the Pulmonology Clinic

Swaroop Pinto, MD
Fellow, Pediatric Pulmonology

A.K., a 17-year-old obese, pre-diabetic female patient, presented to our sleep program with concerns of daytime sleepiness. She reported loud daily snoring, witnessed apnea, and unrefreshing restless sleep. She was getting into bed at 11 p.m. and falling asleep after an hour. She had several nocturnal awakenings with no difficulty reinitiating sleep. She woke up at 8 a.m. on school days feeling tired and complained of falling asleep frequently in school. She napped for about two hours in the afternoons and felt refreshed after her nap. She did not report sleepiness on weekends. She had undergone adenotonsillectomy a few years prior and had a history of bipolar disorder that was managed with lamotrigine, ziprasidone, and benztropine. An outside sleep study showed obstructive sleep apnea (OSA) with an apnea hypopnea index of 8.4/hr.

On physical examination, she had a class IV Mallampati airway, absent tonsils, and acanthosis nigricans. Her BMI was 30 (>75th percentile) with normal cardiorespiratory findings. A.K. was provided sleep hygiene instructions and had a split-night polysomnogram with continuous positive airway pressure (CPAP) titration. During the first two hours of the study, she had 12 obstructive events per hour, an oxygen saturation nadir of 84%, and multiple respiratory arousals. CPAP of 8 cm H20 via nasal mask resolved snoring and obstructive events.

Two weeks after starting CPAP, A.K. returned for a follow-up visit. Despite >7 hours of nightly CPAP usage, with refreshing sleep and minimal nighttime arousals, she continued to report significant levels of residual daytime sleepiness. Her sleep wake pattern was assessed with a 14-day sleep diary and actigraphy (Figure 1), which showed delayed sleep phase and insufficient sleep. She was advised to incrementally advance her wake time with 30 minutes of exposure to bright light on awakening every morning and good sleep hygiene practices that she implemented in consultation with our sleep behavioral health specialist. She had significant improvement in daytime functioning and currently is managed in the multidisciplinary Pediatric Sleep Program and the Weight Management and Wellness Center.

Discussion

The prevalence of OSA has increased in adolescents with the epidemic of obesity and metabolic syndrome.1 Sleep disruption and hypoxemia with OSA can result in daytime sleepiness that usually reverses with adequate treatment. However, the most common causes of daytime sleepiness in adolescents are insufficient sleep and delayed sleep phase.2 An adolescent with insufficient sleep will typically report a late bedtime and early wake time on school days, with compensatory sleep extension and late wake time on weekends. Insufficient sleep results from the interaction of biological factors, such as delayed sleep phase, and socio-environmental factors, including early school start times, after-school activities, academic and sports demands, cultural influences, and part-time jobs.3 In addition to these factors, caffeine ingestion, light exposure from electronic screens, and social media contribute to decreased quality and poor quality of sleep in teenagers.

Delayed sleep/circadian phase occurs when internal rhythms, such as sleep onset and awakening, occur later in relation to desired social/environmental time, such as school start times. Adolescence is a period of transition to adulthood that is associated with changes in sleep state organization and circadian rhythms, particularly a greater ability to resist sleep and delay in the onset of the “melatonin switch” that precedes sleep onset. The delay in weekend awakening and late night light exposure perpetuate a delayed circadian phase through the week, resulting in difficulty falling asleep.

Figure 1: 7-day Actogram — delayed bedtimes and wake times in a sleepy teenager.

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A SLEEPY TEENAGER IN THE PULMONOLOGY CLINIC  Continued from Page 2

at night and sleepiness on awakening for school. Eventually, this may result in a persistent inability to wake up in time for school and chronic school absences. This is known as delayed sleep phase syndrome or DSPS. Adolescents with DSPS are likely to have a higher prevalence of mental health problems, such as anxiety and depression.4 The management of DSPS is primarily by appropriately timed light exposure in the morning and melatonin administration later in the day. Clinical experience and published data suggest additional benefit with cognitive behavioral therapy in adolescents.5 In addition, evaluation by a behavioral therapist allows detection and management of associated mental health issues.

Narcolepsy, related to hypocretin deficiency in the hypothalamus, is a less common cause of daytime sleepiness that significantly impairs quality of life. The majority of narcoleptics report onset during childhood, and it should be considered in a sleepy teenager.6 Narcolepsy is characterized by bouts of daytime sleepiness, disturbed nocturnal sleep, and early onset of REM sleep. It may be accompanied by cataplexy, a sudden and transient muscle weakness with preserved consciousness, typically triggered by emotions such as laughing, fear, and anger.

The workup of excessive daytime sleepiness in teenagers includes:

• **History and sleep diary:** A detailed clinical sleep history is the first step in the evaluation of sleepiness. Additional information about sleep patterns, especially consistency of bedtimes, wake times, weekend wake times, prolonged sleep onset, and naps, can be obtained with sleep diaries kept over a period of one to two weeks.

• **Actigraphy:** In conjunction with daily sleep diaries, actigraphy (Figure 1, Page 2) provides an objective assessment of sleep patterns over one to two weeks.7 It monitors and records body movements that indirectly measure sleep and awake periods with a wristwatch-like device worn by the patient. Actigraphy provides information on sleep patterns over multiple nights in the home setting and is advantageous in situations where the sleep diary may be unreliable.

• **Epworth Sleepiness Scale:** A Likert scale is used to measure subjective daytime sleepiness that estimates the chances of dozing from 0-3 (0 — no chance and 3 — high chance) in a variety of situations. The maximum possible score is 24; a score of >10 is suggestive of excessive daytime sleepiness.8

![Figure 2: Multiple Sleep Latency Test.](image-url)
A SLEEPY TEENAGER IN THE PULMONOLOGY CLINIC  Continued from Page 3

- Multiple sleep latency test (MSLT): Assessment for narcolepsy includes an overnight polysomnography (PSG) with daytime MSLT (Figure 2, Page 3). The MSLT objectively evaluates an individual’s propensity for daytime sleepiness on the premise that the degree of sleepiness is reflected by time to fall asleep. MSLT is conducted following one night of PSG and involves a series of four or five daytime naps administered at two-hour intervals using standardized procedures. Results are interpreted based on time to fall asleep and the number of sleep-onset REM episodes during naps. These findings are most valuable when integrated with the clinical history and overnight polysomnography to reach a clinical diagnosis.9

The management of sleep problems in adolescents involves addressing underlying physiological sleep disruptors, improving sleep hygiene, maintaining a consistent sleep schedule, and in turn, increasing total sleep. Identification and treatment of underlying causes, such as OSA, DSPS, and narcolepsy, and the management of comorbid conditions, such as obesity and mental health problems, using a multidisciplinary approach that combines physician specialties, behavioral specialists, and social workers, are key to the management of sleep disorders. •

References

ABOUT CHILDREN’S HOSPITAL OF PITTSBURGH OF UPMC

Children’s Hospital of Pittsburgh of UPMC is a leader in the treatment of childhood conditions and diseases, a pioneer in the development of new and improved therapies, and a top educator of the next generation of pediatricians and pediatric subspecialists.

Children’s is consistently recognized for its research and clinical achievements, including ranking seventh among children’s hospitals and schools of medicine (FY14) in NIH funding for pediatric research, and being named to the 2015-16 U.S. News & World Report Honor Roll of America’s Best Children’s Hospitals.

A SLEEPY TEENAGER IN THE PULMONOLOGY CLINIC

RECENT RECOGNITIONS, HONORS, AND AWARDS

John Alcorn, PhD, received the Parker B. Francis Jo Rae Wright Award for Scientific Excellence from the Parker B. Francis Fellowship Program and the Francis Family Foundation.

Juan C. Celedón, MD, DrPH, was elected to the Association of American Physicians in recognition of his research contributions on asthma and chronic obstructive pulmonary disease. He also received the Lifetime Achievement Award for Innovations in Health Equality from the American Thoracic Society.

Jonathan Spahr, MD, received UPMC’s Award for Commitment and Excellence in Service (ACES). •