WAKE UP SLEEPYHEAD: NORMAL SLEEP IN CHILDREN AND COMMON PROBLEMS

Zoran Danov, MD
Associate Professor
University of Kentucky
Division of Pediatric Pulmonology

Faculty Disclosure
• No Financial interests to disclose

Educational Need/Practice Gap

<table>
<thead>
<tr>
<th>Education</th>
<th>Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical schools:</td>
<td>Sleep is central part of child’s development</td>
</tr>
<tr>
<td>13% no education,</td>
<td>25-40% of children have a sleep issue</td>
</tr>
<tr>
<td>Average 2 hours</td>
<td></td>
</tr>
<tr>
<td>Pediatric residencies:</td>
<td>23% no education, Average 2.7 hours</td>
</tr>
</tbody>
</table>

Objectives

Upon completion of this educational activity you will be able to:
• Recognize normal sleep patterns in childhood
• Identify common sleep disorders in childhood
• Develop a management plan for common sleep disorders
• List the indications for an overnight polysomnography

Expected Outcome

• Include sleep history as part of routine health visit
• Advocate for proper sleep hygiene measures
• Properly refer at-risk children for PSG study or evaluation by a pediatric sleep specialist

Which one of the following is true?

A. Main function of the sleep is learning and memory consolidation.
B. Circadian rhythm is solely driven by melatonin production.
C. Stages of sleep include REM (active) and NREM (quiet) sleep.
D. Circadian sleep rhythm is fully developed by one month of age
Functions of sleep

- Growth
- Optimal immune performance
- Learning and memory
- Attention, concentration
- Central nervous system repair
- Emotional functioning

External Factors Affecting Circadian Rhythm

- Light signals wakening
- Darkness signals sleep
- Other
  - Feeding/meal time
  - Ambient temperature
  - Noise
  - Bedtime routines
  - Physical activity
  - Pain
  - Medications

Sleep Architecture and Cycling

- Highly organized and structured process
- Comprised of NREM (stages 1-3) and REM sleep stages
- 60-90 minutes NREM-REM cycles, 3-6 times during the night

Characteristics of REM and NREM sleep

<table>
<thead>
<tr>
<th>Stage</th>
<th>Transition Phase</th>
<th>Sleep Stage</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>NREM</td>
<td>Stage 1 Transitional Phase</td>
<td>Reduced body movement, Drowsiness, Reduced responsiveness</td>
<td>Easily awakened</td>
</tr>
<tr>
<td>NREM</td>
<td>Stage 2 True sleep onset</td>
<td>Reduced muscle tone, Deceleration of heart rate and respirations, The child move freely and reposition in bed</td>
<td></td>
</tr>
<tr>
<td>NREM</td>
<td>Stage 3 SWS</td>
<td>Relaxed body position, Slow rhythmic breathing, Decreased heart rate</td>
<td>Arousal difficult, Child confused and disoriented</td>
</tr>
<tr>
<td>REM</td>
<td>Paradoxical sleep</td>
<td>Muscle paralysis, Dreaming, Variability in respirations and HR, Facial expressions, Muscle twitches</td>
<td></td>
</tr>
<tr>
<td>REM</td>
<td>Active sleep</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Which one of the following is true?

A. Main function of the sleep is learning and memory consolidation.
B. Circadian rhythm is solely driven by melatonin production.
✓C. Stages of sleep include REM (active) and NREM (quiet) sleep.
D. Circadian sleep rhythm is fully developed by one month of age.

All of the following statements regarding sleep in children are true EXCEPT:

A. At age 2 years, the average child has spent about 1500 more hours asleep than awake.
B. Variability in sleep duration is greatest in first year of life.
C. School age children (6-12 years) do not wake up at night.
D. Sleep needs in adolescence do not dramatically differ from those in middle childhood.

Age-related Changes of Parent Reported Sleep Times

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Total Sleep Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-12 months</td>
<td>10.5-18 hours</td>
</tr>
<tr>
<td>1-12 years</td>
<td>10-13 hours</td>
</tr>
<tr>
<td>13-18 years</td>
<td>9-25 hours</td>
</tr>
</tbody>
</table>

Sleep Across Childhood

• By age of 2 years average child has spent 9500 h (~13 months) asleep vs. 8000 h awake
• Between 2-5 years, time asleep = time awake
• In school age children sleep occupies 40% of the 24h day
• Sleep is the primary activity of the brain during early development

Night Awakenings

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Night Awakenings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infants (1-12 months)</td>
<td>1-3 per night</td>
</tr>
<tr>
<td>Toddlers (1-3 years)</td>
<td>2-4 per night</td>
</tr>
<tr>
<td>Preschoolers (3-5 years)</td>
<td>1-2 per night</td>
</tr>
</tbody>
</table>

Sleep Across Childhood

<table>
<thead>
<tr>
<th>Stage</th>
<th>Infants (0-12 months)</th>
<th>Toddlers (1-3 years)</th>
<th>Preschoolers (3-5 years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learn to fall asleep on their own (&quot;settle&quot;)</td>
<td>Becoming more independent</td>
<td>Transition from crib to bed</td>
<td>Development of parasomnias</td>
</tr>
<tr>
<td>Learn to fall back to sleep on their own (self soothe)</td>
<td>Separation anxiety/cognitive development</td>
<td>Nighttime routines and transitional objects important</td>
<td>Snoring and sleep apnea common</td>
</tr>
<tr>
<td>Self soothing is a developmental skill</td>
<td>Bedtime routines and transitional objects important</td>
<td>Routines continue to be essential</td>
<td></td>
</tr>
</tbody>
</table>
Sleep Across Childhood

<table>
<thead>
<tr>
<th>School age 6-12 years</th>
<th>Adolescents 12-16 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low level of day time sleepiness</td>
<td>Sleep less than needed</td>
</tr>
<tr>
<td>Circadian preference: owl vs. lark</td>
<td>Factors affecting adolescent sleep:</td>
</tr>
<tr>
<td>Less parental awareness</td>
<td>• Social pressure</td>
</tr>
<tr>
<td></td>
<td>• School start time</td>
</tr>
<tr>
<td></td>
<td>• Substance abuse</td>
</tr>
<tr>
<td></td>
<td>• Delayed sleep phase</td>
</tr>
<tr>
<td></td>
<td>• Hormonal influence</td>
</tr>
<tr>
<td></td>
<td>• Obesity</td>
</tr>
</tbody>
</table>

Factors affecting adolescent sleep:
- Social pressure
- School start time
- Substance abuse
- Delayed sleep phase
- Hormonal influence
- Obesity

A Crying Child

• A 3 year old girl with frequent episodes of waking up crying during sleep.
  • Falls asleep with no difficulties
  • Wakes up crying about 2 hours later
  • Falls back to sleep easily when her mother lies in bed with her

A Crying Child

• Bedtime routine:
  • Taking a bath, brushing teeth,
  • Put to bed at 8 pm
  • Her mother reads a short book and lies next to her until the girl falls asleep.

A Crying Child

What is your diagnosis?

A. Obstructive sleep apnea
B. Sleep terrors
C. Limit setting sleep disorder
D. Sleep onset association disorder

Insomnia Definition

Difficulty initiating sleep and/or maintaining sleep resulting in daytime impairment

Children
- Behavioral Insomnia of Childhood
  • Sleep onset association type
  • Limit-setting type
  • Daytime impairment = parental impairment

AASM. International Classification of Sleep Disorders, 2nd ed.: Diagnostic and Coding Manual
### Behavioral Insomnia of Childhood

<table>
<thead>
<tr>
<th>Sleep-onset Association Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Child associates sleep onset with circumstances that are demanding of the caregiver</td>
</tr>
<tr>
<td>• Child unable to fall asleep without these associations</td>
</tr>
</tbody>
</table>

From AASM 2006 Sleep Medicine Professional Education

### Treatments for BIC

<table>
<thead>
<tr>
<th>Sleep-onset Association Type</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Education</strong></td>
</tr>
<tr>
<td>• Night awakenings normal</td>
</tr>
<tr>
<td>• Sleep associations are learned</td>
</tr>
<tr>
<td>• Sleep associations are present at all ages</td>
</tr>
<tr>
<td>• New sleep associations can be taught</td>
</tr>
<tr>
<td><strong>Behavioral treatment</strong></td>
</tr>
<tr>
<td>• Place child in crib/bed awake and leave room</td>
</tr>
<tr>
<td>• If child is upset, return to comfort</td>
</tr>
<tr>
<td>• Do not pick up the child; comfort verbally</td>
</tr>
<tr>
<td>• Stay in room briefly, leave before child sleeps</td>
</tr>
<tr>
<td>• Increase time between responses</td>
</tr>
<tr>
<td>• Same routine for awakenings and naps</td>
</tr>
</tbody>
</table>

### Behavioral Insomnia of Childhood

<table>
<thead>
<tr>
<th>Limit-setting Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Emphasize the importance of limit-setting</td>
</tr>
<tr>
<td>• Teach general limit-setting guidelines (day as well as night)</td>
</tr>
<tr>
<td>• Specific and individualized techniques (gate, progressive door closure)</td>
</tr>
<tr>
<td>• Positive reinforcement (star chart)</td>
</tr>
</tbody>
</table>

### Bedtime refusals, stalling and repeated demands |

• May also occur at naptime and nighttime waking |

• Insufficient or inappropriate limit setting demonstrated by the caregiver |

From AASM 2006 Sleep Medicine Professional Education

### Treatment of BIC Limit-setting Type


### A Crying Child

**What is your diagnosis?**

A. Obstructive sleep apnea  
B. Sleep terrors  
C. Limit setting sleep disorder  
D. Sleep onset association disorder |

### The snoring scholar

• A 6 year old boy presents with loud snoring, restless sleep, and difficulty paying attention at school. During class he seems to “day dream”, or “zone out”. He is not sleepy during the day; if anything, he seems “hyperactive”.

• The physical exam is normal. He is not obese and his tonsils extend beyond the pillars but do not approach the uvula.
The Snoring Scholar

Which of the following diagnostic tests would be most appropriate at this point?

A. Lateral neck roentgenogram to assess adenoid size
B. Overnight polysomnogram
C. Psychological evaluation for ADHD
D. No diagnostic tests are needed; treatment should be initiated immediately

Obstructive Sleep Apnea Syndrome

SPECTRUM of conditions determined by relative amount of upper airway obstruction:
(CIRCLES DISPLAY INCREASING UPPER AIRWAY OBSTRUCTION)

- **PS** - Primary snoring:
  - NOISY BREATHING

- **UARS** - Upper airway resistance syndrome:
  - NOISY BREATHING + DISTURBED SLEEP

- **OH** - Obstructive hypoventilation:
  - NOISY BREATHING + DISTURBED SLEEP + ↑ CO² and/or ↓ SaO²

- **OSA** - Obstructive sleep apnea:
  - NOISY BREATHING + DISTURBED SLEEP + ↑ CO² and/or ↓ SaO² + ABSENCE OF AIRFLOW

OSA Epidemiology

- Snoring in children:
  - 7% - 10% Habitual snorers
  - 20% Intermittent snorers
- OSA – 1% to 3% of preschool children
- Peaks ages two to five years
- Male = Female
- Prevalence is higher among African Americans

Pathophysiology of OSA

Risk Factors for Obstructive Sleep Apnea

The degree of tonsillar hypertrophy may not correlate with the presence of OSAS
Clinical Features

Nighttime Symptoms
- Loud snoring
- Observed apneas
- Snorting / gasping / choking
- Restless sleep
- Diaphoresis
- Paradoxical chest wall movement
- Abnormal sleeping position
- Secondary enuresis

Daytime Symptoms
- Daytime somnolence
- Behavioral / school problems
- Difficulty awakening in AM
- Morning headaches
- Nasal congestion
- Mouth breathing

Diagnosis of OSAS
- NO combination of historical or physical findings reliably differentiates OSAS from primary snoring

Role of Polysomnography
- It is essential for diagnosing pediatric OSA
- Differentiate OSA from primary snoring
- Define severity of OSAS
- Evaluate success of treatment

Pediatric Polysomnography
- PSG is indicated in children suspected of having period limb movement disorder
- PSG followed by Multiple Sleep Latency Test (MSLT) is indicated in evaluation of hypersomnia
- MSLT is diagnostic of Narcolepsy
- PSG is NOT indicated in evaluation of parasomnias, insomnias and RLS (except for evaluation of comorbid sleep disorder or epilepsy)

Consequences of Pediatric OSA
- Affects physical growth
- Neurocognitive morbidity
  - Hyperactivity, inattention, aggression
  - Impaired school performance
  - Daytime sleepiness
  - Depression
- Cardiovascular consequences
  - Pulmonary Hypertension
  - Cor Pulmonale
  - Systemic Hypertension

Treatment of Pediatric OSA
- Surgical
  - Adenotonsillectomy
  - Uvulopalatopharyngoplasty
  - Craniofacial surgery
  - Tracheostomy
- Medical
  - Continuous positive airway pressure
  - Weight loss if obese
  - Intranasal steroids (modest effect)
Groups at High Risk for Postoperative Complications

- Less than three years of age
- Severe OSAS by PSG
- Associated medical conditions
  - Craniofacial anomalies
  - Neuromuscular disorders
  - Recent respiratory infection
  - Severe obesity / Premature birth
- Complications of OSAS already present
- Failure to thrive
- Cor pulmonale

Following surgery, high risk patients should be observed overnight in a facility where appropriate monitoring and care are available.

AAP - Guidelines

- Screening of all children for snoring
- Specialty referral of complex high-risk patients
- Urgent evaluation if cardio-respiratory failure
- PSG as Gold Standard for diagnosis
- Adenotonsillectomy as first-line treatment
- Inpatient monitoring of high-risk patients
- Post-operative re-evaluation to determine if additional treatment is required

The Snoring Scholar

Which of the following diagnostic tests would be most appropriate at this point?

A. Lateral neck roentgenogram to assess adenoid size
B. Overnight polysomnogram
C. Psychological evaluation for ADHD
D. No diagnostic tests are needed, treatment should be initiated immediately

Parasomnias Classification

- Undesirable events/experiences during sleep

  - Partial Arousal Parasomnias (NREM sleep)
    - Confusional arousals
    - Night terrors
    - Sleep walking

  - Parasomnias Associated with REM Sleep
    - Nightmares
    - Sleep paralysis
    - REM Sleep Behavior Disorder


Nightmares vs Sleep Terrors

- Most common parasomnia
  - REM sleep
  - 2nd half of night
  - Mild autonomic activity
  - Easily comforted
  - Alert upon awakening
  - Delayed return to sleep
  - Detailed narrative description of episode

- Prevalence 2.0 - 6.5%
  - NREM sleep
  - 1st half of night
  - Intense autonomic activity
  - Resists comforting
  - Confusion on waking
  - Rapid return to sleep
  - Fragmented recall / amnesia

An Unusually Sleepy Teenager

- A 16 year old boy complains of day time sleepiness. He has fallen asleep in class. He watches TV until midnight and falls asleep once the TV is off. He snores and sleeps restlessly but has no witnessed apnea.
- He drinks about 3 cans of Mountain Dew per day. On weekends he goes to bed around 2 AM and sleeps until 1 or 2 pm.
- Physical examination
  - Non-obese
  - No tonsils visible
  - Reminder of the exam was normal
An Unusually Sleepy Teenager

This is most likely example of:

A. Obstructive Sleep Apnea
B. Narcolepsy
C. Delayed Sleep Phase
D. Insufficient Sleep

Impact of Daytime Sleepiness in Children

- Mood
  - irritability, mood instability
- Behavioral
  - Externalizing (aggressiveness, hyperactivity, impulsiveness)
- Performance
  - Poor academic and social functioning
- Neurologic
  - Attention, memory and verbal
  - Executive functions (organization, self-monitoring, planning)
- Family
  - Increased parental stress and depression

General Sleep Hygiene Principles

- No caffeine
- Regular timing of bedtime, wake time and meals
- Regular physical activity (but not too late)
- Quiet dark room, comfortable temperature
- Avoid using bed/bedroom for punishment or other activities
- No electronics within 1 hour of bedtime (and no electronics in bedroom)

Conclusions

- The greatest period of maturation of sleep occurs in the first year of life
- The amount of sleep needed does not dramatically drop in adolescence
- Sleep disorders are common in primary care setting
- Majority of sleep disorders can be diagnosed on the base of the clinical presentation
- PSG is indicated for evaluation of OSA, PLMD, and narcolepsy/hypersomnia
- Sleep restriction is an epidemic (cognitive, emotional and medical implications)
References